



Courses Syllabus – Monsoon 2023

Version 2: 15-07-2023

| S. No. | Course Code | Course Name | Credits | Faculty Name(s) |
|--------|-------------|--|---------|---|
| 1 | | Advanced Computer Architecture | 3-1-0-4 | Suresh Purini |
| 2 | CS3.402 | Advanced Computer Networks | 3-1-0-4 | Ankit Gangwal |
| 3 | CS7.501 | Advanced NLP | 3-1-0-4 | Manish Srivastava |
| 4 | CS3.304 | Advanced Operating Systems | 3-1-0-4 | P Krishna Reddy |
| 5 | CE1.604 | Advanced Structural Design | 3-1-0-4 | Sunita Palissery |
| 6 | CS1.301 | Algorithm Analysis and Design | 3-1-0-4 | Suryajith Ch |
| 7 | CS3.306 | Algorithms and Operating Systems | 3-1-0-4 | Lini Teresa Thomas |
| 8 | EC2.401 | Analog IC Design | 3-1-0-4 | Abhishek Srivastava |
| 9 | HS0.303 | Applied Ethics | 3-1-0-4 | Saurabh Todariya |
| 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 + Shipra Dikshit |
| 12 | CS9.421 | Behavioral Research & Experimental Design | 3-1-0-4 | Vinoo Alluri |
| 13 | SC3.202 | Bioinformatics (H1) | 3-1-0-2 | Nita Parekh |
| 14 | SC3.321 | Biomolecular Structure Interaction & Dynamics | 3-1-0-4 | B.Gopalakrishnan |
| 15 | PD2.421 | Business Fundamentals | 3-1-0-4 | Santanu Mandal |
| 16 | SC2.305 | Chemical Kinetics and Reaction Dynamics (H2) | 3-1-0-2 | Harjinder Singh |
| 17 | HS0.301 | Classical Text Reading-1 | 3-1-0-4 | Ashwin Jayanti + Sushmita Banerji |
| 18 | CL3.202 | Computational Linguistics II: Comp Semantics and Discourse parsing | 3-1-0-4 | Parameshwari K + Rajakrishnan |
| 19 | CS0.301 | Computer Problem Solving | 3-1-0-4 | Lini Teresa Thomas |
| 20 | CS0.101 | Computer Programming | 3-1-3-5 | Abhishek Deshpande + Girish Varma + Shantanav Chakraborty |
| 21 | SC4.101 | Computing in Sciences-1(H2) | 2-0-3-2 | U Deva Priyakumar |
| 22 | CS4.405 | Data Analytics I | 3-1-0-4 | Krishna Reddy Polepalli |
| 23 | CS4.301 | Data and Applications (H2) | 3-1-0-2 | Ponnurangam Kumaraguru |
| 24 | SC4.412 | Data Driven Drug Discovery | 3-1-0-4 | Deva Priyakumar |
| 25 | CS4.409 | Data Foundation Systems | 3-1-0-4 | Vikram Pudi + G Venu Gopal |

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|----|---------|--|---------|--|
| 26 | CS1.304 | Data Structures & Algorithms for Problem Solving | 3-0-2-6 | Vineet Gandhi |
| 27 | CS4.401 | Data Systems | 3-1-0-4 | Kamalakar Karlapalem |
| 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 | Aftab Hussain + Hari Kumar K + Ubaidulla P |
| 35 | MA5.101 | Discrete Structures | 3-1-0-4 | Srinathan K + Pawan Kumar |
| 36 | CS3.403 | Distributing Trust and Block Chains | 3-1-0-4 | Sujit P Gujar |
| 37 | CE1.607 | Earthquake Resistant Design of Masonry Structures | 3-1-0-4 | P Pravin Kumar Venkat Rao |
| 38 | EC2.102 | Electronic Workshop-1 (H2) | 2-0-3-2 | Chiranjeevi Yarra + Ubaidulla P |
| 39 | EC3.202 | Embedded Systems Workshop(H2) | 1-0-3-3 | Abhishek Srivastava + Zia Abbas |
| 40 | CS1.407 | Entropy and Information | 3-1-0-4 | Indranil Chakrabarty |
| 41 | CS9.428 | Environmental Science & Technology | 3-1-0-4 | Ramachandra Prasad Pillutla |
| 42 | CS7.504 | Fairness, Privacy and Ethics in AI | 3-1-0-4 | Sujit P Gujar |
| 43 | CE4.501 | Finite Element Methods | 3-1-0-4 | TBD |
| 44 | CS9.438 | Game Design and Engineering | 3-1-0-4 | Kavita Vemuri |
| 45 | HS7.101 | Human Sciences Lab-1 (H2) | 3-1-0-2 | Radhika Krishnan |
| 46 | CE5.502 | Hydrological modelling and Software Development | 3-1-0-4 | Rehana Shaik |
| 47 | CS9.431 | ICTs for Development | 3-1-0-4 | Nimmi Rangaswamy |
| 48 | CS4.406 | Information Retrieval & Extraction | 3-1-0-4 | Rahul Mishra |
| 49 | EC5.410 | Information Theory | 3-1-0-4 | Prasad Krishnan |
| 50 | CS9.426 | Intro to Cognitive Science | 3-1-0-4 | Vishnu Sreekumar |
| 51 | HS2.202 | Intro to Psychology | 3-1-0-4 | Priyanka Srivastava |
| 52 | SC3.101 | Introduction to Biology | 3-1-0-4 | Vinod PK |
| 53 | | Introduction to Economics | 3-1-0-4 | Anirban Dasgupta |
| 54 | HS3.201 | Introduction to History | 3-1-0-4 | Isha Dubey |
| 55 | CL1.101 | Introduction to Linguistics-1 | 3-1-0-4 | Aditi Mukherjee + Rajakrishnan |
| 56 | HS1.204 | Introduction to Literature | 3-1-0-4 | Nazia Akhtar |
| 57 | CS9.427 | Introduction to Neural and Cognitive Modeling | 3-1-0-4 | Bapiraju Surampudi |

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|----|---------|--|---------|--|
| 58 | CS9.423 | Introduction to Neuroeconomics | 3-1-0-4 | Kavita Vemuri + Guest faculty |
| 59 | | Introduction to Philosophy | 3-1-0-4 | Saurabh Todariya |
| 60 | HS4.201 | Introduction to Politics | 3-1-0-4 | Guest faculty |
| 61 | SC1.421 | Introduction to Quantum Field Theory | 3-1-0-4 | Diganta Das |
| 62 | SC1.320 | Introduction to Stochastic Processes | 3-1-0-4 | Bhaswar Ghosh |
| 63 | CE9.609 | IoT Workshop | 3-1-0-4 | Nagamanikandan Govindan + Sachin Chaudhari |
| 64 | CE1.605 | IS Codes on Design and Structural Safety Assessment | 3-1-0-4 | TBD |
| 65 | CL2.203 | Language and Society | 3-1-0-4 | Radhika Mamidi |
| 66 | CS9.439 | Learning and Memory | 3-1-0-4 | Bhaktee Dongaonkar |
| 67 | HS4.102 | Making of the Contemporary India | 3-1-0-4 | Aniket Alam |
| 68 | SC3.316 | Mathematical Models in Biology | 3-1-0-4 | Abhishek Deshpande |
| 69 | | Mathematical Foundations of Data Sciences | | Suryajith Chillara, Girish Varma |
| 70 | | Foundations for Signal Processing and Communication | | Praful Mankar and Arti Yardi |
| 71 | MA6.301 | Maths for Computer Science 1- Probability and Statistics (H1) | 3-1-0-2 | Uttam Singh |
| 72 | MA6.302 | Maths for Computer Science 2 - Linear Algebra (H2) | 3-1-0-2 | Uttam Singh |
| 73 | CS7.503 | Mobile Robotics | 3-1-0-4 | K Madhava Krishna |
| 74 | EC5.411 | Modern Coding Theory | 3-1-0-4 | Lalitha Vadlamani |
| 75 | CS1.405 | Modern Complexity Theory | 3-1-0-4 | Ashok Kumar Das + Srinathan Kannan |
| 76 | CS7.507 | Multi Agent Systems | 3-1-0-4 | Praveen Paruchuri + Meghna Lowalekar |
| 77 | | Music Language Creativity | 3-1-0-4 | Saroja T K |
| 78 | EC5.101 | Networks, Signals and Systems | 3-1-0-4 | Santosh Nannuru + Anshu Sarje |
| 79 | SC1.310 | Open Quantum Systems and Quantum Thermodynamics | 3-1-0-4 | Samyadeb Bhattacharya |
| 80 | CS3.301 | Operating Systems and Networks | 3-1-0-4 | Karthik Vaidhyanathan |
| 81 | CS1.402 | Principles of Programming Languages | 3-1-0-4 | Venkatesh Choppella |
| 82 | EC2.409 | Principles of Semiconductor Devices | 3-1-0-4 | Anshu Sarje |
| 83 | MA6.102 | Probability and Random Processes | 3-1-0-4 | Gowtham Kurri |
| 84 | MA6.101 | Probability and Statistics | 3-1-0-4 | Tejas Bodas |
| 85 | PD2.501 | Product Marketing | 3-1-0-4 | Ravi Warrier |
| 86 | PD2.401 | Product Management 101 (H1) | 3-1-0-2 | Ramesh Loganathan / RameshSwaminathan |

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|-----|----------|---|---------|--|
| 87 | SC1.203 | Quantum Mechanics | 3-1-0-4 | Subhadip Mitra |
| 88 | | Readings in Hindi Literature | 3-1-0-4 | Harjinder Singh |
| 89 | MA4.101a | Real Analysis | 3-1-0-4 | Samyadeb Bhattacharya |
| 90 | CS3.502 | Real-Time Embedded Systems | 3-1-0-4 | Deepak Gangadharan |
| 91 | CS8.501 | Research in Information Security | 3-1-0-4 | Ashok Kumar Das |
| 92 | EC4.401 | Robotics: Dynamics and Control | 3-1-0-4 | Nagamanikandan Govindan + Spandan Roy |
| 93 | SC1.110 | Science 1 | 3-1-0-4 | Harjinder Singh + Bhaswar Ghosh |
| 94 | SC4.110 | Science Lab I (H1) | 0-0-3-2 | Tapan Kumar Sau + Chittaranjan Hens |
| 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 + Jayanthi Sivaswamy |
| 97 | CS6.302 | Software Systems Development | 3-0-2-4 | Charu Sharma |
| 98 | CS4.408 | Spatial Informatics | 3-1-0-4 | Rajan Krishnan Sundara |
| 99 | SC2.304 | Spectroscopy (H1) | 3-1-0-2 | Marimuthu Krishnan |
| 100 | CL2.405 | Speech Analysis and Linguistics | 3-1-0-4 | Chiranjeevi Yarra |
| 101 | EC5.408 | Speech Signal Processing | 3-1-0-4 | Anil Kumar Vuppala |
| 102 | CS7.403 | Statistical Methods in AI | 3-1-0-4 | Ravi Kiran S |
| 103 | CE1.501 | Structural Dynamics | 3-1-0-4 | Sunitha Palissery |
| 104 | CE1.502 | Structural Engineering Design Studio | 3-1-0-4 | TBD |
| 105 | CE1.509 | Structural Wind Engineering | 3-1-0-4 | Rehana Shaik |
| 106 | SC3.203 | Systems Biology (H2) | 3-1-0-2 | Vinod PK |
| 107 | EC5.202 | Systems Thinking | 3-1-0-4 | Spandan Roy + Vinod PK |
| 108 | CS9.424 | Technology Product Entrepreneurship | 3-1-0-4 | Ramesh Loganathan + Prakash Yalla |
| 109 | HS3.303 | Theories and Practices of Nationalism | 3-1-0-4 | Aniket Alam |
| 110 | CE0.501 | Theory of Elasticity | 3-1-0-4 | P Pravin Kumar Venkat Rao |
| 111 | HS0.202 | Thinking and Knowing in the Human Sciences – II | 3-1-0-4 | Radhika Krishnan + Isha Dubey |
| 112 | MA8.401 | Topics in Applied Optimization | 3-1-0-4 | Pawan Kumar |
| 113 | SC2.401 | Topics in Nanosciences | 3-1-0-4 | Tapan Kumar Sau |
| 114 | CS6.501 | Topics in Software Engineering | 3-1-0-4 | Raghu Reddy Y + TBD |
| 115 | CS9.501 | User Research Methods (H2) | 3-1-0-2 | Priyanka Srivastava |
| 116 | OC3.101 | Value Education-1 (H1) | 0-2-0-2 | Shatrunjay Rawat (Coordinator) |
| 117 | EC2.201 | VLSI Design | 3-1-0-4 | Zia Abbas |
| 118 | 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 :

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 quantitatively, and further develop strategies to mitigate any observed bottlenecks. (Cognitive Level: **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, John 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

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 Analyse 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 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, 2023
Name of the Program: BTech 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
 - o Contextual Distributed Semantics
- Unit 2. Models such as ELMO, BERT, ERNIE and their derivatives
- Unit 3. Statistical Machine Translation methods
 - o Early Neural Machine Translation models
- Unit 4. Extractive and Abstractive Summarization
 - o Neural Summarization Methods
- Unit 5. Reinforcement learning for NLP

Preferred Text Books: 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 SemExam | 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 | P. Krishna Reddy |
| Course Code: | CS3.304 |
| Credits: | 4 |
| L - T - P: | 3-1-0 |
| (L - Lecture hours, T-Tutorial hours, P - Practical hours) | |
| Name of the Program: | MTech I Year |
| Semester, Year: | Monsoon, 2023 |

Pre-Requisites **: None**

Course Outcomes: A computer is a tool which consists of a machine part and operating part. The operating part provides services to users and applications so that the underlying machine can be used in an efficient and convenient manner. The objective of this course is to understand the operating system (operating part) of a computer machine. In this course, we study the general principles of operating system design by focusing on general-purpose, multi-user, uni-processor systems.

This course will primarily study general purpose, time-shared operating systems. The purpose of this course is to introduce some of the fundamental concepts in designing a time-shared operating system. These include:

- Process Management, inter-process communication, synchronization, Concurrency
- CPU scheduling
- Memory management and virtual memory

The course would aim to be hands-on, relying on detailed experimentation to gain better understanding of fundamental principles of operating systems by exploring the Linux kernel. One of the goals of this course is to expose students to Linux OS (a.k.a. Linux Kernel) internals to provide an up-close view of its design and features. For some of the concepts, recent research works proposing extensions/optimizations will also be covered.

Course objectives are:

- CO 1.Understanding the principles of design of operating systems
- CO 2. Look at four major OS Components in depth: System Call, Memory Management, CPU Scheduling and Concurrency
- CO 3. Understanding the design and functioning of Linux kernel components
- CO 4. Experiencing the kernel by passive/active observation
- CO 5. Extending the Linux kernel for deeper understanding
- CO 6. Exploring current research trends in OS, Linux being the reference OS

Course Topics :

History of Operating Systems, Processes and OS Abstractions, OS APIs, Interrupts and system calls, Introduction to the Linux Kernel, Compiling the kernel, Module programming, Writing your own system calls, Overview of kernel startup and initialization, Kernel Debugging Techniques, Interrupts - PICs, APICs, exceptions (traps) and hard interrupts, IDTs, Address Spaces and Loading, Virtual Memory, Memory allocators, Overview of memory spaces: logical segmentation, linear virtual, actual physical, Detecting BIOS-provided physical RAM map, paging, buddy system, setting up page directories (global, upper, middle), tables and PTEs, (N)UMA, nodes, zone, memory types, Setting up buddy system, Allocating contiguous pages from buddy system, Setting up slabs for small memory objects, CPU Scheduling, Threads, Process - structures, organization, initialization, Concurrent Programming, Locking, Deadlocks, Structures: thread union, thread info, stack, task, and thread struct, Creating kernel threads, using kthread, Kernel process scheduling, Scheduling processes with red-black tree, process switching, Context switches, Switching to suspended process, Linux File Systems and Disk Scheduling.

Preferred Text Books :

1. Thomas Anderson and Michael Dahlin
Operating Systems: Principles and Practice, 2nd Edition
Recursive books (August 21, 2014),
ISBN: 0985673524
2. Daniel P. Bovet & Marco Cesati
Understanding the Linux Kernel (3rd edition)
O'Reilly & Associates, November 2005.
ISBN: 0596005652

Reference Books :

1. RemziArpaci-Dusseau and Andrea Arpaci-Dusseau
Operating Systems: Three Easy Pieces
Arpaci-Dusseau Books
August, 2018 (Version 1.00)
2. Jonathan Corbet; Alessandro Rubini; Greg Kroah-Hartman
Linux Device Drivers (3rd edition)
O'Reilly & Associates, February 2005.
ISBN-13: 978-0-596-00590-0
3. Robert Love
Linux Kernel Development (3nd Edition)
Addison-Wesley Professional, 2010.
ISBN: 0672329468
4. Ellen Siever, Stephen Figgins, Robert Love, and Arnold Robbins
Linux in a Nutshell, 6th Edition
O'Reilly & Associates, September 2009.
ISBN: 978-0-596-15448-6

E-book Links :

Grading Plan :

(The table is only indicative)

| Type of Evaluation | Weightage (in %) |
|--------------------|------------------|
| Quiz-1 | 3 |
| Mid SemExam | 16 |
| Quiz-2 | 3 |
| End Sem Exam | 20 |
| Assignments | 18 |
| Project | 40 |

Mapping of Course Outcomes to Program Objectives:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|
| CO1 | 1 | 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) :

Hands-on Project and assignment-driven course to enable better relate concepts with practical reality.

