UG Core & Elective Courses Syllabus – Spring – 2020

Version-2 (20/12/2019)

Sl. No	Course Code	Course Name	Faculty
1.	EC2.103	Analog Electronic Circuits	Zia Abbas + Spandan Roy(Lab)
2.	SC1.102	Classical Mechanics	Subhadip Mitra
3.	CS2.201	Computer Systems Organization	Avinash Sharma
4.	SC4.111	Computing in Sciences-II	Prabhakar B
5.	CL3.101	Computational Linguistics-I	Radhika M
6.		Communications and Controls in IoT	Sachin Chaudhari + Aftab Hussain
7.	ECE337	Communication Networks	Ubaidulla
8.		Communication Theory I	Sachin Chaudhari
9.	CS1.201	Data Structures and Algorithms	Anoop + Ravikiran S
10.		Data Visualizaion	Kamal Karlapalem
11.		Digital signal Analysis	Anil kumar V
12.	EC2.201	Electronics Workshop II	Zia Abbas + Madhava Krishna
13.	SC1.101	Electrodynamics	Subhadip Mitra
14.	SC2.101	General and Structural Chemistry	Tapan Kumar Sau
15.		Introduction to Brain and Cognition	Bapi Raju S + Kavita Vemuri
16.		Introduction to Bioelectronics	Syed Azeemuddin + Prabhakar B
17.		Introduction to Information Security	Ashok Kumar Das + Kannan Srinathan
18.		Introduction to Quantum Information and Computation	Indranil Chakrabarty
19.		Intro to Human Sciences	Nimmi Rangaswamy
20.	CS6.201	Introduction to Software Systems	Raghu Reddy
21.	TS19010	Introduction to IoT	Deepak Gangadharan
22.	EC5.102	Information and Communication	Lalitha V
23.	CL1.102	Introduction to Linguistics-II	Aditi Mukherjee
24.	EC6.202	Introduction to Processor Architecture	Suresh Purini

25.	CS7.301	Machine, Data and Learning	Praveen P
26.	HS4.102	Making of the Contemporary India	Aniket Alam + Radhika Krishna
27.	MA3.101	Linear Algebra	Prasad Krishnan + Indranil Chakrabarty
28.		Program Verification	Venkatesh Choppella
29.		Science-II(New)	Subhadip Mitra + Nita Parekh
30.	ISC202	Science II(Old)	M. Krishnan
31.	SC4.111	Science Lab-II	Prabhakar B + Tapan Kumar Sau
32.		Software Programming for Performance	Rahul Jain
33.	SC1.205	Statistical Mechanics	Harjinder Singh
34.	SC1.204	Thermodynamics	Harjinder SIngh
35.	CL3.101	Thinking and Knowing in the Human Sciences-1	Sushmita Banerji + TBD

TITLE **:Analog Electronic Circuits**

Course Code **:** EC2.103

CREDITS **:** 5

TYPE-WHEN **:** Spring-2020

FACULTY NAME **:** Zia Abbas

COURSE TOPICS :

INTRODUCTION. The role of electronics in signal processing, communication, control and measurement

ACTIVE DEVICES - The role of active devices. BJT and MOSFET - their structure, function and their low frequency models. Modification of the model at high frequencies

BIASING - Biasing of active devices. Need for biasing. Biasing using voltage sources. Current source biasing in integrated circuits. Current mirrors. Basic, Widlar and Wilson.

SINGLE STAGE AMPLIFIERS-CE,CS,CB.CG, CC, CD amplifiers with resistive load. Voltage gain, current gain input impedance and output impedance Comparison of the topologies Single stage amplifiers with active loads using current mirrors.High frequency response

MULTISTAGE AMPLIFIERSusing BJT and MOSFET- Diff amp topology, Versatality of the topology and its modes of operation as amplifier, multiplier and switch. CM gain DM gain and CMRR. Diff amp with active load. Output short circuit current gain and output impedance. High frequency analysis

Cascode topology. Advantages Cascode with active load. Diff amp with cascoded devices and Darlington connected devices. High frequency analysis

Distributed amplification

Anatomy of an Operational Amplifier (Op-Amp). Stages of an Op-Amp. Mid band performance estimates. High frequency analysis pole zero plots. Compensation, dominant pole design. Slew and its origin. Effect of slew on signals.

Commercial Op-Amps. Their equivalent models. Understanding their data sheet.

Using Op-Amps as inverting, non-inverting, diff amp. Nonlinear applications- precision rectifiers, square law devices, log and antilog amplifiers, Application of op-amp in waveform generation- Schmitt trigger, Negative resistance model of Schmitt trigger, multivibrators using Schmitt trigger.

FEEDBACK AND FEEDBACK AMPLIFIERS - Effect feedback on amplifiers, the four topologies based on 2-port interconnection. Loading effects due to the interconnection. Derivation of A and beta taking into account the loading.

POWER AMPLIFIERS - Efficiency and distortion. Classes of power amplifiers. Distortion measures Incorporation of Feedback to reduce distortion

Introduction to Sinusoidal Oscillators, Phase Lock Loop and its applications, different Mixers and their figure of merit.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz-1 Exam	**15**
Quiz-2 Exam	**15**
Mid Sem Exam	**25**
End Sem	**30**
Assignments	**15**

TITLE **: Introduction to Bioelectronics**

Course Code **:**

CREDITS **: (L-T-P-C) 3-0-0-2**

TYPE-WHEN **: Elective-Spring 2020, Second Half**

FACULTY NAME: Syed Azeemuddin and Prabhakar Bhimalapuram

PRE-REQUISITE **:** Interest in relevant chemistry, biology and electronics

OBJECTIVE **:-**

- To appreciate the biochemical interactions relevant for biosensing
- Understand the principles of commonly available biosensors

COURSE TOPICS :

Biology – Basic Chemical and Biochemical Concepts, Cells and their Basic Building Blocks, Basic Biophysical Concepts and Methods, Luminescence, Chemiluminescence, Fluorescence and Phosphorescence, Types of Spectroscopy, The Beer-Lambert Law, Impedance Spectroscopy, Electrochemical Principles and Electrode Reactions, Electrochemical Impedance Spectroscopy (EIS)

Biosensors - Physical and Chemical Methods,Biosensor Parameters, Amperometric Biosensors, Potentiometric Biosensors, Ion Selective Electrodes, Conductometric and Impedimetric Biosensors, Photometric Biosensors, Glucose Sensors, Biocompatibility of Implantable Sensors, Basic Sensor Instrumentation – Transducers, Sensors and Actuators, Conductometric Biosensors, FET Based Biosensors.

PREFERRED TEXTBOOK:

1. INTRODUCTORY BIOELECTRONICSFOR ENGINEERS AND PHYSICAL SCIENTISTS Ronald Pethig and Stewart Smith, Wiley.

***REFERENCE BOOKS:**

1. Principles and Applications of RF/Microwave in Healthcare and Biosensing, Changzhi Li, Mohammad-Reza Tofighi, Dominique Schreurs, Tzyy-Sheng Horng, Academic Press
2. Essential Cell Biology by B. Alberts
3. Class Notes

***PROJECT: NA**

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz-1	25
Mid SemExam	N/A
Quiz-2	N/A
End Sem Exam	40
Assignments	20

Project	15 (Reading & Presentation)
Term Paper	**N/A**
Other Evaluation _____	**N/A**

OUTCOME: Student can expect to develop understanding of biology, bio-material and biosensing.

REMARKS:

TITLE : Communications & Controls in IoT

Course Code :

CREDITS : 2

TYPE-WHEN : Spring 2020 (half-course in H1 (Jan-Feb 2020))

FACULTY NAME: Sachin Chaudhari and Aftab Hussain

PRE-REQUISITE : No

OBJECTIVES :

COURSE TOPICS :
Introduction to IoT, Sensing, Actuation, Microcontroller based Embedded System Design, Interfacing of sensors and actuators, Basics of Networking, Communication Protocols 1: WiFi/Bluetooth/Zigbee/LoRaWAN/NB-IoT, Data Protocols: MQTT/CoAP, Sensor Networks, *Edge, Fog and CloudComputing*, Interoperability in IoT, Smart City Applications

PREFERRED TEXT BOOKS:

1. Raj Kamal, *Internet of Things,* McGraw Hill, 2018
2. O. Hersent, D. Boswarthick, O. Elloumi, *The Internet of Things*, Wiley, 2016

***REFERENCE BOOKS:**

1. D. Norris, *The Internet of Things*, McGraw Hill, 2015

2. A. Bahga and V. Madisetti, *Internet of Things*, University Press, 2016

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz-1	**20%**
Mid SemExam	**60% (This will be our endSem)**
Assignments	**0**
Project	**Yes (20%)**
Other Evaluation _____	**0**

COURSE DESCRIPTION

TITLE : Communication Theory I

Course Code : ECE335

CREDITS : 3-1-0-4

TYPE-WHEN : Spring 2020

FACULTY NAME : Dr. Sachin Chaudhari

PRE-REQUISITE : Signals and Systems, Probability Theory

OBJECTIVE : This course is a core UG course of second year and serves as a pre-requisite to many communications related courses of ECE stream. The main objective of the course is to introduce the basic concepts of communication.

