

International Institute of Information Technology, Hyderabad School of Multi-disciplinary Computing

<u>Dual Degree Programme - B.Tech in Computer Science and Master of</u> <u>Science in Computational Linguistics by Research</u>

Table of Contents

Sl. No	Item
1	Vision and Mission Statements of the School of Multi-
1.	disciplinary Computing
2.	PEOs, POs, and PSOs
3.	Curriculum
4.	Course Descriptions for Core and Elective courses



1. Vision and Mission for the School of Multi-disciplinary Computing

Vision

To be recognized as a globally reputed school by offering innovative academic programs and specializations in core computing, computing technologies, and computing in association with multiple disciplines, at all levels (UG, PG, Ph.D.) with state-of-the-art curricula, by promoting quality research in thrust areas, and blending research outcomes into teaching programs.

Mission Statements

MS1: To produce competent next-generation technology leaders, who can apply the science and engineering of computing to add immense value to their profession.

MS2: To implement a state-of-the-art curriculum in all the academic programs in line with the multidisciplinary societal and technological needs and encourage students to imbibe creativity, research, problem-solving skills, professional ethics, and human values.

MS3: To design and execute innovative multidisciplinary academic programs, specializations, and courses that combine computing and other domains organically, by involving all the stakeholders such as students, teachers, research scholars, experts from industry, academia, and alumni.

MS4: To conduct quality research in fundamental, applied, multidisciplinary, and futuristic domains and become a key player in the educational ecosystem within the country and abroad.

MS5: To create and sustain a strong suite of academic outreach programs catering to varied segments such as industry professionals, external students, and early career researchers.

MS6: To collaborate with other reputed institutions in India and abroad and implement best practices to achieve excellence.



2. PEOs, POs, and PSOs for the Dual Degree programme in Computational Linguistics

PROGRAM EDUCATIONAL OUTCOMES:

- **PEO 1:** Demonstrate competency and creativity in some subareas of computer science so as to develop solutions and software systems for applications in computational linguistics
- **PEO 2:** Demonstrate requisite breadth and depth of knowledge in some subareas of computational linguistics so as to excel in research and academic environments in these sub-areas
- **PEO 3:** Exhibit communication skills and collaborative skills required to plan, participate effectively in multi-disciplinary teams.
- **PEO 4:** Develop an aptitude for self-learning and life-long learning so as to keep abreast with rapid change in NLP and computing technology
- **PEO 5:** Practice ethics and human values in their profession

PEO vs MS	MS1	MS2	MS3	MS4	MS5	MS6
PEO1	3	3	3	3	3	3
PEO2	3	3	3	3	3	3
PEO3	3	3	2	3	3	3
PEO4	3	3	2	2	3	2
PEO5	3	3	2	2	3	3

Mapping between PEOs and Mission Statements



PROGRAM OBJECTIVES:

- **PO 1:** Scientific Knowledge: Understand, train in and use concepts in varied disciplines including Sciences, Mathematics, Electronics and Computer Sciences to engineer and develop systems of varying scale.
- **PO 2:** Problem Analysis: Identify, formulate and analyze complex scientific and engineering problems, reaching substantial conclusions using principles of Mathematics, NLP and Engineering Sciences
- **PO 3:** Design/ Development of Solutions: Identify and bring to fore the necessary concepts to arrive at solutions to problems in critical linguistics that take into account the societal, cultural and ethical considerations.
- **PO 4:** 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.
- **PO 5:** Modern Tool usage: Demonstrate requisite hands-on sills to work with variety of software packages, libraries, programming languages, and software development environment tools useful in engineering large scale systems
- **PO 6:** The engineer and society: Make judicious use of resources and understand the impact of technology across the societal, ethical, environmental and economic aspects.
- **PO 7:** Environment and sustainability: Find scientific and technological solutions by considering the environmental impact for sustainable development
- **PO 8:** Ethics: Practice principles of professional ethics and make informed decisions after a due impact analysis
- **PO 9:** Individual and teamwork: Work efficiently in individual and team –oriented projects of varying size, cultural milieu, professional accomplishments, and technological backgrounds
- **PO 10:** Communication: Effectively communicate and exchange ideas and solutions to any individual including peers, end-users and stakeholders
- **PO 11:** Project management and Finance: Apply principles of project management in general and scientific project management
- **PO 12:** Life-long learning: Exhibit the aptitude for independent, continuous and life-long learning required to meet their professional career goals.