Title of the Course: Advanced Structural Design

Name of the Faculty : Sunitha Palissery
Course Code: CE1.604

Credits: 4
L - T - P: 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year: Monsoon 2023
Name of the Program: M.Tech CASE

Pre-Requisites : Design of RC and Steel Structures (Undergraduate course content), Stability of Structures

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 reinforced concrete and steel moment frame buildings
- CO-2. Employ the computer application skills in developing structural behavior intuition and predict structural response to dynamic loading like earthquakes
- CO-3. Demonstrate problem solving skills for various scenarios of structural design and work towards a research-based approach to the seismic design of structures
- CO-4: Develop critical thinking to help improve and control structural behavior, with focus on seismic loading effects on moment frame buildings and other structural systems

- CO-5. Analyze ethical and effective structural design practices in line with good seismic behavior of structures under earthquake loading
- CO-6. Reorganize inter-personal skills required to manage possible negotiations with structural engineering design practitioners and promote a seismically safe built environment

Course Topics :

Unit 1: Seismic Elastic and Inelastic Behaviour of Structures

Configuration, Structural Plan Density, Initial proportioning, estimation of loads and load combinations, numerical modelling concepts interpretation of linear elastic structural analysis and modal analysis results-concept of lateral stiffness, strength, ductility, collapse mechanism, deformability, energy dissipation.

Unit 2: Seismic Design Recommendations in Indian and International Design Standards

IS Code recommendations in IS1893:2016, IS 13920:2016, IS800:2007, ACI318:2019, ASCE07-10, AISC documents

Unit 3: Seismic Design of Reinforced Concrete Special Moment Frame Building

Design and detailing of RC structural members for loading effects-axial, flexure, shear design for combined effects; RC beam-column joints

Unit 4: Seismic Design of Steel Special Moment Frame Building

Design of steel members, connections-Joint panel zones, prequalified connections; Design of Column Bases

Unit 5: Nonlinear Static Behaviour of Special Moment Frame Buildings

Nonlinear Static response: Lateral Stiffness, Lateral Strength, Ductility Capacity, Collapse Mechanism and Energy Dissipation Capacity of RC and Steel Building Designed as part of the course.

Preferred Text Books :

1. Elnashai,A.S., and Di Sarno,L., (2008), *Fundamentals of Earthquake Engineering*, John Wiley and Sons, UK
2. Gioncu,V., and Mazzolani,M., (2002), *Ductility of Seismic Resistant Steel Structures*, SPON Press, Taylor and Francis, New York

3. Ingle,R.K., Jaiswal,O.R., Jain,S.K., and Brzev,S., (2016), *Explanatory Examples on Ductile Detailing of RC Buildings*, Document No. IITGN-WB-EQ5-V3.0, GSDMA, Gujarat
4. Park,R., and Paulay,T., (1975b), *Reinforced Concrete Structures*, John Wiley & Sons, UK
5. Paulay,T., and Priestley,M.J.N., (1992), *Seismic Design of Reinforced Concrete and Masonry Buildings*, John Wiley and Sons, New York
6. Salmon,C.G., and Johnson,J.E., (1996), *Steel Structures Design and Behaviour*, Prentice Hall, NJ
- 7.

Reference Books :

1. American Concrete Institute (ACI), (2014), Building Code requirements for Structural Concrete (ACI 318-14), Farmington Hills, MI, USA
2. American Institute of Steel Construction (AISC), (2016), Seismic Provisions for Structural Steel Buildings, (ANSI/AISC341-16), Chicago, Illinois, USA
3. American Institute of Steel Construction (AISC), (2016), Specifications for Structural Steel Buildings, (ANSI/AISC360-16), Chicago, Illinois, USA
4. American Society of Civil Engineers (ASCE), (2010), Minimum Design Loads for Buildings and Other Structures (ASCE 7-10), USA
5. American Society of Civil Engineers (ASCE), (2013), Seismic Rehabilitation of Existing Buildings, (ASCE/SEI 41-13), Virginia, USA
6. Bureau of Indian Standards (BIS), (2000), Indian Standard Plain and Reinforced Concrete - Code of Practice, IS 456:2000, New Delhi, India
7. Bureau of Indian Standards (BIS), (2007), Indian Standard Code of Practice for General Construction in Steel, IS800:2007, New Delhi, India
8. Bureau of Indian Standards (BIS), (2016), Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces, Code of Practice, IS 13920:2016, New Delhi, India
9. Bureau of Indian Standards (BIS), (2016), Indian Standard Criteria for Earthquake Resistant Design of Structures, IS:1893:2002-Part 1, New Delhi, India
10. Booth,E., (2014), *Earthquake Design Practice for Buildings*, ICE Publishing, London
11. Agarwal,P., and Shrikande, M., (2010), *Earthquake Resistant Design of Structures*, PHI Learning Pvt Ltd, New Delhi
12. Chen,W.F., and Lui,E.M., (2005), *Earthquake Engineering for Structural Design*, CRC Press, Taylor and Francis, Boca Raton
13. Murty,C.V.R., Goswami,R., Vijayanarayana,A.R., and Mehta,V.V., (2012), *Earthquake Behaviour of Buildings*, GSDMA, Gujarat
14. Varghese,P.C., (2010), *Design of Reinforced Concrete Foundation*, PHI Learning Pvt Ltd, New Delhi

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: (1 – Lowest, 2—Medium, 3 – Highest, or a ‘-’ dash mark if not at all relevant). Program outcomes are posted at

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 | PSO4 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 1 | 2 | 1 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 1 | 3 | 1 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 1 | 3 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 1 | 3 | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 2 |
| CO6 | 1 | 2 | 1 | 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 reinforced concrete and steel moment frame buildings to reinforce linear and nonlinear structural analysis concepts and seismic design methods commonly used in design practice
3. Assignments involving analysing structural data to understand linear and nonlinear static response of buildings
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 nonlinear behaviour of buildings under earthquakes.

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 2023 |
| 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 known algorithms.

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 cope with hardness.

CO-4: Understand the notion of approximation and randomized algorithms. If time permits, 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 O2 | PS O3 | PS O4 |
|-----|-----|-----|------|------|-----|-----|-----|------|------|-------|-------|-------|-------|-------|-------|-------|
| 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 lecture content by using small examples that students work out during the class itself and promote active and participatory learning. A good part of the lecture will involve problem solving and

finding solutions to problems rather than expositing known material. In class tests that are held periodically are useful as summative assessments. Homework assignments are designed to reiterate the material covered in class lectures and also solve problems that are based on simple extensions of concepts described in the lectures.

| Title of the Course | Algorithms and Operating Systems |
|--|---|
| Name of the Faculty | Lini Teresa Thomsa |
| Course Code | CS3.306 |
| Credits | 4 |
| L - T - P | 3-1-0 |
| (L - Lecture hours, T-Tutorial hours, P - Practical hours) | |
| Semester, Year: | Monsoon 2023 |
| 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 Synchronisation
 - 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 practising 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%
- Homeworks : 20%
- MidSemester Examination : 20%
- End Semester Exam : 35%

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

1. Prerequisite Course / Knowledge:

Analog Electronics, Network theory.

2. Course Outcomes (COs)

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

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

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

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

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

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

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

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

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

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

3. Detailed Syllabus:

Unit 1 (Basics of analog design): MOS model for analog circuits, large signal modeling, incremental modeling, MOS parasitics, mismatches, speed (f_T), passive components for IC

design (R, C and L), biasing, negative feedback for biasing, introduction to layout, Gain-BW-Swing-Power-Noise-Area trade-offs. (4-lectures/6-hours)

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

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

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

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

REFERENCES:

1. B. Razavi, "Design of Analog CMOS Integrated Circuits," 2nd ed., McGraw Hill, 2017.
2. P. E. Allen and D. R. Holberg, "CMOS Analog Circuit Design," 3rd ed., Oxford, 2013.
3. Paul R. Gray & Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits," 4th ed., John Wiley & Sons, 2008.

5.Teaching-Learning Strategies in brief:

Fundamentals of analog IC design and practical design approaches will be discussed in the course with examples. SPICE tools will be introduced, and regular assignments will be given based on topics covered in lectures. Weekly tutorials will be conducted for problem solving and further discussions on any questions related to topics covered in lectures. A course project will be given that will involve analysis, design and simulations (schematic and post-layout level) of an analog circuit for given specifications.

5. Assessment methods and weightages in brief:

6.

| 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

Applied Ethics

| | |
|------------------------------|-----------------|
| Name of the Faculty | Saurabh Todaria |
| Course code | HSo.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

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: 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 emphasises 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.

5. 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**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, Pushdown Automata, the basics of Turing Machines

CO-2. Design grammars and automata for different languages

CO-3. Identify formal language classes and prove language membership properties

CO-4. Describe the limitations of the different computational 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 denotes ‘High-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low’-level’ mapping

4. Detailed Syllabus:

Unit 1: 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

Unit 2: 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 Learning 2012.
- 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:

The lectures will be arranged in a manner that facilitates inter-student and faculty-student discussions. 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%

Final exam: 35%

Title of the Course

Basics of Ethics

Name of the faculty

Ashwin Jayanti + Shipra Dikshit

Course code

HSo.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 emphasises 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

| | |
|------------------------------|--------------|
| CourseCode | CS9.421 |
| Faculty Name | Vinoo A R |
| L-T-P | 3-1-0 |
| Credits | 4 |
| Name of the Academic Program | B.Tech.inCSE |

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 be able 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 operationalization and 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 | PSO | |
|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|------------|------------|---|
| | | | | | | | | | | | | | 2 | 3 | 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 | 2 | 2 | - | 1 | 1 | 1 | 3 | 3 | |
| CO3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | - | 1 | 1 | 2 | 3 | 3 | |
| CO4 | 3 | 3 | 3 | 3 | 3 | 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 Behavioral 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; 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 square type designs, Between-subject and within-subject factors in an experiment; Scaling Behavioral 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 tests of difference – chi-square test, Mann Whitney U test, Binomial Sign test, Wilcoxon's T 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 Behavioral and Neuroimaging data in more detail].
6. Communicating and Assessing Research: Writing, Poster and general Presentations (formatting of the research paper using APA and IEEE journal/conference formats)

7.

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 Behavioral 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, run experiments, 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: BioDatabases: Major Bioinformatics Resources – NCBI, EBI, PubMed, Primary Nucleotide and Proteins Databases - GenBank, UniProt, PDB, Genome Browsers – Ensembl, 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 **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, 2023 |
| 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 Text Books : [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_iit_ac_in/EldcZ_Lqj3JBICDryuvU5z4B8twcGifr3I4ovKjixUVqSg?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 analyse the relationship of few molecular systems.

Title of the Course : Business Fundamentals

Name of the Faculty : Shantanu Mandal
 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 2023

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 Opentax Publication.
<https://d3bx9geuw4e147.cloudfront.net/oscmsqa/media/documents/IntroductionToBusiness-OP.pdf>
- Fundamentals of business organization and management, 2nd Edition, Y K Bhushan, ISBN: 9789351610618.
- Business Fundamentals: How to Become a Successful Businessman, First Edition, Roger W. Babson.

https://vttechworks.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 SemExam | 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 **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 : Classical Text Readings-1

Name of the Faculty : Ashwin Jayanti + Sushmita Banerji

Course Code : HS0.301

Credits : 4 (four)

L - T - P : 3-1-0

(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

Semester, Year : Monsoon 2023

Pre-Requisites : Making of Contemporary India, Making of the Contemporary World, Thinking and Knowing in the Human Sciences – 1

Course Outcomes :

CO-1: Identify and recognize various conceptions of state, legitimacy, citizenship, and political economy through a thorough reading of classical texts in the original

CO-2: Classify and describe various theories and interpretations of state and authority through history

CO-3: Compare Indian and Western approaches to the state

CO-4: Evaluate and assess the moral principles guiding the different conceptions of state and economy and identify the changes through history.

CO-5: Develop and synthesize various perspectives on state and political economy in the light of contemporary theories and their historical influences.

Course Topics :

1. Unit 1: Classical texts and their contemporary relevance; historical background of political thought in the Indian subcontinent; Buddha and the *Dhammapada*; Kautilya's *Arthashastra*

Unit 2: Ancient Greece; Plato's *Republic*; Aristotle's *Politics*

Unit 3: Thomas Hobbes' *Leviathan*; Jean-Jacques Rousseau's *On the social contract*; Adam Smith's *Wealth of Nations*; Karl Marx's *The Communist Manifesto*

Unit 4: Gandhi's *Hind Swaraj*; Ambedkar's "Buddha or Karl Marx"; Hannah Arendt's *Eichmann in Jerusalem*

Preferred Text Books :

- F.M. Cornford (trans.), *The Republic of Plato*, Oxford University Press, 1970.
- Ernest Barker (trans.), *Aristotle: Politics*, Oxford University Press, 1998
- Irving Babbitt (trans.), *The Dhammapada*, New Directions, 1965
- Patrick Olivelle (trans.), *King, Governance and Law: Kautilya's Arthashastra*, Oxford University Press, 2014
- Thomas Hobbes, *Leviathan*, J.C.A Gaskin (ed.), Oxford University Press, 1998
- Donald A. Cress, *Basic Political Writings of Jean-Jacques Rousseau*, Hackett, 1987
- Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations*, R.H. Campbell, A.S. Skinner, W.B. Todd (eds.), Liberty Classics, 1981
- Karl Marx and Friedrich Engels, *The Communist Manifesto*, Oxford University Press, 1992
- M.K. Gandhi, *Hind Swaraj*, Rajpal Publishing, 2015
- Valerian Rodrigues (ed.), *The Essential Writings of Dr. B.R. Ambedkar*, Oxford University Press, 2013.
- Hannah Arendt, *Eichmann in Jerusalem: A Report on the Banality of Evil*, Penguin, 1994

Reference Books :

- Stanley Rosen (ed.), *The Philosopher's Handbook: Essential Readings from Plato to Kant*, New York: Random House, 2003
- Mitchell Cohen (ed.), *Princeton Readings in Political Thought – Essential Texts from Plato to Populism*, Princeton University Press: 2018
- Rajeev Bhargava and Ashok Acharya (eds.), *Political Theory: An Introduction*, Pearson India, 2008
- Upinder Singh, *Political Violence in Ancient India*, Harvard University Press, 2017
- Shefali Jha, *Western Political Thought: From The Ancient Greeks to Modern Times*, Pearson, 2018

- S. Marc Cohen, Patricia Curd, C.D.C. Reeve (eds.), *Readings in Ancient Greek Philosophy from Thales to Aristotle*, Hackett, 1985
- Richard Schmitt, *An Introduction to Social and Political Philosophy: A Question-Based Approach*, Rowman and Littlefield, 2009

E-book Links :

Grading Plan :

| Type of Evaluation | Weightage (in %) |
|---------------------|------------------|
| Quiz | 10% |
| Assignments (Three) | 60% |
| End Sem Exam | 20% |
| Class Participation | 10% |

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

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

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

Upon completion of this course, students will be able to appreciate, analyze, and critically engage with canonical texts which form the foundation for our current thinking around political and economic theories and their limitations. By making sense of the political and economic world around us, they would be in a better position to understand and engage in contemporary debates surrounding these very pressing and relevant topics. The main strategy is to share the readings and resource material beforehand for the students to acquaint themselves with the topics and use the class time to discuss and evaluate the implications of the various positions respective to each topic.

Title of the Course

Computational Linguistics 2

| | |
|--|-------------------------------|
| Name of the Faculty | Parameshwari K + Rajakrishnan |
| Course Code | CL3.202 |
| L-T-P | 3-1-0 |
| Credits | 4 |
| Name of the Faculty (P=Practical hours) | Parameshwari K + Rajakrishnan |
| 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 analyse 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; cooperative interaction and Gricean maxims; speech act theory; language as action, performatives, direct and indirect speech acts and felicity conditions; politenessmaxims; 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 analyse 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 | Lini Teresa Thomas |
| Course Code | CSo.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 analyse 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: Abhishek Deshpande + Girish Varma + Shantanav Chakraborty

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 in Computer Science and Engineering

1. Prerequisite Course / Knowledge:

Logical thinking and mathematical concepts at the level of a 10+2 standard student with a math major. No prior programming experience or computing background is required.

2. Course Outcomes (COs)

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

CO-1: Explain the syntax of programming language constructs and their semantics **and describe** a program structure and its execution model. (Cognitive Level: **Understand**)

CO-2: Describe the steps in program editing, compilation and execution using tools such as Visual Studio Code, GCC compiler on a Linux/Windows/MAC operating system.