COURSE TOPICS :

1. Representation of bandpass signals and systems; linear bandpass systems, response of bandpass systems to bandpass signals, representation of bandpass stationary stochastic processes
2. Analog Communication Methods: AM-DSB and SSB, PM, FM-narrowband and wideband, demodulation of AM and PM/FM, Phased locked loop (PLL); Brief view of Line Coding and PWM
3.Digital Modulation: Representation of Digitally Modulated Signals; Memoryless modulation methods: PAM, PSK, QAM, Orthogonal Multi-Dimensional Signals
4. Random Processes: Review of Correlation, ESP and PSD; Noise Modelling, Thermal Noise, AWGN.
5. Performance of Analog methods in the presence of AWGN.
6. Optimum digital demodulation: Hypothesis testing, Signal Space Concepts, Performance analysis of ML reception, Bit error probability, Link budget analysis

PREFERRED TEXT BOOKS:

- U. Madhow: Introduction to Communication Systems

***REFERENCE BOOKS:**

- J.G.Proakis, M.Salehi, "Fundamentals of Communication Systems", Pearson Education 2006
- S. Haykin, M. Moher, "An Introduction to Analog and Digital Communications," Wiley, 2006
- B.P.Lathi, "Modern Digital and Analog Communication Systems", 3rd Edition, Oxford University Press, 2007.

Exams and Evaluation

Assignment + Quizzes - 20
MidSem-1 - 20
MidSem-2 - 20
Final Exam - 40

TITLE **: Computing in Sciences II**

Course Code **:** SC4.111

CREDITS **:** 2 credits (1 hr. lecture + 3 hr. lab per week)

TYPE-WHEN **:** I year CNS core - Monsoon

FACULTY NAME **: Prabhakar Bhimalapuram**

PRE-REQUISITE :

OBJECTIVE **:** This course is the second of the two course series: it intends to introduce application of computational methods to problems seen in chemistry, physics and biology. By the end of the semester, the students will have some knowledge on where, why and how some specific computational tools are to be used and explain the reasons behind the observations.

COURSE TOPICS :

1. **Ideas related to precision and accuracy in computation**
2. Computation of Statistical properties of datasets
3. **Solving simple equations:** Newton-Raphson method.
4. Solutions for Linear Algebriac Equations (**Eigensystems**)
5. Numerical solution to **simple differential equations:** Euler and Runge-Kutta methods.
6. Numerical solutions time dependent to **Chemical kinetics**.
7. Monte Carlo Integration scheme for classical mechanics

PREFERRED TEXT BOOKS:

* Numerical Recipies: Art of Scienctific Computing

***REFERENCE BOOKS:**

Provided based on the exact problems covered by the Instructor

***PROJECT:**

* Each student will identify a problem on chemical/biological process, investigate using appropriate methods, analyze, and submit a report.

GRADING PLAN:

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

OUTCOME: By the end of the semester, given a problem, the student will be able to conceive model systems, apply appropriate computational methods to examine the molecules/molecular process, solve the problem and explain the reasons behind the observations.

TITLE : **Computational Linguistics I**

COURSE CODE : CL3.101

CREDITS : 3-1-0-4

Type When **:** Spring 2020

FACULTY **: Radhika Mamidi**

PRE-REQUISITE **:** None

OBJECTIVE: To provide students with the basic understanding of language analysis based on linguistic theories and show them how these can be applied for NLP. The course will familiarise the students with the linguistic challenges in processing natural languages, analyzing the structures and dealing with ambiguities in language.

COURSE TOPICS: Text Processing, Speech Processing

1. Introduction to the Course: What is CL and where does it apply? Issues and challenges

2. Language processing pipeline for text processing: Structural Analysis at various levels – word (POS, morphology), phrase (chunk), sentence (syntactic parsing). Word meaning: Lexical Semantics, Dealing with Ambiguities (WSD/WTD)

2.1. Morph Analysis: Morph analysers and word generators

Recap of basic units in word formation: morphemes, allomorphs. Word formation: Affixation, suffixation, prefixation, infixation; Non-concatenative, Compounding, Morphotactics; Constraints on affixes; Morphophonology. Types of word formation processes (function based) : inflectional, derivational. Developing morph analysers and generators : finite state automata, paradigm tables, add-delet rules.

2.2. Shallow Parsing and Sentence Parsing: Words and their arrangements in a sentence.

POS Tagging - Word classes, Parts of Speech, POS tagging, Rule based parts of speech taggers, Statistical parts of speech taggers, Annotating POS tagged data, Issues in tagging, Defining tagset for your languages.

Shallow parsing (arrangement of words in a sentence)

Local Word Grouping (LWG) - Grouping functional words such as prepositions/postpositions and auxiliaries with the content words (nouns, verbs).

Chunking: Forming minimal phrases

2.3. Multiword Expressions (MWEs): Named entities (NEs), Idioms, compounds. Types of named entities; compositionality in MWEs.

2.4. Syntactic Parsing: Analysing the structure of a sentence, grammatical approaches

Constituency Analysis: Constituents/ phrases.
Deriving sentences using phrase structure rules (CFG); Constraints on rules; Subcategorization; verb argument structure. Representing phrase structures: X-bar schema, Complements and Adjuncts. Syntactic operations: Substitution, adjunction and movement. Syntactic phenomena: Passive, Raising, Control.

Dependency Analysis: Dependency structures: Head – modifier relations.

Paninian grammar – a dependency framework – relations in Paninian grammar : karaka, tadarthya, hetu etc.; Vibhakti - relation marker; karaka vibhakti mapping, karaka chart

Parsing approaches: English parsers, Hindi/IL parsing using Paninian framework.

3. Speech Processing: Introduction to speech processing: Speech production, Speech perception, Speech analysis, Speech Recognition, Speech Synthesis

PREFERRED TEXT BOOKS:

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

2. Bharati et al., 1995; Natural Language Processing: A Paninian Perspective

3. Fundamentals of Speech Recognition by Lawrence Rabiner, Biing-Hwang Juang

REFERENCE BOOKS:

Fromkin, V, Robert Rodman, Nina Hyams (2002) An Introduction to Language, Thomson Wadsworth

Fromkin, V (editor) (2003) Linguistics: An introduction to Linguistic Theory

Aronoff, Mark and Janie Rees-Miller (eds) (2003), The Handbook of Linguistics, Blackwell Publishers
Akmajian, Adrian, Richard A Demers, Ann K Farmer and Robert M. Harnish (2001), Linguistics An Intorduction to Language and Communication, Prentice Hall

PROJECT: The course will have a project content where students will study and solve a problem using real language data.

GRADING: HA 15%, Mid term 30%, Project 20%, End term 35%

OUTCOME: At the end of the course the students will be able to understand and analyse actual

language data and develop computational resources for various levels of language structures

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TITLE **: Classical Mechanics**

Course Code **:** SC1.102

CREDITS **:** 2 credits

TYPE-WHEN **:** Program Core/ Spring

FACULTY NAME **: Subhadip Mitra**

PRE-REQUISITE **:** NONE
OBJECTIVE **:** Introduction to classical mechanics of many particles

COURSE TOPICS :

1. Introduction: What is Mechanics? The domain of Mechanics
2. Newtonian formulation. Single particle dynamics, laws of motion, angular momentum and torque, conversion of a 2-body problem to c.m. and relative coordinates
3. Lagrangian formulation. Calculus of variations
4. Central force motion, elastic collisions, Rutherford scattering formula
5. Oscillations. Geometric description of mechanics. Nonlinear oscillations

6. Rigid body dynamics.
7. Hamiltonian formulation.
8. Liouville Theorem. Virial Theorem
9. Special theory of relativity

PREFERRED TEXT BOOKS:

- Classical Dynamics of Particles and Systems by S T Thornton and J B Marion

***REFERENCE BOOKS:**

- Course Of Theoretical Physics, Vol. 1 Mechanics by L D Landau & E M Lifshitz
- Classical Mechanics by K R Symon
- Classical Mechanics by H Goldstein

***PROJECT: None**

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	30
End Sem Exam	40
Assignments	30

OUTCOME: Student will be able to write the equations of motion of many particle systems as applied to some of the interesting problems in computational mechanics like molecular dynamics.

