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Syllabus for Courses listed above in red color is not available now.

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**Title of the Course**  
Advanced Computer Networks

**Course Code:**  
CS3.402

**Faculty Name:**  
Ankit Gangwal

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

**Credits:**  
4

**L-T-P:**  
3-1-0  \((L= \text{Lecture hours, } T=\text{Tutorial hours, } P=\text{Practical hours})\)

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**

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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:

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):

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<tr>
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<td>Mid Semester Examination</td>
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<td>End Semester Examination</td>
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</table>
Title of the Course: Advanced Graphics, AR & VR

Course Code: CS5.502

Faculty Name: Avinash Sharma + P J Narayanan

Name of the Academic Program: BTech in Computer Science & Engineering

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

Credits: 4

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

1. Prerequisite Course / Knowledge: ..................

2. Course Outcomes (COs):

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

CO-1 Explain the 3D shape representation and modeling for Computer Graphics applications.

CO-2 Analyze Graphics libraries for development of graphics applications.

CO-3 Explain advance Graphics concepts/algorithms for realistic rendering of 3D objects.

CO-4 Apply various Geometry Processing algorithms for 3D shape processing.

CO-5 Apply the fundamental constructs in Augmented and Virtual Reality systems and develop a virtual platform.

CO-6 Explain the real world AR/VR systems after interaction with industry experts via invited talks.

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

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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 5: Invited talks: Industry experts to discuss various challenges for developing an AR/VR system.

Reference Books:

1. Computer Graphics with OpenGL by Hearn and Baker
3. Augmented Reality (1/e), DeiterSchmalstieg and Tobias Hollerer, Addison Wesley.
4. Virtual Reality, StevanLaValle, Cambridge University Press (Free Online Version)

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

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

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

Homeworks/Assignments: 30%
Course Project: 20%
Title of the Course:  Advanced Natural Language Processing

Faculty Name:  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, 2022
(Ex: Spring, 2022)
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/

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
Other Evaluation |

Mapping of Course Outcomes to Program Objectives:

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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.

Note: This course description format comes into effect from Spring 2022.

Title of the Course: Advanced Operating Systems

Faculty Name: Manish Shrivastava
Course Code: CS3.304
Credits: 4
L - T - P: 3-1-0
(L - Lecture hours, T-Tutorial hours,
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)*
   ISBN: 0596005652

**Reference Books**

1. Remzi Arpaci-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)*

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*
   ISBN: 978-0-596-15448-6

**E-book Links**

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

<table>
<thead>
<tr>
<th>Type of Evaluation</th>
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<tr>
<td>Quiz-1</td>
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<td>Quiz-2</td>
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<td>Assignments</td>
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<td>Project</td>
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<td>Term Paper</td>
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**Mapping of Course Outcomes to Program Objectives:**
Teaching-Learning Strategies in brief (4-5 sentences):

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

Note: This course description format comes into effect from Spring 2022.

Title of the Course: Advanced Structural Design  
Faculty Name: Sunitha Palissery  
Course Code: CE1.604  
Credits: 4  
L - T - P: 3-1-0  
(Ex: Spring, 2022)  
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

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 :

Reference Books :
1. American Concrete Institute (ACI), (2014), Building Code requirements for Structural Concrete (ACI 318-14), Farmington Hills, MI, 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
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

**E-book Links**

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

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**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

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**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.

Note: This course description format comes into effect from Spring 2022.

Course Title: Algorithm Analysis and Design

Faculty Name: 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 2022
(Ex: Spring, 2022)

Name of the Program: B.Tech

Pre-Requisites: Discrete Mathematics, and Data Structures and Algorithms

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 intractibility
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)

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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: Analog IC Design
Course Code: EC2.401
Name of the Faculty: Abhishek Srivastava
L-T-P: 3+1+0
Credits: 4

(L= Lecture hours, T= Tutorial hours, P= Practical hours)
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 opamp up to tapeout 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**

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

4. **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:

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.

6. Assessment methods and weightages in brief:

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<th>Type of Evaluation</th>
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<td>End semester exam</td>
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Title of the Course: Applied Ethics
Name of the Faculty: Ashwin Jayati
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

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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.
Reference books:


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.

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. 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%.
Course Code: CS1.302
Faculty Name: Shantanav Chakraborty
L-T-P: 3-1-0
Credits: 2

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

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

1. Prerequisite Course / Knowledge:

Data structures, 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

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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:

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
---|---
Course code | HS0.203
Name of the faculty | Ashwin Jayanti
L-T-P | 3-1-0
Credits | 2

Name of the faculty | Ashwin Jayanti
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

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‘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:


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
---|---
**Course Code** | CS9.421
**Title of the Course** | Behavioral Research: Experiment Design
**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 Specific Outcomes (PSOs)**

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**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
3. Types of Experimental design: Non-Experimental Designs, Pilot Testing. 4. Data Collection: Surveys, Questionnaires; Data Representation: Levels of Measurement, Human Annotation, Different types of design: Simple randomized design, Factorial designs, Simple repeated measures design, Randomized blocks design, Latin 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: Ineferential Statistics Tests of Difference and Tests of Association: Multilevel tests (ANOVA): nonparametric and parametric testsof difference– chi-square test, Mann-Whitney U test, Binomial Sign test, Wilcoxon’s T test, Related and Unrelated t tests; nonparametric and parametric testsof association– correlation, regression; Significancetesting[NOTE:Whilethiscourseemphasizes basic descriptiveandinferentialstatisticalanalysis, the Second part of the course set 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)

Reference Books:
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, 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 (team of two or individual – apply, design, run, experiments, analyze with appropriate statistics): 40%

Title of the Course: Bio Instrumentation & Devices 2

Course Code: EC1.301

FACULTY NAME: Anshu Sarje

CREDITS: 2

TYPE-WHEN: Monsoon for 3rd and 4th yr B Tech

PRE-REQUISITE: AEC, IC circuit design, Bio instrumentation & devices 1

OBJECTIVE: Hands on experience in fabrication, fluidics & instrumentation.

COURSE TOPICS:

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

Experiments and/or order of experiments may change subject to availability of space and lab materials.

1. Lab1 (Week 1 & 2): Record your muscle electrophysiology. Design amplifier and record your muscle activity.
2. Lab2 (Week 3 & 4): Make your own fluidic channel and separate out different particles.
3. Lab3 (Week 5 & 6): Let us detect fluorescence. We will explore different ways of detecting fluorescence and record fluorescence using a camera.
4. Lab4 (Week 7 & 8): Photolithography. We will transfer pattern using photolithography on a substrate and develop it.
5. Lab5 Bonus: We will explore optics and its use in diagnostics.
PREFERRED TEXT BOOKS: No specific book. Notes will be provided.

*REFERENCE BOOKS:

*PROJECT: Students have to complete experiments which they can adapt with prior approval.

GRADING PLAN:

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<td>Lab discipline &amp; work</td>
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<td>Viva &amp; Discussions</td>
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OUTCOME:

* After completion of this course successfully, the students will be able to..  
  CO-1 Describe ECG signals and muscle electrophysiology.  
  CO-2 They will be able design system for picking up the electrophysiological signal and amplify it.  
  CO-3 Design and use microfluidics and soft lithography for.  
  CO-4 They will be able design and fabricate fluidic channels.  
  CO-5 Design and describe fluorescence detection  
  CO-6 Explain, perform, use photolithography for device patterning and fabrication.

REMARKS:

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a ‘-’ dash mark if not at all relevant).
Title of the Course | Bioinformatics
--- | ---
Course Code | SC3.202
NAME OF FACULTY | Nita Parekh
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**

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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:

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%).
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]

E-book Links:
https://iiitaphyd-my.sharepoint.com/:f:/g/personal/shweta_kumari_research_iit_ac_in/ElEzcLqj3JBlCDryuvU5Z4B8 twcGifr314vKjixUVq5g?e=LpyvBS

Active links are also available in Moodle.

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

https://iiitaphyd-my.sharepoint.com/:w:/r/personal/dyacad_iiit_ac_in/Documents/NBA-2020-21/Course%20Content/IIIT-CSE-ECE.docx?d=w111f0effcaea41b3a4d1e8a3fbc6332d&csf=1&web=1&e=z1Khby

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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.

Note: This course description format comes into effect from Spring 2022.
Semester, Year: 2nd Sem – Year 1 (Monsoon, 2022)

Pre-Requisites: None

Course Objective

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

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

CO-1 Demonstrate a good understanding of an organization's financial health and position through the study of financial statements.

CO-2 Demonstrate a good understanding of various Financial Ratios and parameters derived out of the monetary positions of an organization.

CO-3 Demonstrate the ability to understand and analyze the working capital decision-making based on the above parameters and hands-on skills in applying allocation of the working capital.

CO-4 Demonstrate the ability to understand and analyze the valuation exercise as an entrepreneur of one's startup organization and make decisions on the decision making again related to the Use Case Scenarios.

CO-5 Demonstrate the ability to determine, analyze and make decisions as per the Time Value of Money (TVM) of the assets owned in running own businesses.

Course Topics:

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

Preferred Text Books:
Reference Books:

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

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

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

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

Title of the Course: Chemical Kinetics and Reaction Dynamics
Course Code: SC2.305
Faculty Name: Prabhakar Bhimalapuram

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

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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:


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:

<table>
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<tr>
<th>Component</th>
<th>Weightage</th>
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<tr>
<td>Assignments</td>
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<tr>
<td>Quizzes</td>
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<td>End-Sem Exam</td>
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</table>
Title of the Course: Computational Linguistics 2  
Course Code: CL3.202  
L-T-P: 3+0  
Credits: 4  
Faculty Name: Radhika Mamidi  
(L= Lecture hours, T= Tutorial hours,  
P= Practical hours)  
Name of the Academic Program: CLD

1. Prerequisite Course / Knowledge:  
Introduction to Linguistics-1 and 2; 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

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</table>
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
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.

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<tr>
<th>Type of Evaluation</th>
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<td>Assignments</td>
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<td>Seminar</td>
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<td>Endsem Exam</td>
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**Title of the Course**: Computer Problem Solving  
**Course Code**: CS0.301  
**NAME OF FACULTY**: Lini Teresa Thomas  
**Name of the Academic Program**: MTech CASE  
**L-T-P**: 3-1-3  
**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

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
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. 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): 30%
   - Quizzes: 25%
   - Lab Exams: 25%
   - Assignments: 20%

   end semester examination

   - mid semester examination (August)
   - Three-four quizzes (or extended project)
   - Lab Exams (September, November)
   - Assignments (best 3 of 4)
Title of the Course: Critical Viewing and Reading: Readings in Partition Literature
Faculty Name: Sushmita Banerji

Course Code: HS1.301
L-T-P: 3-0-0
Credits: 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Name of the Academic Program:

1. Prerequisite Course / Knowledge:
None

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

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

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

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

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

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

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Outcomes (PSOs) – Course Articulation Matrix

Note: 3 in the box for high level mapping, 2 for medium level mapping and 1 for low level mapping
4. Detailed Syllabus:

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

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

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

Reference Books:


5. Teaching-Learning Strategies

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

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

6. Assessment methods and weightages:

<table>
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<th>Percentage of Grade</th>
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</table>
Title of the course | Data Analytics-I
---|---
Course Code | CS4.405
FACULTY NAME | P. Krishna Reddy
L-T-P | 3-1-1
Credits: (L= Lecture hours, T=Tutorial hours, P=Practical hours) | 4

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 of from large data. Data analytics based platforms are being operated in multiple domains to extract valuable and actionable insights from the data to improve the business performance. The objective of this first level course is 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

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‘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 data warehousing 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:
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]
Course Code: CS4.301
Faculty Name: Ponnurangam Kumaraguru
Name of the Academic Program: B.Tech. in Computer Science and Engineering
L-T-P: 3-1-0. Credits: 2

1. Prerequisite Course / Knowledge:
Data Structures

2. Course Outcomes (COs)

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

CO-1. State data requirements for an application.

CO-2. Develop a conceptual model (such as, Entity Relationship Model and Diagram) for a set of data requirements.

CO-3: Comprehend relational data model and integrity constraints, and relational database design with normalization.

CO-4. Map the conceptual model to a relational data model and create and populate its corresponding relational database

CO-5. Map user queries into correct relational algebra, Structured Query Language (SQL), and tuple relational calculus expressions/statements. And updates using SQL.

CO-6. Implement an application to access, query and update a relational database.

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

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‘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:


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: Business Fundamentals – 1

Course Code: PD2.321
Name of the Faculty: Himanshu Warudkar
Name of the Program: M.Tech – Product Design and Management
Credits: 2
L - T - P: 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year: Monsoon 2022

Pre-Requisites: An open inquisitive mind

Course Objectives:
Much of 21st century economy has depended on organizational ability to identify needs of customers and to quickly create products that meet these needs and can be produced at low cost. Achieving these goals is not solely a marketing problem, nor is it solely a design problem or a manufacturing problem; it is a product development and management problem involving all these functions. This course on Business Fundamentals provides a collection of tools and techniques intended to enhance the abilities of cross-functional teams to work together to develop great products. A product is something sold by an enterprise to its customers. Product development and management is the set of activities beginning with the perception of a market opportunity and ending in the production, sale, and delivery of a product. At the end of the Business Fundamentals 1 course, students will be well equipped with a knowledge of key competencies required to be successful in product management roles.

Course Outcomes:

CO1: Demonstrate sound understanding of key concepts of modern management
CO2: Demonstrate ability to distinguish between a good and bad strategy and be able to analyze the industry they are operating in using models such as Porter's 5 Forces
CO3: Develop competencies for sound decision making in a world of uncertainty. This would be based on concepts of Decision Making Under Uncertainty, Bounded Rationality, Prospect Theory
CO4: Develop an understanding of various leadership theories and practical usage of the same. Students will be able to analyze for themselves, types of leadership, their pros / cons.
CO5: Demonstrate competency in the process of conceptualizing, defining, designing, and delivering technology products for markets. Synthesize products or solutions for complex engineering that meet the specified market needs

Course Topics:

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<th>#</th>
<th>Session Name</th>
<th>Learning Objective</th>
<th>References</th>
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| 1. | Introduction to Management | - Overview of various competencies required to be a manager  
- Introduction to key management theories and their evolution  
| 2. | What is Strategy? | - Understanding of strategy as a series of choices  
- Introduction to Porter’s analysis of industry  
| 3. | Decision Making in Organizations | - Key concepts around Decision Making  
- Decision Making Under Uncertainty, Bounded Rationality, Prospect Theory  
- Developing knowledge of various decision-making techniques and traps  
- Introduction Behavioral Economics  
| 4. | Leadership for a VUCA World | - Leadership Theories and Practical Usage  
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<td><strong>5.</strong></td>
<td><strong>Product Engineering Knowledge</strong> – Mahesh Natarajan, Thermo-Fischer</td>
<td><strong>-</strong> Demonstrate competency in the process of conceptualizing, defining, designing, and delivering technology products for markets. <strong>-</strong> Usha to facilitate as Mahesh is based in Hyderabad</td>
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<tr>
<td><strong>6.</strong></td>
<td><strong>Design / Development of solutions</strong> – Mahesh Natarajan, Thermo-Fischer</td>
<td><strong>-</strong> Synthesize products or solutions for complex engineering that meet the specified market needs <strong>-</strong> Consideration for public health and safety, and the cultural, societal, and environmental considerations <strong>-</strong> Usha to facilitate as Mahesh is based in Hyderabad</td>
</tr>
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</table>
| 8. | Managing Teams | - Building and managing diverse teams  
|---|---|---|---|
| 11. | Delivering for Quality | - Key concepts in developing quality products  
- Measuring quality of services  
| 12. | Innovation & Creativity | - Theories of innovation  
- Open innovation paradigms  
Entrepreneurial Leadership
Historical Research Reference in Entrepreneurship.