CO-3: Choose appropriate primitive data types and design new composite data types to model the relevant data in a given computation problem **and also discover** the algorithmic logic required to solve well-defined computational problems. (Cognitive Levels: **Apply and Analyze**)

CO-4: Compare and contrast the performance of different algorithmic approaches for simple computational problems with respect to time and memory. (Cognitive Levels: **Analyze** and **Evaluate**)

CO-5: Write programs involving basic dynamic data structures such as linked lists and use tools such as Valgrind to detect any memory leaks. (Cognitive Levels: **Apply** and **Analyze**)

CO-6: Use debugging tools such as GDB proficiently to rapidly isolate and remove subtle/complex bugs in programs. (Cognitive Levels: **Apply** and **Analyze**)

CO-7: Manage complex large projects using source code management tools such as GIT and build tools such as Make. (Cognitive Levels: **Apply** and **Analyze**)

CO-8: Assess and evaluate the solutions of their classmates through a peer review process (Cognitive Level: **Evaluate**)

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 | - | - | - | - | - | - | - | 2 | 3 | 3 | 3 |
| CO2 | 3 | - | 3 | - | 3 | - | - | - | - | - | - | - | 2 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | - | 2 | 2 | 3 | 3 |
| CO4 | 2 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 2 | 2 | 3 | 3 |
| CO5 | 2 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 2 | 2 | 3 | 3 |
| CO6 | 1 | 1 | 1 | 1 | 3 | - | - | - | - | - | - | - | 2 | 3 | 3 | 3 |
| CO7 | 3 | 2 | 2 | 2 | 3 | - | - | 3 | 3 | 3 | - | - | 2 | 3 | 3 | 3 |
| CO8 | 1 | 2 | 2 | 2 | 2 | - | - | 3 | 3 | 3 | - | - | 2 | 2 | 3 | 3 |

4. Detailed Syllabus

- **Unit 1:**
 - Basic computer organization, Von Neumann architecture and stored program concept
 - High level programming languages, assemble code, binary instructions, compilers and assemblers
 - Programming editing, compilation and execution cycle
- **Unit 2:**
 - Use of variables as reference to memory locations
 - Basic data types and their representation
 - Operators and precedence levels, expressions
 - Writing straight-line sequence of code
 - Standard I/O Libraries
- **Unit 3:**
 - Conditional Statements (if-then-else) and Loops (for, while, etc.)
 - Arrays
 - Functions and parameter passing mechanisms
 - Standard libraries for string manipulation, disk file access etc.
 - Structures, Unions and Enumerations
- **Unit 4:**

- Recursion
- Program stack, scope and lifetime of variables
- Pointers, heap memory, dynamic memory management, linked lists and memory leaks
- **Unit 5:**
 - Preprocessor directives
 - Source code management tools like GIT and use of GDB for program debugging
 - Multi-file programming and Makefiles

Reference Books:

1. K. N. King. 2008. C Programming: A Modern Approach, Second Edition. W.W. Norton & Company.
2. Nick Parlante. 2017. Essential C. Independently published.

5. Teaching-Learning Strategies in brief

Lectures are conducted in a highly interactive fashion. Programming problems are solved in-class along with students in a collaborative fashion. Sometimes two-three students are given an opportunity to present their programs to the class. At the end of every class, a small homework problem which helps in enhancing the concepts discussed in the class will be released. Students need not submit this homework. Tutorial sessions are used to teach the utilization of tools such as Visual Studio Code, GCC, GDB, GIT, Makefiles, 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. Key milestones are defined. Feedback from the students at those milestones are taken. The provided feedback is taken to fine tune the course and provide special support to students who are lagging behind. Five to six programming assignments are designed which gives an in-depth understanding of various concepts discussed in the class and their application to new problem scenarios along with proper analysis. Some problems involve evaluating, comparing and contrasting multiple solution approaches.

6. Assessment methods and weightages in brief

1. Programming Assignments (5 to 6) : 50 percent
2. Best 2 out of 3 Programming Lab Exam: $2 \times 15 = 30$ percent
3. Best 2 out of 3 Theory Exams: $2 \times 10 = 20$ percent

For programming assignments and lab exams, online judges such as DMOJ are used to provide immediate feedback to students. While some test cases are revealed, others are hidden. Partial marks are allocated for code peer-reviewing in programming assignments.

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

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 Optimisation 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. Student will be encouraged to read carefully all the log files and

become familiar with technical language, in addition to home work 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.

Endsemester will carry 40% weightage of which 75% component will be based on demonstrating familiarity with scientific software taught in the course.

Home work 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 | P. Krishna Reddy |
| 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 day in multiple domains. We are drowning in data, but starving for knowledge or actionable insights. Data mining or data analytics constitute a collection of concepts and algorithms, which are being developed to answer “how” questions by extracting interesting and useful knowledge 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 to learn 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 the corresponding solutions
-

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|
| CO1 | 3 | 2 | 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, Third edition, 2012, Elsevier 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-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

| Title of the Course: | Data and Applications [Half] |
|--|---|
| Name of the Faculty: | Ponnurangam Kumaraguru |
| Course Code: | CS4.301 |
| Name of the Academic Program: | B.Tech. in Computer Science and Engineering |
| L-T-P: | 3-1-0 |
| Credits: | 2 |
| (L= Lecture hours, T=Tutorial hours, P=Practical hours) | |

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 andintegrity 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

'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

Title of the Course: **Data Driven Drug Discovery**

Faculty Name : U. Deva Priyakumar

Course Code : SC4.412

Credits : 3-1-0-4

L - T - P :

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

Semester, Year : Monsoon 2023

Name of the Program : All undergraduate programs (as science/CNS elective) and MS by Research/PhD

Pre-Requisites : **SMAI and Science I/II or equivalent**

Course Outcomes :

- Describe the complete drug discovery process and the role of computing.

- Employ modern machine learning methods to accelerate select tasks in the drug design pipeline.
- Explain specific use cases of data driven methods applied for drug discovery.
- Analyze and examine the codebase of a select method in data driven approaches for drug design.
- Design and develop a system implementing the selected method that takes relevant inputs (eg. Molecules as input) and gives the corresponding outputs (eg. Molecular properties as an output) using a web interface.

Course Topics :

- Drug discovery: Stages of drug discovery and development –What make a molecule a drug? Serendipitous drug discovery – Dominance of natural products or their derivatives as drugs
- Rational drug design: Use of molecular structure, understanding of biological disease pathways for rational design. Target identification and validation.
- Computing in drug design: Sequence to structure of proteins, Binding pocket identification, Ligand libraries, protein-ligand binding affinity and structure based drug design.
- ML for Drug discovery: Datasets relevant to drug design. Use of modern ML methods for sequence to structure of proteins, binding pocket identification, binding affinity prediction, inverse design of molecules, Toxicity prediction, ADME property prediction.
- System building: Implementing an existing ML framework/model for use by non-CS experts based on a web interface.

Preferred Text Books : Molecular Modeling by Andrew Leach

Reference Books : Machine learning for drug discovery by Melo, Maasch and Nunez. Other material will be uploaded to the course webpage

Grading Plan : (The table is only indicative)

| Type of Evaluation | Weightage (in %) |
|--------------------|------------------|
| Quiz-1 | 5 |
| Mid SemExam | 10 |
| Quiz-2 | 5 |
| End Sem Exam | 15 |
| Presentations | 25 |
| Project | 40 |

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

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

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

- The following sequence will be followed for effective learning
 - Introductory lectures on drug discovery
 - Presentations by students from the curated articles on ML algorithms applied to drug design
 - Lectures on computing applied to drug design
 - Presentations by students on the codebase of the chosen articles
 - Lectures on data driven drug discovery
 - Presentations by students on the implementation of the code in a web interface
-

Title of the Course: Data Foundation Systems – A Project-Based Elective Course

Name of the Faculty: Vikram Pudi + G. Venu Gopal

Course Code: CS4.409

Credits: 4

L - T - P : 1-1-3

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

Name of the Program : Elective for B.Tech/M.Tech/MS/PhD students in CSE

Semester, Year : Monsoon, 2023

Pre-Requisites : SSAD, SSDD, or background knowledge/experience in python web programming

Course Outcomes :

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

1. Participate in building large, deployable software systems
2. Automate data ingestion
3. Fluently use Javascript, NodeJS and related frameworks to build interactive web-components
4. Fluently use one or more modern Python backend web frameworks
5. Rapidly build responsive websites with complex layouts

Course Topics :

1. Code and design review of large software systems
2. NodeJS
3. Asynchronous Javascript web components
4. One or more modern python web framework (e.g. django, py4web, etc.)
5. Responsive webpages and complex layouts
6. Data scraping and ingestion

Preferred Text Books :**Online material:**

1. Python documentation
2. NodeJS documentation
3. HTML5/CSS and bootstrap (or similar) layouts tutorial
4. Django/py4web documentation

Reference Books :**E-book Links :****Grading Plan :**

(The table is only indicative)

| Type of Evaluation | Weightage (in %) |
|--------------------|---|
| Quiz-1 | 15% |
| Quiz-2 | 15% |
| Assignments | 10% |
| Project | 60% |
| Other Evaluation | <p>Project evaluation will be based on deliverables at intermediate deadlines, including for requirements, screenshots, database design, prototype building, etc.</p> <p>A: If deliverable is deployable, well-designed and efficient A-: If deliverable is deployable</p> <p>B: If deliverable is deployable with some more effort B- to C-: If deliverable is deployable with considerably more effort.</p> <p>F: If deliverable is not deployable.</p> |

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 | PO4 | 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 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 3 | 2 | 2 | 3 | 2 | 1 | 2 | 1 |
| CO 2 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 3 | 2 | 2 | 3 | 2 | 1 | 2 | 1 |
| CO 3 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 3 | 2 | 2 | 3 | 2 | 1 | 2 | 1 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 3 | 2 | 2 | 3 | 2 | 1 | 2 | 1 |
| CO 5 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 3 | 2 | 2 | 3 | 2 | 1 | 2 | 1 |

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

This is a practicals oriented course, where the students will participate in projects to collaboratively build a large-scale application, which is the data-foundation – a technology-platform to collect, create, curate, annotate, secure and deploy a library of datasets for developing solutions driven by AI and analytics in socially-relevant domains such as Healthcare, Mobility, Buildings and Systems.

Necessary background skills, languages and tools for backend and frontend programming will be taught during lectures, along with code and design reviews of large software systems.

Students will work in teams to build a deployable system. This exposure will enable students to become industry-ready with skills to innovate and build large software systems and/or startups.

According to Massimo Di Pierro, the creator of py4web: “The ability to easily build high quality web applications is of critical importance for the growth of a free and open society. This prevents the biggest players from monopolizing the flow of information.” This course is geared towards that goal.

Sample projects to choose from:

1. Dataset library
2. Data ingestion from various sources
3. Data annotation plugins
4. Dataset approval workflow
5. Javascript components to handle medical images (CT/MRI/X-Ray)

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

Name of the Faculty: Vineet Gandhi

Course Code: CS1.304

Credits: 6

L - T - P: 3-1.5 - 3

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

Semester, Year: Monsoon 2023

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 SemExam | 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-workbased 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: **Data Systems**

Name of the Faculty: Kamalakar Karlapalem

Course Code: CS4.401

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

2. Course Outcomes (COs)

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

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

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

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

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

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

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

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

| | P O1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|-----|---------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|
| CO1 | 2 | 2 | 2 | 2 | 3 | - | 1 | - | 3 | 1 | 3 | 2 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 1 | 3 | - | 1 | - | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 1 |
| CO3 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | - | 2 | 2 | 2 | 1 | 3 | 3 | 3 | 2 |
| CO4 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | - | 2 | 2 | 2 | 1 | 3 | 3 | 3 | 2 |
| CO5 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | - | 2 | 2 | 2 | 1 | 3 | 3 | 3 | 2 |
| CO6 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | - | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |

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

4. Detailed Syllabus:

- Unit 1: Introduction, Data storage, Representing data elements (9 hours)
Unit 2: Index structures, Multidimensional indexes (7.5 hours);
Unit 3: Query execution, The query compiler (9 hours)
Unit 4: Coping with system failures, Concurrency control (7.5 hours);
Unit 5: Transaction management, NoSQL and big data systems (9 hours)
- Five mini projects related to the above syllabus will be done by students in the laboratory

References :

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

5.Teaching-Learning Strategies in brief:

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

6. Assessment methods and weightages in brief:

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

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 2023 |

PRE-REQUISITE : Good background in Linear Algebra and Probability theory, Statistical Methods in AI (Optional), 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), mutual information and the information bottleneck, Word2vec and its relationship to latent semantic indexing (LSI).

CO-5: Convolutional neural networks (CNNs), backpropagation in CNNs, LeNet, AlexNet, Inception, VGG, GoogLeNet, ResNet.

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, Variational autoencoders, Restricted Boltzmann Machines, Unsupervised Learning, RBMs, Contrastive divergence for RBMs, Autoregressive Models: NADE, MADE, PixelRNN, Generative Adversarial Networks (GANs).

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO1 0 | PO1 1 | PO1 2 | PO1 3 | PSO 2 | PSO 3 | PSO 4 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----------|----------|----------|----------|----------|----------|----------|
| 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 %) |
|----------------------------|------------------|
| Small Quizzes (10 quizzes) | 25% |
| Quiz-1 | 10% |
| Quiz-2 | 10% |
| End Sem Exam | 10% |
| Assignments | 30% |
| Project | 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 Testability |
|--|--|
| Name of the Faculty: | Usha Gogineni |
| 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.

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 | - | 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% |
| Mid term (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, 2023)

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-Centred (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 behaviour 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 – Ro806E)
7. Book: Innovation Through Design by Bill Moggridge
8. Book: 101 Design Methods: A structured approach for driving innovation in your organisation 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, 2023)

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-Centred (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. PROJECT 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 FINALISING 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- Democratising 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 Namboodiri

Course Code: CS7.404

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

Credits: 4

(L=Lecturehours,T=Tutorialhours,P=Practicalhours)

Name of the Academic Program: B.Tech.inComputerScienceandEngineering

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, Image Restoration, Image Compression)

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 | PO O1 | PO O2 | PO O3 | PO O4 |
|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|-------|
| CO 1 | 2 | 2 | 2 | 2 | 3 | - | 1 | - | 3 | 1 | 3 | 2 | 3 | 3 | 2 | 3 |
| CO 2 | 3 | 3 | 3 | 1 | 3 | - | 1 | - | 2 | 2 | 2 | 3 | 3 | 2 | 1 | 1 |

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

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

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

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

Name of the Faculty: Aftab M.Hussain, Harikumar K + Ubaidula P

Course Code: EC2.101

L-T-P 3-1-3

Credits: 5

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

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.CourseOutcomes(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 of a basic 8-bit von Neumann architecture processor.

CO-5: Develop skills for simulating circuits using basic components on online simulation tools (example, TinkerCAD).

CO-6: Design, implement and test a given logic circuit using basic electronic components such as breadboards, 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, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. DetailedSyllabus:

Unit1: Numbersystems and interconversions (binary, decimal, hexadecimal), postulates of Boolean alg

ebra, binary logic gates, binary functions

Unit 2: Simplification of binary expressions using K-maps, logic function implementation, combinational circuits

Unit 3: 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 circuits
Unit 5: Registers and counters, memory and processor architecture

Reference Books:

1. M. Morris R. Mano and Michael D. Ciletti (2013), *Digital Design*, 6th Ed, Pearson.

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

The course instruction is delivered through lectures with examples of real-world application of electronics 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 methods and weightages in brief (4 to 5 sentences):

Continuous evaluations: Assignments – 10%

MCQ Quizzes – 20%

Lab reports – 20%

Comprehensive evaluations:

Lab exam – 15%

End semester exam in Theory – 35%

Title of the Course:

Discrete Structures

Name of the Faculty:

Ashok Kumar Das + Venkatesh Choppella

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 | 3 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 3 |
| CO3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 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, Cantors numbering.
- **Unit 2:**Group, subgroup/normal subgroup, homomorphism/automorphism/isomorphism/eipmorphism,kernel,cosets,quotientgroup,productsetin a group,centerofagroup,order/conjugateofanelement,commutator. Coding theory (Application to group theory).
- **Unit 3:**Ring, Field, Finite field over a prime. Applications to finite fields.
- **Unit 4:Recurrence relations, generating functions, numeric functions.** Applications to recurrence relations.
- **Unit 5:**Basics of probability theory, birthday attacks. Applications on hash functions.
- **Unit 6: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,"ElementsofDiscreteMathematics:AComputerOrientedApproach," Tata McGraw-Hill Edition,2017.
3. D.S.MalikandM.K.Sen,"DiscreteMathematicalStructures:TheoryandApplications,"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: Distributing Trust, Block chains and Their Applications

Name of the Faculty: Sujit P Gujar

Course Code: CS3.403

L-T-P..... 3-1-4

Credits: 4

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

Name of the Academic Program BTech in CSE

1.Prerequisite Course / Knowledge: Nil**2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):**

After completion of this course successfully, the students will

CO-1 learn what is bit coin and in general what is blockchain technology. Also, the participants will learn program in solidity

CO-2 learn security aspects of bitcoins, how alternate cryptocurrencies are proposed to improve certain aspects

CO-3 what are key concepts behind block chain technology, how to design smart contracts using block chains

CO-4 learn how to write smart contracts in solidity, hydeperledger

CO-5 develop new applications using block chain technology

CO-6 Understand need for privacy of databases through differential privacy

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

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

4.Detailed Syllabus:

- (i) Basic maths (probability theory) and cryptography concepts such as encryption, hashing and Merkel Trees. (Introduction to basic stuff so that course can be self-sufficient).
- (ii) What is cryptocurrency? What is bitcoin? How does bitcoin work?
- (iii) What is double spending? How it is avoided by proof of work in bitcoins?
- (iv) Bitcoin mining: strategies and incentives, and mining pools.
- (v) Distributed consensus. Block chain technology.
- (vi) Use of block chains to design smart contracts (Ethereum/solidity) and their applications such as secure auction, distributed machine learning, secure crowd sensing etc.
- (vii) Other Cryptocurrencies: Altcoins, ZeroCash etc.
- (viii) Differential Privacy: Concepts and important results

Reference Books:

1. Bitcoin and Cryptocurrency Technologies, Narayanan, Bonneau, Felten, Miller, Goldfeder, Clark, Princeton University Press 2016
2. The Algorithmic Foundations of Differential Privacy, Cynthia Dwork and Aaron Roth

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

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

| Type of Evaluation | Weightage (in %) |
|---------------------------------|------------------|
| Mid Sem Exam | 20 |
| End Sem Exam | 30 |
| Quizzes/Reading Assignment | 10 |
| Programming/Reading Assignments | 30 |
| Scribes | 5 |
| Course Participation | 5 |

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 behaviour 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: Behaviour 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 behaviour 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: Behaviour 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 behaviour 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: | Chiranjeevi Yarra, Ubaidulla P |
| 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, bread-boards, 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 | 1 | 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, analyze 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: 2-0-3