TITLE **: Computer Systems Organization**

Course Code **:** CS2.201

CREDITS **:** 4

TYPE-WHEN **:** Spring 2020

FACULTY NAME **: Avinash Sharma**

PRE-REQUISITE **:** Digital Systems and Microprocessors

OBJECTIVE **:**The objective of this course is to understand the structure andorganization of a computer system starting with Instruction Set Architecture abstraction and leading to the abstractions provided by an Operating System and their design.

COURSE TOPICS **:**

1. Von Neumann model of computing.
2. Machine representation of data
3. Instruction Set Architecture design principles from programmer's perspective.
4. Assembly Language Programmimg. Translation of high level language abstractions to assembly code and its relation to compilers.
5. Basics of Processor Design.
6. Introduction to Operating Systems. Bootstrapping Process.
7. System Call Interface provided by Operating System and its implementation.
8. Process Control and Management
9. Virtual Memory
10. Loaders and Linkers

PREFERRED TEXT BOOKS:

1. Computer Organization and Design: A Hardwar/Software Interface (MIPS Edition) by Patterson and Hennessy
2. Computer Systems: A Programmer's Perspective by Randal Bryant and David O'Hallaron

Note: I am debating on which of the above two books can be the primary text book for the course. I will decide by mid December after doing a proper study.

***REFERENCE BOOKS:**None

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	20
Mid Sem-2 Exam	20
End Sem Exam	40
Assignments	20
Project	None
Term Paper	None
Other Evaluation _____	

OUTCOME:

REMARKS:

Title : Data Structures and Algorithms

Course Code: CS0.201

Credits : 3-1-3-5

Type-When: UG core-Spring

Faculty Name: Anoop N + Ravi Kiran S

Course Topics :

Asymptotic Notations
Sorting- quick recap of sorting algorithms done in the CProg course followed by QuickSort and MergeSort
Queues
Stacks
Doubly linked list (with recap of linked list)
Hashing
Binary Trees
Heaps and Heap Sort
Binary Search Trees
AVL Trees
23 trees and BTrees(if time permits)
Graphs, BFS, DFS
Topological Sort, Strongly connected components
Single Source Shortest Path Algorithms- Bellman Ford, Dijkstras
All pair shortest path algorithms- Floyd Warshall, Johnsons Algorithm
Minimum Spanning Trees- Krushkals (union find datastructure), Prims
Tries, BIT and Segment Trees,
LCA, String Algorithms(if time permits)

TITLE **: Data Visualisation**

Course Code **:** TBD

CREDITS **:** (2) 2-0-1-2

TYPE-WHEN **:**Two credit elective course.

FACULTY NAME **:**Kamal Karlapalem

PRE-REQUISITE **:**Statistics
OBJECTIVE **:**Ability to take data and come up with appropriate easy to comprehend visualisations

COURSE TOPICS :

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

The Purpose of Visualization.
Visualization Design.
Exploratory Data Analysis.
Perception.
Interaction.
Using Space Efficiently:2D
Color.
A project to showcase data visualization of complex data set.

PREFERRED TEXT BOOKS:

The Visual Display of Quantitative Information (2nd Edition). E. Tufte. Graphics Press.

***REFERENCE BOOKS:**

https://magrawala.github.io/cs448b-fa18/

***PROJECT:**

Compulsory Components:

A lab exam on D3 visualisation library
An individual project for visualizing some data set

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	**None**
Mid Sem-2 Exam	**None**
End Sem Exam	**None**
Assignments	**ADBI**
Project	**At least 60%**
Term Paper	**N/A**

ADBI – As Decided by Instructor

The assessment details can be got from the faculty.

OUTCOME:

A very good understanding of core concepts and practice of data visualization practice.

REMARKS:

A cool course on data visualisation.

TITLE : Digital signal Analysis
Course Code :
CREDITS : 2
TYPE-WHEN : Breadth Elective/CLD Core - Spring
FACULTY NAME : Anil Kumar Vuppala

PRE-REQUISITE : Fundamental of Mathematics (Mathematics I and II).

OBJECTIVE :

(i) Introduce the fundamentals of digital signal representation and processing to undergraduate students of CLD/CS/CSD.
(ii) Introduce the advantage of a transformed domain representation.
(iii) Introducing to basics of speech signal processing.
(iv) Introducing other signal processing applications.

COURSE TOPICS :

1. Fourier series and transform. (3 classes)
2. Sampling and quantisation. (1 class)
3. Different types of discrete signals and systems (LTI systems, linear and circular convolution) (3 classes)
4. Z Transform (2 classes)
5. Introduction to Digital Filter Design (2 classes)
6. Applications. (2 classes)

PREFERRED TEXT BOOKS:

1. Digital signal processing by Alan V. Oppenheim and Ronald W. Schafer.
2. Digital signal processing by John G. Proakis and Dimitris K Manolakis.

***REFERENCE BOOKS:**

***PROJECT: NA**

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz-1	

	30%
Mid Sem Exam	**NA**
Quiz-2	**NA**
End Sem Exam	**50%**
Assignments	**20%**
Project	**NA**
Term Paper	**NA**
Other Evaluation _____	**100 %**

OUTCOME: Understand the basic concepts of signal processing and their applications.

REMARKS: This course help non-ECE background ground students to work on signal processing related research issues.

TITLE **: Electrodynamics**

Course Code **:** SC1.101

CREDITS **:** 2 credits

TYPE-WHEN **:** Program Core/ Spring

FACULTY NAME **: Subhadip Mitra**

PRE-REQUISITE **:** NONE

OBJECTIVE **:** Introduction to Maxwell laws of electrodynamics and simple examples of their application.

COURSE TOPICS :

1. Maxwell Laws of Electrodynamics
2. Electrostatics and solutions to Laplace equations
3. Dielectric materials
4. Magentostatics
5. Electrodynamics: Electromagnetic Induction, Faradays Law
6. Electromagnetic waves: Light
7. Fresnels Laws

PREFERRED TEXT BOOKS:

- "Introduction of Electrodynamics" by Griffiths 3rd Ed

***PROJECT:** None

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	30
Mid Sem-2 Exam	NA
End Sem Exam	40
Assignments	30

OUTCOME: Systematic introduction to laws of electromagnetism.

TITLE : Introduction to Brain and Cognition

Course Code :

CREDITS : 2

TYPE-WHEN : Spring semester

FACULTY NAME: Dr. S. Bapi Raju and Dr**.** Kavita Vemuri

PRE-REQUISITE:
None
OBJECTIVE:

This is an introductory course to familiarize students with the scope, challenges and recent research directions in Cognitive Science.

COURSE TOPICS:

Topics include the basics of brain anatomy, physiology, principles of cognition, empirical and computational methods used in Cognitive Science. There will be demonstrations of experiments, methods and practices for empirical investigation of cognition utilizing instruments such as Eye Tracker, Motion Capture (MoCap), Physiological measurements using BioPac, EEG, MRI (structural and functional MRI), Music processing, VR and AR. Familiarity with the current research directions by doing rotations to different research teams in Cognitive Science Lab.

PREFERRED TEXT BOOKS:

NA
REFERENCE BOOKS:

1) Eric Kandel, James H. Schwartz, and Thomas Jessell (2012). Principles of Neural Science. McGraw Hill Education (5th Edition).
2) John R. Anderson (2009). Cognitive Psychology and its Implications. Worth Publishers (7th Edition).
3) V. Srinivasa Chakravarthy (2019). Demystifying the Brain: A Computational Approach. Springer, Singapore (1st Edition).

PROJECT: (see below)

GRADING:

Mid-term Exam(s) (1):	30%
Final Exam:	40%
Quiz / Assignment / Project:	25%
Other:	5%

OUTCOME:

At the end of the course, students will have an appreciation of the methods and practices of Cognitive Science; familiarity with open problems and research directions related to the brain and cognition.