PROGRAM SPECIFIC OUTCOMES:

- **PSO 1:** Exhibit broad general knowledge in some sub-areas of computer science and engineering such as machine learning and artificial intelligence
- **PSO 2:** Exhibit broad general knowledge sub-areas of language technologies such as machine translation, information retrieval and speech technologies
- **PSO 3:** Demonstrate research skills to identify problems of NLP that can benefit from utilizing advanced techniques of Computer Sciences, and participate in work at the frontier of scientific research in such inter-disciplinary areas
- **PSO 4:** Demonstrate knowledge and skills of required depth in at least one area of computational linguistics and in computer sciences to excel in post-graduate and research programs as an inter-display bridge

PO vs PEO	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	3	3	2	3	2
PO2	3	3	2	3	2
PO3	3	3	2	3	2
PO4	3	3	2	3	2
PO5	3	3	2	3	2
PO6	2	2	2	3	3
PO7	2	2	2	3	3
PO8	2	2	2	3	3
PO9	2	2	2	3	3
PO10	2	2	2	3	3
PO11	2	2	2	3	3
PO12	2	2	2	3	3
PSO1	3	3	2	3	2
PSO2	3	3	2	3	2
PSO3	3	3	2	3	2
PSO4	3	3	2	3	2

Mapping between POs, PSOs and PEOs



Curriculum

Computational linguistics is a transdisciplinary field of study. It deals with computational modeling of natural language understanding and generation using rule based or statistical methods. The graduates of this programme will work towards developing man - man and man-machine communication systems which include natural language understanding and natural language generation. They can also contribute to the field of linguistics by studying linguistic problems using computational methods. Since the field is interdisciplinary in nature, an ability to synthesise knowledge from the fields of Computer Science and Linguistics is required. The curriculum for CLD has to equip the students with fundamentals from the following areas:

- a) **Linguistics**: phonetics/Phonology, morphology, syntax, semantics, discourse, pragmatics, the relation between language and society etc.
- b) **Computer Science:** programming languages, data structures, algorithm analysis, automata theory, AI, software design etc

c) **Maths** : Discreet maths, Probability and statistics, calculus, differential equations and matrices, linear regression, real analysis, abstract algebra etc.

Therefore, the CLD curriculum has a balanced mixture of courses from different fields (Computer Science, Maths, Linguistics, Humanties, Science etc). The total credit requirement is 201 of which 24 are to be from a research thesis. The broad structure of the programme is as shown below.



Details of the requirements for the CLD programme are described next.



1. <u>Maths requirement</u> (16 credits): 3 core + 1 elective

Maths courses

Discrete Structures	Semester 1
Linear algebra	Semester 2
Probability and Statistics	Semester 3
Maths Elective	Semester 8

2. <u>Science</u> requirement (8 credits): 2 core

Core Science courses

Science 1 - scientific method, the micro and the macro principles of	Semester 5
Natural phenomena	
Science 2 - electromagnetism, applications of classical and quantum	Semester 6
mechanics	

3. <u>Humanities and Social Sciences</u> (HSS) requirement (16 credits): 2 core + 2 elective courses **Core HSS Science courses**

Intro to Human Sciences (4 credits)	Semester 4
Ethics -1 (2 credits)	Semester 7
Ethics-2 (2 credits)	Semester 8

4. Institute core requirement (12 credits): 4 credits each in Sports, Arts and Value education

Sports (4 credits)	Semesters 1 through 4
Arts (4 credits)	Semesters 1 and 2
Value education (4 credits)	Semesters1 and 4

5. <u>Programme core</u> requirement: These are to be completed in the first 5 semesters. The list of programme core courses is as below.

Core courses in the CLD Programme:

Monsoon	Course title	Credits	Snring	Course title	Credit	
monsoon	course the	creates	oping	course the	S	
	Introduction to	1		Introduction to	4	
	Liguistics-1	4		Linguistics-2	4	
Same 1	Digital Systems and	5		Data structures and	_	
	Microcontrollers	5		algorithms	5	
	Computer Programming		Som 2	Computational	4	
Selli I			Sem 2	Linguistics-1	4	
		5		Introduction to Software	2 4	
		5		Systems		
				Computer Systems		
				Organization		
Monsoon	Course title	Credits	Spring	Course title	Credit	



					S
	Language and Society	4		Language Typology and Universals	4
	Computational	4		Introduction to Natural Language Processing	4
	Linguistics-2			Digital Signal Analysis	2
Sem 3	Algorithm Analysis and Design	4	Sem 4	Machine, Data and Learning	4
	Data and Applications	2		Design and Analysis of Software Systems	4
	Automata Theory	2		Introduction to Human Sciences	4
Sem 5	Advance NLP	4			
	Operating Systems and Networks	4			

6. <u>Other programme requirements</u>: credits in electives 48 + 8 credits of Honours projects.