Credits: 4

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

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

1. Prerequisite Course /Knowledge:

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 interoperability 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 ArticulationMatrix

| | 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. DetailedSyllabus:

1. Sensing/Actuators andInterfacing

1. Sensor/Actuator selection (using datasheets)
2. Physics of sensors and actuators related toprojects
3. Interfacing: Serial interfaces, Analog out, SPI, UART, I2C, "propriety" such asDHT22

2. Controller, Embedded Systems and Peripherals-

1. Platform selection – ATTEL328, ESP32, STM8 Architecture; timers, interrupts, AVR, SAMRarchitectures
2. Embedded Systems: power management, interrupts, memory managements, leaks, OTA firmware update, reliability, onboarddebugging
3. Peripherals: RTC, ADC channels, resolution, onboard memory, power,external/internalwatchdog

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 using one M2M
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
 - 2.
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. Hersistent, 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 EQUIPARTITION 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 ENTROPY MAXIMUM 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 SemExam | 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) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO1 0 | PO1 1 | PO1 2 | PO1 3 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----------|----------|----------|----------|----------|----------|----------|----------|
| CO1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO2 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO3 | 2 | 2 | 2 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO5 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO6 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 2 |

4. Detailed Syllabus:

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, Co₂, 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. Jackson and J. M. Jackson, Longman
2. Environmental Science (2001): S. C. Santra, New Central Book Agency (P) Ltd
3. Environmental Science (6th 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 Age International (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 or working 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

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|----------|----------|
| CO1 | 1 | 1 | 1 | 2 | 1 | 3 | 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 free ness, 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: TBD
Course Code: CE4.501
L—T—F: 3-1-0
Credits: 4

1. Prerequisite: Calculus, Linear algebra

2. Course Outcomes

| | | | | | | | | | | | | |
|------|---|--|--|--|--|--|--|--|--|--|--|--|
| CO 1 | Solution by Weak formulation of Boundary Value Problems | | | | | | | | | | | |
| CO 2 | Solution of Poisson Equation | | | | | | | | | | | |
| CO 3 | Solution by Variational Formulation | | | | | | | | | | | |
| CO 4 | Solve steady state problems in heat transfer | | | | | | | | | | | |
| CO 5 | Solve steady state problems in solid mechanics | | | | | | | | | | | |
| CO 6 | Initial value and eigenvalue problems | | | | | | | | | | | |

3. Course Articulation Matrix

| Course outcomes | Program Outcomes | | | | | | | | | | | | Program Specific Outcomes | | | |
|-----------------|------------------|---|---|---|---|---|---|---|---|----|----|----|---------------------------|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 |
| 1 | 3 | 3 | 3 | 2 | 3 | 1 | | | 1 | 1 | | 2 | | | | |
| 2 | 3 | 3 | 1 | 1 | 2 | 1 | | | 1 | 1 | | 2 | | | | |
| 3 | 3 | 2 | 2 | 1 | 2 | 1 | | | 1 | 1 | | 2 | | | | |
| 4 | 3 | 3 | 2 | 2 | 3 | 1 | | | 1 | 1 | | 2 | 3 | | 2 | 2 |
| 5 | 3 | 3 | 2 | 2 | 3 | 1 | | | 1 | 1 | | 2 | 3 | | 2 | 2 |
| 6 | 2 | 2 | 1 | 1 | 2 | 1 | | | 1 | 1 | | 2 | | | | |

4. Detailed Syllabus

| | | |
|--------|--|---------|
| Unit 1 | Galerkin method, Axially loaded bar, Heat conduction in one dimension, Heat conduction with convection transfer. | 6 hours |
|--------|--|---------|

| | | |
|--------|--|---------|
| Unit 2 | Poisson equation, Triangular element, Rectangular element, Heat conduction in two and three dimensions. | 6 hours |
| Unit 3 | Variational functional, Ritz method, Euler-Bernouli beam, Finite element solution of beam | 6 hours |
| Unit 4 | Basic equations of elasticity, Torsion problem, Finite element solution of torsion problem, Plane stress | 9 hours |
| Unit 5 | Isoparametric elements — one dimensional, two dimensional, triangular; Numerical integration | 9 hours |
| Unit 6 | Helmholz equation, Natural frequencies | 3 hours |
| Unit 7 | Parabolic equations, Hyperbolic equations | 3 hours |

References:

- J.N. Reddy, An introduction to the finite element method
- S.S. Rao, The finite element method in engineering
- Y.W. Kwon, The finite element method

5. Teaching-Learning Strategies

Lectures in class room, weekly tutorials on problem solving, active learning by students.

6. Assessment Methods and Weightage

Assignments 20, Quizzes 20, Mid Semester 20, End Semester 40 marks.

Title of the Course: Game Design and Engineering

| | |
|----------------------|---------------|
| Name of the Faculty: | Kavita Vemuri |
| Course Code: | CS9.438 |
| L-T-P: | 3-0 -1. |
| Credits: | 4 |

1.Prerequisite Course / Knowledge:

1. Programming Languages
2. Networks and compilers
3. Computer graphics.
4. Intro to cognitive science or intro to psychology.
5. Knowledge of game platforms – Unity, Unreal for example

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

A student introduced to the concepts in the course will be able to:

CO-1: Design a game – physical or digital.

CO-2: Analyze game play behavior – psychology and game theoretic

CO-3: Apply principles of Human-computer interface and usability

CO-4: Demonstrate the knowledge of the production and marketing of games

CO-5: Exhibit proficiency in Game product development.

CO-6: Develop serious games

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

4.Detailed Syllabus:

1. Game Design:

- o Pitch and Story of the Game
- o Look and Feel,
- o Gameplay Breakdown
- o Rules,
- o Balance,
- o Strategy,
- o Complexity,
- o Randomness,
- o Narrative,
- o Human/player behavior
- o Skill driven emergent behavior
- o Mechanics

2. Game Engineering:

- o Hardware (includes electronics)
- o Software (game engines, includes OS/Platforms)
 - Games in Software
 - Arcade Games
 - PC Games
 - Web Games
 - Mobile Games
 - AR/VR Games

- Getting Started with Development Tools
 - Quick Walkthrough
 - Unity 3D
 - GotDot Engine
 - Java Script Engine
 - Pixie/Phaser
 - Action Script overview
 - Interfacing
 - Game Servers
 - Communication Basics
 - Networking Basic/Principles
 - Client/Server Architecture
 - Protocols
 - Network Games
 - Architectural Patterns
 - Multi-player Games
 - Massively Multiplayer Online Games
 - Games on Cloud
 - Microservices
 - Quick Walkthrough
 - Smartfox Server
 - Custom Game Server
 - Scalability
 - Materials
 - Fabrication
 - Usability
- Game as a Project:
 - Agile Development
 - SCRUM
 - Sprint
 - Planning
 - Gantt Charts
 - Burndown Charts
 - Retrospective
 - Team Dynamics
- Game as a Product: (Launching, Distribution, Marketing/Virality, Advertising/Advergaming)
- In addition, cover Game theory, AI in games, mathematics – induction, deduction, probability, rationality etc.,

The class starts with ethics in game design.

Reference Books:

1. The Art of Game Design – Jesse Schnell
2. Artificial Intelligence for Games – Ian Millington – 2009
3. Behavioral Mathematics for Game AI – Dave Mark - 2009

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

The inclass lectures will cover game elements (mechanics, space, play, rules, chance) and of the role of narrative/script writing as basic starting point. This will be followed by game design based on understanding of player behaviour, expectations in a game and the cognitive challenges. Game AI, graphics and basic programming will be covered for the final project. Game production and publishing are introduced at the end. Nearly all topics are introduced with case studies of popular games. Importantly, ethics in game design is discussed at the beginning of the class with examples of games with sexists, racists and fascist content.

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

| Type of Evaluation | Weightage (in %) |
|-------------------------------------|------------------|
| Game Devl (individual) mid-sem | 30 |
| Team game devl (end sem) | 25 |
| Presentation, GDD & hosting of game | 15 |
| Assignments (2) | 20 |
| Quizzes (2) | 10 |

Title of the Course:

Human Sciences Lab

Faculty Name: Radhika Krishnan
 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, analyse 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

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO 11 | PO1 2 | PS O1 | PSO 2 | PSO 3 | PSO 4 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|----------|----------|
| CO 1 | 1 | 3 | 1 | 1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 1 |
| CO 2 | 1 | 3 | 1 | 1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 1 |
| CO 3 | 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 to develop a good grasp of distilling research work to its core meaning while drawing out their implications 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

CourseCode: CE5.502

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

Credits: 4

(L=Lecturehours, T=Tutorialhours,P=Practicalhours)

Name of the Academic Program: B.Tech. in Computer Science and EngineeringOpenElective(Monsoon)

1.Prerequisite Course / Knowledge:

General awareness about the 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, analysing 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:

- Subrahmanyam, 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 analyse, visualise 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 : ICTs for Development

| | |
|----------------------------|--------------------|
| Name of the Faculty | : Nimmi Rangaswamy |
| Course Code | : CS9. 431 |
| L-T-P: | 4-0-0 |
| Credits: | 4 |

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

1.Prerequisite Course / Knowledge: UG3 and above – no other prerequisite knowledge

2. Course Outcomes (COs)-

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

- CO-1. Develop a holistic definition and the role of information and communication technology [ICTS] in socio-economic development
- CO-2. Learn critical theoretical theories of development and ICTD from a global perspective
- CO-3: Grasping context aware concepts and application of ICTD in India
- CO-4. Deep analysis of ICTD case studies in India and the global South
- CO-5. Develop a research project applying foundational learnings from the course

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

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

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

Course Structure in Detail

Overview of Course

OBJECTIVES

To introduce the idea of channeling the potential of Information and Communication Technology [ICTs] for socio-economic development to students of Engineering and Computational Humanities

To debate the notion of development as a sociological concept, with a particular focus on India, and discuss impacts of the development process on society as a multi-faceted phenomenon

To focus upon and formulate the idea of social media, as a component of ICTs, and the role they play in shaping the contours of social and everyday life

COURSE TOPICS/CONTENT/OUTLINE

Information and Communications Technology for Development is a growing area of research and community of scholars studying the role of technology in international development. Students in this course will study contemporary debates, issues and field projects that engage with information and communication technologies [ICTs] in the service of socio-economic progress and human development. This means a range of things: it could refer to the scope of technology in alleviating poverty, in impacting low-resource settings, in designing and engineering relevant technologies to close digital literacy gaps in specific populations.

Topics that will be covered as part of the course are the following. These are broad umbrella categories which contain sub-topics

Introduction to the idea of Development:

Studying development is essentially a multidisciplinary exercise rooted in a range of technical and social-science research. By combining a variety of subject areas, the course will engage deeply with some of the complex problems associated with developing economies especially unstable infrastructures, scarce resources, and social disadvantages. We will discuss A Sen, K Galbraith among others

Globalization and Development

The course will specifically look at globalization as a socio-economic disruptor having far-fetched implications for not only wealth generation for a country but also bringing cultural transformations. We will discuss several historical trajectories of globalization in specific country contexts. We will include works of J Sachs, W Easterly

Technology and Development

The course will introduce a variety of social environments across resource and economic constraints that are targets for socio-economic development either through a top down model of deploying ICTs or through a more market driven and organic social processes. These can range from building low-cost technologies to studying user-driven innovations of ICTs to fit contexts of use. We will cover certain domain areas, using relevant theoretical models and practical outcomes, within ICTs and Development, like, education, healthcare, livelihoods, entertainment, and governance. Students will develop a critical lens to evaluate the processes and impacts and gain a well-rounded and practical perspective on issues of assessment and successes of development projects

Introducing Information and communication technologies as harbingers of social change

Under this topic we will debate and discuss the nature and contours of new channels of information, social networking the rise of social media and online content generation. Questions posed by these digital artifacts evaluate the inherently democratizing, process of owning, using, and networking with new media technologies. With the help of case studies, with a focus on India, we will articulate the implications of new and digital media in everyday life. We will focus on the sociology of new media technologies, with a specific aim to anchor them within select theoretical debates and in specific geographic contexts.

Social Media as a Developmental tool

Research has pointed to the rich field of utilization of new media tools for leisure and social networking as well as the unique affordances they spawn in the arena of self-expression and acquiring socio-digital identities. For example, the pre-pay mobile internet made web surfing an affordable and engaging activity even in the down markets and resource poor social ecologies of urban India. The course will critically evaluate the impacts of media technologies in the development discourse of a nation. The topic will include case-studies from the global North and South centering on social segments in resource-poor and emerging market settings

This class has no pre-requisite requirements and open to students from any background.

Students will be continuously evaluated with periodic quizzes/short tests and a course end assignment that will gauge student ability in engaging with and comprehending the course readings and classroom discussions.

PREFERRED TEXT BOOKS:

1. J. Timmons Roberts and Amy Bellone Hite, Eds. The Globalization and Development Reader: Perspectives on Development and Global Change, Blackwell: London, 200

***REFERENCE BOOKS:**

1. Amartya Sen, Development as Freedom, Anchor Books: New York, 1999
2. C K Prahalad, The Fortune at the Bottom of the Pyramid: Eradicating Poverty Through Profits, Revised and Updated 5th Anniversary Edition, Prentice Hall, New Jersey
3. Jeffrey Sachs, The End of Poverty: Economic Possibilities for Our Time, Penguin Books: New York, 2006

4. Friedman, Thomas L. 2006. *The World Is Flat: A Brief History of the Twenty-first Century*, Farrar, Straus and Giroux
5. Easterly, W. 2002. "The Elusive Quest for Growth: Economists' Adventures and Misadventures in the Tropics. MIT Press
6. Turkle, S. (1984) *The second self*. New York: Simon & Schuster.
7. Mizuko Ito, Daisuke Okabe, and Misa Matsuda, eds., 2005, *Personal, Portable, Pedestrian: Mobile Phones in Japanese Life*(Cambridge, MA: MIT Pres
8. Turkle, S. (1995). *Life on the screen: Identity in the age of the Internet*. New York: Simon & Schuster.
9. Castells, Manuel (2001): *Internet Galaxy*. Oxford University Press
10. Lessig, Lawrence. 2009. "RE, Revived" i Remix: Making Art and Commerce Thrive in the Hybrid Economy. The Penguin Press, New York
11. Lister et. al. (2008): *New Media A Critical Introduction*. London and New York, Routledge.

GRADING PLAN:

Type of Evaluation Weightage (in %)

Mid Sem Quiz 10%

End Sem Quiz 10%

Project Oral Presentation 20%

Project Report 1 15%

Project Oral Presentation 20%

Project Report 2 15%

Class Participation & Attendance 10%

OUTCOME:

Students will be able to identify and apply a developmental lens in a variety of and diverse socio-economic contexts. The course will provide a strong grounding in developing a sociological perspective of digital media and their impact in the evolution of a digital society as a part of parcel of socio-economic development. One of the critical question the course will attempt to unpack is how technology seeks to address the needs and aspirations of people who increasingly consuming technologies and services despite are living in low resourced eco systems.

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 world wide web

CO-3: Design Web crawling systems

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

CO-5. Develop information extraction systems

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

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

Course Code : EC5.410

Credits : 4

L - T - P : 3-1-0

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

Semester, Year_____: Monsoon 2023

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, Gaussian 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 Text Books :

1. "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 '-' hash 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**

Name of the Faculty: **Vishnu Sreekumar**

Course Code: **CS9.426**

TAs: **NancyHada and KumarNeelabh**

Day/Time: Mondays and Thursdays: 2:00 pm – 3:25 pm.

Credits: **4**

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

(L = lecture hours, T = tutorial hours, P = practical hours)

Prerequisite: None

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.

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 unless COVID restrictions make us move online (Microsoft Teams).

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)

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 | PS O1 | PSO 2 | PSO 3 | PSO 4 |
|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|----------|----------|
| CO1 | 2 | 2 | 3 | 2 | 1 | 2 | 1 | 2 | 1 | 1 | - | 2 | 2 | 1 | 1 | 3 |
| CO2 | 1 | 2 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 3 |
| CO3 | 3 | 2 | 2 | 2 | - | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 2 | 3 |
| CO4 | 1 | 3 | 2 | 1 | - | 1 | 1 | 2 | 1 | 2 | - | 2 | 1 | 2 | 2 | 3 |
| CO5 | 2 | 2 | 1 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | - | 2 | 2 | 1 | 1 | 3 |

Note: '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping or a '-' dash mark if not at all relevant

List of topics and activities

- **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 (20 marks) | 20% |
| Mid-Sem exam(20 marks) | 20% |
| End semester exam (40 marks) | 40% |
| 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 (40 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 (20 marks = 10 marks for presenting + 10 marks for a short report)

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.

Submission window for the short report: Nov 1-10

No extensions will be given because this is a wide window.

You are welcome to make multiple submissions within this window.

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 (20 marks)

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.

Submission window for the term paper/debate reaction paper: Nov 1-10

No extensions will be given because this is a wide window.

You are welcome to make multiple submissions within this window.

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 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 and are assigned as follows:

| Letter Grade | Percentage |
|---------------------|-------------------|
| A | [92,100)% |
| A- | [84,92)% |
| B | [76,84)% |
| B- | [68,76)% |
| C | [60,68)% |
| C- | [52,60)% |
| D | [45,52)% |
| F | < 45% |

IMPORTANT NOTE: [x,y) indicates that x is included (square bracket) in the range and y is not (curly bracket). The normal rules of rounding will apply: So if you get 75.5, it will be rounded to 76 and you will get a B. However, if you get 75.444, it can only be rounded downwards and hence the final grade will be B-. No disputes on this matter will be entertained and such emails will not get a response.