REMARKS:

TITLE **: Introduction to the Human Sciences Spring 2020**

Course Code **:**

CREDITS **:** Four

TYPE-WHEN **:** Core, UG 2 year.

FACULTY NAME **:** Nimmi Rangaswamy (coordinator)

OBJECTIVE **:** This course introduces the student of engineering technology and science to the world of the humanities and social sciences, or as is often termed, the human sciences. It will consist of four modules offering a bird's eye view of the origin and development of key disciplines of the human sciences. Through key modes of understanding and everyday examples, class lectures will enable students to connect and ponder about the society and culture that surrounds her. The course will provide the student with a broad sense of what are the human sciences, how they pursue their enquiry and what is their contribution to the world of knowledge.

COURSE TOPICs: The course will be divided into fourmodules, each of which will introduce the students to one discipline.

1. Literary Studies
2. Sociology/Cultural Anthropology

3. Philosophy
4. Psychology

Each module will offer a systematic worldview, tools of enquiry to study and analytical frameworks to make sense of this world.

Overall, the course will bring students closer in understanding the world we live in and the rules that make it function as a social organism

PREFERRED TEXT BOOKS: Readings for each of the modules will be given with the commencement of the lectures. There is no single textbook as such.

GRADING PLAN:

Students will be evaluated for each of the four modules and the pattern of evaluation will be decided by the tutor and will carry 25 % of total marks. We usually expect the tutor to either evaluate students on a quiz or a term paper

OUTCOME: The student should have an idea of what the human sciences are, how they originated as other branches of knowledge but developed specific areas of research, ways of enquiry and crystallized into academic disciplines. She will have an understanding of how four of the most prominent of the human sciences are organized and have an overview of the main questions driving and shaping each discipline to find answers. The student, by the end of the course, should be able to relate some of these questions, the intellectual tools to reflect on them and apply them to the context of India and the world she is living in.

REMARKS: The course will be based on classroom lectures. Each module will have one teacher giving six lectures of 90 mins each.

COURSE TITLE **: Introduction to Linguistics II: Semantics, Pragmatics and Discourse**
COURSE CODE : CL1.102
CREDITS : 3-0-1-4
FACULTY NAME : **Aditi Mukherjee**
TYPE WHEN : Spring 2020
PREREQUISITE : Introduction to Linguistics I

COURSE TOPICS:

SEMANTICS - Semantics as a discipline. Types of meaning: Connotation, denotation, affective etc. Sentence meaning and proposition. Reference and sense. Word meaning and sentence meaning. Entailment, contradiction, transitivity and reflexivity. Predicates. Diexis and definiteness. Lexical semantics: sense relations among words: Synonymy, antonymy, hyponymy, meronimy, lexical ambiguity. Componets and contrasts of meaning: componential analysis. Semantic Universals: colour and kinship terms.

PRAGMATICS - Speech act theory: language as action, performative verbs, perlocution and illocutions, direct and indirect illocutions, propositions and illocutions, felicity conditions. Conversational implicature. Entailment, inference and presupposition. Gricean maxims: cooperative principles.

DISCOURSE - Structure of text and coherence. Local coherence and global structure. Conversational analysis. Turn taking. Adjacency pairs, preference organization. Deixis, anaphora, discourse connectives and relations.

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

SUGGESTED TEXT BOOKS:

Geoffrey Leech (1983) *Semantics: the Study of Meaning*
Alan Cruse (2004). *Meaning in Language*.
John Lyons (1995). *Linguistic Semantics.*
Cruse Alan (2004). Meaning in Language: *An Introduction to Semantics and Pragmatics.* Part 2 and Part 4.
Levinson, Stephen C. (1983). *Pragmatics.*
Brown, G and Yule, G. (1983). *Discourse Analysis.*
Cutting Joan (2002). *Pragmatics and Discourse: A resource book for students.*
James R. Hurfordamd Brenden Heasly. *Semantics: a Course book*

GRADING: Assignment 15, seminar 10, mid-sem 35, end-sem 40

OUTCOME: Students will have a good understanding of semantic and contextual analysis of texts which will enable them in building text processing tools and systems.

TITLE : **Introduction to Information Security**

Course Code :

CREDITS : 3-1-0-2 (2 credits)

TYPE-WHEN : Spring Semester

FACULTY NAME: Ashok Kumar Das + Kannan Srinathan

PRE-REQUISITE : None

OBJECTIVE : The main objective of this introductory half course is to introduce the basics of cryptography and connect cryptography to its applied areas such as system and network security including Internet-of-Things (IoT) security and Blockchain technology.

COURSE TOPICS :

Part 1: Basics of Cryptography [8 Lectures]

- Cryptographic goals and objectives
- Types of attacks, passive and active attacks
- Introduction to Number Theory
- Complexity Theoretic Connections
- Overview of symmetric and public key cryptography

Part 2: Basics of System Security [2 Lectures]

- Overview of intrusion detection: Types of intruders, intrusion detection and prevention mechanisms
- Overview of software vulnerabilities: overview of phishing, Buffer Overflow (BOF), heap overflow, and SQL injection attacks

Part 3: Basics of Network Security [3 Lectures]

- Overview of encrypting communication channels
- Introduction to IoT security: IoT architecture, various IoT applications, security requirements, security attacks, threat model for the IoT ecosystem, taxonomy of security protocols
- Introduction to Blockchain technology: Various applications of blockchain of Things (BCoT), centralized versus decentralized models, types of blockchain, brief overview of various consensus algorithms, block formation and addition in a blockchain

PREFERRED TEXT BOOKS:

***REFERENCE BOOKS:**

1. William Stallings, Cryptography and Network Security: Principles and Practices, Pearson Education, 6th Edition, 2014.
2. Bernard Menezes, Network Security and Cryptography, Cengage Learning, 2010.
3. Behrouz A. Forouzan, Cryptography and Network Security, Special Indian Edition, 2010.
4. Research papers

***PROJECT:** None

GRADING PLAN: Relative

Type of Evaluation	Weightage (in %)
Quiz-1	**30**
Mid Sem Exam	**60**
Quiz-2	**– (as it is half course)**
End Sem Exam	**– (as it is half course)**
Assignments	**10**

OUTCOME:

The students later can take more relevant depth courses on Principles of Information Security (Cryptography), and System and Network Security. In addition, the students will be beneficial to take other elective courses on IoT and Blockchain so that they will be able to pursue better research on those relevant areas.

REMARKS:

TITLE : Introduction to Quantum Information And Computation
Course Code :
Note: Please use course code for previously existing course
CREDITS : 1-1-0-2
TYPE-WHEN : Spring 2020
FACULTY NAME : Dr. I. Chakrabarty
PRE-REQUISITE : Knowledge of Advanced Linear Algebra, Quantum Mechanics, Classical information Theory .

OBJECTIVE : Quantum information and computation science is an emerging field at the crossroads of physics, mathematics, computer science, and technology. It promises to revolutionize our abilities to compute and communicate. The basic purpose of this course is to develop the basic foundations of the field of quantum information and computation among the graduate students so that they can pursue their research in this field and can put their contributions in the development of this future technology.

COURSE TOPICS :
1. Introduction and Overview: Transition from Classical to Quantum (2L)
2. Foundations of Quantum Theory I: States, Ensembles, Qubits, Pure and Mixed states, Multi-qubit states, Tensor Products, Unitary transformations, Spectral Decomposition theorem, Singular value Decomposition, Generalized Measurement, Projective Measurement, POVM (4L)
3. Quantum Entropy and Entanglement: Quantum Entropy, EPR Paradox, Schmidt Decomposition. (2L)
4. Basic Quantum Information Processing Protocols: Teleportation, Super Dense Coding, Entanglement Swapping. (2L)
5 Quantum Computation : Introduction to quantum computing, Pauli Gates, Hadamard Gates, Universal Gates, Quantum algorithms . (2L)
PREFERRED TEXT BOOKS:
1. Quantum Computation and Quantum Information –M. A. Nielsen, I. L. Chuang. Cambridge University Press.
***REFERENCE BOOKS:**
1. Quantum Computer Science: An Introduction --- N. D. Mermin, Cambridge University Press.
2. Quantum Computing: From Linear Algebra to Physical Realizations---M. Nakahara, T. Ohmi, Taylor and Franchis Group.
3. Lectures on Quantum Information (Physics Textbook)---D. Brub, G. Leuchs, WILEYVCH.
***PROJECT:** Each student has to submit a project to be decided upon by the faculty concerned. They have to submit the project before the end of the semester 25% of the total grading will come from the project.