Once the foundation is built via core courses in the first four semesters, the CLD curriculum allows a student the flexibility to pursue choose her/his stream of research and do courses to build the depth in the stream in the last two years. The electives in different streams provide that opportunity. Of the 48 credits in electives, a minimum of 14 credits have to be earned in the domain area, 16 in Computer Science and the rest (18 credits) can be earned via courses from across disciplines.

<u>CLD electives</u> are organized into 4 streams (Figure-1 above), with each stream consisting of introductory as well as advanced level courses. The offerings at the advanced level can change from time to time. Every student is expected to do 3 electives in the chosen stream and the fourth from any other stream. Any change needs the approval of the advisor and the programme coordinator.

Hons projects (8 credits): This is to be done as 2-credit projects each in Semesters 6 and 7, 8 and 9 preferably on the same topic.

2 seminar credits in the 8th and 9th semesters.

1 unit (0 credits) of **technical writing** in the summer at the end of the 3^{rd} year. This is to be registered in the 7^{th} Semester.

1 unit (0 credits) of research proposal by the end of 4th year. Register in 8th semester.

Thesis (24 credits): This is to be done in the fifth year.



C	omputat	ional Linguistic	es (Dua	l De	gre cha	ee) - ang	- Sem	ester	wise l	Plan (Subje	ct to mi	nor								
							(0)														
Yea r & Se	Course Code	Course Name	Full/Ha lf Sem	Lect Tute Prae Hot	tures orial ctica urs p veek	s-L, -T, l-P per		Credits earned						Credits earned							
m				L	Т	Р	Ins Core	Prog Core	Prog Elec	CS Elec	Maths	Science	Hum	Open Elec	Hon s						
						Mor	isoon														
	MA5.101	Discrete Structures	Full	3	1	0	-	-	-	-	4	-	-	-	-						
	CL1.101	Intro to Linguistics- 1:Phontics, Phonology, Morphology and Syntax	Full	3	1	0	-	4	-	-	-	-	-	-	-						
	CS0.101	Computer Programming	Full	3	1	3	-	5	-	-	-	-	-	-	-						
1-1	EC2.101	Digital Systems and Microcontroller	Full	3	1	3	-	5	-	-	-	-	-	-	-						
	OC2.101	Arts-1	Full	0	2	2	2	-	-	-	-	-	-	-	-						
	OC1.101	Sports-1	Full	0	0	2	1	-	-	-	-	-	-	-	-						
	OC3.101	Value Education-1	Full	2	1	0	2	-	-	-	-	-	-	-	-						
		Sub Total		14	7	1 0	5	14	0	0	4	0	0	0	0						
		Total													23						
						Sp	ring														
	MA2.101	Linear Algebra	Full	3	1	0	-	-	-	-	4	-	-	-	-						
	CL1.102	Introduction to Linguistics-2: Semantics, Discourse and Pragmatics	Full	3	1	0	-	4	-	-	-	-	-	-	-						
	CL3.101	Computational Linguistics-1: Comp phon, morphology and sentence parsing	Full	3	1	0	-	4	-	-	-	-	-	-	-						
I-II	CS1.201	Data Structures and Algorithms	Full	3	1	3	-	5	-	-	-	-	-	-	-						
	CS6.201	Introduction to Software Systems	Half	1	0	3	-	2	-	-	-	-	-	-	-						
	CS2.201	Computer Systems Organization	Full	3	1	0	-	4	-	-	-	-	-	-	-						
	OC1.102	Sports-2	Full	0	0	2	1	-	-	-	-	-	-	-	-						
	OC2.102	Arts-2	Full	0	2	2	2	-	-	-	-	-	-	-	-						
		Sub Total		16	7	1 0	3	19	0	0	4	0	0	0	0						
		Total													26						