Preferred Textbooks:

Reference Books :

E-book Links :

Grading Plan :

(The table is only indicative)

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<thead>
<tr>
<th>Type of Evaluation</th>
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<tbody>
<tr>
<td>Quiz-1</td>
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<td>Mid Semester Exam</td>
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<td>Quiz-2</td>
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<td>End Semester Exam</td>
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<td>Assignments</td>
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<td>Case Write-ups</td>
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<td>Term Paper</td>
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<td>Other Evaluation (Class Participation)</td>
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*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

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</table>
Title of the Course:  
Business Fundamentals – 2

Course Code: PD2.421
Name of the Faculty: Himanshu Warudkar
Name of the Program: M.Tech – Product Design and Management
Credits: 2

L - T - P: 3-1-0
(L - Lecture hours, T - Tutorial hours, P - Practical hours)

Semester, Year: Monsoon 2022

Pre-Requisites: Business Fundamentals - 1

Course Objectives: This course is a continuation of Business Fundamentals – 1 course and provides further insights into advanced topics around creating, running a product company, and/or performing a product owner/manager role. Whilst Business Fundamentals – 1 course provided basics of Management, Decision Making, Leadership, Value Co-Creation, Managing Teams etc. Business Fundamentals – 2 course is aimed at covering application of the concepts learnt in Business Fundamentals – 1. Participants will be introduced with topics such as Platforms (moving from Product to Platforms), identifying Societal Grand Challenges to be solved using Product Mindset, Introduction to Finance, Sales/Marketing and Market Research. Participants will be exposed to products in a variety of domains through case studies. At the end of the Business Fundamentals 2 course, participants should be well equipped with applied knowledge of for identifying both problem space and solution space around product management.

Course Outcomes:

**CO1:** Develop ability to transition from a services mindset to a product mindset

**CO2:** Develop awareness of key competencies in HRM for product ventures

**CO3:** Develop knowledge of key concepts in financial management in product management roles
**CO4:** Develop awareness of sales / marketing and competencies for execution of turnkey projects

**CO5:** Develop capability to start own product venture or step into a product owner / manager role

**Course Topics:**

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<tbody>
<tr>
<td></td>
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<td>- Identify opportunities to move pipeline business to a platform business</td>
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<td>16</td>
<td>Assessing Business Performance</td>
<td>- Understanding and overcoming challenges in launching a product in a nascent but overcrowded market</td>
<td>Philips India: Launch of New Air Purifiers – HBSP Case Study</td>
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| 18. | Human Resources for Product Management | - Key concepts in human resource management such as hiring, diversity, psychological safety etc.  
- Valuation of companies | The CEO's guide to corporate finance – McKinsey  
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<tr>
<td>21.</td>
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<td>22.</td>
<td>Creating Business Cases</td>
<td>Understanding how to write business cases and get buy-in</td>
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<td>23.</td>
<td>Market Research &amp; Development - Mahesh Natarajan, Thermo-Fischer</td>
<td>Market research tools and techniques</td>
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<td>Modern tool usage</td>
<td>Use of various product</td>
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Teaching-Learning Strategies in brief (4-5 sentences):

This course may be taught based on presentations covering key topics for each session, discussion on mini and / full length case studies requiring students to critically analyze various real-life situations. Students will be required to identify a topic of their interest and analyze a new product idea, existing product and prepare a write-up on the same. Learning will also be enhanced through a variety of domain-based case studies, guest lectures.

 Course Title: Data Driven Drug Discovery

Course Code : SC4.412
Faculty Name : Deva Priyakumar
Credits : 3-1-0-4

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

Semester, Year : Monsoon 2022
(Ex: Spring, 2022)

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 :
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<td>Presentations</td>
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<td>Project</td>
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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_iit_ac_in/Documents/NBA-2020-21/Course%20Content/IIIT-CSE-ECE.docx?d=w111f0effcaea41b3a4de8a3f0bc6332d&csf=1&web=1&e=Z1KbY

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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

Note: This course description format comes into effect from Spring 2022.

Title of the Course: Data Structures & Algorithms for Problem Solving
Faculty Name: 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 2022

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:
by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein

Grading Plan:
(The table is only indicative)

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<td>Quiz-2</td>
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<td>Weekly Labs</td>
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<td>Mid Lab exam</td>
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<td>Final Lab exam</td>
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Mapping of Course Outcomes to Program Objectives:
Teaching-Learning Strategies in brief (4-5 sentences):

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

Note: This course description format comes into effect from Spring 2022.

Title of the Course: Data Systems
Name of the Faculty: Kamal Karlapalem
Course Code: CS4.401
L-T-P: 3-1-1
Credits: 4
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
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‘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:

- 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


Course Code: CS7.601
CREDITS: 4 Credits
L-T-P: 3:0:1
TYPE-WHEN: Spring 2020
FACULTY NAME: Dr. Naresh Manwani

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-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
PREFERRED TEXT BOOKS:

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:

<table>
<thead>
<tr>
<th>Type of Evaluation</th>
<th>Weightage (in %)</th>
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<tbody>
<tr>
<td>Small Quizzes (10 quizzes)</td>
<td>25%</td>
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<tr>
<td>Quiz-1</td>
<td>10%</td>
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<td>Quiz-2</td>
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<tr>
<td>End Sem Exam</td>
<td>10%</td>
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<tr>
<td>Assignments</td>
<td>30%</td>
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</tbody>
</table>
**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).

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**Title of the Course:** Design for Testability

**Faculty Name:** 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

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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**
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**


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):

<table>
<thead>
<tr>
<th>Type of Evaluation</th>
<th>Weightage (in %)</th>
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<tbody>
<tr>
<td>Home Assignments (Problem Sets 3-4)</td>
<td>15%</td>
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<tr>
<td>Quizzes (2)</td>
<td>20%</td>
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</table>
Title of the Course: Design of Wearable Systems

Course Code: PD1.502
Name of the Faculty: Raghu Reddy Y
L-T-P: 3:0:0
Credits: 2 (Half Course)
( L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program: Master of Technology in Product Design and Management

1. Prerequisite Course / Knowledge:

Students must have knowledge of basic electronics or seek permission from instructor.

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

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

CO1: Understand the design and construction of a bare-minimum wearable system

CO2: Demonstrate the ability to explore and identify feature requirements for building a wearable system

CO3: Apply engineering principles and practices from existing use-cases of wearable systems

CO4: Demonstrate use of tools required to design and prototype a wearable system

CO5: Practice social ethics and human values while building wearable system for the targeted audience

CO6: Exhibit aptitude for working in teams and deliver task outcomes effectively

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

<table>
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<th>PO1</th>
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Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write ‘3’ in the box for ‘High-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low-level’ mapping.

4. Detailed Syllabus:

UNIT 1:

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

UNIT 2:

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

UNIT 3

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

UNIT 4

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

Reference Books:

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

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

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

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<tr>
<th>Assessment Method</th>
<th>Weightage</th>
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<tbody>
<tr>
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<td>Assignments</td>
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<td>Other In-class Activities</td>
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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
(Semester, Year: 1st Sem – Year 1 (Monsoon, 2022)
(Ex: Spring, 2022)

1. Prerequisite Course / Knowledge:

No prerequisites are required

2. Course Objectives & Outcomes (COs)

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

After completion of this course successfully, the students will be able to...
CO-1 Understand the Human-Centered (HCD) led Empathy (end user advocacy) & Creative Thinking based approach for Problem solving and designing/delivering new products, solutions and services.

CO-2 Demonstrate good understanding of various methods and tools used to understand the user’s socio-cultural-economic context during the research/empathies and define stages of the Design Thinking Process.

CO-3 Apply hands-on skills, methods and tools for user research including User Research, Empathy, Contextual Inquiries, Shadowing, User Personas, Use and User Journey mapping, etc.

CO-4 Create, document and present the various deliverables and communications including Stakeholder Mapping, User Personas, Use Case Scenarios, User Journey Maps, Empathy Maps etc. related to the Design Thinking process and deliverables.

CO-5 Demonstrate the ability to collaborate and co-create the design solution and integrate the DT process within the overall product development and management life-cycle.

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

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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
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.
- Introduce/Initiate Design Thinking Pilot Project which is built into course structure and will run parallel to the course content in the DT-Part 1 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 actionable 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
5. Book: Design Thinking for Strategic Innovation by Idris Mootee
8. Book: 101 Design Methods: A structured approach for driving innovation in your organisation by Vijay Kumar
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):

<table>
<thead>
<tr>
<th></th>
<th>Classroom/Home activities &amp; assignments</th>
<th>20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Project Individual/Group</td>
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<tr>
<td>4.</td>
<td>Final Exam</td>
<td>20%</td>
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<tr>
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<td>TOTAL</td>
<td>100%</td>
</tr>
</tbody>
</table>

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, 2022)
(Ex: Spring, 2022)

1. Prerequisite Course / Knowledge:
Design Thinking 101 – Research to Define Course
2. Course Objectives & Outcomes (COs)

This course is the extension of the earlier course “Design Thinking101-Research to Define” and will introduce the knowledge and skills required for the second diamond of the overall design thinking process. This course is aimed at guiding the students to work through the Ideation & Prototyping (Diversion) and Test/Evaluate (Convergence) phases of the second diamond of the overall Design Thinking Process. This course will help the student appreciating the criticality and value of generating lots of ideas, early prototyping and user testing/validation of the ideas at the early stage of design development for delivering solution which has higher fit between the products and the user needs and business model.

This course is core knowledge/skill and will also serves as a foundation for further learning for any student irrespective of their specific domain such as product design, product management, user experience design, service design, software & IT, technology design and business.

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

**CO-1** Understand the Human-Centered (HCD led Empathy (end user advocacy) & Creative Thinking based approach for Problem solving and designing/delivering new products, solutions and services

**CO-2** Demonstrate good understanding of various methods and tools used to understand the user’s socio-cultural-economic context during the research/empathies and define stages of the Design Thinking Process.

**CO-3** Apply hands-on skills, methods and tools for user research including User Research, Empathy, Contextual Inquiries, Shadowing, User Personas, Use and User Journey mapping, etc.

**CO-4** Create, document and present the various deliverables and communications including Stakeholder Mapping, User Personas, Use Case Scenarios, User Journey Maps, Empathy Maps etc. related to the Design Thinking process and deliverables.

**CO-5** Demonstrate the ability to collaborate and co-create the design solution and integrate the DT process within the overall product development and management life cycle.

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

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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 FINANLISING THE SOLUTION (Week 7 - Project Completion)
• Tweaking the ideas and further development of the same.
• Final presentation of the work.

Reference Books:

• Case1: Design Thinking and Innovation at Apple, Stefan T. & Barbara F. (HBS 9-609-066)
• Case2: Embrace- A Baby Warmer, Project by Stanford University.
• Case3: TALA- 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):

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Title of the Course: Digital Image Processing

Name of the Faculty: Santosh Ravi Kiran
Course Code: CS7.404
L-T-P: 3-0-1.
Credits: 4
Name of the Academic Program: B.Tech. in Computer Science and Engineering
1. **Prerequisite Course/Knowledge:**

Programming, Data Structures, Algorithms

2. **Course Outcomes (COs)**

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

CO-1. Discuss how images are stored and represented in digital machines using suitable examples

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)

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

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<th>CO 1</th>
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'3' in the box denotes 'High-level' mapping, '2' for 'Medium-level' mapping, '1' for 'Low'-level' mapping

4. **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 (9 hours)

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)
5. **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.

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

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

---

**Title of the Course:** Distributed Systems

**Faculty Name:** Kishore Kothapalli  
**Course Code:** CS3.401  
**L-T-P:** 3-1-0  
**Credits:** 4  

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

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

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1. **Prerequisite Course / Knowledge:**

An understanding of operating systems, networks, and algorithms

2. **Course Outcomes (COs):**

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

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

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

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

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

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

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

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

4. Detailed Syllabus:

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

Reference Books:


3. Other significant papers from conferences such as OSDI, USENIX, NSDI, for material that is not part of textbooks

5. Teaching-Learning Strategies in brief:

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

6. Assessment methods and weightages in brief:

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

Title of the Course: Distributing Trust, Blockchains and Their Applications

Faculty Name: 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:
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 bitcoin 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, hydeyperledger

**CO-5**
develop new applications using block chain technology

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

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

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

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Title of the Course: Earthquake Resistant Design of Masonry Structures

Course Code: CE1.607
NAME of Faculty: P. Pravin Kumar Venkat Rao
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

CO 3: Understand the failure modes and complete behaviour of masonry under different actions like: compression, tension, shear, and bending

CO 4: Analyze the seismic safety of masonry buildings and suggest the retrofit measures using codal provisions.

CO 5: 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.