GRADING: Mid - 25%
End Sem- 35%
Assignment- 15%
Quizz- 25%

OUTCOME:
REMARKS:

Title :Introduction to Processor Architecture
Course Code : EC6.202
Credits : 2
When : Spring 2020
Faculty Name : Suresh Purini
Prerequisite : Digital Systems and Microcontrollers

Objective : Provide a whole stack view of a Computing System;
Learn Processor Design fundamentals

Course Topics :
1. Instruction Set Architecture; Fetch-Decode-Execute model of computing
2. Fundamentals of Operating System: System Calls, Processes and Virtual Memory
3. Processor Design: Single Cycle and Pipelined Design of Processors

Preferred Text Books: Computer Organization and Design: The Hardware/Software Interface
by Hennesy and Patterson

Grading Plan (Tentative):

Type of Evaluation	Weightage (in %)
Quiz 1	**15%**
End Sem- Exam	**50%**
Assignments	**15%**
Project	**20%**

TITLE : The Making of Contemporary India

Course Code : HS4.102

CREDITS : **4**

TYPE-WHEN : **Spring, II Sem, CHD core**

FACULTY NAME : **Aniket Alam, Radhika Krishnan, G. Haragopal**

PRE-REQUISITE : **CHD Core**

OBJECTIVE :Introduce the student to the main events, structures and trends of contemporary India through a study of its development over the 20th century.

It will expose the students to ways in which differing ideas and ideologies shaped India, and how their interaction creates the world we live in.

This course will hope to both be an informative outline on contemporary India, as well as an introduction to varied perspectives of ethics, society, nation, development.

COURSE TOPICS : 1. The Colonial Background: This part of the course will give an overview of the main features of colonial rule and of India's independence movement.

It will also cover some of the more important social and economic trends which started in the late 19th and early 20th century. (6 lectures)

2. The Constitution: This part will focus on the salient features such as democracy, socialism, secularism, federalism, fundamental rights as freedoms and directive principles as justice.

The thrust would be on the vision of creation of Independent India. (6 lectures)

3. Overview of 1950s to 1990s: This part of the course will bring out how India's polity and society passed through transition and faced new challenges.

This part will start with the Nehruvian Vision and the importance of addressing poverty, the rise of identity politics and neo-liberalism leading to polarisation of socio-political forces. (10 lectures)

4. Focus on some cross-cutting themes of contemporary India:

These could be themes like literacy and education, infant mortality and sex-ratios, migration and urbanization, travel and communication, etc. but could be changed depending on how the course develops. (4 lectures)

PREFERRED TEXT BOOKS:

1. Sugata Bose, Ayesha Jalal: *Modern South Asia*
2. Granville Austin: *The Indian Constitution – Cornerstone of a Nation*
3. Paul Brass: *The Politics of India since Independence*
4. Niraja Gopal Jayal, Pratap Bhanu Mehta: *The Oxford Companion to Politics in India*

***REFERENCE BOOKS:**

1. Sumit Sarkar: *Modern Times*
2. Stuart Corbridge, John Harris, Craig Jeffrey: *India Today – Economy, Politics, Society*
3. Rajeev Bhargava: *Politics and Ethics of the Indian Constitution*
4. Francine R. Frankel: *India's Political Economy 1947-2004*
5. Pranab Bardhan: *The Political Economy of Development in India*
6. Jean Dreze, Amartya Sen:*An Uncertain Glory: India and Its Contradictions*
7. Devesh Kapur, Pratap Bhanu Mehta: *Public Institutions in India: Performance and Design*
8. Amartya Sen: *The Country of First Boys, and other essays*
9. Kanti P. Bajpai, Harsh V. Pant:*India's Foreign Policy: A Reader*
10. M. N. Srinivas: *Social Change in Modern India*
11. Ravi Agrawal: *India Connected: How the Smartphone is Transforming the World's Largest Democracy*

***PROJECT:** Students will be given a set of topics after the end of the second module and will have to make a presentation at the end of the semester, as well as submit a 2,500-word essay.

The project will involve finding and using computational tools to study certain themes in contemporary India.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz-1	**7%**
Mid SemExam	**14%**
Quiz-2	**7%**
End Sem Exam	**22%**
Assignments (4)	**7% each; 28% total**
Project	**15%**
Book Review	**7%**

OUTCOME: The student will have an overview of the main political, social, and economic trends in India since Independence.

S/he will have a sense of the main frameworks and methods which scholars have used to study India and be able to identify the important milestones of 20th century India.

This will equip the student to now move ahead to courses which discuss topics and themes at greater depth. It will also expose the student to the varied methods of researching contemporary India.

REMARKS: The student will be expected to read about 1,000 pages of printed matter and write about 7,500 to 10,000 words during the course.

Students are encouraged to purchase the either the Paul Brass or the Niraja Gopal Jayal textbook, .

TITLE : Machine, Data and Learning

Course Code : CS7.301

CREDITS :3-1-0- 4

TYPE-WHEN : Spring 2020

FACULTY NAME: Praveen Paruchuri

PRE-REQUISITE : None
OBJECTIVE : To provide breadth of knowledge in data and learning topics

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

Overview of AI and ML
Data and generalization
Overfitting, Underfitting, Bias-variance tradeoff
Techniques to avoid overfitting [Introductory level]
Decision Tree Learning, Construct decision trees from examples
Notion of information gain
Basics of Probability and Bayes nets
Utility theory
How to construct formal model from data ?
Decision Theory - Markov Decision Process
Modeling observation errors
Genetic Algorithms, Local Search
Application modeling or two additional topics in brief

PREFERRED TEXT BOOKS:

Python ML by Example
AI: A Modern Approach by Russell and Norvig

***REFERENCE BOOKS:**

***PROJECT:**

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz-1	**5**
Quiz-2	**5**
Mid Sem Exam	**20**
End Sem Exam	**35**
Assignments	**30**
Project	**-**
Term Paper	**-**
Other Evaluation _Additional quiz or will be adjusted suitably_	**5**

OUTCOME: Expected to provide basics for advanced AI and ML courses

REMARKS: -

TITLE **: Information and Communication**

Course Code **:** EC5.102

CREDITS **:** 4

TYPE-WHEN **:** Spring 2020

FACULTY NAME **:** Dr. V. Lalitha

PRE-REQUISITE : None

OBJECTIVE **:**The course provides a broad overview of important principles involved in the design of information systems, the details of which will be learnt in later courses of the curriculum. Relevant mathematical background required (for instance, working knowledge of probability) will be covered within the course.

COURSE TOPICS :

- **Acquisition**
  Signals, Examples of analog and digital signals, Sampling theorem, Quantization, A/D conversion and D/A conversion
- **Compression**
  Sources of information, Information measure, Entropy, Representing sources as bit sequences, Source codes

- **Communication**
    a. Communication Resources – Power, Bandwidth, Baseband signals, Bandpass signals
    b. Modulation – Analog Modulation, Digital Modulation (BPSK,QAM)
    c. Noise, Types of channels – Wireline channel, Wireless channel, Other examples (Optical etc)
    d. Probability of error, Hypothesis testing
    e. Channel Capacity, Introduction to error correcting codes
    f. Transmitter and receiver block diagram, RF Front end, Synchronization, Receiver Imperfections
    g. Upper layers in the OSI model – MAC, Transport, Multiple access schemes and Routing
- **Security**
  Introduction to Cryptography
- **Systems**
    Examples of Communication Systems – Cellular Systems, Sensor Networks

PREFERRED TEXT BOOKS:
Course Notes (including problems) will be provided well in advance.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	20
Mid Sem-2 Exam	20
End Sem Exam	40
Other Evaluation- Quizzes	20

OUTCOME:A high level understanding of various aspects of information systemsand helps in developing a perspective of what to expect from various courses which are part of ECE curriculum down the line.

TITLE : **Introduction to Software Systems**
Course Code : CS6.201
CREDITS : 2
TYPE-WHEN : N/A
FACULTY NAME : Dr. Y. Raghu Reddy
PRE-REQUISITE : N/A

OBJECTIVE : The aim of this course is to provide a working knowledge on tools and processes for building software systems.