	Monsoon														
	MA6.101	Probability and Statistics	Full	3	1	0	-	-	-	-	4	-	-	-	-
	CS2.203	Language and Society	Full	3	1	0	-	4	-	-	-	-	-	-	-
	CL3.202	Computational Linguistics-2: Comp Semantics and Discourse parsing	Full	3	1	0	-	4	-	-	-	-	-	-	-
11-1	CS1.301	Algorithm Analysis and Design	Full	3	1	0	-	4	-	-	-	-	-	-	-
	CS1.302	Automata Theory	Half	3	1	0	-	2	-	-	-	-	-	-	-
	CS4.301	Data and Applications	Half	3	1	0	-	2	-	-	-	-	-	-	-
	OC1.103	Sports-3	Full	0	0	2	1	-	-	-	-	-	-	-	-
		Sub Total		18	6	2	1	16	0	0	4	0	0	0	0
		Total													21
						Spi	ring								
	CS7.303	Digital Signal Analysis	Half	3	1	0	-	2	-	-	-	-	-	-	-
	CSL1.204	Language Typology and Universals	Full	3	1	0	-	4	-	-	-	-	-	-	-
	CS7.401	Introduction Natural Language Processing	Full	3	1	0	-	4	-	-	-	-	-	-	-
пп	CS6.301	Design and Analysis of Software Systems	Full	3	1	0	-	4	-	-	-	-	-	-	-
11-11	CS7.301	Machine, Data and Learning	Full	3	1	0	-	4	-	-	-	-	-	-	-
	HS8.102	Introduction to Human Sciences	Full	3	1	0	-	-	-	-	-	-	4	-	-
	OC1.104	Sports-4	Full	0	0	2	1	-	-	-	-	-	-	-	-
	OC3.102	Value Education-2	Full	2	1	0	2	-	-	-	-	-	-	-	-
		Sub Total		20	7	2	3	18	0	0	0	0	4	0	0
		Total													25
						Mor	isoon		[[1				
	CL9.302	Honours-1	Full	0	2	6	-	-	-	-	-	-	-	-	2
	CS7.501	Advance NLP	Full	3	1	0	-	4	-	-	-	-	-	-	-
	CS2.201	and Networks	Full	3	1	0	-	4	-	-	-	-	-	-	-
111-1		CS Elective-1	Full	3	1	0	-	-	-	4	-	-	-	-	-
		Science-1	Full	3	1	0	-	-	-	-	-	4	-	-	-
		HSS Elective - 1	Full	3	1	0	-	-	-	-	-	-	4	-	-
		Sub Total		15	7	6	-	8	0	4	0	4	4	0	2
		Total													22
III-		I	[1	1	Spi	ring					Γ			
II	CL9.303	Honours-2	Full	0	2	6	-	-	-	-	-	-	-	-	2
		CL Stream-1	Full	3	1	0	-	-	4	-	-	-	-	-	-

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		CS Elective-2	Full	3	1	0	-	-	-	4	-	-	-	-	-
		Open Elective - 1	Full	3	1	0	-	-	-	-	-	-	-	4	-
		Science – 2	Full	3	1	0	-	-	-	-	-	4	-	-	-
		HSS Elective – 2	Full	3	1	0	-	-	-	-	-	-	4	-	-
		Sub Total		15	7	6	-	0	4	4	0	4	4	4	2
		Total													22
						Mor	isoon					-			
	CL9.402	Honours-3	Full	0	2	6	-	-	-	-	-	-	-	-	2
		CL Stream-2	Full	3	1	0	-	-	4	-	-	-	-	-	-
		CL Stream-3	Full	3	1	0	-	-	4	-	-	-	-	-	-
IV-I		Ethics-1	Half	3	1	0	-	-	-	-	-	-	2	-	-
		CS Elective-3	Full	3	1	0	-	-	-	4	-	-	-	-	-
		Open Elective-2	Full	3	1	0	-	-	-	-	-	-	-	4	-
		Sub Total		15	7	6	-	0	8	4	0	0	2	4	2
		Total													20
						Sp	ring								
	CL9.403	Honours-4	Full	0	2	6	-	-	-	-	-	-	-	-	2
		Maths Elective	Full	3	1	0	-	-	-	-	4	-	-	-	-
		Ethics-2	Half	3	1	0	-	-	-	-	-	-	2	-	-
IV-		CL Stream-4	Full	3	1	0	-	-	2	-	-	-	-	-	-
		CS Elective-4	Full	3	1	0	-	-	-	4	-	-	-	-	-
		Open Elective – 3	Full	3	1	0	-	-	-	-	-	-	-	4	-
		Sub Total		15	7	6	-	0	2	4	4	0	2	4	2
		Total													18
						Mor	isoon								
	CL9.605	Thesis	Full				-	12	-	-	-		-	-	-
V-I	OC9.600	Institute Seminar-1	Full				1	-	-		-	-	-	-	-
		Sub Total					1	12	0	0	0	0	0	0	0
		Total													12
						Sp	ring								
	CL9.605	Thesis	Full				-	12			-		-	_	-
V-II	OC9.600	Institute Seminar-2	Full				1	-	-		-	_		-	-
		Sub Total					1	12	0	0	0	0	0	0	0
		Total													12