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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:


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 Name: Embedded Systems Workshop
Faculty Name: Sachin Chaudhari + Abhishek Srivastava
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 inoperability of IoT data
(Analyze) CO-7: Examine various available solutions for data storage and cloud computing

(Create) CO-8: Design and fabricate a functional PCB and mechanical enclosure for their IoT project

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

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

1. **Sensing/Actuators and Interfacing**
   1. Sensor/Actuator selection (using datasheets)
   2. Physics of sensors and actuators related to projects
   3. Interfacing: Serial interfaces, Analog out, SPI, UART, I2C, “propriety” such as DHT22

2. **Controller, Embedded Systems and Peripherals**
   1. Platform selection – ATMEL328, ESP32, STM8 Architecture; timers, interrupts, AVR, SAMR architectures
   2. Embedded Systems: power management, interrupts, memory managements, leaks, OTA firmware update, reliability, onboard debugging
   3. Peripherals: RTC, ADC channels, resolution, onboard memory, power, external/internal watchdog

3. **Communications, Networking and IoT Architecture**
   1. Different IoT communication protocols: Comparison of Zigbee/WiFi/BLE/4G/5G/eSim/LoRaWAN
   2. Data Protocols: MQTT/HTTPS/CoAP

4. **Data Storage and Computation**
   1. Cloud storage and computing
   2. Data retrieval optimization
   3. IoT standards for interoperability: Implementation using oneM2M

5. **PCB and Enclosure Design**

6. **Data privacy and security**

7. **Dashboard and Visualization**
   1. Software/Approaches: UI/UX and Time Series Data Visualization; Front-end and back-end technologies
8. **Documentation**

1. User document and developer’s documentation

2. Best practices for writing the two documents

3. Referring style manual. For example, *Microsoft/Chicago manual of style*

**Reference:**

2. P. Lea, *Internet of Things for Architects*, 2018

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:**

<table>
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<th>Assessment Method</th>
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**Title of the Course Name:** Embedded Systems Workshop

**Faculty Name:** Zia Abbas + Aftab Hussain

**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

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Title of the Course: Environment and Politics in India
Name of the Faculty: Radhika Krishnan
Course Code: HS4.301

L-T-P: 3-0-0
(L= Lecture hours,
T= Tutorial hours, P= Practical hours)
Credits: 4
Name of the Academic Program: Humanities Elective offered to UG3/UG4.
1. **Prerequisite Course / Knowledge**: Preferably Introduction to Sociology or Introduction to Politics

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 have a sense of environmental history and the emergence of ‘environment’ as a concern, globally as well as in India.

   **CO-2**:
   
   Students will understand basic concepts in environmental justice, environmental politics and environmental citizenship.

   **CO-3**:
   
   Students will appreciate the difference between environmentalism in the global North and the global South, by studying their respective demands, agendas, strategies and concerns.

   **CO-4**:
   
   Students will learn to analyse the dynamics of environmental legislation and regulation in India (with a specific focus on legislation related to forest management, water management and wildlife conservation).

   **CO-5**:
   
   Students will learn to see the various entanglements of environment, resource use and misuse and governance. They will identify actors and stakeholders involved in various resource conflicts, and get a sense of competing claims and counterclaims.

   **CO-6**:
   
   Students will get a sense of the various expressions of environmentalism in India, emerging from different actors such as workers and trade unions, adivasis and Dalits. They will be able to identify the underlying differences, political and cultural significance, as well as the impact of these various expressions on environmental narratives in India.
3. Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

**Applicable for CSE**

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

**Applicable for ECE**
4. **Detailed Syllabus:**

**Unit 1:**
Environmental History: Emergence of ‘environment’ as a discourse, themes in global environmentalism, themes in Indian environmentalism

**Unit 2:**
Environmental Justice, Rights and Environmental Citizenship: Applying concepts and principles of justice, rights, equality and citizenship in resource use debates.

**Unit 3:**
Environmentalism in the Global North and the Global South: Differences in concerns, strategies, demands and agendas. Impact of global environmental discourses and narratives in India. Emergence of the Environmental Justice Movement in the West and its implications for environmentalism in India. Environmentalism of the poor.

**Unit 4:**
Case Studies used include Forest/Wildlife Management in India, Big Dams in India.

**Unit 5:**
Various expressions of environmentalism in India: Trade Union and their relationship with the environmental question, Dalit environmentalism, Environmentalism and Indigeneity. Introduction to Cultural Ecology.

**Reference Books:**


Amita Baviskar, *In the Belly of the River: Tribal Conflicts over Development in the Narmada Valley* (New Delhi: Oxford University Press, 2004 [reprint, 1995]).


5. **Teaching-Learning Strategies in brief (4 to 5 sentences):**
Students are introduced to theories and concepts through lectures. Photographs, short 4-5 minutes videos, posters, pamphlets, songs and slogans related to environmental issues are used during the lectures. Discussions and interventions in the classroom are highly encouraged. Students are given reading-based assignments through the course, which help them to firstly understand the concepts in some depth and secondly apply the concepts in specific situations. Each assignment involves 40-50 pages of intense reading. Quizzes are designed to test analysis of a specific case.

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

<table>
<thead>
<tr>
<th>Type of Evaluation</th>
<th>Weightage (in %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid Sem- Exam</td>
<td>15%. Questions designed to evaluate understanding of basic concepts.</td>
</tr>
<tr>
<td>End Sem Exam</td>
<td>30%. Questions designed to evaluate understanding of basic concepts. One long question which involves application of concepts discussed in the course.</td>
</tr>
<tr>
<td>Assignment 1</td>
<td>20%. Related to Unit I, II III (Essay question)</td>
</tr>
<tr>
<td>Assignment 2</td>
<td>20%. Related to Units IV V (Essay Question)</td>
</tr>
<tr>
<td>Quiz 1</td>
<td>7.5% Related to Unit I, III, III (Analysis of a case)</td>
</tr>
<tr>
<td>Quiz 2</td>
<td>7.5% Related to Unit IV, V (Analysis of a case)</td>
</tr>
</tbody>
</table>

**Course Name:** Fairness, Privacy and Ethics in AI  
**Faculty Name:** 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-freeness, 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

<table>
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<tr>
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<th>PO1</th>
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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’.

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):

<table>
<thead>
<tr>
<th>Type of Evaluation</th>
<th>Weightage (in %)</th>
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<tbody>
<tr>
<td>Mid Sem Exam</td>
<td>15</td>
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<tr>
<td>End Sem Exam</td>
<td>25</td>
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<tr>
<td>Quizzes (Option of Reading Assignment + Viva in lieu of in class quizzes)</td>
<td>15</td>
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<tr>
<td>Programming Assignments (2)</td>
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<tr>
<td>Reading Assignment</td>
<td>10</td>
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<tr>
<td>Use Case Development</td>
<td>10</td>
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<tr>
<td>Scribes</td>
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<tr>
<td>Course Participation</td>
<td>5</td>
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**Title of the Course:** Finite Element Method

**Name of Faculty:** Venkateswarlu Mandadi

**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

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<thead>
<tr>
<th>Course outcomes</th>
<th>Program Outcomes</th>
<th>Program Specific Outcomes</th>
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4. Detailed Syllabus

<table>
<thead>
<tr>
<th>Unit</th>
<th>Content</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Unit 1</td>
<td>Galerkin method, Axially loaded bar, Heat conduction in one dimension, Heat conduction with convection transfer.</td>
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<tr>
<td>Unit 2</td>
<td>Poisson equation, Triangular element, Rectangular element, Heat conduction in two and three dimensions.</td>
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<tr>
<td>Unit 3</td>
<td>Variational functional, Ritz method, Euler-Bernouli beam, Finite element solution of beam</td>
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<tr>
<td>Unit 4</td>
<td>Basic equations of elasticity, Torsion problem, Finite element solution of torsion problem, Plane stress</td>
<td>9 hours</td>
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<tr>
<td>Unit 5</td>
<td>Isoparametric elements — one dimensional, two dimensional, triangular; Numerical integration</td>
<td>9 hours</td>
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<td>Unit 6</td>
<td>Helmholtz equation, Natural frequencies</td>
<td>3 hours</td>
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<tr>
<td>Unit 7</td>
<td>Parabolic equations, Hyperbolic equations</td>
<td>3 hours</td>
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</tbody>
</table>

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**

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4. **Detailed Syllabus:**

1. Game Design:
   - Pitch and Story of the Game
   - Look and Feel,
   - Gameplay Breakdown
   - 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
   o Interfacing
   o 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
   o Materials
o Fabrication
o Usability

- Game as a Project:
  o Agile Development
    ▪ SCRUM
    ▪ Sprint
  o Planning
    ▪ Gantt Charts
    ▪ Burndown Charts
  o Retrospective
  o 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

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

The inclass lectures will cover game elements (mechanics, space, play, rules, chance) and 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):**

<table>
<thead>
<tr>
<th>Type of Evaluation</th>
<th>Weightage (in %)</th>
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<tbody>
<tr>
<td>Activity</td>
<td>Marks</td>
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<td>------------------------------------------------------------------------</td>
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<tr>
<td>Game Devl (individual) mid-sem</td>
<td>30</td>
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<tr>
<td>Team game devl (end sem)</td>
<td>25</td>
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<tr>
<td>Presentation, GDD &amp; hosting of game</td>
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<tr>
<td>Assignments (2)</td>
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<td>Quizzes (2)</td>
<td>10</td>
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<tr>
<td>Other Evaluation</td>
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</tbody>
</table>

Title of the Course: Human-Computer Interaction

Name of the Faculty: Raman Saxena
Course Code: PD1.501
L-T-P: 3-1-0-2
(L= Lecture hours, T= Tutorial hours, P= Practical hours)
Semester, Year: II Sem – Year 1 (Monsoon, 2022)

1. Prerequisite Course / Knowledge:
No prerequisites are required

2. Course Objectives & Outcomes (COs)

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

Lecture topics are aimed at guiding the students through analyzing and discussing the interaction between products and people based on cognitive, physical and emotional factors. It will introduce fundamentals of interaction design such as mental models, human action cycles and difference between User Experience, User Interface and Interaction Design. It will look at the various types of human-computer interaction and how it affects the people intended goals and objectives. How a good HCI design delivers higher perceive usefulness, usability or ease of use leading to positive and delightful user experience. It will build understanding the factors that influence the interaction between people and products in a desired direction. The course will explain the process of User-centered software design and development and the deliverables within the same such as user cases, user stories, workflow, task analysis, information architecture, wireframes, storyboards and low fidelity and high-fidelity prototypes. The course will also introduce the concept and practice of usability testing and evaluation. The course will also investigate the technology trends such as AI, Chatbots. etc. and their influence on the interactions between human and computers. The course will also cover User Experience. The course will divide into lectures including classroom exercises, quizzes, a short project and home assignments.

The students of this course will be able to apply the knowledge/learning’s from this course to their own professional work as HCI Designer, Interaction designer, UX Designer and design interaction layer of the software/IT products including Mobility, Healthcare, Learning, E-commerce and Utility etc. The course will include a short project to offer opportunity to the students to experience the full HCI cycle.

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

CO-1 Demonstrate good understanding of Human-Computer Interaction and How it influences the User Experience of digital products, systems, solutions and services.

CO-2 Demonstrate good understanding of methods and tools used to understand the HCI from the perspectives of technology, human-centered design and human/social sciences such as cognitive, and digital anthropology perspective.
CO-3 Demonstrate good understanding of incorporating human-centered approach in HCI to deliver useful and easy to use software and IT products including Mobility, Healthcare, Learning, E-commerce and Utility etc.

CO-4 Demonstrate the ability to create, document and present the various deliverables and communications related to HCI, UX and UI Design including Human-Action Cycle, Personas, Use Cases, Task Flow and Analysis, Information Architecture diagram, Wireframes, UI Design, and Usability Testing etc.

CO-5 Demonstrate the ability to 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

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<th>PO 1</th>
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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. Introduction to Human-Computer Interaction (Week 1 - Lecture 1)
- Introduction to HCI?
- History of HCI
- How Human interact with outside world?
- Human Conceptual/Mental models
- Conflict between Mental Models and Design Models.

UNIT 2. UNDERSTANDING Human-Machine System (Week 2 - Lecture 2)
- Understanding Human-Machine System
- Human-Action Cycle (HAC)
- 7 stages of Human-action cycle.
- Classroom exercise on HAC
- User Experience

UNIT 3. Art and Science of User Experience and UI Design (Week 2 Lecture 3 & Week 3 - Lecture 4)
- Attention and Memory
- Gestalt theory and principles
- UI Elements including color and interaction model
- Information and Interaction Design principles

UNIT 4. User-Centered approach to software Design (Week 3 - Lecture 5 & Week 4 - Lecture 6)
- Introducing HCI Project
- Perceived Usefulness and Perceived Ease of Use
- Understanding User Persona
- Why user person is important
- Use cases, User stories
- Task Flows & Task Analysis
- Human-centered software Design Workflow.

UNIT 5. Usability Engineering and Testing (Week 4 - Lecture 7 & Week 5 - Lecture 8)
• HCI Project Continue
• Information Architecture
• Wireframes and Storyboards
• Low and High-Fidelity prototypes

UNIT 6. HCI PROJECT WORK – UX Design (Week 5 - Lecture 9 & Week 6 - Lecture 10)
• HCI Project Discussions and Feedback
• Design Documentation

UNIT 7. HCI PROJECT WORK – UX Design (Week 6 - Lecture 11 & Week 7 - Lecture 12)
• HCI Project Discussions and Feedback
• Rapid Prototyping
• Testing and Final Presentation
• Documentation and presentation

Reference Books & Cases:
• Book: Human-Computer Interaction in the New Millennium, by Carroll, John
• Book: Learn Human-Computer interaction: Solve human problems and focus on rapid prototyping and validating solutions through user testing., by Christopher Reid Becker
• Book: Lean UX: Designing Great Products with Agile Teams, by Jeff Gothelf & Josh Seiden
• Book: Designing with Mind in Mind: Simple guide to understanding User Interface Guidelines, by Jeff Johnson
• Book: Sketching User Experiences: Getting the Design Right and the Right Design, by Bill Buxton
• Book: Human-Computer Interaction: Solve human problems and focus on rapid prototyping and validating solutions through user testing, by Christopher Reid Becker
• Book: Interaction Design: Beyond Human-Computer Interaction, By Helen Sharp, Jennifer Preece & Yvonnes Roger
• Book: Designing User Interfaces: Exploring User Interfaces, UI Elements, Design Prototypes and the Figma UI Design Tool, Dario Calonaki
• Book: Designing Interfaces: Patterns for Effective Interaction Design, By Jennifer Tidwell, Charles Brewer and Aynee Valencia
• Book: UX for XR: User Experience Design and Strategies for Immersive Technologies (Design Thinking), by Cornel Hillmann
• Book: Information Visualization: Design for Interaction, by Prof. Robert Spence
• Book: Moderating Usability Test: Principles and Practices for Interacting, by Dumas, Joseph
• Case1: Design of Mainframe User Experience
• Case2: Design of a Conversational UI’s.

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 will introduce and discuss a couple of case studies including cases related to HCI, User Experience and UI Design of software products.
• A HCI project to practice HCI, UX, UI and Usability learnings.
• Other than attending lectures and doing classroom exercises & assignments, students need to spend 4 hours per week on home/field assignments.