COURSE TOPICS : Linux and Shell Scripting,Javascript and related libraries, OOPS, Python, Basics of SDLC and Networking.

PREFERRED TEXT BOOKS: Not applicable.

REFERENCE BOOKS:

1) Mastering Linux Shell Scripting : A practical guide to Linux command-line, Bash scripting, and Shell programming, by Mokhtar Ebrahim, Andrew Mallett
2) Learning Python: Powerful Object-Oriented Programming, by Mark Lutz
3) JavaScript: The Definitive Guide, by David Flanagan

Tutorials/LAB WORK: Linux Commands, Shell Scripting, GitHub, HTML, CSS, JavaScript, Cyber Attacks, XML, JSON, LAMP Stack, Python

GRADING PLAN:

Type of Evaluation	Weightage (in %)	
Exam - I	**20%**	**Exam 1 to be held during Mid-2**
Exam - II	**20%**	**Exam 2 to be held during Final Exam**
Assignments	**60%**	

OUTCOME: The students will be able to build basic software applications and get an understanding on basics of software development life cycle.

REMARKS: Course will be for the entire semester (although it's a half course). There will be ONE class per week and ONE tutorial every 2 weeks.

TITLE : Introduction to Internet of Things

Course Code : TS19010

CREDITS : 1-0-3-3

TYPE-WHEN : 2-hr lecture and 2-hr lab per week.

FACULTY NAME : Deepak Gangadharan

PRE-REQUISITE :

OBJECTIVE :

COURSE TOPICS :

Introduction to IoT and its Architecture (1 week)

1. What is IoT?

2. IoT Node Architecture

3. Multi IoT Node Architecture

4. Use case study and requirements analysis

Section 2: Microcontroller based Embedded System Design (3 weeks)

1. Introduction to the architecture - control flow and data flow

2. Interrupts

3. Polling Techniques

4. Memory and I/O Mapped I/O

5. Programmable Interrupt Controllers

Section 3: Sensors and Actuators (2 weeks)

1. Introduction to sensors, signals and systems; Sensor classification; Units of measurement

2. Sensor characteristics: Calibration, Accuracy, Resolution, Output format, Uncertainty

Section 4: Essential Electrical and Electronics for interfacing Sensors/Actuators with Microcontrollers (3 weeks)

1. Analog to digital converters

2. Operational amplifiers

3. Current generators

4. Voltage references

Section 5: Communication (3 weeks)

1. Introduction to the different wired and wireless communication interfaces

2. Design considerations for choosing interfaces

3. Radio basics and Introduction to Zigbee

4. Network topologies, star, ring mesh.

Section 6: Prototyping and Manufacturing (1 week)

1. PCB Design

2. 3D Printing

3. Manufacturing processes

The topics may not necessarily be discussed in the order but may be covered using a top down approach with the help of **Case Studies and Laboratory Experiments.**

PREFERRED TEXT BOOKS:

***REFERENCE BOOKS:**

1. Fraden, Jacob, Handbook of Modern Sensors, 4th ed. New York, Springer, 2010.

2. David G Alcatoir and Michael B. Histand, Introduction to Mechatronics and Measurement Systems, 4th Edition, Tata McGraw-Hill 2011

3. Robert Faludi, Building Wireless Sensor Networks: with ZigBee, XBee, Arduino, and Processing, 1st edition, O'Reilly, 2011

4. Steven F. Barrett, Arduino Microcontroller Processing for Everyone, Third Edition, Synthesis Lectures on Digital Circuits and Systems, 2013

5. Dargie, Waltenegus, and Christian Poellabauer. Fundamentals of wireless sensor networks: theory and practice. 1st edition, John Wiley & Sons, 2010

6. Tom Igoe, Making Things Talk, 2nd edition, O'Reilly, 2011

***PROJECT: None**

GRADING PLAN: Type of Evaluation	**Weightage (in %)**
Mid Sem-1 Exam	**20%**
Lab exam instead of mid -2 Exam	**20%**
End Sem Exam	**40%**
Assignments (six)	**20%**

TITLE **: Linear Algebra**

Course Code **:** MA3.101

CREDITS **: 3-1-0-4**

TYPE-WHEN **:** Spring 2020

FACULTY NAME **: Indranil Chakrabarty + Prasad Krishnan**

PRE-REQUISITE **:** Good knowledge of high school math
OBJECTIVE **:**Theoretical and working knowledge of Linear Algebra

COURSE TOPICS **:**

PART-1

Main Definitions and examples: Vector spaces, subspaces, Linear dependence, Span, Basis, Dimension, Finite dimension vector spaces *[Space of finite energy signals L_2]*.

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].

System of Linear Equations and their solutions: System of Linear Equations, Row-echelon form, reduced row-echelon form. Gauss-Jordon elimination, Solution of linear systems using Gauss-Jordon elimination, matrix inversion by Gauss Jordon elimination, Understanding Range Space and Solution Space using Rank-Nullity Theorem.

Determinants: Determinant, Properties of determinants, Non-recursive formula,Multilinear alternating functions, Determinant of a product, Inverse of a Matrix, Cramer's rule for solving linear equations.

Eigen Values and Eigen Vectors: Motivation for studying Invariant subspaces, characteristic polynomial, Eigen values, Eigen vectors of the matrix, show by examples several cases (a) eigen values don't exist for some matrices (b) eigen values exist for all complex matrices (c) algebraic and geometric multiplicity defns - eigen spaces with less and equal dimension to algebraic matrices (d) linearly independent eigen vectors for real symmetric complex Hermitian. *[Compression and Expansion of Vectors between Low-D and High-D spaces and their utility]*

PART 2

Dual Spaces, Dual transformation and matrix (Transpose)

Diagonalizability and Triangularizability: Similar and equivalent(for rectangular) matrices,Triangularizability of all complex matrices, Diagonalizability criteria using Eigen basis, Geometric and Algebraic Multiplicity Unitary and Orthogonal operators and their matrices,Diagonalization of Complex Hermitian (self-adjoint), Real Symmetric Case, more

Some more practical decompositions (with applications hopefully): Recall Inner product spaces Gram-schmidtorthnormalization (LU). QR, Cholesky, singular value decomposition and pseudoinverse

Advanced Spectral Theory :

See Linear Algebra done wrong (last chapter), Cayley-Hamilton theorem, Nilpotent maps, Jordon canonical form, minimal polynomial

Infinite dimensional vector spaces – Relook at space of L_2 functions. Fourier as an infinite basis, Linear Time Invariant Systems and Eigen functions of such(optional) Finite dimensional algebras (vector spaces with multiplication (i.e., vector spaces which are also commutative rings)) and their applications in brief.

Optional:

Bilinear Quadratic Form;

Recollect Vector spaces with inner products and norms,

PREFERRED TEXT BOOKS:

1. 'Linear Algebra', 2nd edition, K. Hoffman and R. Kunze.
2. 'Finite Dimensional Vector Spaces' P. Halmos

***REFERENCE BOOKS:**

1. Introduction to Linear Algebra, Gilbert Strang.
2. Linear Algebra Done Wrong, Sergei Treil.

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	**15**
Mid Sem-2 Exam	**15**
End Sem Exam	**30**
Assignments	**20**
Other Evaluation 1. Quizes 2. Scribing	**15** **5**

ECE337 Communication Networks 3-1-0-4

FACULTY NAME : Ubaidulla P

Introduction: Information Transport, Point-to-point links, multipoint connectivity, Networking Issues; History of Communication Networks- Telephone/ Computer.

ITU-T Reference Model: ISO-OSI Layered Architecture; Protocols and Standards

Digital Transmission-Multiplexing methodologies (time/ frequency/ wavelength/ statistical), Standard digital hierarchies- plesiochronous and synchronous (PDH/SDH);

Networking Mechanisms: Multiple Access, Scheduling, Switching, Routing, Flow Control; Standard Protocols and Algorithms

Network Taxonomy: Circuit, Packet and Label Switched Networks; Wide Area-/ Metropolitan Area- /Local Area and Access Networks;

Network Architectures and Evolution: TCP/IP, B-ISDN, Ethernet, recent advances

Modeling and Performance Analysis: Queuing Theory, Voice traffic and Erlang formulae; Poisson and Self-similar traffic modeling

PREFERRED TEXT BOOKS:

Leon Garcia and Indra Widjaja, "Communication Networks- Fundamental; Concepts and Key Architectures", Tata McGraw Hill 2000.