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. 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

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)

1. Prerequisite Course / Knowledge:None

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

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
- analyze the major goals of psychological science, and utilized different research methods used by psychological research.
- Evaluate the challenges and merit of psychological observations and 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, behavioral, and cultural etc.
- analyze 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, analyze, evaluate and interpret the results of basic psychological research.
- analyze, interpret, and evaluate the individual experience and socio-cultural perspectives to explain psychological phenomenon

CO-3: apply research ethics of human/ behavioral sciences

- analyze 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 team work, 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 |
|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|----------|----------|
| CO1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
| CO2 | 3 | 1 | 2 | 3 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 2 |
| CO3 | 2 | 1 | 2 | 2 | 1 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 1 |
| CO4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 |
| CO5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2 | 1 | 3 | 1 | 1 | 1 | 1 |

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

4. Detailed Syllabus:

| Unit 1 | 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 |

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 materials 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 | N=2 | 10% |
| 2. | Home and Class Activities (Student presentation) | N=2 | 5% |
| 3. | Mid Semester Exams | N=2 | 20% |
| 4. | Project in Group – with 2-3 students | N=1 | 30% |
| 5. | End Semester 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 | B | C | D | F |
|------|------|------|------|-----|
| >=85 | >=70 | >=55 | >=45 | <45 |

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

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

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

Project Evaluation – Rubric (100)

| S.No. | Topic Description | Marks |
|-------|--|-------|
| 1. | Clarity in Problem Statement, Method, Result, and Discussion | 20 |
| 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) | 5 |
| 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) | 5 |
| 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 Signalling, Cell cycle

Unit 11: Analysing 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 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 the 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 :

Credits :

4

L - T - P :

L-3, T-1

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

Semester, Year :

Monsoon 2023

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:Analyse how the conditions of economic life are distinct in developing countrieslike 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 SemExam | 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

| | 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 | - | 2 | 3 | - | 3 | 3 | 3 | 2 | 2 | - | 2 | - | 1 | - | 2 |
| CO 2 | 1 | - | 1 | 2 | - | 2 | 2 | 2 | 2 | 2 | - | 2 | - | 1 | - | 3 |
| CO 3 | 1 | 1 | 2 | 2 | - | 3 | 3 | 2 | 2 | 2 | - | 2 | 1 | 2 | 1 | 3 |
| CO 4 | 1 | - | 2 | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | - | 1 | - | 2 |
| CO 5 | 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 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 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 2023

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

Pre-Requisites : Introduction to Human Sciences, HS8.102

CourseOutcomes :

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. Develop their own understanding about History and the Past.

CourseTopics :

(1) Historical Time and Space: In this module students will be introduced to how historians have understood the flow of time and periods of 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 of time, and of space; and how the modern map and watch 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, Structuralism 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 limitations of the inductive and deductive methods, oral history, qualitative and quantitative methods, etc. that historians deploy in their identification of facts 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 them with the debates around the relationship between the past and the present, memory and history, remembrance and forgetting and the opening up of the discipline of history beyond the academy.

Preferred Text Books:

- E.H.Carr: *What is History.*
- Marc Bloch: *The Historian's Craft*
- Umberto Eco: *This is not the end of the Book;*
- Shawn Graham, et al: *The Historian's Macroscope.*

Reference Books:

- Romila Thapar: *From Lineage to State.*

- Mircea Eliade: *The Myth of the Eternal Return*.
- Edward Said: *Orientalism*.
- Sumit Sarkar: *Modern Times*.
- Vanessa Ogle: *The Global Transformation of Time*.
- Richard Eaton: *India in 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 Sugar in Modern History*.
- Douglas A. Boyd, Mary A. Larson: *Oral History and Digital Humanities – Voice, Access, and Engagement*
- Anne Kelly Knowles: *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".
- Bernard S. 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".
- Ranajit Guha: "On Some Aspects of the Historiography of Colonial India".
- Ranajit Guha: "The Prose of Counter-Insurgency"
- Shahid Amin: "Gandhi as Mahatma"
- David Arnold: "Touching the Body: Perspectives on the Indian Plague"
- Jacques le Goff: "Merchant's Time and Church Time in the Middle Ages"
- Marianne Hirsch: "The Generation of Postmemory"
- 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"
- Emmanuelle Roy Ladurie: "The History of Rain and Fine Weather"
- Philippe Ariès: "Pictures of the Family"
- Maurice Aymard: "The Costs of War"
- Fernand Braudel: "History and the Social Sciences - The Longue Durée"
- Jean Meuvret: "Food Crises and Demography in France during the Ancien Régime"
- Karl Marx: *Communist Manifesto*, Chapter 1.
- Karl Marx: "British Rule in India, 10 June 1853"
- Karl Marx: "Future Results of British Rule in India, 22 July 1853"
- D.K. Kosambi: "Social and Economic Aspects of the Bhagavad Gita"

- Irfan Habib: "Potentialities of Capitalist Development in the Economy of Mughal India"
- Romila Thapar: "Somnath"
- Robert Darnton: "Peasants Tell Tales"
- Clifford Geertz: "The Balinese Cock-Fight"
- Arthur Conan Doyle: "Sign of Four"

E-book Links :
Grading Plan : (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, or a dashmark if not at all relevant). **Computer Science and Engineering**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | 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(4-5 sentences):

The course will be based on classroom lectures and will require intensive reading and writing. On an average, each student will be required to read 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 about the topics on hand.

Title of the course:**Introduction to Linguistics 1**

| | |
|----------------------|--------------------------------|
| Name of the Faculty: | Aditi Mukherjee + Rajakrishnan |
| Course Code: | CL1.101 |
| Credits: | 3-0-1-4 |
| Type when : | Monsoon 2023 |
| 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 analyze 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 structural 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, Cengage Learning (Indian Edition)

REFERENCE BOOKS:

1. Linguistics by Jean Aitchison, 5th edition. London: Hodder Headline, Teach Yourself Books, 1999. ISBN: 0-340-73733-6. Retitled and reprinted with corrections as: Linguistics: An Introduction.

2nd edition. London: Hodder Headline, 1999. ISBN: 0-340-75792-2).

2. Introduction to Language by Fromkin, V.A. and Rodman, R., 1997. Harcourt Brace. 6th edition

Title of the Course : Introduction to Literature

Name of the Faculty : Nazia Akhtar

Name of the Program : Humanities Elective

Course Code : HS1.204

Credits : 4 credits

L - T - P: : 42 hours (28 classes)

Semester, Year : Monsoon 2023

Pre-Requisites : Introduction to Human Sciences

Course Outcomes :

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

1. critically interpret, analyze, and appreciate literature and, by extension, other kinds of texts and narratives too;
2. apply this basic foundation in the study of creative writing to conduct computational research on topics associated with it;
3. examine and discuss the literary merit of creative texts beyond casual impressions or value judgements; and
4. connect human, creative expression to the issues that make up and are made by the world in which we live.

Course Topics :

This course is for those who have little or no introduction to reading literature in the classroom. It will introduce students to the study of literature and equip them with a foundational understanding of major concepts, methods, and theories used to analyze and interpret literary expression, including in the present digital age, which has thrown up new genres and media to accommodate the needs and aspirations of new generations. On successful completion of the course, the student will have an appreciation of the perspective of a literary scholar and understand the importance of creative verbal expression.

Literature acquires meaning and, indeed, finds realization in how it is read and interpreted by readers, who have the opportunity to appreciate different worldviews, experiences, and subject positions through such reading. Over the duration of this course, we will reflect on three key questions through our reading of short stories, novels, poetry, and plays: what is literature, and why and how do we study it? The course will discuss issues fundamental to the study of literature – the meaning of literature; its relation to other artistic productions; an overview of traditional genre classifications of literature; an understanding of the role of canon in maintaining the visibility of certain texts and writers; and the social, cultural, and historical contexts of literary production, publication, and reception. In other words, we will look at the world of the literary text and attendant aspects of reading cultures and communities through the following themes or topics:

1. Defining Literature and Its Place in the World;
2. The “Literariness” of Literature; Representation and Reality;
3. Major Genres of Literature;
4. Major Concepts, Methods, and Theories of Literature; and
5. Literature in the Digital Age.

Preferred Text Books :

Ali, Agha Shahid. “I Have Loved,” “Beyond English” (2003; poetry)

Ao, Temsula. “Laburnum for my Head” (2009; short story).

G. Shyamala. “But Why Can’t the Baindla Woman Ask for Her Land?” (2012; short story)

Margaret, Mercy. “Prega News” (poetry)

Masud, Naiyer. “The Woman in Black” (2006; short story)

Merchant, Hoshang. “Broken Love” (1989; poetry)

Narayan, R.K. “Like the Sun” (1985; short story)

Nongkynrih, Kynpham Sing. Selections from *Time’s Barter: Haiku and Senryu* (2015; poetry)

Pritam, Amrita. "Today I Say Unto Waris Shah" and other poems (various years; poetry)
 Rushdie, Salman. *Haroun and the Sea of Stories* (1990; novel)
 Tendulkar, Vijay. *Silence! The Court is in Session* (1967; play)

Reference Books :

Woolf, Virginia. "How Should One Read a Book" (1925)
 Eagleton, Terry. *How to Read Literature* (2013)
 Abrams, M.H. *A Glossary of Literary Terms* (1957)
 Barnet, Sylvan, William Burto, and William E. Cain, eds. *An Introduction to Literature: Fiction, Poetry, and Drama* (1961)
 Moretti, Franco. *Distant Reading* (2013)

E-book Links :

Grading Plan :

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

Mapping of Course Outcomes to Program Objectives:

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

Teaching-Learning Strategies in brief:

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

Title of the Course **Introduction to Neural and Cognitive Modeling**

Faculty Name: Bapi Raju Surampudi

Course Code: CS9.427

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 | PO 10 | 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 |

DetailedSyllabus:

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.

ReferenceBooks:

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 GEneralNEurAlSimulation System*, Internet Edition.
3. Peter Dayan and L. F. Abbott (2005). *Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems*. MIT press.
4. Thomas Trappenberg (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-LearningStrategiesinbrief(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 assignments designed to achieve course outcomes and collaboratively working on a final project. 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

project. This allows them to appreciate how a complex, dynamic system such as the brain and cognition can be understood from a functional and computational points of view.

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

| | | | |
|--------------|---------------------------------|-----|-------------|
| 1. | Assignment | N=3 | 15% |
| 2. | Mid Semester Exams | N=2 | 30% |
| 4. | Project in Groups of 2 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: **Intro to Neuroeconomics**

Name of the Faculty: Kavita Vemuri + Guest Faculty
 Course Code: CS9.423
 L-T-P: 3-0 -1.
 Credits: 4

1. Prerequisite Course / Knowledge:

1. Intro to psychology
2. Cognitive Science
3. Cognitive Neuroscience
4. Game theory

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

A student introduced to the concepts in the course will be able to:

- CO-1: Apply methods from neoclassical economics
- CO-2: Test the theories or models with experiments
- CO-3: Apply models in real-life conditions
- CO-4: Analyze the Brain and decision making process
- CO-5: Explain the cultural diversity role in risk-taking behavior
- CO-6: Explain the cognitive process – memory, decision making, empathy, learning
- CO-7: Implement the ethics of Neuroeconomics.

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 | PO1 1 | PSO 2 | PSO 3 | PSO 4 |
|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|----------|----------|
| CO1 | 1 | 4 | 4 | 4 | 0 | 2 | 2 | 3 | 1 | 1 | 1 | 3 | 1 | 0 | 0 | 4 |
| CO2 | 3 | 4 | 4 | 4 | 4 | 3 | 1 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 4 |
| CO3 | 3 | 3 | 2 | 4 | 2 | 2 | 2 | 2 | 0 | 2 | 2 | 3 | 3 | 3 | 1 | 4 |
| CO4 | 3 | 3 | 3 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 4 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 4 |
| CO6 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 4 |
| CO7 | 1 | 1 | 1 | 1 | 2 | 1 | 4 | 4 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 4 |

4. Detailed Syllabus:

OBJECTIVE : Extend the understand of brain and behavior to economics and decision making.

The course will be a seminar-style course covering the brain and behaviour pertaining to decision making as applied to economic theories. The course will begin with introduction to classical economics, the brain (brief intro to anatomy) structures attributed to learning, decision making, emotions, reward etc. The core part will be modern neuroeconomics and applications.

By the end of the course the student will be able to:

- Demonstrate knowledge of some of the main theoretical and empirical debates in Behavioural Economics.
- Understand the way in which Behavioural economics has developed and how we can relate it to traditional models of economics.
- Assess the strengths and weaknesses of different theories of Economic Behaviour.
- Demonstrate an ability to apply the main concepts to a variety of other economic fields.
- Construct and substantiate arguments on a variety of topics covered in the module.
- Present clearly and methodically in their own words, but also using equations and diagrams.

COURSE TOPICS :

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

1. A Brief History of Neuroeconomics – 1 lecture: Mostly from the introduction chapter in Glimcher's book. This lecture will introduce the conjunction of economics and psychology. The focus on decision making process – what is a rational choice, how does subjective interpretations, perceptions, individual cognitive abilities consequences on decision making and why it is important to discussions on behavioural economics. The discussion will start from Neoclassical Economics , Adam Smith's 1776 book, Keynes theory, etc. Maurice Allais (1953) – Allais paradox. But, the first lecture will also cover the restrictions of any interpretations from neuro/behav studies on decision/choices.(SG)

2. Basic Methods from Neoclassical Economics - 1 lectures

Chapter 1 of the Glimcher& Fehr. Tentative list, it is to be noted that some topics can be expanded based on student interest and interactions.

Rational Choice and Utility Theory: Some Beginnings

Early Price Theory and the

Marginal Revolution Early Decision Theory and

Utility Maximization

The Ordinal Revolution and the Logic of Choice

Quantitative Tests of Qualitative Theories: Revealed

Preference GARP

Understanding Rationality

Axiomatic Approaches: Strengths

Axiomatic Approaches:

Weaknesses

Expected Utility Theory

Defining the Objects of Choice: Probabilistic

Outcomes Continuity Axiom

Independence

The Expected Utility Theorem Axioms and

Axiomatic Reasoning

Using Axioms: The Neoclassical Approach in

NeuroeconomicsThe Reward Prediction Error Hypothesis

The DRPE Axioms and the Ideal Data Set

3. Experimental Economics and Experimental Game Theory - 1 lecture

In this lecture, the learnings from the game theory, will be extended with examples from economics.

Game Theory Described

Normal and Extensive Form Games

Game Theory Experiments Design and Practice

Experiments with Normal Form Games

Experiments with Extensive Form

Games

Neuroeconomics

experiments Design

and Practice

Neuroeconomics Experiments with the Trust Game
Neuroeconomics Experiments with the Ultimatum
Game

Towards a Neuroeconomics Theory of Game Playing

4. Overview of behavioural economics- 1 lecture
(some aspects from the below topics, examples and applications will be covered by student presentations)

(The below topics are from book: Choices, Values & Frames by Daniel Kahneman&Amos Tversky)

Prospect theory and extensions

-Prospect theory: an analysis of decision under risk

Advances in prospect theory: cumulative representation of Uncertainty

The uncertainty effect and the weighting Function

-Compound invariant weighting functions in prospect theory

- Weighing riskanduncertainty

- Belief-based account of decision under uncertainty Loss aversion and the valuefunction

- Loss aversion in riskless choice: a reference-dependent model Anomalies: the endowment effect, loss aversion, and status Quobias

Rational Choice and the Framing of Decisions

Framing, Probability Distortions, and Insurance

Decisions Mental Accounting Matters

5. Introduction to Neuroscience & Experimental Methods in Cognitive Neuroscience
– 2 lectures

- Fundamentals of brain have been covered in Cognitive Neuroscience course . Here the functional connectivity maps attributed to decision making, memory, emotion will be reiterated. Experimental techniques like eye tracking, EEG, FMRI, MEG and physiological indexes like GSR/SCR in the context of responses will be covered.

Importantlythe limitations will be explained with examples.

6. Decision making - 3lectures

Neuroscience of decision making will cover role of time, emotions, heuristics and bias, reward/punishment, trust, risk & uncertainty.

The above topics will illustrate the theory with examples and the limitations as a function of context or situational awareness.

(KV & PM)

Student presentations & discussions

In student presentations, taking off from the introduction to terminology, definitions and limitations published papers with experimental work will be discussed. The ambiguity to each case from subjective perceptions, cognitive capability and social structures will be discussed.

7. Risk /Ambiguity (student presentations) (2 lecture hours or 4presentations)Choice (student presentation) (2 lecture hours or 4presentations)
8. Time (2 lecture hours or 4presentations)
9. Reward/Loss (student presentations or 4presentations)
10. Reinforcement Learning ((student presentation) (2 lecture hours or 4presentations)
11. Social behaviour (student presentation) (2 lecture hours or 4presentations)
12. Neuro-Morality (1 lecture followed by 2 studentpresentation)

This topic was introduced to discuss the complexity of judgement and values, at a generic level and then its implications to economics. It's a new topic to bridge these two areas.

While moral judgement is well covered from neuroscience and cognitive science, its weight to economic theory needs to be explored.

Reference Books:

1. NEUROECONOMICS, Decision Making and the Brain, SECOND EDITION
Edited by PAUL W. GLIMCHER & ERNSTFEHR
2. NEUROSCIENCE OF DECISION MAKING, Oshin Vartanian & David R. Mandel (eds)
3. Choices, Values & Frames by Daniel Kahneman & Amos Tversky

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

The inclass lectures will cover basics – of classical, neoclassical economics but primary focus is on behaviour economics and neuro studies on decision making, risk-taking and the underlying complex cognitive processes. Quizzes are conducted periodically to evaluate transfer of knowledge and critical thinking of the implication of each study finding. The end-sem project will have the student design an experiment or test an existing theory on diverse set of people and analyse the differences in findings. Second, by considering a socially relevant problem the students will be exposed to the complexity of economic policy and financial systems.