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

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<th>Classroom/Home activities &amp; assignments</th>
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<td>Project Individual/Group</td>
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<td>3</td>
<td>Final Exam</td>
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Title of the Course: Hydrological Modeling and Software Development
CourseCode: CE5.502
Faculty Name: Shaik Rehana
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 Engineering Open Elective (Monsoon)

1. Prerequisite Course/Knowledge:

General awareness about the water and climate related problems and computational programming skills to develop tools for 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 provide the 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: Demonstrate 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

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</table>
4. Detailed Syllabus:

- **Unit 1:** Introduction: fundamentals of fluid mechanics and open channel flows; hydrology, rainfall and runoff processes and hydro-climatology, statistical analysis, optimization methods.
- **Unit 2:** Water Resources Systems: river basin and urban hydrology, river water quality modelling, flood and drought management, irrigation and reservoir operation and climate change.
- **Unit 3:** 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.
- **Unit 4:** Development and Application of Software: Real-world applications at various scales for water resources management

References:


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 source software tools.

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

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

---

**Title of the Course:** Information Retrieval and Extraction

**Name of the Faculty:** Vasudeva Varma

**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 languages, 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**
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'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:

- 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 in theory: 10 marks
Quizzes in theory: 10 marks
Mid Semester Examination: 20 marks
End Semester Examination: 60 marks

Title of the Course: Information Theory

Name of the Faculty: Lalitha Vadlamani and Arti Yardi
Course Code: EC5.410
Credits: 4
L - T - P: 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year: Monsoon 2022
(Ex: Spring, 2022)
Name of the Program: B. Tech in Electronics and Communication Engg.

Pre-Requisites: Basics course in probability is a must

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:** Calculate the achievable rates of Slepian Wolf coding and MAC channels in network information theory

**Course Topics:**

**Unit 1:** Motivation for digital communication and information theory, Probability overview.

**Unit 2:** Source Coding - Entropy and its properties, Relative entropy, Mutual information, Huffman codes and optimality, Asymptotic Equipartition Property and Typical set based source coding.

**Unit 3:** Channel coding - Channel capacity motivation and definition, Discrete memoryless channel, Channel coding theorem for DMC- achievability and converse.

**Unit 4:** Gaussian channel - Differential entropy, Gaussian channel with power limitation, Gaussian channel coding theorem and converse.

**Unit 5:** Network Information Theory - Slepian-Wolf coding, MAC channels

**Preferred Text Books:**


**Reference Books:**

“Information Theory, Inference and learning algorithms”, David McKay (available online)

1. “A First Course in Information Theory”, Raymond Yeung.
2. “Network Information Theory” by Abbas El Gamal and Young Han Kim (available online)
### E-book Links

### Grading Plan

(The table is only indicative)

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<th>Type</th>
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<td>Quiz-2</td>
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<td>End Sem Exam</td>
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<td>Assignments</td>
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<td>Project</td>
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**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
### 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.

Note: This course description format comes into effect from Spring 2022.

Title of the Course: Intro to Cognitive Science
Course Code: CS9.426
Name of the Faculty: Vishnu Sreekumar
TAs: Nancy Hada and Kumar Neelabh

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

Course Information
Course Description: Cognitive Science is a highly interdisciplinary field of study that seeks to understand how the mind works. In this course, we will discuss a diverse range of perspectives from philosophy, linguistics, psychology, neuroscience, and computer science, on how to unravel the mysteries of human cognition.

Credits: 4

L-T-P: 3-1-0 (L = lecture hours, T = tutorial hours, P = practical hours)

Prerequisite: None

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

Course Technology Requirements
- You will need access to the following tools to participate in this course.
  - Laptop/desktop computer
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**

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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

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<tr>
<th>Description</th>
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<td>Debate reaction paper or debate team participation (20 marks)</td>
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<td>Mid-Sem exam (20 marks)</td>
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<td>End semester exam (40 marks)</td>
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<td>Total (100 marks)</td>
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**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:
<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>[92,100)%</td>
</tr>
<tr>
<td>A-</td>
<td>(84,92)%</td>
</tr>
<tr>
<td>B</td>
<td>[76,84)%</td>
</tr>
<tr>
<td>B-</td>
<td>(68,76)%</td>
</tr>
<tr>
<td>C</td>
<td>[60,68)%</td>
</tr>
<tr>
<td>C-</td>
<td>(52,60)%</td>
</tr>
<tr>
<td>D</td>
<td>[45,52)%</td>
</tr>
<tr>
<td>F</td>
<td>&lt; 45%</td>
</tr>
</tbody>
</table>

**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:


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

<table>
<thead>
<tr>
<th><strong>Title of the Course</strong></th>
<th><strong>Introduction to Neural and Cognitive Modeling</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Faculty Name:</strong></td>
<td><strong>Bapi Raju Surampudi</strong></td>
</tr>
<tr>
<td><strong>Course Code:</strong></td>
<td><strong>CS9.427</strong></td>
</tr>
<tr>
<td><strong>L-T-P</strong></td>
<td><strong>3-1-0</strong></td>
</tr>
<tr>
<td>(L= Lecture hours, T= Tutorial hours, P=Practical hours)</td>
<td></td>
</tr>
<tr>
<td><strong>Credit</strong></td>
<td><strong>4</strong></td>
</tr>
<tr>
<td><strong>Name of the Academic Program</strong></td>
<td><strong>B. Tech in CSE</strong></td>
</tr>
</tbody>
</table>

**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)

<table>
<thead>
<tr>
<th>PO 1</th>
<th>PO 2</th>
<th>PO 3</th>
<th>PO 4</th>
<th>PO 5</th>
<th>PO 6</th>
<th>PO 7</th>
<th>PO 8</th>
<th>PO 9</th>
<th>PO 10</th>
<th>PO 11</th>
<th>PO 12</th>
<th>PSO 1</th>
<th>PSO 2</th>
<th>PSO 3</th>
<th>PSO 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO 1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO 2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
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<td>2</td>
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<td>3</td>
</tr>
<tr>
<td>CO 3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
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<td>1</td>
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<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Detailed Syllabus:

Part I: Single-Neuron Level Models (1/3rd of the semester)
Introduction to Neuroscience; Passive membrane models, Leaky Integrate and Fire (LIF) models, Hodgkin-Huxley model, Cable models of dendrites, Synapse model, Compartmental models.

Part II: Network Level Models (1/3rd of the semester)
Neural population codes; information representation; neural encoding and decoding; hierarchy and organization of sensory systems; Spiking Network models of sensory systems; Neuroplasticity and learning.

Part III: Abstract Models (1/3rd of the semester)
Introduction to Hebbian, Competitive and Error-driven learning rules; Reinforcement learning, Neural Network models of Perception, Attention, Memory, Language and Executive Function.

Reference Books:

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

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):

<table>
<thead>
<tr>
<th></th>
<th>Assignment</th>
<th>N=3</th>
<th>15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Mid Semester Exams</td>
<td>N=2</td>
<td>30%</td>
</tr>
<tr>
<td>4.</td>
<td>Project in Groups of 2 students</td>
<td>N=1</td>
<td>25%</td>
</tr>
<tr>
<td>5.</td>
<td>End Semester Exam</td>
<td>N=1</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>

Grading Policy: Relative grading policy scheme

Project Evaluation Breakdown:

<table>
<thead>
<tr>
<th></th>
<th>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</th>
<th>5%</th>
</tr>
</thead>
</table>
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 credit course):

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

   CO-1: apply psychology knowledge base –

   - describe and discuss major concepts, theories, models and overarching themes in psychology
   - describe applications of psychology
   - analyze the major goals of psychological science, and utilize different research methods used by psychological research.
   
   - Evaluate the challenges and merits 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 experiences 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

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
<th>PSO4</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
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<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
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<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
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<tr>
<td>CO4</td>
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<td>CO5</td>
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<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: ‘3’ in the box for ‘High-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low’-level’ mapping
4. **Detailed Syllabus:**

<table>
<thead>
<tr>
<th>Unit 1</th>
<th>Unit 2</th>
<th>Unit 3</th>
<th>Unit 4</th>
<th>Unit 5</th>
<th>Unit 6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction</strong></td>
<td><strong>Methods</strong></td>
<td><strong>Health &amp; Psychology</strong></td>
<td><strong>Social &amp; Personality</strong></td>
<td><strong>Cognitive</strong></td>
<td><strong>Learning &amp; Development</strong></td>
</tr>
<tr>
<td>Psychology as a Science</td>
<td>Research methods for psychological observations</td>
<td>Psychological health and disorders</td>
<td>Social</td>
<td>Attention</td>
<td>Learning</td>
</tr>
<tr>
<td>Goals of Psychology</td>
<td>Neuroscience and behaviour</td>
<td>Psychological interventions and treatments</td>
<td>Gender</td>
<td>Perception</td>
<td>Life-span development</td>
</tr>
<tr>
<td>History of Psychology</td>
<td></td>
<td></td>
<td>Emotion</td>
<td>Memory</td>
<td>Personality</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Personality</td>
<td>Intelligence</td>
<td></td>
</tr>
<tr>
<td>3 hours</td>
<td>3 hours</td>
<td>6 hours</td>
<td>6 hours</td>
<td>6 hours</td>
<td>3.5 hours</td>
</tr>
<tr>
<td>2 Lectures</td>
<td>2 Lectures</td>
<td>4 Lectures</td>
<td>4 Lectures</td>
<td>4 Lectures</td>
<td>3 Lectures</td>
</tr>
<tr>
<td>CO 1 &amp; 2</td>
<td>CO 1, 2 &amp; 3</td>
<td>CO 1, 2, &amp; 5</td>
<td>CO 1, 2, &amp; 5</td>
<td>CO 1, 2, &amp; 5</td>
<td>CO 1, 2, &amp; 5</td>
</tr>
</tbody>
</table>

**Reference Books:**


**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 teams 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:**

<table>
<thead>
<tr>
<th></th>
<th>Assignment</th>
<th>N=2</th>
<th>10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Home and Class Activities (Student presentation)</td>
<td>N=2</td>
<td>5%</td>
</tr>
<tr>
<td>3</td>
<td><strong>Mid Semester Exams</strong></td>
<td>N=2</td>
<td>20%</td>
</tr>
<tr>
<td>4</td>
<td>Project in Group – with 2-3 students</td>
<td>N=1</td>
<td>30%</td>
</tr>
<tr>
<td>5</td>
<td><strong>End Semester Exam</strong></td>
<td>N=1</td>
<td>30%</td>
</tr>
<tr>
<td>6</td>
<td>Experiment participation based on credits</td>
<td>N=2</td>
<td>5%</td>
</tr>
</tbody>
</table>

**TOTAL 100%**

**Project Evaluation Breakdown:**

<table>
<thead>
<tr>
<th></th>
<th>Idea presentation / Proposal</th>
<th></th>
<th>4%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Progress Report 1: with hypothesis, experiment design, paradigms, tasks, measures, prediction, and statistical analyses to use</td>
<td></td>
<td>8%</td>
</tr>
<tr>
<td>3</td>
<td>Progress Report 2: with pilot data and preliminary analysis</td>
<td></td>
<td>8%</td>
</tr>
</tbody>
</table>
4. Final Presentation + Peer evaluation (should be based on critical feedback) 8% + 2%

**TOTAL 30%**

**Grading Policy: Absolute grading policy scheme**

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;=85</td>
<td>&gt;=70</td>
<td>&gt;=55</td>
<td>&gt;=45</td>
<td>&lt;45</td>
</tr>
</tbody>
</table>

**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)**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Topic Description</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Clarity in Problem Statement, Method, Result, and Discussion</td>
<td>20</td>
</tr>
<tr>
<td>2.</td>
<td>Critical understanding of Literature – motivation for your research project</td>
<td>20</td>
</tr>
<tr>
<td>3.</td>
<td>Method: Participants, material, stimuli, procedure, task, measure of performance, sampling</td>
<td>20</td>
</tr>
<tr>
<td>S.No.</td>
<td>Topic Description</td>
<td>Marks</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>1.</td>
<td>Clarity and coherence in describing topic</td>
<td>10</td>
</tr>
<tr>
<td>2.</td>
<td>Summary and Critical Evaluation to find the gaps in the given literature</td>
<td>15</td>
</tr>
<tr>
<td>3.</td>
<td>Future direction: Limitation and Scope of the current research/objective, and Impact</td>
<td>15</td>
</tr>
<tr>
<td>4.</td>
<td>Citations and Reference (APA style)</td>
<td>5</td>
</tr>
<tr>
<td>5.</td>
<td>Organization</td>
<td>5</td>
</tr>
</tbody>
</table>

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

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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
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 Course: Introduction to Literature
Name of the Faculty: Nazia Akhtar
Course Code: HS1.204
Credits : 4 credits
L - T - P: 36 hours (24 classes)
Name of the Program: Humanities Elective
Semester, Year: Monsoon 2021
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, acquiring – in the process – fundamental skills in oral and written communication; and
4. connect human, creative expression to the issues that make up and are made by the world in which we live.

Course 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. “In Arabic” and other poems (various years; poetry)
Hyder, Qurratulain. “A Night on Pali Hills” (1995; play)
Margaret, Mercy. “Prega News” and other poems (various years; poetry)
Merchant, Hoshang. “Secunderabad Sans Light” and other poems (various years; poetry)
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)
Tendulkar, Vijay. *Silence! The Court is in Session* (1967; play)

**Reference Books:**

Woolf, Virginia. “How Should One Read a Book” (1925)
Abrams, M.H. *A Glossary of Literary Terms* (1957)
Moretti, Franco. *Distant Reading* (2013)

**E-book Links:**

**Grading Plan:**

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<td>2. Analysis of Secondary Sources</td>
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<tr>
<td>3. Final Project Submission</td>
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**Mapping of Course Outcomes to Program Objectives:**
**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.

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**Title of the Course:** Intro to Neuroeconomics

**Faculty Name:** Kavita Vemuri

**Course Code:** CS9.423

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

**Credits:** 4

1. **Prerequisite Course / Knowledge:**
   1. Intro topshology
   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

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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.

CUSROETOPICS : (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, Kaynes 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.
The Ordinal Revolution and the Logic of Choice
Quantitative Tests of Qualitative Theories:
Revealed Preference GARP Understanding
Rationality Axiomatic Approaches: Strengths
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 Neuroeconomics
The 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
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 risk and uncertainty
  - Belief-based account of decision under uncertainty Loss aversion and the value function
- 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. Importantly the limitations will be explained with examples.