***REFERENCE BOOKS:**

Dmitri Bertsekas and Robert Gallager, "Data Networks", Prentice-Hall Inc., 1997.
William Stallings, "ISDN & Broadband ISDN, Frame Relay & ATM", Pearson Education 2004.

***PROJECT:**
GRADING PLAN:

Type of Evaluation	Weightage (in %)
Mid Sem-1 Exam	**25**
Mid Sem-2 Exam	**25**
End Sem Exam	**40**
Assignments	**10**
Project	
Term Paper	
Other Evaluation _____	

OUTCOME:
REMARKS:

OC3.102 **Value Education-2** **0-2-0-2**

Faculty Name : Dipti Mishra Sharma (Coordinator)

Objective: The course is aimed at furthering the understanding of human values gained in Human Values-1 course; and putting it into action at the level of self and local organization. It will help in developing correct perception of human life and human happiness; furthering understanding of

framework of universal human values; practical methods for inculcating values; applying them to self and to local organization.

Course Topics: The classes in the course will run as a series of discussions in small groups as well as activities. It is expected there would be activities and discussions on alternate weeks. Some topics covered in the earlier Human Values course which will be continued for discussion are given below.

1. Relationships: Applying concepts to relationships with friends, with teachers, with family members, with others. Activity: Applying the above to deal with conflict situations with friends etc. 2. Respect - do you respect yourself? Do you respect others? 3. Inner self as a source of our strength. Is your self-respect dependent on the other? Confidence and initiative. Key to happiness. Activity: Apply it in the context of Felicity (IIIT cultural festival). 4. Role of values in Society. Following rules and norms. Social behavior. Legality versus morality 5. I and Nature: How to build mutually enriching relationship with nature? Activity: Tree plantation and caring for the tree. How to conserve? Activity: Further sensitization of right utilization of physical facilities, i.e., water, electricity, food, labs., internet, personal items. Applying it to self as well as local organization level.

There would be no formal lectures in the course. For the above topics, scenarios would be created, and used to initiate discussion. Activities, as mentioned above, would pertain to applying Jeevan Vidya in day to day life, dealing with relationships, handling conflicts; to nature, tree plantation and nourishing the planted tree, cleaning the campus, cultural programme depicting values; managing the mess or other hostel affairs.

Outcome: At the end of the course, students are expected to start applying the ideas learnt from the course to their own life, and to local organization around them.

TITLE : **Program Verification**

Course Code :

CREDITS : 2

TYPE-WHEN : Breadth Elective - Spring

FACULTY NAME : Venkatesh Choppella

PRE-REQUISITE : Automata Theory, Discrete Maths

OBJECTIVE : To get the student to carry out basic modeling of correctness of programs and systems.

COURSE TOPICS :

1. Transition systems. Verification of sequential iterative and recursive programs: partial and total correctness using mathematical induction. [4 lec]

2. Type Safety of programming languages: Structural induction. Simply typed lambda calculus. Preservation and Progress theorems. [4 lec]

3. Verification of reactive systems: Kripke models. Safety, Deadlock freedom, Liveness. Specification of properties using LTL. Tools for model checking. [5 lec]

PREFERRED TEXT BOOKS:

1. Benjamin Pierce: Types and Programming Languages

2. Bair and Katoen: Principles of Model Checking

3. (Chapters from other references will be kept in the Reference Section of the Library).

***REFERENCE BOOKS:**

***PROJECT:**

GRADING PLAN:

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

OUTCOME: After this course, a student should be able to

1. Prove the correctness of simple sequential programs.

2. Write down specifications of sequential and concurrent programs

3. Use basic tools for carrying out verification exercises.

REMARKS:

TITLE : Science II (New)
Course Code :
CREDITS : 4
TYPE-WHEN :

FACULTY NAME : Subhadip Mitra and Nita Parekh

PRE-REQUISITE :

OBJECTIVE :

COURSE TOPICS :

First Half: Electromagnetism

1. The mathematical background: Vector calculus, coordinates and Dirac delta function
2. Electrostatics: Coulomb's law, electric field, Gauss's law, electric potential, electrostaticenergy, conductors, electric fields in matter: polarization, bound charges, dielectrics
3. Magnetostatics: Lorentz force law, Bio-Savart law, Ampère's law, vector potential, mag-netic fields in matter: dia-/para-/ferro-magnets, bound currents
4. Electromotive force, Faraday's law
5. Maxwell's equations and electromagnetic waves

Second Half: Introduction to Biology

I Introduction

- Classification of Living Organisms
- Origin of Life and Evolution
- Biomolecules – Nucleotides, Amino Acids, Proteins, Enzymes

II Cell Biology

- Structure and Function - Prokaryotic and Eukaryotic Cells
- Cell Cycle – Cell division – Mitosis, Meiosis
- DNA Replication, Transition, Translation – Central dogma
- DNA amplification, sequencing, cloning, restriction enzymes

III Genetics

- Mendelian Genetics – Genetic Disorders
- Mendelian Inheritance Principles
- Non-Mendelian Inheritance
- Clinical Perspective

IV Macromolecules

- DNA, Proteins – Structure, Function, Analysis – alignment, database search, phylogeny
- Carbohydrates – Features, Structure, Metabolism, Kreb cycle

V Biological data analysis

- Biological Data – sequence, structure, expression, etc.
- Sequence Data Analysis • Applications

PREFERRED TEXT BOOKS:

Electromagnetism:

1. Introduction to Electrodynamics by David J Griffiths

Introduction to Biology:

1. Essential Cell Biology by Alberts, Bray, Hopkin, Johnson, Lewis, Raff, Roberts, Walter

2. Bioinformatics by D. Mount

***REFERENCE BOOKS:**

Electromagnetism:

1. Classical Electrodynamics by J D Jackson
2. The Feynman Lectures on Physics, Volume II

Introduction to Biology:

1. Molecular Biology of the Cell by Alberts, Johnson, Lewis, Morgan, Raff, Roberts, Walter
2. Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox
3. Reading the Story in DNA: A Beginners Guide to Molecular Evolution by Lindell Bromham

***PROJECT:**

GRADING PLAN:

Electromagnetism:

Type of Evaluation	Weightage (in %)
Quiz-1	**30**
Quiz-2	**-**
Mid Sem Exam	**60**
End Sem Exam	**-**
Assignments	**10**
Project	
Term Paper	
Other Evaluation _____	

Introduction to Biology

Type of Evaluation	Weightage (in %)
Quiz-1	**-**
Quiz-2	**30**
Mid Sem Exam	**-**
End Sem Exam	**60**
Assignments	**10**
Project	
Term Paper	
Other Evaluation _____	

Outcome:

Remarks:

ISC202 **Science II(Old)** **3-1-0-4**

Faculty Name : Marimuthu Krishnan

Objective: These courses (Science-I and Science-II) will provide integrated knowledge of basic physics and mathematics applied to the molecular world of natural systems. Most topics will be covered in an interrelated manner. The level of sophistication will gradually develop with

motivational content in the beginning to sophisticated details at the end. Illustrations and suitable problems will be offered at every stage of the course.

Course Topics: 1) The microscopic world, the need for a reductionist approach in science, Mechanics, predictability, Newtonian and Quantum, indeterminacy in the subatomic world, the generalized coordinate, examples of forces and interaction potentials and their interrelation, the phase space, simple harmonic trajectories in phase space, anharmonicity, interaction between two atoms described in phase space, Lagrangian and Hamiltonian, geometric view of dynamical systems, angular momentum, laws of conservation. **2)** Failures of classical physics, wave particle duality, intereference of waves, electron diffraction, application of quantum mechanics, particle in a box problem applied to conjugated molecular systems and nano-particles, 1-D harmonic oscillator, rotation in space. **3)** Harmonic oscillator and vibrational spectroscopy, Rigid rotor, H atom eigenfunctions (no derivations). **4)** Quantum mechanical harmonic oscillator, Rigid rotor, H atom. **5)** The structure of atoms and molecules , molecular orbitals, chemical bonding. **6)** Periodic potential and solid state; crystalline and amorphous solids, ionic and covalent crystals, van der Waals bond, metallic bond, band theory of solids, semiconductor devices. **7)** Bridging the micro and the macro, statistical basis of thermodynamics, Boltzmann statistics. **Research Project, Optional:** An individual research project can be opted for by the students; students have to declare interest and select a research topic by the Add-Drop date or by the third lecture (which ever is sooner). The research project can be under the guidance of any of the CCNSB faculty and has to deal with "Science" (as against enginnering/technology). On the first Monday after the mid-semester examination, a progress report has to be submitted. A final presentation after the end-semester examination is also required. (See below, Option-2 for grading scheme for those who opt for this option)

Preferred Text Books: 1) Concepts of Modern Physics by Arthur Beiser. **2)** Feynman Lectures in Physics, vols. I-III by R Feynman et al. **3)** Physical Chemistry by P W Atkins. **4)**Thermodynamics, Kinetic Theory and Statistical Thermodynamics by F Sears.