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

| Type of Evaluation | Weightage (in %) |
|--|------------------|
| Mid semester Quizzes | 20 |
| Project | 40 |
| Open book exam or 30 minute quiz | 20 |
| Other Evaluation Class presentation & Viva | 20 |

Title of the Course: Introduction to Philosophy

Name of the Faculty: Saurabh Todariya

Course Code:

Credits: Four (4)

L - T - P: 3-0-0

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

Semester, Year: Monsoon, 2023

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.
- CO4: 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. Nicomachean 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 SemExam | 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

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|----------|----------|
| CO1 | - | - | 1 | 2 | - | 1 | 1 | 1 | 1 | - | 1 | - | - | - | 1 | 1 |
| CO2 | - | - | 1 | 2 | - | 1 | 1 | 1 | 1 | - | 2 | - | - | - | 2 | 2 |
| CO3 | - | - | 1 | 2 | - | 2 | 2 | 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, with reference to India**

Name of the Faculty: Guest Faculty
Course Code: HS4.201
Credits: 4

L - T - P:

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

Semester, Year : Monsoon 2022

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 of Political 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 for reforms.

CO5: Assess the nature of Constitutional Government and Democracy in India from various perspectives.

CO6: Develop one's own understanding on how to address contemporary challenges in the Indian Political System.

Course Topics :

(please list the order in which they will be covered, and preferably arrange these as five to 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 of State: divine theory and social contract theory; Forms and functions of government **Module 2:** Brief introduction to key concepts of Political Science; Liberty: Negative and Positive; Equality: Equality of Opportunity; Justice: Social Justice; Rights: Legal Rights and 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 Text Books :

Selected Chapters from-

1. Andrew Heywood: *Politics* (forth 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 Politics in India*
5. Bidyut Chakrabarty and Rajendra Kumar Pandey: *Indian 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): *Political 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 Preerna Singh, (ed.): *Routledge handbook of Indian politics*
9. Sujit Choudhry, Madhav Khosla, And Pratap Bhanu Mehta, (ed.): *The Oxford Handbook 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% |
| Mid SemExam | 20% |
| Quiz-2 | |
| End Sem Exam | 30% |
| Assignments | 20% x 2= 40% |
| Project | |
| Term Paper | |
| Other Evaluation | |

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

Matrix for CSE

| | P O1 | P O2 | P O3 | P O4 | P O5 | P O6 | P O7 | P O8 | P O9 | P O10 | P O11 | P O12 | P S O1 | 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 O10 | P O11 | P O12 | P S O1 | 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 |

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 assigned reading material. On an average, each student will be required to read between 500 to 700 pages of books and articles and submit written work between 3000-4000 words, cumulatively. The students will be expected to follow the latest news and developments in 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

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 Noether'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. Pal: 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 underlying mathematical structure. To make teaching more interactive in the online mode, instead of showing slides, mathematical derivations are done live during the class. Refined versions of the class materials are 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 Stochastic Processes

- Name of the Faculty: Bhaswar Ghosh
Course Code: SC1.320
L-T-P: 3-1-0
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Credits: 4
 Name of the Academic Program: CSE

CO 1: Stochastic processes are wide-spread both in natural sciences and engineering systems. This course explains the basic concepts of stochastic processes in Physics, Chemistry and Biology.

CO 2: The stochastic effects in physical systems lead to fluctuations in observables giving rise to error in measuring quantities. The precision in measurement is quantified using information theory. The course will further introduce fundamental concept of information in stochastic processes.

CO3: The concepts will be used to simulate stochastic processes and compute various statistical features including variance, auto-correlation, cross correlation of various observables.

CO4: Analysis and interpretation of stochastic processes using statistical techniques like information theory would be introduced.

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 | 2 | | | | | | | | | 3 | 2 | 1 | 1 |
| CO2 | 3 | 2 | 3 | 2 | | | | | | | | | 3 | 2 | 1 | 1 |
| CO3 | 1 | 3 | 2 | 2 | | | | | | | | | 3 | 2 | 1 | 1 |
| CO4 | 1 | 3 | 2 | 2 | | | | | | | | | 3 | 2 | 1 | 1 |

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

4. Detailed Syllabus

Introduction

Unit 1: Stochastic processes: Markov processes

The Markov property, stationary Markov processes, decay processes

Birth and death Markov processes

Unit 2: Langevin dynamics and Fokker Planck equation

Introduction. Derivation of Fokker Planck equation, Brownian motion

Random walk and diffusion; Langevin treatment of Brownian motion, Applications

Unit 3: First passage time UnMaster equation and solution through small noise approximation

Numerical Monte Carlo methods to solve master equation

Unit 4: Information theory for stochastic processes

Entropy, Relative Entropy, Mutual and fisher information

Entropy ,Joint entropy and conditional entropy
The second law of thermodynamics .
Entropy production rates in random walk and chemical reactions
Unit 5: Connection between information and thermodynamics
Maxwell's demon Szilard engine;Landauer's principle
work and entropy in information channels
Information transmission and power dissipation through noisy biochemical networks

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

The objective of the course is to provide the students with basic concepts of stochastic processes and their applications to Physics, Chemistry and Biology. It will provide students with theoretical and computational tools to analyze fluctuations in stochastic processes and exact underlying information. Although the course mostly emphasizes on application of stochastic processes in sciences, the basic concepts taught in the course would in general help students to apply them in other fields as well ranging from engineering to financial markets etc.

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

Assignments (30%), Quizzes and midterm (30%), Final exam (40%).

Reference books

Theory and Applications of Stochastic Processes : An Analytical Approach by Zeev Schuss.
Stochastic Methods: A Handbook for the Natural and Social Sciences by Gardiner, Crispin
Elements of Information Theory by Thomas M. Cover, Joy A. Thomas

| Title Course of the Name: | IoT Workshop |
|--|--|
| Name of the Faculty: | Nagamanikandan Govindan + Sachin Chaudhari |
| 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. Hersistent, 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 Name: IS Codes on Design and Structural Safety Assessment

Name of the Faculty Name: **TBD**

Course Code: CE1.605

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., 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 code provisions in the design of structures;
- CO-2** Explain the basis behind code provisions;
- CO-3** Analyse and design the structure using commercially available software
- CO-4** Compare the provisions of Indian standards with other relevant international standards
- CO-5** Demonstrate understanding of the challenges in construction industry and get equipped to address some of the challenges

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

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

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

4.Detailed Syllabus:

Unit 1: IS Code provisions: Design of RC structures, tall buildings, detailing, assessment and retrofitting

Unit 2: IS 16700-2017: Criteria for Structural Safety of Tall Concrete Buildings: General requirements, Loads and load combinations, Structural analysis of tall buildings, Structural design of tall buildings, Foundations for tall buildings, Non-structural elements in tall buildings, Recommendations for monitoring deformations in tall buildings.

Unit 3: IS 1893-2016: Criteria for Earthquake Resistant Design of Structures: General principles, Design criteria, Design of buildings, Regular & Irregular buildings.

Unit 4: IS 13920-2016: Ductile Design & Detailing of RC structures subjected to seismic forces – Code of Practice: General specifications, Beams, Columns & Inclined members, Special Confinement reinforcement, Beam-column joint, Special shear walls, Gravity columns in buildings.

Unit 5: IS15988-2013: Seismic evaluation & strengthening of existing RC Buildings-Guidelines:
Preliminary evaluation, Detailed evaluation, Seismic strengthening.

Reference Books:

1. IS 16700-2017: Criteria for Structural Safety of Tall Concrete Buildings
2. IS 1893-2016: Criteria for Earthquake Resistant Design of Structures
3. IS 13920-2016: Ductile Design & Detailing of RC structures subjected to seismic forces – Code of Practice
4. IS 456-2000 Plain and Reinforced Concrete - Code of Practice
5. IS15988-2013: Seismic evaluation & strengthening of existing RC Buildings-Guidelines

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: **Language and Society**

| | |
|---|----------------|
| Name of the Faculty: | Radhika Mamidi |
| 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 2023 |

Pre-Requisites : **None**

Course Outcomes :

1. The course intends to familiarise 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 behaviour

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 analyse 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 scenario.
6. The students will be working on real data projects in teams which will give them an 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, pigdinization 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 Text Books :

- 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 SemExam | 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 – From Brain to Behaviour

Name of the Faculty : Bhaktee Dongaonkar

Course Code : CS9.439

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 2023

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 behaviour. The content is a mix of cognition, neuroscience, and neural network models.

Course Outcomes :

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

Course Topics :

Introductory Module

- Psychology of Learning and Memory
- Neuroscience of Learning and Memory

Learning Module

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

- Operant Conditioning: Learning the Outcome of Behaviors
- Generalization, Discrimination Learning, and Concept 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 Text Books :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 behaviour 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 | PO O1 | PS O2 | PS O3 | PS O4 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|----------|----------|
| 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 Name: **Mathematical Models in Biology**

Name of the Faculty: Abhishek Deshpande

Course Code: SC3.316
 L-T-P: 3-1-0
 (L= Lecture hours, T=Tutorial hours, P=Practical hours)
 Credits: 4
 Name of the Academic Program: CND

1.Prerequisite Course / Knowledge: NA

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

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

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

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

Note: 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) Short treatise on Differential Equations: Existence and uniqueness of solutions, System of differential equations, Eigenvalues and eigenvectors. Application to population dynamics models.
- 2) Introduction to dynamical systems: Flows, Fixed points and linearization.
- 3) Introduction to reaction networks: Persistence, Permanence, Globally Attracting sets, Deficiency and Multistability (Species-Reaction graphs).
- 4) Absolute concentration robustness, Network translation, Deficiency zero and Deficiency one theorems.

- 5) Applications to biological signal transduction pathways, phosphorylation-dephosphorylation cycles and MAPK cascades.
- 6) Numerical simulations and analysis of dynamical systems using pplane and MATLAB.

Reference Books:

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

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

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

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

Assignments (25%), Midterm I (20%), Midterm II (20%), Final exam (35%)

Title of the Course: **Foundations for Signal Processing and Communication**

Faculty Name: Praful Mankar and Arti Yardi

Course Code:

Credits: 4

L - T - P : 3-1-0

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

Semester, Year : Monsoon, 2023

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 want to 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, DoA 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 SemExam | 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: **Mathematical Foundations of Data Science**

Name of the Faculty: Suryajith Chillara, Girish Varma

Course Code:

Credits 4

L -T - P: 3 - 1 - 0

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

Semester, Year: Monsoon 2023

Name of the Program: BTech/MS/MTech/PhD in Computer Science

Pre-Requisites : Linear Algebra, Probability, Discrete Mathematics, Algorithms

Course Outcomes :

CO1: Understand how probability, statistics and graph theory can be used to model data science problems

CO2: Design efficient algorithms for Data Science problems with provable guarantees on runtime and accuracy

CO3: Study how to draw good samples efficiently and how to estimate statistical and linear algebra quantities, with such samples

CO4: Enable students to analyse higher dimensional data using abstract methods

CO5: Learn the theory for understanding when optimization over training samples can be expected to lead to good performance on new, unseen data

Course Topics :

Foundations:

Estimation from Random Samples and Confidence Intervals, Random Walks in Graphs and PageRank, Best fit subspace or PCA using SVD.

Algorithms for Large Datasets:

Streaming Algorithms, Property testing, Hashing, Approximate Nearest Neighbours using Locality Sensitive Hashing

Theory of Supervised Learning:

PAC Learning, Sample Complexity, VC Dimension, Learning Half spaces, Juntas
Preferred Textbooks :

1. Foundations of Data Science by Avrim Blum, John Hopcroft, and Ravindran Kannan <https://www.cs.cornell.edu/jeh/book.pdf>

2. Data Streams: Algorithms and Applications by S. Muthukrishnan <https://www.cs.princeton.edu/courses/archive/spr04/cos598B/bib/Muthu-Survey.pdf>

3. Graphical Models, Exponential Families, and Variational Inference by Martin J. Wainwright and Michael I. Jordan

https://people.eecs.berkeley.edu/~wainwrig/Papers/WaiJoro8_FTML.pdf

Reference Books :

1. Algorithms for Big Data by Moran Feldman

<https://www.worldscientific.com/worldscibooks/10.1142/11398#t=toc>

2. Understanding Machine Learning: From theory to Algorithms by Shai Shalev- Schwartz and Shai Ben David

<https://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/understanding-machine-learning-theory-algorithms.pdf>

Grading Plan : (The table is only indicative)

| Type of Evaluation | | Weightage (in %) | | | | | | | | | | | | | | |
|---------------------------|--|-------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Quiz-1 | | 10% | | | | | | | | | | | | | | |
| Mid Sem Exam | | 20% | | | | | | | | | | | | | | |
| Quiz-2 | | 10% | | | | | | | | | | | | | | |
| End Sem Exam | | 35% | | | | | | | | | | | | | | |
| Assignments | | 25% | | | | | | | | | | | | | | |

Mapping of Course Outcomes to Program Objectives:

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

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O 1 | PS O 2 | PS O 3 | PS O 4 |
|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|--------|--------|--------|--------|
| CO 1 | - | 3 | 1 | 3 | 1 | 2 | 2 | - | - | 1 | - | - | 2 | 2 | 2 | 3 |
| CO 2 | - | 3 | 1 | 3 | 1 | 2 | 2 | - | - | 1 | - | - | 2 | 2 | 2 | 3 |
| CO 3 | - | 3 | 1 | 3 | 1 | 2 | 2 | - | - | 1 | - | - | 2 | 2 | 2 | 3 |

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

Teaching-Learning Strategies:

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

Fundamentals of Data Science

Table of Contents

1. Estimation from Random Samples

Use Linearity of Expectation, Tail bounds, Confidence Intervals

Examples in Vote Share surveys, Medical Tests etc.

Mathematical Formulation in terms of Random Vari

Linearity of Expectation & Tail Bounds

Gaussian & Confidence Intervals

Predictions, Precision/Recall Curve

2. WWW Graph, Page Rank & Eigenvalues

Matrices, Eigenvalues, Convergence, Page Rank

World Wide Web Graph and Ranking Problem

Random Walks and Eigenvalues

Stationery Distributions and Degree

Convergence and Second Largest Eigen Value

3. Dimensionality Reduction

SVD, PCA and Best fit subspaces

Dimension Reduction Problem

- Examples: Spiral Galaxy, Recommender Systems
 - Singular Value Decomposition
 - Best fit subspaces from SVD
 - Low Rank Assumption and Applications
 - Projection to Random Subspace (Johnson-Lindenstrauss)
4. Data Streaming Algorithms
- Finding missing numbers and duplicates
 - Streaming algorithms
 - Fingerprinting Method
 - Frequency Moments and k-wise Independence
 - Limits of Streaming Algorithms
5. Nearest Neighbor Search, Hashing and Clustering
- Nearest Neighbor Classifier
 - Hashing
 - Appropriate NN from Locally Sensitive Hashing
 - Clustering
6. Sublinear time algorithms
- Property testing
 - Sublinear time algorithms for graphs
 - Sublinear time algorithms for boolean functions
 - Distribution testing
7. Decision Trees
- Sample complexity
 - Decision Tree algorithms
 - Random Forests
- 8 . Sample Complexity and VC Dimension
- 9 . Supervised Learning
- PAC Learning. Learning Linear functions using gradient updates. Overfitting*
10. Neural Network Learning

Neural Networks
 Gradient Descent and Backpropagation
 Convolutional Neural Networks for Images
 Recurrent Neural Networks for Time Series
 Regularization and Dropouts

Title of the Course: **MCS 1 – Probability and Statistics**

| | |
|---------------------|-------------|
| Name of the Faculty | Uttam Singh |
| 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 A posteriori 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.

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: | Uttam Singh |
| 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 Quizzes: 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 | PO1 0 | PO 11 | PO1 2 | PS O1 | 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 | 1 | 3 | 1 | 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 | Lalitha Vadlamani |
| 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 2023 |

Pre-Requisites :

Linear Algebra (must have good conceptual understanding of vector spaces, basis, subspaces, nullspace 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 Text Books :

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).

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 0 | PO1 1 | PO1 2 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|----------|
| 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, Srinathan Kannan

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 Circuits and 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 complexity class.

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 | P O 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PO 1 | PS O 2 | PS O 3 | PS O 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.
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 VertexCover, Independent Set, Knapsack etc.

Unit 4: Advanced Topics: Definitions and relationships between PH, RP, BPP, NC including theorems like Karp-Lipton, Adleman's theorem, Derandomization Techniques.

Reference Books:

- S. Arora and B. Barak (2000), Computational Complexity: A Modern Approach, Cambridge University Press.
- C. Moore & S. Mertens (2011), The Nature of Computation, Oxford University Press.
- M. Sipser (2014), Introduction to Theory of Computation, Cengage 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 and will 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 Quizzes: 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:

Multi-Agent Systems

| | |
|----------------------|---|
| Name of the Faculty: | Praveen Paruchuri & Meghna Lowalekar |
| Course Code: | CS7.507 |
| Credits: | 4 |
| L - T - P: | 3-1-0 (L - Lecture hours, T-Tutorial hours, P - Practical hours) |

Name of the Program: Computer Science
Semester, Year: Monsoon 2023

Pre-Requisites: Machine, Data and Learning

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

- CO1: Demonstrate a familiarity and the ability to apply the concepts related to different sub-areas within multi-agent systems field.
- CO2: Build an negotiation agent using automated negotiation algorithms.
- CO3: Identify and formulate relevant real world city scale resource allocation problems as sequential decision-making problem and solve it using approximate dynamic programming framework
- CO4: Design and evaluate solutions for constraint satisfaction and constraint optimization problems.
- CO5: Identity, formulate and efficiently solve the real-world problems of providing maximum security coverage with limited security resources using the framework of Bayesian Stackelberg security games.
- CO6: Work in a team to critically analyze and implement research papers in multi agent systems field and communicate the results to others using presentations.