6. Decision making - 3 lectures
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 4 presentations) Choice (student presentation) (2 lecture hours or 4 presentations)

8. Time (2 lecture hours or 4 presentations)

9. Reward/Loss (student presentations or 4 presentations)

10. Reinforcement Learning ((student presentation) (2 lecture hours or 4 presentations)

11. Social behaviour (student presentation) (2 lecture hours or 4 presentations)

12. Neuro-Morality (1 lecture followed by 2 student presentations)

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 & ERNST FEHR

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 5 sentences):

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 5 sentences):

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<tr>
<th>Type of Evaluation</th>
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<td>Term paper</td>
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<td>Project</td>
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Course Title: Introduction to Politics, with reference to India
Faculty Name: Aakansha Natani
Course Code: HS4.201
Credits: 4

L · T · P:
(L · Lecture hours, T·Tutorial hours, P · Practical hours)
Semester, Year : Monsoon 2022
(Ex: Spring, 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


Preferred Text Books:
Selected Chapters from-
1. Andrew Heywood: Politics (forth edition)
2. Andrew Heywood: Political Theory: An 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
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 Prerna 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)

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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

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Teaching-Learning Strategies in brief (4-5 sentences):
The course will be based on classroom lectures and in class discussion of assigned reading material. On an average, each student will be required to read between 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.

Note: This course description format comes into effect from Spring 2022.
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

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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
4. Lewis H. Ryder: Quantum Field Theory
5. Amitabha Lahiri & Palash B. Pall: A First Book of Quantum Field Theory
6. David Tong: Quantum Field Theory
7. Michael E. Peskin & Daniel V. Shroeder: An Introduction to Quantum Field Theory

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

Aim of the course is to introduce to the students the main concepts and mathematical framework of Quantum Field Theory. A typical class consists of discussion of a new concept and its underlyng mathematical structure. To make teaching more interactive in the online mode, instead of showing sides, mathematical derivations are done live during the class. Refined versions of the class materials is then circulated to the students. Students are encouraged to go through the materials and work out the mathematical derivations for better understanding of the concepts. Assignments are given on a regular basis. The assignments are designed in such a way that students can apply the concepts to solve problems. At the end of the course students will acquire several tools of Quantum Field Theory.

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

Assignments: 30%, Quizzes (Mid-sem exams): 30%, End Semester: 40%

Title of the Course: Introduction to Sociology
Name of the Faculty: Radhika Krishnan
Course Code: HS2.201
L-T-P: 3-0-0
( L= Lecture hours, T=Tutorial hours, P=Practical hours)
Credits: 4
Name of the Academic Program: Humanities Elective offered to UG3/UG4.
1. **Prerequisite Course / Knowledge:** Introduction to Human Sciences (Core course for UG2).

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 have a sense of how the discipline of Sociology developed; its colonial roots, its core concerns and the impact of its roots and concerns on its methodologies.

   **CO-2:**
   Students will have an understanding of core conceptual frameworks and debates in Sociology.

   **CO-3:**
   Students will have a sense of major theoretical frameworks in Sociology. They will be introduced to the Durkheimian, Marxist and Weberian frameworks and methodologies, as well as to later theorists.

   **CO-4:**
   Students will be able to employ a sociological approach to the study of social institutions in India, such as caste, class, gender and tribe.

   **CO-5:**
   Students will be able to employ a sociological approach to the study of social, political and economic processes in India, such as development, industrialization, urbanization and migration.

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

   **Matrix for CSE**

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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.

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4. Detailed Syllabus:

**Unit 1:**
Development of Sociology as a Discipline: Sociology’s emergence in Europe, its roots and causes. The connection between anthropology and colonialism. Enduring influences in the practice of sociology.

**Unit 2:**

**Unit 3:**
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 4:**
Study of Social Institutions in India: Caste, Class, Tribe and Gender

Unit 5:
Political Sociology: Introduction to methods in Political sociology. Case studies from Indian politics to understand and identify shifting sociological and political narratives, political formations and political cultures. Introduction to concepts of power elites and ruling class.

Unit 6:
Study of Social Processes: Development, Industrialisation, Urbanisation and Migration

Reference Books:

Carol Upadhyay, Reengineering India: Work, capital, and class in an offshore economy (Delhi: Oxford University Press, 2016).

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

Students are introduced to theories and concepts through lectures. Relevant photographs, short 4-5 minutes videos, short films and clips from films are used during the lectures. Discussions and interventions in the classroom are highly encouraged. Students are given reading-based assignments through the course, which will help them to firstly understand the concepts in some depth and secondly apply the concepts in specific situations. Each assignment involves 30-40 pages of intense reading. Quizzes are designed to test analysis of a specific case.

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

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<td>Mid Sem- Exam</td>
<td>15%. Questions designed to evaluate understanding of basic concepts.</td>
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<tr>
<td>End Sem Exam</td>
<td>30%. Questions designed to evaluate</td>
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understanding of basic concepts. One long question which involves application of concepts discussed in the course.

| Assignment 1 | 20%. Related to Unit I, II III (Essay question) |
| Assignment 2 | 20%. Related to Units IV V (Essay Question) |
| Quiz 1       | 7.5% Related to Unit I, III, III (Analysis of a case) |
| Quiz 2       | 7.5% Related to Unit IV, V (Analysis of a case) |

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

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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

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**
Faculty Name: Nagamanikandan Govindan + Sachin Chaudhari
Course Code: **CE9.609**
Title of the Course Name: IS Codes on Design and Structural Safety Assessment
Name of the Faculty Name: Pradeep Kumar Ramancharla
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

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</table>
4. Detailed Syllabus:

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


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.

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 Name: Learning and Memory – From Brain to Behaviour
Faculty Name: 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 2022  
(Ex: Spring, 2022)
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](https://www.macmillanlearning.com/college/ca/product/Learning-and-Memory/p/1319107389)

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

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<th>Type of Evaluation</th>
<th>Weightage (in %)</th>
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<tr>
<td>In class quizzes</td>
<td>40% (8 quizzes x 5%)</td>
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<td>Mid Sem-Exam</td>
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<td>End Sem Exam</td>
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<td>In-class discussions&amp;</td>
<td>15%</td>
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<td>presentations</td>
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**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
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.

<table>
<thead>
<tr>
<th>Title of the Course Name:</th>
<th>Mathematical Models in Biology</th>
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<tbody>
<tr>
<td>Name of the Faculty:</td>
<td>Abhishek Deshpande</td>
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<td>Course Code:</td>
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<td>L-T-P:</td>
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<td>Name of the Academic Program:</td>
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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

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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:
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:
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: Mobile Robotics  
Course Code: CS7.503  
Faculty Name: Madhava Krishna K  
L-T-P: 3-1-0  
Credits: 4

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)*

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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

Faculty Name: Prasad Krishnan
Name of the Program: B.Tech ECE (Elective)
Course Code: EC5.411
Credits: 3-1-0
L - T - P: (L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year: Monsoon 2022
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 MPD for 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:**

Reference Books:
3. Research papers.

E-book Links:

Grading Plan:
(The table is only indicative)

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<tr>
<th>Type of Evaluation</th>
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<td>End Sem Exam</td>
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<td>Assignments</td>
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<td>Project</td>
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Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a ‘-’ dash mark if not at all relevant).

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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

Course Code: CS1.405
Faculty Name: Srinathan Kannan
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...

CO1: Understand different models of computation including Turing Machines, Boolean Circuits and complexity measures of time, space, depth.
CO2: 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.
CO4: 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)**

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

**Detailed Syllabus:**

**Unit 1:** Models of Computation and Impossibility Results: Turing Machines, Circuits, Encoding of Problems, Halting Problem, Shannon’s Counting Lower Bound.

**Unit 2:** Complexity Measures and Classes: Time, Space, Depth measures of complexity, Time, Space hierarchy theorems, Nondeterminism, Savitch’s Theorem, P, NP, P/poly, PSPACE, EXP, L, NL.

**Unit 3:** Completeness and Hardness Reductions: 3SAT, Cook-Levin Theorem, NP-Complete, NL-Complete, Hardness reductions for common problems like Vertex Cover, Independent Set, Knapsack etc.

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

**Reference Books:**

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 report. This will encourage self-exploration and lead the students to 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 Scribenotes: 10%
Name of the Program          : Computer Science
Semester, Year               : Monsoon 2022
(Ex: Spring, 2022)

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 anegotiation 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.

https://iiitaphyd-my.sharepoint.com/:b/r/personal/dyacad_iiit_ac_in/Documents/NBA-
2020-
21/Reference%20Documents/Curriculum%20Design%20in%20NBA%20Framework%20and%20Course%20Design%20for%20All%20Faculty%20IIIT%20Hyderabad%207th%20July%202021.pdf?csf=1&web=1&e=387W1k

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


Grading Plan :  
(The table is only indicative)  

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<th>Weightage (in %)</th>
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<td>Quiz-2</td>
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<td>End Sem Exam</td>
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<td>Term Paper</td>
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<td>Other Evaluation</td>
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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_iit_ac_in/Documents/NBA-2020-21/Course%20Content/IIIT-CSE-ECE.docx?d=w111f0effcaea41b3a4d1e8a3fbc6332d&csf=1&web=1&e=z1Khby

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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.

==========
Note: This course description format comes into effect from Spring 2022.
Title of the Course: Multivariate Analysis
Name of Faculty: Venkateswarlu Mandadi
Course: CSE
Course Code: MA4.405
L—T—F: 3-1-0
credits: 4

1. Prerequisite: Basic statistics, Matrix analysis, Calculus
2. Course Outcomes
   
   After completion of this course, the students will be able to

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<tr>
<td>Explain the intricacies of simultaneous analysis of several variables</td>
<td>Discuss the theoretical foundation for multivariate analysis</td>
<td>Discuss the different areas of applications of multivariate analysis</td>
<td>Discuss the statistical inference in the context of several variables</td>
<td>Analyze the multivariate extensions of standard univariate procedures</td>
<td>Demonstrate the knowledge of the additional multivariate techniques and apply them to solve problems</td>
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3. Course Articulation Matrix

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<th>Course outcomes</th>
<th>Program Outcomes</th>
<th>Program Specific Outcomes</th>
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4. Detailed Syllabus

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<th>Unit</th>
<th>Topic</th>
<th>Hours</th>
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<tbody>
<tr>
<td>1</td>
<td>Random variables, vectors, and matrices. Partitioning. Linear functions. Mahalanobis distance</td>
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<td>Multivariate Normal, properties, estimation of parameters, Maximum likelihood method, Wishart distribution</td>
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<td>Hotelling T-square tests, likelihood ratio test, Union-Intersection test, Confidence intervals and Tests, Tests on subvector</td>
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<td>Multivariate analysis of variance, one way classification, Two-way analysis, Tests on subvector</td>
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<td>Discrimination, Two groups, Several groups, Tests of hypotheses, Classification, Two groups, Several groups, Estimation of error rates</td>
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<td>Multiple regression, Multivariate regression, Fixed x’s, Estimation, Hypothesis tests.</td>
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<td>Canonical Correlations and variates, Properties, Tests of significance, Interpretation of canonical variates</td>
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<td>8</td>
<td>Principal Components, Methods for discarding components, Interpretation, Relationship between Principal Components and Regression</td>
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<td>Basic factor model, estimation of loadings and commonalities, Determining the number of factors, Rotation of factor loadings</td>
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Note: 3 in the box denotes high level mapping, 2 for medium level and 1 for low level mapping
References:
K.V. Mardia, Multivariate analysis, Publishers, Edition, Year?

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 Exam: 20, End Semester Exam: 40 marks.

Title of the Course: Open Quantum systems and Quantum

Title of the Course: Operating Systems and Networks
Name of the Faculty: Krishna Reddy P
Course Code: CS3.301
L-T-P: 3-1-1.
Credits: 4
(L= Lecture hours, T=Tutorial hours,
P=Practical hours)
Course: CSE
Name of the Academic Program: B.Tech. in CSE

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

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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 thread management (9 hours);

Unit 2: CPU scheduling, Process Synchronization, Deadlocks (12 hours);

Unit 3: Memory management, Virtual memory (9 hours);

Unit 4: File systems, Protection and Security (6 hours);

Unit 5: Networking (9 hours);
Five mini projects related to the above syllabus will be done by students in the laboratory

Reference Books:

1. Silberschatz, A, Galvin, P, Gagne, G. Operating system concepts, Addison-Wesley, 2018

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: Organizational Operations

Faculty Name: Mayank Mathur
Course Code : PD2.423
Credits : 2 Credits
L - T - P: 1.5 -0- 3
(L - Lecture hours, T-Tutorial hours, 
P - Practical hours)
Semester, Year : 2nd Sem – Year 1 (Monsoon, 2022)
(Ex: Spring, 2022)
Name of the Program: M. Tech in Product Design and Management program
Pre-Requisites: None
**Course Objective:**
Operations are the work of managing the inner workings of your business so it runs as efficiently as possible. Whether you make products, sell products, or provide services, every small business owner has to oversee the design and management of behind-the-scenes work. Organizational operations management involves converting input into efficient outputs to achieve desired results for an entrepreneur. The course contains various operations models, tools, and techniques for supply chain management, quality control systems, and streamlining workflows. You will learn how to innovate business operations to improve productivity and capacity with the resources. You will develop skills that will empower you to configure business processes to channel operations and reduce bottlenecks.

**Course Outcomes:**

**CO-1** Understand key functional areas of operations with the type of decisions they are typically involved in to run a business efficiently.

**CO-2** Identify key differences between service and manufacturing organizations and the business operations in the two sectors of the businesses.

**CO-3** Understand and map each process phase to formulate an organizational strategy with actions typically performed at that phase.

**CO-4** Identify and categorize different transformation characteristics of manufacturing and service operations strategies.

**CO-5** Understand the concept of organizational strategy, the four-phase process for formulating this strategy, and how the strategy should be aligned with operations strategy in the manufacturing and services context.

**Course Topics:**

**Operations Management:** Basics of production systems, Planning, Scheduling, Sequencing, Workplace Layouts, Locational problems of warehouses. **Four sessions**

**Basics of Lean Operations:** Classification of wastes, 5S, Kaizen, Jidoka, Kanban, Kaizen, Value Stream Mapping, Total Productive Maintenance. **Three sessions**

**Service Operations** - Service strategy, service enterprise design, service operations, service blueprint, Capacity planning, queueing models, forecasting demand, and managing service inventory. **Three sessions**
Supply Chain Management - Measuring supply chain performance, drivers and metrics, planning and managing inventories in the supply chain, managing economies of scale, uncertainty, optimal product availability, sourcing decisions, Three sessions

Basics of Information Systems and Impact on Operations - Basics of Business Analytics and Business Intelligence, Enterprise Management Systems, necessity, functions of ERP systems Four sessions

Modern Technology interventions - Impact of technology interventions like IoT, Blockchain, Artificial Intelligence, and Robotics on Manufacturing and service applications of the future Four sessions

Preferred Text Books:


Reference Books:

- Operations Management: Processes and Supply Chains 11th Edition, by Lee Krajewski (Author), Manoj Malhotra (Author), Larry Ritzman (Author)

- Operations Management (11th Edition) by Heizer, Jay, Render, Barry

Grading Plan:
(The table is only indicative)

<table>
<thead>
<tr>
<th>Type of Evaluation</th>
<th>Weightage (in %)</th>
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<tr>
<td>Quiz-1</td>
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<tr>
<td>Mid SemExam</td>
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<tr>
<td>Quiz-2</td>
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<td>End Sem Exam</td>
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</table>

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a ‘.’ dash mark if not relevant).
Teaching-Learning Strategies in brief (4-5 sentences):

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

==========

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

Course code: CS1.402

Faculty Name: Venkatesh Choppella

1 Coursestructure

NameCSC415PrinciplesofProgrammingLanguages

Credits4, 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 an industrial scale programming language like C or Java.