Outcome: The desired outcome of the course is to generate in the students an overall excitement about the world of science; also a basic familiarity of the terminology and tools of chemical, physical and biological sciences.

Grades:

Mid-1 : 12.5%
Mid-2 : 12.5%
End sem : 30%
Assignment : 15%
Quizzes : 15%
Project : 15%

TITLE : Science Lab II
Course Code : SC4.111
CREDITS : 4
TYPE-WHEN : Spring 2020
FACULTY NAME : Tapan Kumar Sau + B. Prabhakar

PRE-REQUISITE:
OBJECTIVE :
Main objective of this laboratory course is to understand the concepts of select science topics through lab sessions.
List of proposed experiments:
UV-Vis Absorption Spectroscopy
FT-IR Spectrscopy
Cyclic Voltametry
Determination of Wavelength of a Source – Diffraction Grating. Newton's Rings Radius of Curvature of Plano –
Convex lens: Laser –single and double slits
Melde's Expt. - Transverse & Longitudinal Modes:
Magnetic Field Expt: Stewart & Gees method
Determination of Velocity of sound-volume resonator
Project:
1.1.1. Groups of two students
1.1.2. Start date Jan 21, 2011
1.1.3. Submission of working experiment April 10, 2011
1.1.4. Talk to instructors a few times before the start date; only approved experiments will be supported by lab infrastructure.
Grading: Tentative
60 % Lab work (Report + Performance)
20 % Viva voce/ quiz
20 % Project
PREFERRED TEXT BOOKS: No preferred textbooks. Hands-out will be provided.
OUTCOME:
This laboratory course is designed to introduce students to the bachelor level science laboratory techniques. Students completing this course are expected to learn the following: (i) hands on experience of select science topics (ii) measure and report physical quantities with appropriate precision, (iii) convert raw data to a physically meaningful form, (iv) apply appropriate methods of analysis to raw data, (v) recognize the relevance of data, (vi) work safely in the lab, (vii) adhere to instructions on laboratory safety, (viii) recognize hazardous situations and act appropriately, and (ix) recognize the applicability of scientific principles to real world situations.

TITLE : Software Programming for Performance

Course Code :

CREDITS : 3-1-0-2

TYPE-WHEN : Spring

FACULTY NAME : Rahul Jain

PRE-REQUISITE : Basics of Algorithm Analysis, Computer Architecture

OBJECTIVE : Motivate the student understanding towards performance engineering of large software systems

COURSE TOPICS :

1. Optimizing a program using Compiler Optimization options
2. Memory Hierarchy (Cache, DRAM, Disk) aware Optimizations
3. Roof Line Analysis to identify performance bottlenecks and identify optimization opportunities
4. Using performance counters and other profiling tools to identify hotspots and bottlenecks
5. Using SIMD units on a sequential core
6. Programming Multi-cores [Use OpenMP]
7. Accelerating Software Systems using Hardware Accelerators (GPU, FPGA)
8. Programming GPUs [Basic Intro, Use OpenCL/OpenACC/...]

PREFERRED TEXT BOOKS:

No Text book as such, but the material would be taken from different books like:

1. Cormen, Thomas H., et al. *Introduction to algorithms*.
2. Hennessy, John L., and David A. Patterson. *Computer architecture: a quantitative approach*.
3. GCC Manual: https://gcc.gnu.org/onlinedocs/gcc/index.html

***REFERENCE BOOKS:**

***PROJECT:**

1. One final project towards optimizing a large software system

GRADING:

1. 35% Exams/Quizzes
   2. 1 Quiz: 10% each
   3. 1 Mid-Term Exam: 25% each
4. 20% Assignments
5. 45% Final Project

OUTCOME:

REMARKS:

TITLE : Statistical Mechanics

Course Code : SC1. 205(405 for MS/PhD students)

CREDITS : 2

TYPE-WHEN : Spring 2019-20

FACULTY NAME : Harjinder Singh

PRE-REQUISITE : Thermodynamics
OBJECTIVE : Fundamentals of Statistical Thermodynamics

COURSE TOPICS : (1L : 90 mins)

1. The purpose of statistics : Bridging the micro and the macro, random walk, binomial distribution and the Gaussian limit: 1L

2. Ensemble, micro-canonical, canonical and grand canonical; Partition function, Lagrange multiplier technique to obtain the Boltzmann distribution : 2L

3. Statistical expressions for thermodynamic functions for monatomic, diatomic and polyatomic perfect gases, equilibrium constant using partition function: 2L

4. Classical statistical mechanics, Liouville equation, Equipartition of energy : 1L

5. Identical particles, Quantum statistics - Fermi-Dirac and Bose-Einstein statistics : 2L

5. Special topics (Real gases, Liquids, Lattice dynamics, Ising spins, etc.) : 3L

Additional work required for MS/PhD students : term paper

PREFERRED TEXT BOOKS:

1) Physical Chemistry, by P. W. Atkins.
2) Statistical Thermodynamics (or Statistical Mecahnics) by D. A. McQuarrie
3) Fundamentals of Statistical and thermal Physics, by F Reif (Berkeley Physics, vol. 5)

***REFERENCE BOOKS: (1) 10 copies; (2) 5 copies; (3) 4 copies**

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz-1	**N.A.**
Quiz-2	**25%(*20%)**
Mid Sem Exam	**N.A.**
End Sem Exam	**55% (*45%)**
Assignments	**20% (*15%)**

Project	
Term Paper	***20%**
Other Evaluation _____	

***for MS/PhD students only**

OUTCOME: Expertise in statistical thermdynamics

REMARKS: -

TITLE **: Thermodynamics**

Course Code **: SC1. 204(404 for MS/PhD stundets)**

CREDITS **: 2**

TYPE-WHEN **: Spring 2019-20**

FACULTY NAME **: Harjinder Singh**

PRE-REQUISITE **:** None
OBJECTIVE **:** Fundamentals of Thermodynamics

COURSE TOPICS **:** (1L : 90 mins)

1. Thermodynamic space, system and surroundings, variable, function, Thermodynamic process and energy transaction : Work, Heat; Walls : Diathermal, Adiabatic, (im)permeable 1L

2. Properties of Gases: Perfect and real : 1L

3. Zeroth law and temperature, first law and internal energy, enthalpy, thermochemistry, Hess's law :1L

4. Expansion Work, Isothermal and Adiabatic Changes, Heat capacity :1L

5. Second law and equivalence of different ways of stating it, Clausius inequaltiy The Joule-Thomson Effect, Entropy, Heat Engine, Refrigerator, Carnot Cycle : 2L

6. Helmholtz And Gibbs Free Energies, thermodynamic equation of state, criteria for spontaneity, chemical potential, variation with temperature and pressure, Maxwell relations :2L

7. Fugacity and activity :1L

8. Thermodynamics of mixing, Phase Diagrams and Phase Transitions : 2L

9. Chemical equilibrium, Equilibrium constant and standard free energy :1L

Additional work required for MS/PhD students : term paper

PREFERRED TEXT BOOKS:

1) Physical Chemistry, by P. W. Atkins.
2) Physical chemistry: a molecular approach by Donald Allan McQuarrie and John Douglas Simon.
3) Physical Chemistry, by G. W. Castellan.
4) Heat and Thermodynamics by M W Zemansky and R H Dittmna

***REFERENCE BOOKS: (1) 10 copies; (2) 4 copies; (3) 1 copy; (4) 1 copy**

***PROJECT:**

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Quiz-1	**25%(*20%)**
Quiz-2	**N.A.**
Mid Sem Exam	**Final exam for the course : 55%(*45%)**
End Sem Exam	**See above**
Assignments	**20%(*15%)**
Project	
Term Paper	**(*20%)**
Other Evaluation _____	

***for MS/PhD students only**

OUTCOME: Expertise in thermodynamics

REMARKS: -

Sd/-
Dean(Academics)