(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.)

- a) Introduction and Applications
- b) Automated Negotiation Algorithms
- c) CSPs
- d) MDP, Decentralized MDP
- e) Large scale sequential decision making problems under uncertainty
- f) Approximate dynamic programming
- g) Distributed Constraint Optimization
- h) Review of Game Theory Basics
- i) Bayesian Stackelberg Games and Applications
- j) Project presentations: Will be spaced through semester and will be part of exam syllabus

Preferred Text Books : Artificial Intelligence by Russell and Norvig,

Reference Books : Approximate Dynamic Programming: Solving the Curses of Dimensionality By Warren B Powell

E-book Links :<https://zoo.cs.yale.edu/classes/cs470/materials/aima2010.pdf>

Grading Plan : (The table is only indicative)

| Type of Evaluation | Weightage (in %) |
|--------------------|------------------|
| Quiz-1 | 0 |
| Mid SemExam | 15 |
| Quiz-2 | 5 |
| End Sem Exam | 30 |
| Assignments | 20 |
| Project | 25 |
| Term Paper | 0 |
| Other Evaluation | 5 |

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

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

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

The course will introduce both theoretical concepts and will encourage students to apply the knowledge gained to build useful applications. The real-world application examples used during the course will help students to understand how the concepts taught during the course are useful in finding solutions to some important problems.

The project and assignment presentations will encourage class discussions. The course project will enhance collaborative learning. By discussing ideas with their teammates, they will be able to learn better.

Title of the Course: **Music-Language-Creativity**

Name of the Faculty: **Saroja T K**

Course Code: **HSS 338**

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

Credits: **4**

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

1.Prerequisite Course / Knowledge:... Faculty Consent

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

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

CO-1Understand the significance of language in music

CO-2 Delineate music as a powerful mode of imagination

CO-3Realise the importance of music as an aesthetic means to communicate, mingle with each other and express oneself.

CO-4Appreciate the heights of creativity in Indian music in specific and music in general

CO-5Comprehend the inter disciplinary approach in music with respect to various spheres of knowledge..

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

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PO O1 | PS O2 | PS O3 | PS O4 |
|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|----------|----------|
| CO1 | 1 | - | 1 | 1 | - | 2 | 1 | 2 | 2 | 2 | - | 2 | - | 2 | 1 | 2 |
| CO2 | 1 | - | 1 | 1 | - | 1 | 1 | 2 | 2 | 2 | - | 2 | - | 2 | 1 | 2 |
| CO3 | 1 | - | 1 | 1 | - | 1 | 1 | 2 | 2 | 2 | - | 2 | - | 2 | 1 | 2 |
| CO4 | 1 | - | 1 | 1 | - | 1 | 1 | 2 | 2 | 2 | - | 2 | - | 2 | 1 | 2 |
| CO5 | 1 | - | 1 | 1 | - | 1 | 1 | 2 | 2 | 2 | - | 2 | - | 2 | 1 | 2 |

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

4.Detailed Syllabus:

Chapter 1: Basics of musicand Language

- a. Notes, semitones, microtones, octave, ornamentations, rhythm, patterns, speeds, linear structures.
- b. Basic concepts of Indian music:

Sruthi, Swara, Raga, Laya, Tala, Alankaras, Gamaka, Naad, compositional forms

- c. Language:

Letters, words, idea of grammar, expressions, poetic ideas.

- d. Musical concepts synonymous to the words:

Indian music has so many concepts named after their content nature and behavior. A discussion on such terms which are concepts by themselves is studied.

Unit 2: Study of songs of various composers in different languages:

Songs are the hubs of creativity, linguistic beauty, information, expression and communication.
Study of all those features and practice to sing various such songs to experience the same.

Unit 3: Music ideas based on language

Musical concepts that took their birth from language perspective are discussed. Lot of musical exercises that help in understanding the relevance of those concepts would be practiced.

Unit 4: Music as language vs Spoken language

Melodic and rhythmic features of music based on language are discussed.

Unit 5: Experiments

Attempt to conduct simple experiments with music and language.

Discussing various experiments (compositions) by different composers who have worked on new ideas in the combination of music and language.

Reference Books:

1. The Hindu Speaks on Music - compilation of 232 selective music

articles by The Hindu -- Publishers: Kasturi and Sons Ltd, December 1999.

2.. A Southern Music (The karnatic story) by T.M. Krishna, Published by Harper Collins, January 2013

3 South Indian Music(volumes I to VI) by P.Sambamurthy, The Indian Music Publishing House, 1994

4.. Nuances of Hindustanu Classical Music by Hema Hirlekar, Unicorn books Pvt ltd, 2010

5.. Videos and audios on the Youtube and other platforms.

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

This is a course which is designed with 60percent practical and 40 percent theoretical approach.

The students would be taught a good number of songs that enable them to understand the role of creativity in binding music and language together to generate aesthetics. Personal demonstrations and you tube videos would be the main resources. Various experiments in music based on creative ideas would be discussed. At least one or two lecture demonstrations by experienced artists and professionals.

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

... Assignments: 20%

... Mid term exams: 20%

Quizzes: 10%

Class participation 10%

Project: 40%

Title of the Course: **Network, Signals & Systems**

Name of the Faculty: Santosh Nannuru + Anshu Sarje

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

1.Prerequisite Course / Knowledge:

A prior knowledge of calculus and complex numbers is required.

2.Course Outcomes (COs):

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

CO-1 Describe various circuit elements (R, C, L), supply (current, voltage), devices (op amp, diode).

CO-2 Explain the operation and characteristics of each circuit element, behavior in specific circuit configuration (DC, AC, series, parallel, mixed).

CO-3 Calculate equivalent circuit parameters (Thevenin, Norton), node voltages, branch currents etc. using reduction, KCL, KVL and reduction techniques.

CO-4 Calculate circuit response (steady state, transient) to various input stimulation **and also explain** the concept of time constant for RC, RL and RLC circuits.

CO-5 Demonstrate understanding of and calculate Power, Energy, Loss and phasors w.r.t. circuit.

CO-6 Apply the above concepts to analyze and solve a real-life circuit problem.

CO-7 Describe signals using various representations including Fourier series representation for periodic signals

CO-8 Describe systems abstractly using block diagrams and differential equations

CO-9 Apply convolution operation and impulse responses for system analysis

CO-10 Analyze signals and systems using Laplace transform representation

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|
| CO1 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 0 | 0 | 0 |
| CO2 | 1 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 3 | 0 | 0 | 0 |
| CO3 | 2 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 0 | 0 | 0 |
| CO4 | 2 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 0 | 0 | 0 |
| CO5 | 2 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 0 | 0 | 0 |
| CO6 | 2 | 1 | 2 | 3 | 1 | 3 | 1 | 1 | 3 | 3 | 1 | 3 | 3 | 0 | 0 | 0 |
| CO7 | 3 | 3 | 1 | 1 | 1 | - | - | - | - | - | 1 | - | 3 | - | - | - |
| CO8 | 3 | 3 | 3 | 1 | 1 | - | - | - | - | - | 1 | - | 3 | - | - | - |
| CO9 | 3 | 3 | 3 | 1 | 1 | - | - | - | - | - | 1 | - | 3 | - | - | - |
| CO10 | 3 | 3 | 3 | 1 | 1 | - | - | - | - | - | 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: Circuit elements
- Unit 2: Network theorems
- Unit 3: Transient and Steady state analysis
- Unit 4: Sinusoidal input and phasors
- Unit 5: Two port network
- Unit 6: Signals, representation, sinusoids, and Fourier series
- Unit 7: Systems and representations – differential equations, block diagram, operator, and functional form
- Unit 8: Convolution integral and impulse response
- Unit 9: Transfer function – Laplace transform, poles and zeros

Reference Books:

1. Engineering Circuit Analysis by Hyatt, Kimmerley& Durbin
2. Signals and Systems by A.V. Oppenheim, A.S. Willsky and S.H. Nawab (2015)

5.Teaching-Learning Strategies in brief (4 to 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 is posted at beginning of class to gauge understanding of previous lecture. Occasionally self-assessment test (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 teams to encourage collaborative problem solving, team participation, and coming up with solution as a team.

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

| Type of Evaluation [3 credit- lecture] | Weightage (in %) |
|---|---------------------|
| Mid semester exam1 | 10 |
| Mid semester exam 2 | 10 |
| End semester Exam | 30 |
| Assignments | 25 |
| Mini Project | 25 |

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, 2023

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 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 a 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-pareite 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 Text Books : 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=oYx5VzaMYm8C&redir_esc=y

2. <https://link.springer.com/book/10.1007/978-3-540-70861-8>

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 | PO1 | 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 |

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, 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. William 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

Title of the Course: Principles of Programming Languages (PoPL)

Name of the Faculty: Venkatesh Choppella

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 of the following sample tasks:

- 1. CO1: Document Abstract Syntax** Document and critique the abstract syntax of industrial scale programming language like C or Java.
- 2. CO2: Design domain specific languages** Design a small, domain purpose 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 embedding it into a base language.

4. **CO4: Compare languages** Compare and analyse the semantic expressibility (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 software application like a spreadsheet or a word processor in terms of its interface as a language of user operations and its internal structure as an abstract machine.

4 Mapping to Programme and Programme Specific Outcomes

Table 1: Mapping of Course Outcomes to programme and programme specific outcomes

| Programme Outcome (PO/PSO) | CO1 | CO2 | CO3 | CO4 | CO5 |
|-------------------------------------|-----|-----|-----|-----|-----|
| PO1 Engg. Knowledge | 3 | 3 | 3 | 3 | 3 |
| PO2 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 Engr. & Society | 1 | 2 | 2 | 2 | 2 |
| 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 | CO2 | CO3 | CO4 | CO5 | P11 |
|----------------------------------|-----|-----|-----|-----|-----|-----|
| Project Mgmt & Finance | 1 | 1 | 1 | 1 | 1 | |
| 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 | 2 | 3 | 3 | 3 | 3 | |

| | | | | | |
|------------------------|---|---|---|---|---|
| Research & Development | | | | | |
| Skills | | | | | |
| PS04 | 3 | 3 | 3 | 3 | 2 |
| Potential for PG study | | | | | |

5 Syllabus

Functional Programming: Abstract vs. Concrete Syntax. Racket syntax, Functions, recursion, syntactic extensions, higher-order functions, map, reduce and other combinators.

Operational Semantics: Abstract Reduction Systems, Transition Systems, Reduction, Simplification and Evaluation relations. Judgements and Rules. Rule Induction.

Scope: Identifiers, Scope and extent, Lexical scope, Environments, ‘Dynamic scope’ and parameters. Closures

State: Stores and imperative constructs, explicit and implicit store references, objects, invariants and safety, interfaces and constructors, inheritance, 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 and Wand.

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 1 and 2.

PLAI *Programming Languages: Application and Interpretation* 2nd Edition. Available online.

SSICS *Simply Scheme: Introducing Computer Science*. Brian Harvey and Matthew 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 will have 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 concept 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 text book. Tutorials will walk-through abstract syntax tree annotation, components of the interpreter implementation, and

inductive proofs of properties in 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 including Computer Science, Electronics, Mathematics, and the Sciences, to engineer and develop systems of varying scale.
- PO2 Problem analysis** Identify, formulate and analyze complex engineering problems reaching substantial conclusions using first principles of Mathematics, Natural Sciences and Engineering Sciences.
- PO3 Design/Development of solutions** Identify and bring to fore the necessary concepts from Computer Science and arrive at creative ways to solve problems that take into account the societal, cultural, and ethical considerations.
- PO4 Conduct investigations of complex problems** Interpolate and extrapolate based on existing knowledge base and self-learning skills to investigate the dynamics of complex problems and find solutions.
- PO5 Modern tool usage** Demonstrate requisite hands-on skills to work with a variety of software packages, libraries, programming languages, and software development environment tools useful in engineering large-scale systems
- PO6 The engineer and society** Make judicious use of resources and understand the impact of technology across the societal, ethical, environmental, and economic aspects.
- PO7 Environment and sustainability** Find technological solutions by considering the environmental impact for sustainable development
- PO8 Ethics** Practice principles of professional ethics and make informed decisions after a due impact analysis.
- PO9 Individual and team work** Work efficiently in individual and team-oriented projects of varying size, cultural milieu, professional accomplishments, and technological backgrounds.
- PO10 Communication** Effectively communicate and exchange ideas and solutions to any individual including peers, end-users, and other stakeholders.
- PO11 Project management and Finance** Apply the principles of project management in general and software project management in particular with focus on issues such as the life cycle, scoping, costing, and development.
- PO12 Life-long learning** Exhibit the aptitude for independent, continuous, and life-long learning required to meet their professional and career goals.

Programme Specific Outcomes (PSOs)

- PSO1** Exhibit specialized knowledge in some sub-areas of Computer Science and Engineering such as Theoretical Computer Science, Computer Systems, Artificial Intelligence, Cyber-physical Systems, Cyber-security and use this specialized knowledge base to solve advanced problems
- PSO2** Perform gap analysis in terms of systems and technologies and prepare roadmaps for incorporating state-of-the-art technology into system analysis, design, implementation, and performance.
- PSO3** Demonstrate research and development skills needed to define, scope, develop, and market futuristic software systems and products.
- PSO4** Demonstrate knowledge and skills at the required depth and breadth to excel in post-graduate and research programs.
-

Title of the Course:

Principles of Semiconductor Devices

| | |
|--|----------------|
| Course Code: | EC2.409 |
| Name of the Faculty | Anshu Sarje |
| 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 & valence 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 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|
| CO1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2 | 2 | 1 | 3 | |
| CO2 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 1 | 3 | 2 | 3 | 3 | 3 | |
| CO3 | 2 | 2 | 3 | 2 | 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 physics

Unit 6: MOS & MOSFET

Unit 7: 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. Class room learning will be done in interactive method as much as possible. Occasionally self assessment test (1 minute 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 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|
| 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, Conditional distribution, densities, conditional expectation, moment generating functions, characteristic functions.

Unit 4: Markov, Chebyshev and Chernoff bounds. Random sequences and modes of convergence, Strong and weak laws of large numbers, central limit theorem.

Unit 5: Random processes, Mean and covariance functions, Stationary processes and wide-sense stationary processes, 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 Signal Processing, 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 the course, 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 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

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 Text Books: 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 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO0 | PO1 | PO1 | PS O1 | PS O2 | PS O3 | PS O4 |
|------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|------------|------------|--------------|--------------|--------------|--------------|
| CO1 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 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:

Product Management 101

Faculty Name: Ramesh Loganathan+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, 2023

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. Feature less 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 Text Books : 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: **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 Modern Hindi Literature

Course Code :

Credits : 4

L - T - P : (24-0-0)

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

Semester, Year : Monsoon 2023

Pre-Requisites : Ability to read and comprehend Hindi. 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 Chughtai, 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%26CPOs%26PSOs-ofAllProgrammes-Jan2023.pdf>

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 o | PO1 1 | PO1 2 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|----------|----------|
| CO 1 | | | | | | | | | | | | | | | | |
| CO 2 | | | | | | | | | | | | | | | | |
| CO 3 | | | | | | | | | | | | | | | | |
| CO 4 | | | | | | | | | | | | | | | | |
| CO 5 | | | | | | | | | | | | | | | | |

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

Title of the Course:

Real Analysis

Faculty Name: Samyadeb Bhattacharya
 Course Code: MA4.101a
 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-valued functions of a real variable..

2.Course Outcomes (COs)

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

- 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

| | 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 |

‘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 contourintegrals. (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-Düsseldorf, 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. López, 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

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 schedulability 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 schedulability of a real-time system with different types of scheduling algorithms (global, partitioned, semi-partitioned) on a multiprocessor platform

CO-5. Analyze the schedulability 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

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
|------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| CO1 | 1 | 1 | 1 | 1 | - | 1 | - | - | - | 2 | - | 3 | 1 | 3 | 2 | 2 |
| CO2 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | - | 1 | - | 3 | 3 | 1 | 2 | 2 | 2 |
| CO3 | 3 | - | 3 | 1 | 2 | 2 | 1 | - | 1 | - | 3 | 3 | 3 | 2 | 3 | |
| CO4 | 3 | - | 3 | 1 | 2 | 2 | 1 | - | 1 | - | 3 | 3 | 3 | 2 | 3 | |
| CO5 | 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 Buttazzo, 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

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

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: Demonstrate skills 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 of Formal 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 Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

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

Note: 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, Proxysignature
- **Unit 2:** Security in vehicular adhoc networks/Internet of Vehicles (IoV), Security in smartgrid/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. Teaching-Learning Strategies in brief (4 to 5 sentences):

- * Recognition of interplay between theory and practice
- * Design of efficient and secure research problems
- * Various security analysis techniques against potential attacks
- * Automated software validation tools based formal security verification

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

- In-Class Tests:20%
 - Assignments:20%
 - Research Project: 40% (including report and presentation)
 - End Semester Examination:20%
 -
-

Title of the Course

Robotics: Dynamics and Control

Faculty Name - Nagamanikandan Govindan,Spandan Roy
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, 2023

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 Text Books :

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 | 3 | 2 | 3 | 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 : Harjinder Singh + Bhaswar Ghosh
 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: Analyse 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 upto 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 Lagrangian 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, band-gap 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 editioon)
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, Chittaranjan Hans |
| 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 oscillator, 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 pK_a 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 | 1 | 0 | 2 | 0 | 2 | 1 | 0 | |
| CO2 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 2 | 1 | 0 | |
| CO3 | 3 | 3 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 3 | 2 | 1 | |
| CO4 | 3 | 3 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 3 | 2 | 1 | |
| CO5 | 3 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 1 | 1 | |
| CO6 | 3 | 2 | 2 | 1 | 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 exam along 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, Jayanthi Sivaswamy
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 study signals and systems

CO-3: Apply sampling theorem to do analog-to-digital conversion of signals, perform ideal and 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 MATLAB software

CO-7: Analyze a signal processing application or problem by reading research papers and performing simulations as part of the course project

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 | 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 time-invariant (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, efficient implementation 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 the beginning of class to gauge understanding of previous lecture. 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 Systems Development

Name of the Faculty: Charu Sharma

Course Code : CS6.302

Credits: 4

L - T - P : 3-0-2

(L - Lecture hours, T-Tutorial hours,

P - Practical hours)

Semester, Yea: Monsoon 2023

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/softwares 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 PhD students

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 Rasters
4. GIS Data collection, Editing and Dataformats
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 in GIS/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 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|
| CO1 | 3 | 1 | 1 | 3 | - | - | - | 1 | 2 | - | - | 3 | 2 | - | - | - |
| CO2 | 2 | - | - | - | 3 | - | - | - | 2 | - | - | - | 2 | - | 2 | 2 |
| CO3 | 3 | 2 | - | - | 3 | - | - | - | 2 | - | - | - | 2 | 2 | 3 | 2 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 2 | - | 3 | 2 | 3 | - | 3 | 3 | 2 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 |

PREFERRED TEXT BOOKS:

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-AcomputingperspectivebyMichealWorboysandMattDuckham
4. Concepts and techniques of geographic information systems by C P Lo and Albert K W Yeung

Course Assessment Plan (Monsoon 2020)

| | | |
|--------------------------------|---|-----|
| Assignments | - | 10% |
| 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: **Spectroscopy**

Name of the Faculty: Marimuthu 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 |
| CO5 | | | | | | | | | | | | | | | | |

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 CO₂ and H₂O 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 2023

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 linguistic.