2. CO2: Design domains specific languages Design a small, domain specific language like a language for propositional logic and implement it.

3. CO3: Design object oriented language Design a small object oriented language and 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 like 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

<table>
<thead>
<tr>
<th>Programme Outcome (PO/PSO)</th>
<th>CO1</th>
<th>CO2</th>
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<th>CO4</th>
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<th>CO4</th>
<th>CO5</th>
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</table>
5 Syllabus

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


**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 TextsandReferences

6.1 Textbook

EOPLEssentialsofProgrammingLanguages3rdEdition.FriedmanandWand.This isthe main textfor the course.Available on Amazon.in.

6.2 References

HtDPHowtoDesignPrograms.Felleisenetal.Availableonline.


TRaATTermRewritingandAllThat.BaaderandNipkow.Chapters1and2.


RGRacketGuide.Availableaspartoflanguagedocumentation.

7 TeachingandLearningstrategies

Lectureswillcoverthetheoreticalaspectsofoperationalsemanticsbutwillhave plenty of examples explaining interpreters of programming languagaes visually and interactively. Question-answer discussion will accompany each class. Quizzes each week will test student’s attention diligence, and con-cept recall, understanding and application. Summative assessments will bethrough a mid-semester and a final exam or project. Reading assignmentswill precede each lecture. Homework (programming) assignments will mostlyinvolve implementation of interpreters discussed in the class and the textbook. Tutorials will walk-through abstract syntaxtree annotation, components of the interpreter implementation, and inductiveproofs of properties in operational semantics.

8 Assessment(Tentative)

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<tr>
<th>Item</th>
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<th>quizzes (1 per week)</th>
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<td>Mid-semester exam</td>
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<tr>
<td>Final exam/Project</td>
<td>30</td>
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</table>

Appendix: Programme and Programme Specific Outcomes

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 environment 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 stake-holders.

**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 lifecycle, 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  
**Faculty Name:** 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:**  
   AEC, EW1 & EW2

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

   After completion of this course successfully, the students will be able to..
   - **CO-1** Describe quantum mechanics basics: Heisenberg’s principle, energy band (conduction & valance bands, energy gap).
   - **CO-2** Explain the basic physics for PN junctions, MOS, MS junctions, MOSFET & BJT
   - **CO-3** Calculate basic semiconductor device parameters and solve problems related to design of above mentioned semiconductor devices.
   - **CO-4** Design very simple diode & MOSFET circuits

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

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<th>PO1</th>
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<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
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<th>PO12</th>
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<th>PSO2</th>
<th>PSO3</th>
<th>PSO4</th>
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</tbody>
</table>

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):

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<tr>
<th>Type of Evaluation [3 credit-lecture]</th>
<th>Weightage (in %)</th>
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<td>Mini Project</td>
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<td>1 minute paper (in class) [weekly prescheduled]</td>
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Title of the Course: Probability and Random Processes

Course Code: MA6.102
Faculty Name: Praful Mankar
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:

- **CO1:** Describe the probability space associated with an experiment, conditional probability and Bayes theorem
- **CO2:** Give examples of discrete and continuous random variables and their distributions
- **CO3:** Calculate conditional and marginal distributions, distributions of functions of random variables, expectation and variance
- **CO4:** Analyze the properties of independent random variables, sums of random variables
- **CO5:** Interpret the tail bounds, law of large numbers and central limit theorem
- **CO6:** 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**

<table>
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<tr>
<th></th>
<th>PO1</th>
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</table>

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


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):

<table>
<thead>
<tr>
<th>Type of Evaluation</th>
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Title of the Course: Probability and Statistics

Name Of the Faculty: Pawan Kumar, Tajas Bodas
Course Code: MA6.101

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

1. Prerequisite Course / Knowledge:
Linear Algebra, Real Analysis

2. Course Outcomes (COs)

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

CO-1. **Explain the** axioms of probability and rules, discrete and continuous random variables.
CO-2. **Derive** the density function of transformations of random variables and use these to generate data corresponding to various distributions.
CO-3: **Derive** marginal and conditional distributions of multivariate random variables and probability bounds.
CO-4. **Discuss the** classical and Bayesian inference theory and applications.
CO-5. **Discuss the** basic random processes and **their** applications.
CO-6. Outline a proof of stated theorem and write the logically derived proof.

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

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4. Detailed Syllabus:


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)


References:
- Online resource: https://www.probabilitycourse.com/

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

6. Assessment methods and weightages in brief:
Assignments in theory: 15 marks, Mid Semester Examination-1: 25 marks, Mid Semester Examination-2: 30 marks, End Semester Examination: 30 marks

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**Title of the Course:** Product Design Workshop

**Faculty Name:** Prakash Yalla

**Course Code:** PD1.411

**Credits:** 2 Credits

**L - T - P:** 1.5 - 0 - 3

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

**Name of the Program:** M. Tech in Product Design and Management program

**Semester, Year:** 2nd Sem – Year 1 (Monsoon, 2022)

(Ex: Spring, 2022)

**Pre-Requisites:** Basic principles of, Software programming, Design thinking and Product design. Basics of workshop tools and equipment operations (lathe, cnc, 3d printing ,laser cutter & pcb maker). Else tutorials need to be taken ). Basics of rapid prototyping CAD software for mechanical and electronics design (else tutorial to be taken)

**Course Objective & Overview:**

This course module intends to equip students with tools and techniques to rapid prototype a physical product that solve real life problems. Some of the most impactful systems interact with physical world. All of these have software driven intelligence. The objective of this learning module is to empower students with tools and techniques and to design real world physical systems.

**Mode:** Hands on workshop and project-based delivery. The course will involve a series of micro level projects that add up-to a larger project leading to a physical system (s).

**2. Course Outcomes (COs)**

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

CO-1. Apply Product design & rapid prototyping tools in development of physical systems/products.

CO-2: Re-engineer/Design products based on end user needs

CO-3. Integrate and create an end to end physical system ( SW, Mechanicals and Electronics).

CO-4. Deploy in live setting and capture usable information from physical world.

**3. Detailed Syllabus:**
The course has four parts to it with each part naturally dovetailing into the other.

**Part 1: Understanding Physical Objects & Rapid Prototyping:**

In this module students get introduced to basics of rapid prototyping and usage of equipment like 3D printers, laser cutters, CNC machines etc. The students replicate everyday objects as is using these tools (builds an understanding on the right tool for right job).

**Part 2: Problem Solving – understanding user need, usage scenario and re-imagining:**

In this module students are given design problems that makes one re-imagine know systems based on user needs e.g. How could the everyday object manifest in the context of say r a Parkinson's patient.

**Part 3: Embedding Intelligence:**

In this module students are taught how to capture physical world information and how to embed smarts in a seamless manner into the physical system. This module brings into focus the behavior of software systems while engaging with real world parameters.

**Part 4: Putting it all Together: Final project**

This part of the course assembles all the learning in the form of a end to end system/object that students showcase. The end semester exam for this is an end use feedback: the usability, the aesthetics, the functionality, the smarts etc.

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

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<td>Rapid Prototyping Techniques &amp; Tools</td>
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<td>2</td>
<td>Shapes, Cuts and Joints: Usage and realise using RPT tools</td>
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<td>Materials and selection depend upon their applications.</td>
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<td>Product aesthetics: Materials Texture, Feel, and colour.</td>
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<td>Embedded Intelligence</td>
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<td>6</td>
<td>System Integration &amp; Live deployment</td>
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‘3’ in the box denotes ‘High-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low’-level’ mapping.

5. Teaching-Learning Strategies in brief:

The course is experiential in nature. It is workshops and discussions-based methodology to discover solutions to problems and projects that enables students to see their designs work in real world.

Lectures by integrating ICT into classroom teaching, weekly tutorials involving problem solving and active learning by students and Project-based Learning by doing 4 mini-projects & one major project in laboratory by the students.

6. Assessment methods and weightages in brief:

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<tr>
<th>Assessment Method</th>
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<tr>
<td>In-class activities and quizzes</td>
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<td>Weekly Lab assignments</td>
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<td>Main Project</td>
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<td>End Semester Exam</td>
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Title of the Course: Product Management 101

Faculty Name: Ramesh Loganathan

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: II Sem – Year 1 (Monsoon, 2022).

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)

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<tr>
<th>Type of Evaluation</th>
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<td>Quiz-1</td>
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<td>Mini Project</td>
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<tr>
<td>Other Evaluation (Product Workshop)</td>
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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
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

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**

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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%)

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Title of the Course: Real Analysis

Faculty Name: Samyadeb Bhattacharya
Course Code: MA4.101
L-T-P: 3-1-0.
Credits: 4
Course: CSE

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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

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4. Detailed Syllabus:

Unit 1 Sequence 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 2 Mean 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, Multipleintegrals,
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)


(9 hours)

5. A project related to the above syllabus will be done by students to be submitted by the end of the semester.

References:


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

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 project: 30 marks

---

**Title of the Course:** Real-Time Embedded Systems

**Faculty Name:** 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**  
Computer Systems Organization, Basics of 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 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**

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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:**

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

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<td>Research Paper Presentation</td>
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Title of the Course: Research in Information Security

Faculty Name: 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:** Demonstrates 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

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**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 ad hoc networks/Internet of Vehicles (IoV), Security in smart grid, 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.

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 validations tools based formal security verification

6. **Assessment methods and weightages in brief (4 to 5 sentences):**
   - In-Class Tests: 20%
   - Assignments: 20%
   - Research Project: 40% (including report and presentation)
   - End Semester Examination: 20%

---

**Course Title** - 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, 2022

**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:

Reference Books:

Grading Plan:
(The table is only indicative)

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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
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.

Note: This course description format comes into effect from Spring 2022.
**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 K2Cr2O7  
3. **Unit-3:** Kinetic Study of the Decomposition of H2O2 in the Presence of FeCl3 Solution and the Effect of the Catalyst on the Rate Constant  
4. **Unit-4:** Verification of the Beer-Lambert’s Law with a given solution and the determination of the concentration of a solution  
5. **Unit-5:** Determination of pKa of a Weak Acid by pH-Metric Titration Method  
6. **Unit-6:** Newtons Ring Method to measure Radius of Curvature of Plano-Convex Lens  
7. **Unit-7:** Determination of Young’s Modulus of Material of a Beam by Method of Flexure  
8. **Unit-8:** To determine the number of rulings per unit length of a diffraction grating  
9. **Unit-9:** Stewart and Gee’s Method for Determining the Magnetic Field of the Earth  
10. **Unit-10:** To Measure Slit-Width and the Separation between two Slits of Double Slit, by Observing Diffraction and Interference Fringes and to Compare them by Microscopic Measurement

### Reference Books:

1. Introduction to Protein by Branden and Tooze  
2. Fundamentals of Biochemistry by Voet, Voet and Pratt

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

null
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

Course Code: EC5.406
Name of the faculty: Santosh Nannuru
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)

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Detailed Syllabus:


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:

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%

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**Title of the Course:** Signal Processing

**Course Code:** EC5.201

**Faculty Name:** 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 studies 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)**

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**Detailed Syllabus:**

**Unit 1:** Fourier transform (FT) of continuous-time signals, analysis of linear and timeinvariant (LTI) systems using Fourier transform

**Unit 2:** Sampling and reconstruction of bandlimited signals, analog-to-digital conversion, aliasing, quantization

**Unit 3:** Analysis of discrete-time signals and systems using Fourier
transform (DTFT) and Z-Transform

**Unit 4:** Discrete Fourier transform (DFT) for finite length sequences, 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:**


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

Lectures are used to explain the core concepts in signal processing and work out a few problems. Detailed handwritten notes are shared along with book sections and practice problems. A short question is posted at beginning of class to gauge understanding of 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 - Social Science Perspective on Human-Computer Interaction

Course Code: CS9.425
Faculty Name: Nimmi Rangaswamy
Name of the Academic Program: B. Tech. in CSE
L-T-P: 4-0-0
Credits: 4
(L= Lecture hours, T=Tutorial hours,
P=Practical hours)

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 understanding of the fundamentals of Human Computer Interaction [HCI] and Human sciences

CO-2. Understand and apply main theoretical foundations of HCI from a human centric perspective

CO-3: Grasping concepts and application of Design in HCI systems

CO-4. Deep analysis of case studies of HCI systems

CO-5. Develop a research project around a HCI platform, system or theory

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

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Course Structure in Detail

Overview of Course

Quote: “A sushi restaurant puts sensors on its plates to assess, in real time, what’s being eaten so it can adjust its food offerings” [Goodman, The Atomic Age of Data, 2015] Radically different ways of interacting with computationally based systems are possible, ranging from the visual [surfaces, input devices] to the invisible [sensor technologies, backend processors] and importantly social [which means non-technological] affectations triggering diverse ways of interfacing with technology. Human-Computer Interaction [HCI] is a vision for a world of interconnected devices, that have acquired smartness due to computing power. As computational technologies continue to ‘disappear’ and merge with the physical world, becoming increasingly tangible, embedded and embodied in a range of environments, architectures and artifacts, new research agendas and design approaches are called for [Nansen et al, 2014].

Broad Objectives:

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

To bring a social perspective and the importance of lived contexts in the framing and understanding of man-machine interaction

To get a grasp of the theoretical and applied frameworks supporting the domain of HCI

Importantly, to introduce the idea of cross-fertilisation of academic domains, especially computer sciences and humanities to originate Human-Computer Interaction as a fertile research and academic science

COURSE TOPICS/OUTLINE/CONTENT
Introducing seminal topics and key concepts: 10 Hours

This course is an introduction to the field of Human-Computer interaction research with a focus on ‘human’ and how the HCI domain interfaces with the social sciences. The course begins with a selection of seminal work that establish the HCI domain: interactive systems/techniques, design and user interfaces. We will then move on to topics including social and context aware computing, design research and evaluation methods.
Role of Objects in the Social sciences: 4 Hours

The course will also present a perspective based on the importance and role of objects in social relations. We situate this work in relation to a conceptual understanding of objects and social relations, suggest effective methodological and theoretical tools to study of a more object-centered sociality and suggest design opportunities to make better products.