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 Text Books :

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 | 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 be able to..

CO-1: Explaining the speech production and modeling of it.

CO-2: Analyzing the algorithms for speech events extraction.

CO-3: Applying mathematical foundations of signal analysis for speech feature extraction.

CO-4: Analyzing the speech signals using excitation source and prosody.

CO-5: Explaining the basics of speech applications.

CO-6: Designing the algorithms for speech events detection and speech applications building.

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

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

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

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

Mapping with PSOs, where applicable.

Detailed Syllabus:

Unit 1: Overview of signal processing, speech production, speech perception, types of speech, and LTI model of speech production.

Unit 2: Pitch, formants, epochs and vowel region extraction.

Unit 3: Speech analysis: STFT analysis, Linear prediction analysis and cepstral analysis.

Unit 4: Prosody analysis and excitation source analysis of speech.

Unit-5: Applications of speech processing such as speech recognition, speaker recognition and speech synthesis.

Reference Books:

1. Introduction to Digital Speech Processing by Lawrence R. Rabiner and Ronald W. Schafer, now Publishers Inc. Hanover, USA, 2007.
2. Discrete Time Speech Signal Processing: Principles and Practice-Thomas F. Quateri, Ed., PE, 2004.
3. Speech Communications Human and Machine by Douglas O Shaughnessy, 2nd Edition, IEEE Press, 2000.
4. Speech and Audio Signal Processing, Processing and Perception of Speech and Music-Ben Gold and Nelson Morgan, Wiley- India Edition, 2006.

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

It is an introduction to speech processing course, so regular software oriented assignments are given to understand the concepts. Surprise class tests are conducted based on assignments to test the seriousness in assignment solving. As part of teaching, practical systems like speech recognition, speaker recognition etc are demonstrated in the class. Course projects are given on the concepts learned to design speech applications.

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

Quizzes

30%

| | |
|-------------|-----|
| Assignments | 25% |
| Project | 20% |
| End Viva | 25% |

Title of the Course: Statistical 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, Perceptrons, 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 LayerPerceptrons, 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 2023

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.Reorganise 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- β 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 on IS 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 Text Books :

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

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:

TBD

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 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|
| CO1 | 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 |
| CO4 | 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 Jersey
2. Hibbeler,R.C., (2012), Structural Analysis, Pearson Prentice Hall, New Jersey (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 Wind Engineering**

Name of the Faculty: Dr. Shaik Rehana
Name of the Program: Computer-aided Structural Engineering (CASE) M.Tech (CASE)
Course Code : CE1.509
Credits : 4
L-T-P: 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : **Monsoon 2023**

Pre-Requisites :

Basics of Fluid Mechanics, Fluid Dynamics, Boundary Layer Theory, Turbulent Flow, Structural Dynamics

Course Outcomes :

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

- CO-1: Design wind speed profiles and structural interaction with aerodynamic forces
CO-2: Design wind loads for various types of buildings such as single and multistoried structures subjected to various terrains and wind profiles
CO-3: Synthesize the wind induced responses under extreme wind speeds
CO-4: To assess the wind damages and wind impact on structures
CO-5: To assess the wind loads as per the codes and standards

Course Topics :

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

- Wind climate, nature and types of high winds and storms
- Wind damages, damage index, wind impact on structures
- Estimation of design wind speed and pressure distribution
- Estimation of wind loads on buildings, factors affecting wind load
- Prediction of design wind speed and structural safety
- Estimation of extreme wind speeds
- Atmospheric boundary layer and wind turbulence: mean wind speed profiles, wind spectra, topographic multipliers
- Structural interaction with aerodynamic forces, pressure, lift, drag and moment effects on structures
- Wind loads, codes and standards

Preferred Text Books :

John D. Holmes (2003), Wind Loading of Structures, ISBN 0-419-24610-X, ISBN 0-203-30164-1 Master e-book ISBN.

Reference Books :

Y. Tamura A. Kareem (2013), Advanced Structural Wind Engineering, ISBN 978-4-431-54336-7 ISBN 978-4-431-54337-4 (eBook), DOI 10.1007/978-4-431-54337-4, Springer Tokyo Heidelberg New York Dordrecht London.

E-book Links

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 | 15 |
| Project | 15 |
| 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 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 |
| CO4 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO5 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 |

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

Lectures and tutorials on design of wind loads for diverse type of practical structures. Hands on session to solve and design wind induced structures such as tall and multistorey buildings with

diverse terrains and wind profiles. Term projects with real-time case studies for developing design tools for the quantification of wind loads for user-defined structural requirements.

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 | PO1 o | PO1 1 | PO1 2 | PS O1 | PS O2 | PS O3 | PS O4 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----------|----------|----------|----------|----------|----------|----------|
| 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 | 1 | 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 | 1 | 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 the lecture content by using small examples that students work out during the class itself and promote active and participatory learning. A good part of the lecture will involve problem solving and finding solutions to problems. Homework assignments are designed to reiterate the material covered in class lectures and apply 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: **Technology Product Entrepreneurship**

Name of the Faculty: Ramesh Loganathan, Prakash Yalla

Course Code : CS9.424

Credits : 4

L - T - P : 3-1-0

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

Semester, Year : Monsoon 2023

Name of the Program: Technology product entrepreneurship-

Pre-Requisites : No prerequisites

Course Outcomes :

This course introduces the fundamentals of technology product entrepreneurship. You will learn the process of building a technology enterprise in a workshop format. Starting from a technology idea, mapping the idea to a high-potential commercial opportunity, defining/designing/validating the product, figuring out the market avenues & how to sell the product, and planning/managing rapid growth.

The class will apply the learning to their tech product ideas and create a ventureable product & plan; in a workshop mode thru extensive hands-on assignments concurrent with course modules.

CO1-Understand how to evaluate product ideas and assess the market opportunity in real-time, along with learning from current scenarios.

CO2-Connect products with markets and identify market & customer segments with the help of frameworks and business models.

CO3-Assess competition and evolve Value proposition for the product in cognisance of the current market trends and ever-evolving customer needs.

CO4-Be able to put a complete business plan for a technology product, after analysing the markets and building a GTM strategy.

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

https://iiitaphyd-my.sharepoint.com/:w/r/personal/dyacad_iiit_ac_in/Documents/NBA-2020-21/Course%20Content/IIIT-CSE-ECE.docx?d=w111foeffcae41b3a4d1e8a3fbc6332d&csf=1&web=1&e=z1Khby

PreferredTextBooks:

High Tech Start Up, Revised and Updated: The Complete Handbook For Creating Successful New High Tech Companies by John L. Nesheim

The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses by Eric Ries

Reference Books:

Technology Entrepreneurship: Overview, Definition, and Distinctive Aspects

1. http://timreview.ca/sites/default/files/article_PDF/Bailetti_TIMReview_February2012.pdf
2. Toward a General Modular Systems Theory and Its Application to Interfirm Product Modularity
3. <http://amr.aom.org/content/25/2/312.abstract>
4. Harvard: Why Lean Startup Changes everything
5. http://host.uniroma3.it/facolta/economia/db/materiali/insegnamenti/611_8959.pdf
6. The Power of Integrality: Linkages between Product Architecture, Innovation, and Industry Structure
7. <http://www.sciencedirect.com/science/article/pii/S0048733308001091>

E-book Links: The Art of the Start by Guy Kawasaki

1. Demand: Creating What People Love Before They Know They Want It by Adrian J. Slywotzky with Karl Weber
2. The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business by Clayton M. Christensen
3. Running Lean: Iterate From Plan A to a Plan That Works by Ash Maurya
4. Positioning: The Battle for Your Mind by Al Ries and Jack Trout
5. Venture Deals by Brad Feld and Jason Mendelson
6. Lean Analytics by Alistair Croll and Benjamin Yoskovitz
7. Crossing the Chasm by Geoffrey A. Moore

Grading Plan:

| Type of Evaluation | Weightage (in %) |
|---------------------|------------------|
| Quiz-1 | 20% |
| Labs | 20% |
| Tech Product Quiz-2 | 20% |

| | |
|-----------------------|------------|
| Demo and Presentation | 10% |
| Final submission | 30% |

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

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

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

- Introduction: Assignment: Create startup website; Vision; Basic Positioning statement;
- Creativity & Innovation: Assignment: Based on team’s tech idea considered, list 3 product possibilities, applying Idea hexagon framework.
- Frameworks & Models: Assignment: Assess opportunity for the ideas. And pick the “venturable business.”
- Customer Discovery/Opportunity mapping: Assignment: Apply Lean Startup Methodology, and Validate customer interest, need &... ; Assignment: First cut of Musiness Model Canvass filled in
- Design Thinking: Assignment: Rapidly create and refine the product functionality for the teams product using design thinking process
- Customer Development: Assignment: Competitive Positioning; Assignment: Update Product functionality capturing the competitive proposition
- Sales & Market Strategy: Assignment: Evolve the GTM plans
- Business Plans: Assignment: Completed, defensible, business model canvass; Assignment: Product roadmap- market & technical, GTM plans, revenue projections
- Technical Architecture considerations: Assignment: Study 2 similar solutions in market and compare/contrast tech architecture used by your product
- Corporate Technology Innovation : TBD

- Tech Product Pitch/Plan presentations
-

Title of the Course: **Theories and Practices of Nationalism**

Name of the Faculty: Aniket Alam
Course Code : HS3.303
Credits: 4
L - T - P :
(L - Lecture hours, T-Tutorial hours, P -Practical hours)
Semester, Year : Monsoon 2023
Name of the Program : B.Tech in Computer Science and Engineering

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

Course Outcomes :

CO1: Define the concept of Nationalism.
CO2: Explain range of academic theories interpreting Nationalism.
CO3: Analyze the different characteristics which form Nationalism.
CO4: Evaluate the positive and negative attributes of Nationalism.
CO5: Develop their own understanding about the role of Nationalism in today's world.

Course Topics :

- (1) Academic theories of Nationalism
 - a) Imagined Communities
 - b) Industrialised Societies
 - c) Colonial and Post-Colonial
- (2) Brief history of the nation-state in the world
 - a) Latin America
 - b) Europe
 - c) Asia and Africa
- (3) Nationalism in India
 - a) Cultural Nationalism
 - b) Anti-Colonial Nationalism
- (4) Theories of Nationalism in India
 - a) Gandhi
 - b) Bankim
 - c) Nehru
 - d) Tagore
 - e) Iqbal
 - f) Savarkar, Golwalkar
 - g) Jinnah

Preferred Text Books :

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

Reference Books :

1. Benedict Anderson: *Imagined Communities*.
2. Ernest Gellner: *Nations and Nationalisms*.
3. Eric Hobsbawm: *Nations and Nationalism since 1780*
4. Hans Kohn: *The Idea of Nationalism*
5. E. H. Carr: *Nationalism and After*
6. Partha Chatterjee: *Nationalist Thought and the Colonial World*
7. Javeed Alam: *India- Living With Modernity*
8. M.K. Gandhi: *Hind Swaraj*.
9. V. D. Savarkar: *Hindutva*.
10. Rabindranath Tagore: *Nationalism*.
11. M. S. Golwalkar: *We or Our Nationhood Defined*.
12. Jawaharlal Nehru: *Discovery of India*.
13. Bankim Chandra Chattopadhyay: *Anandamath*.
14. Rabindranath Tagore: *Gora*.
15. Bipan Chandra: *Colonialism and Nationalism in Modern India*.
16. Sumit Sarkar: *Modern India*.

E-book Links :**Grading Plan :**

(The table is only indicative)

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

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

BTech in CSE

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

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

The course will be based on classroom lectures and will require intensive reading and writing. On an average, each student will be required to read between 1,000 to 1,200 pages of books and articles and submit written work between 5,000 to 6,000 words, cumulatively.

In each class some select students will be given a small topic from the next class to read up on, and they will be expected to initiate discussions around these.

Pictures, Extracts from primary sources, audio and video resources will be used to illustrate the points being taught.

The assignments and project will focus on training students to develop their own ideas, and apply them to real life conditions.

Title of the Course: Theory of Elasticity

Name of Faculty: P. Pravin Kumar Venkat Rao

Course Code: CEo.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, and constitutive 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 of theory 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: Radhika Krishnan + Isha Dubey
 Course Code: HSo.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 courses in 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 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 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 o | PO1 1 | PO1 2 | PO1 3 | 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 |
| CO4 | 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 BlackSwan, 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

Title of the Course: Topics in Nanosciences

Name of the Faculty: 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 Nanosystems. 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: Topics in Software Engineering

Name of the Faculty: Raghu Reddy Y

Course Code: CS6.501

L-T-P: 3-0-1

Credits: 4

Name of the Academic Program: MS/PhD in Computer Science and Engineering

1. Prerequisite Course/Knowledge:

Students must have taken an Software Engineering or equivalent course at the undergraduate level.

2. Course Outcomes (Cos)

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

CO-1: Understand state-of-researchin advanced areas of software engineering such as Artificial Intelligence for software engineering, self-adaptive systems, software reengineering, etc.

CO-2: Apply standard principles of software architectingto construct software systems

CO-3: Apply specialized knowledge to identify open research problems and disseminate state-of-the art software 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 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 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 3 |
| 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 | 2 | 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:

- Art of writing research papers,
- Software Aging
- Introduction to software architecture
- Software architectural framework and patterns
- Applying AI for software engineering practices,
- Introduction to self-adaptive systems
- Applying ML for self-adaptation, microservices and serverless architectures,
- Software product lines
- Software reengineering
- Software evolution

Reference Books:

1. Software Architecture in Practice. Fourth Edition, Len Bass et al.
2. Pattern-OrientedSoftware Architecture. Bushmann et al.
3. Design it! From Programmer to Architect by Michael Keeling
4. The Software Architect Elevator: Redefining the Architect's Role in the Digital Enterprise by Gregor Hohpe, Orielly Publications
5. Designing data-intensive applications by Martin Kleppmann, O'Rielly
6. Building Microservices by Sam Newman, O'Rielly

7. Modernizing Legacy Systems: Software Technologies, Engineering Processes, and Business Practices, Seacord, Plakosh, Lewis, Addison-Wesley, 2003.
8. Refactoring: Improving the Design from Existing Code, Addison-Wesley, 2000
9. Successful Evolution of Software Systems, Yang & Ward, Artech House Publishers, ISBN 1580533493, 2003.
10. Software Evolution and Feedback : Theory and Practice, Nazim H. Madhavji, M.M. Lehmann, J. Ramil, Dewayne Perry, John Wiley & Sons, 2005.

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. Topics like software architecture, software architectural framework and patterns, self-adaptive systems are taught and reinforced via mini projects. The lectures emphasize on cutting edge research in the advanced areas of software 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 review assignments to students and supporting students to develop novel research proposals. Entire class is run in a working research session mode to foster advanced discussion among students as well as between students and instructors.

6. Assessment Methods and Weightage in brief (4 to 5 sentences)

| | |
|------------------------------------|-----|
| Final Project | 40% |
| 3 Mini Projects (3*10) | 30% |
| Research paper reviews (4*2.5) | 10% |
| Research paper Presentations (2*5) | 10% |
| Other in-class activities | 10% |

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, like 3-dimensional framework using attitudinal and behavioural, 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 highlights 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 perspectives, people | Field study, site visits, naturalistic observations, controlled field experiment, individual and group survey and focused interviews, customer satisfaction, remote testing | | Quantitative Analysis – count, accuracy, response time or time taken to complete the task or speed analysis, visualization, learning curve, |

| | | | |
|--|---|--|--|
| with disability or accessibility, | | | |
| 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 Text Books :

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 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PS O1 | PS O2 | PS O3 | PS O4 |
|------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|------------------|------------------|
| 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 toshape 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;

Unit 5: 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 analyse and some activities to keep the students engaged in class throughout. Talks by experts who made a difference are also organised for the batch. 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 : | Zia Abbas |
| 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-lectures/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:

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 emphasise 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%.