Idea and application of Design in HCI: 6 Hours

The course will center on the processes and challenges of ideating, designing and evaluating technologies as products, their usability and immersion into the social contexts of users. We will study contextual design as a field that emerged in response to the challenges of designing for context and usability.

Context and Mediation in HCI systems- 6 Hours

Another important strand in this course will dwell on the sociological aspects of HCI and explore the ‘mediation’ of technology use by a range of contextual situations: socio-cultural obligations, habits, values, infrastructure, material objects and not in the least family, kinship and human bonds. Some examples of the above are:

Case Studies- 14 Hours

Understanding social interactions with a webcam as an important new development in communication interfaces and its widespread adoption in the real world supporting family relationships, business work flows and social networking.

A deep look at social networking as everyday HCI- Facebook; Twitter; Messaging applications

Another example will be looking at technologies driven by data science, like mobile marketing analytics, and their consequences for society

A third example will be studying real world application of big data to social situations: real time traffic; real world geographic navigation; geo-location-based services [ food delivery; friendship; dating]; Consumer-centric health care services [ monitoring parameters; precision medicine; Health care platforms]

A close look at the impacts of peer to peer sharing platforms [ Uber, AirBnB]

This class has no pre-requisite requirements and open to students from any background. Students are expected to do all the readings. Students will be evaluated with a quizzes, research project design, research report, and 2 class presentations. The students will also be evaluated on the ability in engaging with and comprehending the course readings in classroom discussions. The quiz/test and the research projects will be based on the class lectures and readings assigned for the course
PREFERRED TEXTBOOKS:

*REFERENCE BOOKS:
Lucy Suchman Human-machine reconfigurations, Cambridge University Press
Sterling, B. *The Epic Struggle Of The Internet Of Things*, Moscow: Strelka Press
Rogers, Y. *HCI Theory: Classical, Modern, and Contemporary*. Morgan & Claypool

*REFERENCE ARTICLES:

**GRADING PLAN:**

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<tr>
<th>Type of Evaluation</th>
<th>Weightage (in %)</th>
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<tr>
<td>Quizzes/exam</td>
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<tr>
<td>Individual Research Project</td>
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<tr>
<td>Class participation</td>
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OUTCOME:

Students will be able to identify and apply a sociological lens to a human-computer interaction context. This will mean applying informed ways to draw boundaries to an HCI context, use the right theoretical tools of study and processing appropriate data to conduct an independent academic study of selective HCI situations in the real world.

Title of the Course: Software Systems Development

Faculty Name: Charu Sharma
Course Code: CS6.302
Credits: 4
L - T - P: 3-0-2
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year: Monsoon 2022
(Ex: Spring, 2022)

Name of the Program: PG Program (M.Tech 1 year 1 Semester - CSE & CSIS)

Pre-Requisites: No

Course Outcomes: The aim of this course is to provide a working knowledge of tools and technologies to build software systems. At the end of this course, students are expected to be:

- Comfortable enough to work with various Unix-like computing environments.
- Able to write simple to complex scripts/programs.
- In a position to build small to medium sized software applications using various tools and technologies to automate tasks/solve problems.

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, Bashscripting, 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**: 

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<td>Other Evaluation (Lab activities + Class activities)</td>
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**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_iit_ac_in/Documents/NBA-2020-21/Course%20Content/IIIT-CSE-ECE.docx?d=w111foeffcaea41b3a4d1e8a3fbc6332d&csf=1&web=1&e=z1Khby
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.

Note: This course description format comes into effect from Spring 2022.

Title of the Course: Spectroscopy

Name of the Faculty: Marimutu Krishnan
Name of the Academic Program: CND
Course Code: SC2.304
L-T-P: 3-1-0
Credits: 2

1. Prerequisite Course / Knowledge:
   Basic quantum mechanics and computing skills

2. Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):
   After completion of this course successfully, the students will be able to
   CO-1 Outline the basic principles of different spectroscopic techniques
CO-2 Analyze electronic, vibrational, and rotational spectra of molecules
CO-3 Apply classical and quantum mechanical models to spectroscopy
CO-4 Calculate the normal modes of simple molecules

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

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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 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%)

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<th>Speech Analysis and Linguistics (SAL)</th>
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<tbody>
<tr>
<td>Faculty Name:</td>
<td>Chiranjeevi Yarra</td>
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<tr>
<td>Course Code</td>
<td>CL2.405</td>
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<td>Credits</td>
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<td>Name of the Program</td>
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<td>(Ex: Spring, 2022)</td>
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<td>Pre-Requisites</td>
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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.

Grading Plan:
(The table is only indicative)

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

Note: This course description format comes into effect from Monsoon 2022.

Title of the Course: Speech Signal Processing
Course Code: EC5.408
Faculty Name: 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)*

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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:**


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

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

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

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<td>Quizzes</td>
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**Title of the Course:** Statistical Methods in Artificial Intelligence

**Faculty Name:** Anoop Namboodiri
**Course Code:** CS7.403
**L-T-P:** 3-1-0
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)**

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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 Layer Perceptrons, Backpropagation Algorithms, Exposure to Deep Learning.

Reference Books:

1. MDeisenroth, A. Faisal, C. Ong, Mathematics for Machine Learning, Cambridge Univ Press, 2020

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%
Title of the Course: Structural Dynamics
Faculty Name: Sunitha Palissery
Name of the Program: M.Tech CASE
Course Code: CE1.501
Credits: 4
L - T - P: 3-1-0
(Semester, Year: Monsoon 2022)

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-ß method; Rayleigh's method; Dunkerley's method; 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 and Forced vibration

**Preferred Text Books:**

**Reference Books:**

**E-book Links:**

**Grading Plan:**

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**Mapping of Course Outcomes to Program Objectives:**
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.

Note: This course description format comes into effect from Spring 2022.
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

Pl. insert the mapping table

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

4. Detailed Syllabus:

Unit 2: Numerical Methods – Bi-Section Method, Gauss Elimination, Newton-Raphson


Unit 4: Application of MATLAB – Analysis of Beams & Frames, Gravity and Lateral Load Analysis of Frames, Analysis of Planar Trusses.


Reference Books:
5. Computers and Structures Inc. (CSI), (2012), Structural Analysis Program (SAP) 2000, Version 16, USA

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

Faculty Name: 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
(Semester, Year: Monsoon 2022)
(Ex: Spring, 2022)

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:

Master e-book ISBN.

Reference Books:

E-book Links:

Grading Plan:
(The table is only indicative)

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

https://iiitaphyd-my.sharepoint.com/:w:/r/personal/dyacad_iiit_ac_in/Documents/NBA-2020-21/Course%20Content/IIIT-CSE-ECE.docx?d=w111f0effcaea41b3a4d1e8a3fbc6332d&csf=1&web=1&e=z1Khby

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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.

==============
Note: This course description format comes into effect from Monsoon 2022.

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**

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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

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: Technology Product Entrepreneurship- Tools & Techniques

Faculty Name: Ramesh Loganathan, Prakash Yalla
Course Code: PD2.431
Credits: 2
L - T - P : 3:1:0
(L - Lecture hours, T - Tutorial hours, P - Practical hours)
Semester, Year: II Sem 1st Year
(Ex: Spring, 2022)
Name of the Program: Technology product entrepreneurship- Tools and techniques

Pre-Requisites: No prerequisites

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

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

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

CO2- Connect products with markets and identify market & customer segments with the help of frameworks and business models.
**CO3**- Assess competition and evolve Value proposition for the product in cognisance of the current market trends and ever-evolving customer needs.

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

**Course Topics:**

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<tr>
<th>Sl No</th>
<th>Topics</th>
<th>Week</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction&lt;br&gt;Technology Product innovation.</td>
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<td>Successful product cases review</td>
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<td>Creativity &amp; Innovation&lt;br&gt;Stretch the idea. Idea Hexagon framework applied</td>
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<td>3</td>
<td>Frameworks &amp; Models&lt;br&gt;Product &amp; Market first&lt;br&gt;Vision first (Vision/Strategy/Execution)&lt;br&gt;Large opportunity (Big untapped market/ Much better product/ Much better team)&lt;br&gt;Lean Startup models</td>
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<td>4</td>
<td>Design Thinking&lt;br&gt;Design thinking process: understand, observe, define,</td>
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<td>Customer Development</td>
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<td>Models: through trial and error, hiring and firing, successful startups all invent a new, parallel process to product development for sales, marketing and business development</td>
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<th>Market &amp; Competitive Positioning</th>
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</table>

**Preferred Text Books:**

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

2. Toward a General Modular Systems Theory and Its Application to Interfirm Product Modularity
3. [http://amr.aom.org/content/25/2/312.abstract](http://amr.aom.org/content/25/2/312.abstract)
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**E-book Links:**
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1. Demand: Creating What People Love Before They Know They Want It by Adrian J. Slywotzky with Karl Weber
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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:**

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<th>Type of Evaluation</th>
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<td>Quiz-1</td>
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<td>Labs</td>
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<td>Tech Product Quiz-2</td>
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<tr>
<td>Demo and Presentation</td>
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<tr>
<td>Final submission</td>
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</table>

**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
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 Business 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: Technology Product Entrepreneurship2- Tools & Techniques

Faculty Name: Ramesh Loganathan, Prakash Yalla
Course Code : PD2.432
Credits : 2
L - T - P : 3-1-0
(L - Lecture hours,
T-Tutorial hours, P - Practical hours)
Semester, Year: II Sem 1st Year
(Ex: Spring, 2022)

Name of the Program: Technology product entrepreneurship - Tools and techniques

Pre-Requisites : No prerequisites

Course Outcomes :

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

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

CO1-Understand the sales and strategy of a startup while having a clear understanding of markets.

CO2- Creating, developing, and evaluating the Technology Product’s “concept of a business” while using real-time frameworks.

CO3-Assess technology frameworks and leverage existing technology.

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

Course Topics:
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<tr>
<th>Sl No</th>
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<tr>
<td>1</td>
<td>Sales &amp; Market Strategy</td>
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<td>Go to Market avenues, and projections</td>
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<td>GTM Planning</td>
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<td>Business Plans</td>
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<td>2</td>
<td>Creating, developing and evaluating the Technology</td>
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<td>Product’s “concept of a business”</td>
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<td>innovation? Is it a business or a product or both? Sizing the</td>
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<td>market? The technology, market and competitive risks?</td>
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<td>Competitive proposition</td>
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<td>Corporate Technology Innovation</td>
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<td>Applying research technology in corporate environments</td>
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<td>Tech Product Pitch/Plan presentations</td>
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<td>What makes a good product pitch and demo</td>
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<td>6</td>
<td>Final Demo and presentations</td>
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**Preferred Text Books:**

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**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.”
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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
Faculty Name: Aniket Alam
Course Code : HS3.303
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 : 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:
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
11. M. S. Golwalkar: We or Our Nationhood Defined.
12. Jawaharlal Nehru: Discovery of India.
15. Bipan Chandra: Colonialism and Nationalism in Modern India.
16. Sumit Sarkar: Modern India.

E-book Links:

Grading Plan:
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BTech in CSE

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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: **Entropy and Information**

**Faculty Name:** Indranil Chakrabarty

**Course Code:** CS1.407

**LTP:** 3-1-0

**Credits:** 4

**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)**

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

**Detailed Syllabus:**

2. **Probability Measure and Asymptotic Equipartion Property**: Probability as a measure, Law of Large Number, Asymptotic Equipartition Theorem (AEP), Data Compression, Typical Sets, Gambling and Data Compression.


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


**Reference Books:**

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

**Other Books**:
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):

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<tr>
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Title of the Course: Thinking and Knowing in the Human Sciences – II

Faculty Name: Nazia Akhtar, Radhika Krishnan
Course Code: HS0.202
L-T-P: 3-1-0
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Credits: 4
Name of the Academic Program: CHD Core 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

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

4. Detailed Syllabus:

Unit 1:

Unit 2: 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:

Jean-Claude Carriere and Umberto Eco, This is Not the End of the Book (London: Random House, 2009).

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
Title of the Course: Thinking and Knowing in the Human Sciences – I

Faculty Name: Sushmita Banerji, Ashwin Jayanti
Course code: HS0.201
L-T-P: 3-1-0
Credits: 4
Course type: CHD core
Name of the Academic Program: CHD

1. Prerequisite Course / Knowledge: Nil

2. Course Outcomes (COs)

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

CO1: Understand the basics of philosophical discourse and develop interpretative skills
CO2: Demonstrate knowledge of conceptual challenges involved in philosophical analysis
CO3: Discuss philosophical questions about the nature of thought, knowledge and understanding
CO4: Look at the ways in which literary practices imagine and express our relation to the world.
CO5: Survey sets of concepts and intellectual assumptions that constitute historical, cultural, textual, and critical methods of literary analyses
CO6: Consider specific moments of intersection between “meta-inquiry” and questions of representation.

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

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### 4. Detailed Syllabus:

#### Section A: Philosophy

Unit I – Introduction to Philosophy (5 hours): what is philosophy? What is the value of philosophy? Different domains of philosophy; Introduction to logic and logical concepts; sentences and propositions; arguments; identifying premises and conclusions; inductive and deductive arguments; truth, validity, and soundness; fallacies; laws of logic.

Unit II – Knowledge and Truth (6.5 hours): theories of truth; analysis of knowledge; sources of knowledge; rationalism and empiricism.

Unit III – Descartes and the mind-body problem (6.5 hours): Descartes’ philosophical method in *Meditations*; mind-body problem; theories of mind.

#### Preferred Text Books for Section A:


#### Reference Books for Section A:


#### Section B: Literature
PREFERRED TEXT BOOKS FOR SECTION B


   Wilde, Oscar. The Picture of Dorian Gray. 1890.

Unit 2. Lee, Harper. To Kill a Mockingbird. 1960

Morrison Toni. Beloved. 1987

REFERENCE BOOKS FOR SECTION B


5. Teaching-Learning Strategies in brief:

Section A: Philosophy – The students will learn what it is to engage in and with philosophical arguments and how to evaluate them using sound logical analysis and with conceptual clarity. The canonical problems in philosophy such as those of right reasoning, knowledge, and truth shall set the context to see the philosophical method of analysis in action and help the students acquire the conceptual tools and methods that can be put to use for addressing foundational questions of any sort. They will learn how to identify a philosophical question and how to think through it and present their argument in clear and precise language.

Section B: Literature – Plays, novels and poetry have given their authors and their readers an opportunity to consider what it is to be human. This course looks at some the ways in which literary practices imagine and express our relation to the world. The module will survey sets of concepts and intellectual assumptions that constitute historical, cultural, textual, and critical methods of literary analyses. We shall look at specific texts to see how the field of literary studies has evolved to reformulate its primary concerns and moved beyond canon formation to questions of epistemology and subjectivity.

Students are expected to read six full texts in the course of the module.

6. Assessment methods and weightages in brief:

Section A: Philosophy
Title of the Course: **Topics in Applied Optimization**

**Faculty Name:** 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

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‘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:


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 |
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| CO2  | 3   |     |     |     |     |     |     |     |     |      |      |      |      |      | 2    |      |      |
| CO3  | 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. 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)
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.

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, Theragnosticstics (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:

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

Faculty Name: 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-research in 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 architecting to 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

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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:

2. Pattern-Oriented Software 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 Kleemann, O’Rielly
6. Building Microservices by Sam Newman, O’Rielly
8. Refactoring: Improving the Design from Existing Code, Addison-Wesley, 2000

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)

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<tr>
<th>Assessment</th>
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<tr>
<td>Final Project</td>
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<td>3Mini Projects (3*10)</td>
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<td>Research paper reviews (4*2.5)</td>
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Title of the Course: VALUE EDUCATION - I

Faculty Name: Radhika Mamidi
Course Code: OC3.101

L-T-P 12-6-0  (Total number of hours)

Credits: 2

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

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

1. Prerequisite Course / Knowledge: -NIL-

2. Course Outcomes (COs):

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

CO-1: Apply the basic framework of universal human values to the self.

CO-2: Look at larger issues that (for many reasons) most are not exposed to: social, political, community, family, individual, etc. in a sensitized way.

CO-3: Understand themselves and their own roles within the bigger context. What are really, truly important to them? What are made important by others?

CO-4: Engage and connect with others and nurture the relationships.

CO-5: Think to shape and change the world, and not be mere technologists or scientists.

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

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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:


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

Course Code: EC2.201

Faculty Name: Zia Abbas

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
‘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 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:

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:

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<tr>
<th>Type of Evaluation</th>
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<tr>
<td>HomeWorks</td>
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<td>Course project</td>
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<td>Mid Semester exam-1</td>
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<td>Mid Semester Exam-2</td>
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<td>End semester exam</td>
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Title of the Course: Wireless Communications

Faculty Name: 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)**

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‘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:


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%.

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 2nd order 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 modelling

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

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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.

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

Faculty Name: 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**

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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

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:


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.
Title of the Course: Language and Society

Faculty Name: Dipti Mishra Sharma
Name of the Program: CLD
Course Code: CL2.203
Credits: 4
L - T - P: 3 - 1 - 0
(Semester, Year: Monsoon 2022)

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:


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.


4. Language and Culture: Directions of influence. The Whorfian hypothesis


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 Cell Lucas (ed): Sociolinguistic Variation

E-book Links:


Grading Plan:
(The table is only indicative)

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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

https://iiitaphyd-my.sharepoint.com/:w:/r/personal/dyacad_iit_ac_in/Documents/NBA-2020-21/Course%20Content/IIT-CSE-ECE.docx?d=w111f0effcaea41b3a4d1e8a3fbc6332d&csf=1&web=1&e=ztKhby

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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.

============
Note: This course description format comes into effect from Spring 2022.
Title of the Course: MCS 2 - Linear Algebra
Faculty Name: Girish Varma
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)

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‘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 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:

2. Finite Dimensional Vector Spaces, P. Halmos.
3. Introduction to Linear Algebra, Gilbert Strang.
4. Linear Algebra Done Wrong, Sergei Treil.

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

Lectures will initially introduce the motivations, concepts, definitions along with simpler examples. This will be followed by assignments and quizzes that will make sure that the students have understood the concepts. These will be followed by deeper lectures and assignments which lead the students to the bigger questions in the area. These will also be supplemented with real world engineering problems so that they can apply the concepts learned by them.

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

- Light In-class Quizes: 15%
- Assignments: 15%
- Class Test 1: 10%
- Class Test 2: 10%
Title of the Course: MCS 1 – Probability and Statistics
Faculty Name: Pawan Kumar
Course Code: MA6.30
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)

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

**Detailed Syllabus:**

**Unit 1:** Sample Spaces, Counting, Uniform Probability, Axioms of Probability, Continuous Probability Spaces, Conditional Probability, Bayes Rule, Independence.

**Unit 2:** Random Variables, PMFs, Discrete Probability Distributions, Multiple Random Variables, Expectation, Variance, Covariance, Standard distributions of Bernoulli, Binomial, Geometric, Gaussian, Exponential, Poisson.

**Unit 3:** Continuous Probability Distributions, Tail Bounds (Markov, Chebyshev, Chernoff), Law of Large Numbers, Central Limit Theorem.

**Unit 4:** Bayesian Statistics, Maximum Aposteriori Estimation, Maximum Likelihood Estimation, Confidence Intervals.

**Reference Books:**

1. Introduction to Probability, 2nd Edition by Dimitri P. Bertsekas and John N. Tsitsiklis.
2. Introduction to Probability, Statistics and Random Processes. by Hossien Pishro-Nik.  
   Textbook available online: [https://www.probabilitycourse.com/](https://www.probabilitycourse.com/)
3. Introduction to Probability and Statistics for Engineers and Scientists by Sheldon M. Ross.

**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: Introduction to History

Faculty Name: Aniket Alam

Course Code: HS3.201
Credits: 4
L - T - P : (L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Monsoon 2022
(Ex: Spring, 2022)

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

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

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

CO1: Define the concept of History, and Describe the development of the discipline.

CO2: Explain range of academic theories relating to the discipline of History.

CO3: Analyze features of historical writings and Appreciate the importance of the past.

CO4: Evaluate the different methods of historical analysis.

CO5: Assess primary evidence, including through computational tools.

CO6: Develop their own understanding about History and the Past.

Course Topics :
(1) Historical Time and Space: In this module students will be introduced to how historians have understood the flow of time and periodised time into historical ages. They will also appreciate how historians define regions and territory. Apart from this the module will also teach about the development of the ideas of time, and of space; and how the modern map and watches came to define society in new ways.

(2) Historical Fact and Objectivity: This module will define the historical fact, the different interpretations of what a fact is, and the debate among historians relating to historical objectivity: its possibility and desirability.

(3) The Main Theories of History: In this module students will be exposed to the main theoretical models of historical interpretation. These will include, but not be limited to, Rankean and Whig history, Annales history, Marxist history, Structuralist and Post-Structuralist history, etc. Students will also be introduced to the newer theories like ecological history, black history, herstory, etc.

(4) The Main Methods of Historical Analysis: This module will focus on source criticism, the advantages and 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) Computational Tools for Studying History: In this module students will be shown how in recent times historians have used programming tools to identify new sources, ask new questions, proffer new interpretations, and build new narratives.

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*;

Reference Books:
- Romila Thapar: *From Lineage to State*.
- 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-Khaladun: *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*.

ARTICLES:
- E. P. Thompson: “Custom, Law, and Common Right”.
- 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”
- Lucien Febvre: “ Sensibility and History – How to Reconstitute the Emotional Life of the Past”
- Emmanuel le Roy Ladurie: “The History of Rain and Fine Weather”
- Philippe Aries: “Pictures of the Family”
- Maurice Aymard: “The Costs of War”
- Fernand Braudel: “History and the Social Sciences- The Longue Duree”
- Jean Meuvret: “Food Crises and Demography in France during the Ancien Regime”
• 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”
• DDKosambi: “Social and Economic Aspects of the Bhagvad Gita”
• Irfan Habib: “Potentialities of Capitalist Development in the Economy of Mughal India”
• Romila Thapar: “Somnatha”
• Robert Darnton: “Peasants Tell Tales”
• Clifford Geertz: “The Balinese Cock-Fight”
• Arthur Conon Doyle: “Sign of Four”

E-book Links:

Grading Plan:
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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

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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 500 to 800 pages of books and articles, and submit written work between 3,000 to 4,000 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 exams will focus on training students to develop their own ideas, and apply computer science tools, to the topics on hand.

Title of the Course: Theory of Elasticity

NAME of Faculty: P. Pravin Kumar Venkat Rao

Course Code: CE0.501

L-T-P: 3-1-0

Credits: 4

Name of the Academic Program: M.Tech in CASE

1. Prerequisite Course / Knowledge: Solid Mechanics/Strength of Materials

2. Course Outcomes (COs):

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

CO 1: Explain the basics concepts of stress, strain, tensor, vector, traction, and important properties of solids.

CO 2: Discuss the fundamental theories of elasticity.

CO3: Idealize the physical systems through mathematical equations.

CO4: Represent the state of stress and strain in a body (2D and 3D) with respect to different planes or orientations.

CO5: Analyze the boundary value problems using equilibrium, compatibility, 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

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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:


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%

Faculty Name: Saroja T K

Course:

Email: saroja.tk@iiit.ac.in

Mobile: 9949009743
Title of the Course: Understanding Raga-Semiclassical forms of Indian Music

Course Code: HS1.205

L-T-P: 3-0-1

Credits: 4

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

Name of the Academic Program:...

1. Prerequisite Course/Knowledge:

...Faculty Consent? Nil.....

2. Course Outcomes (COs):

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

CO-1 Recognize some ragas with their basic characteristics

CO-2 Identify, sing or play different semi classical compositions like Bhajan, Ghazal, Annamayya composition, Qawwali, Abhang etc

CO-3 Explain the importance of raga in Indian music.

CO-4 Discuss the importance and role of the composers in bringing out variety in music and universal ideas and values.

CO-5 Demonstrate the knowledge of different rhythmic structures that play a major role in the compositions. This gives the understanding of rhythm as a universal idea.

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

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

https://iiitaphyd-my.sharepoint.com/:w:/r/personal/dyacad_iiit_ac_in/Documents/NBA-2020-21/Course%20Content/IIIT-CSE-ECE.docx?d=w111f0effcaea41b3a4d1e8a3fbc6332d&csf=1&web=1&e=z1Khby
4. Detailed Syllabus:

Unit 1: Basic concepts of Indian Music like sruthi, swara, swarasthana, raga, laya, tala, sthayi, musical forms. Practice of different rhythmic patterns with exercises.

Unit 2: Conceptual study of raga by introducing around ten ragas in both North and South Indian music systems. (Raga pairs Carnatic- Hindustani like Kalyani-Yaman, Kapi, Pilu, Chakravakam- Ahibhairav, Sindhubhairavi- Bhairavi, ragas common to both the systems like Shivranjani, Desh)

Unit 3: Introduction and practice of Semi classical forms like Bhajan, Quawwali, Ghazal, Kirtana, Abhang.

Unit 4: Introduction to the composing style of different Vaggeyakaras (composers)

Unit 5: Importance of language, ideas, expressions in different compositions, introduction of musical instruments.

Reference Books:

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


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

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

   The students would be taught line by line all the compositions, the different semi classical forms.

   The basic structure of ragas would be taught to them by playing audios and videos of different genre songs in the specific ragas.

   Students would be made to identify and practice different music patterns through various exercises and examples from songs of different genres of music.

   The students would be made to sing repeatedly all the songs taught.

   Attempt to bring one expert to deliver guest lecture on the practical aspects of musical instruments and their significance.

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

   ... Assignments: 20%

   ... Mid Semester exams: 20%

   ... Quizzes: 20%

   **End Semester Project: 40%**

---

**Title of the Course:** User Research Methods

**Faculty Name:** 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, 2022)

(Ex: Spring, 2022)
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.

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<tr>
<th>Unit 1</th>
<th>Unit 2</th>
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<tr>
<td>Understanding User</td>
<td>Observation Techniques</td>
<td>Ethics</td>
<td>Data Visualization and Presentation</td>
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<tr>
<td>Introduction and Qualitative Research Overview – foundation of user</td>
<td>Conducting studies in usability lab, Lab studies – eye-tracking, behavioural</td>
<td>Code of conduct; Participants Rights, Privacy-data safety, Respect – individual</td>
<td>Qualitative Analysis – Thematic, values, product quality etc. organize and</td>
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<tr>
<td>experience, key terms, highlight the hall of shame, why user-centric design and control is important; attitudinal and behavioural dimension</td>
<td>observations, control design observations</td>
<td>rights, time and effort, Sensitive and Empathetic; Risk analysis; Informed Consent</td>
<td>summarise data</td>
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<td>User need assessments, Qualitative research method, interview protocols followed up with activities. Know your user – age, gender, cognitive / psychological perspectives, people with disability or accessibility,</td>
<td>Field study, site visits, naturalistic observations, controlled field experiment, individual and group survey and focused interviews, customer satisfaction, remote testing</td>
<td>Quantitative Analysis – count, accuracy, response time or time taken to complete the task or speed analysis, visualization, learning curve,</td>
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<td>How to conduct interview, make observations, and extract data from interview, ethics and consent, user research protocols, survey-based observations</td>
<td>Industry practice - A/B and Multivariate testing, card sorting or tree testing, qualitative and quantitative method, How to deliver user research results</td>
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<td>Analysis – Qualitative and quantitative analysis, survey and questionnaire analyses</td>
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**Preferred Text Books**


**Reference Books**

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

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<tr>
<th>S.No.</th>
<th>Type of Evaluation</th>
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<th>Weightage (in %)</th>
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<td>1.</td>
<td>Assignment/ White Paper/ Term Paper</td>
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<td>2.</td>
<td>HW/CW activities</td>
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<td>3.</td>
<td>Project in Group – with 2 students</td>
<td>N=1</td>
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<td>Final Exam</td>
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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

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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
Spatial Informatics

Title of the Course: Spatial Informatics

Course Code: CS4.408
Faculty Name: Rajan KS

Credits: 3-1-0-4

TYPE-WHEN: Open Elective

PRE-REQUISITE: Open to UG-3, UG-4, DD/MS, and PhD students

OBJECTIVE:
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 Data formats
5. Data structures for Spatial data and Spatial data management (Geospatial database)
6. Spatial Data Query and Analysis – Spatial Analysis, Network Analysis
7. Data compatibility - Projections and Georeferencing
8. Spatial reasoning and uncertainty
9. Web-GIS, GML and Map services
10. Geospatial applications in few areas like in Hydrology (Water flows and floods); Ecology and Environment; Land use and Land cover; Urban planning and Transportation; etc.
11. Topics in Spatial Informatics
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:

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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)

<table>
<thead>
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<tbody>
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<tr>
<td>Quiz</td>
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<tr>
<td>Open Book Exam/30 MinQuiz</td>
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**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.