Total%Institute Core127



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CS Core	43	24
Domain (CL) Core	32	18
Programme Electives	14	8
CS Elective	16	9
Maths	16	9
Science	8	5
Humanities	16	9
Open Electives	12	7
Honours	8	5
Total	177	10 0

Choice Based Credit System:

The curriculum aims to continue the implementation of Choice Based Credit System with a minimal core program followed by electives from across disciplines including mathematics, sciences, human sciences, engineering electives, and so on. The curriculum set aside close to 17% of the credits necessarily from courses outside of the program so as to allow scope for students to credit courses from the sciences, mathematics, human sciences, and engineering sciences. A total of 12% credits are set aside as open electives – student can use these credits to either go deeper in the program or to opt for courses outside of the program and broaden their outlook by opting for multi-disciplinary courses too.

All courses use a continuous evaluation model with a combination of homework assignments, quiz exams, mid-term, and final examinations. Students are required to stay clear of plagiarism in any of their work submitted for evaluation. Most elective courses include a course project or a term paper additionally. These course projects often require students to practice team-work, enhance their self-learning and communication skills, and impart essential project management skills. Some courses include a laboratory component with a scheduled laboratory session.

For the highly motivates students, the present curriculum continues to provide the Honors option which requires students to do additional credits including projects and advanced electives and work under the supervision of a faculty member.

Graduation Requirements

In order to graduate with B.Tech Honours in Computer Science and Master of Science in Computational Linguistics by Research, a student must successfully complete 177 course credits and 24 Thesis credits according to the requirements stated in the curriculum handbook and meet the following requirements. The **minimum CGPA required** to graduate is 7.00 for MS or entire programme. Guidelines for the Honours program are provided at <u>https://intranet.iiit.ac.in/offices/static/files/Honours-Guidelines-2022.pdf</u>. Reference documents are available <u>https://intranet.iiit.ac.in/offices/static/files/UG-DD-Curriculua-Jul21_%281%29.pdf</u>.



Both the degrees (Bachelors and Master of Science by Research) are awarded together only after successful completion of the programme requirements.

- Must successfully complete **SAVE** (Sports, Arts, Value Education) credits in the 1st and 2nd years.
- Must successfully complete the **programme** Core.
- Must successfully complete **14 credits of CL electives** in the 4th semester and beyond.
- Must successfully complete **1 Maths elective** in the 3rd and 4th years.
- Must successfully complete **4 CS electives** in the 3rd and 4th years (not more than 1 in any semester).
- Must successfully complete **2 Humanities electives** in the 3rd and 4th years (not more than 6 credits in any semester
- Must successfully complete **2 courses** (2 credits each) in Ethics in the 4th year.
- Must successfully complete **3 Open electives** in the 3rd and 4th years (at least 1 each in semester and not more than 2 in any semester).
- Must successfully complete **8** Honours credits via 2 credits each in 4 semesters (5th to 8th).
- Must successfully complete **2 seminar credits** in the 8th and 9th semesters.
- **1 unit (0 credits)** of **Technical writing workshop (OC4.101)** in the summer at the end of the 3rd year. This is to be registered in the 7th Semester.
- 1 unit (0 credits) of Thesis proposal writing workshop (OC4.201) by the end of 4th year. Register in 8th semester.
- Must register for **24 Research thesis credits** in the 9th and 10th semesters (at most 12 credits in a semester).
- Must successfully complete **MS thesis evaluation process** be including a public presentation and a Defense.



Course descriptions for Core & Elective Courses

Discrete Structures

Name of the Academic Program: B. Tech. in CSECourse code: MA5.101L-T-P: 3-1-0Credits: 4L= Lecture hours, T=Tutorial hours, P=Practical hours)

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

2. <u>Course Outcomes (COs</u>)

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

CO-1: Demonstrate critical thinking, analytical reasoning, and problem solving skills

CO-2: Apply appropriate mathematical and probabilistic concepts and operations to interpret data and to solve problems

CO-3: Identify a problem and analyze it in terms of its significant parts and the information needed to solve it

CO-4: Formulate and evaluate possible solutions to problems, and select and defend the chosen solutions

CO-5: Construct graphs and charts, interpret them, and draw appropriate conclusions

CO-6: Apply the concepts of group theory, ring and field in various applications in computer science

	Р 01	P O2	Р О3	Р О4	Р О5	Р Об	Р 07	Р 08	Р О9	PO 10	РО 11	P O 1 2	PS O1	PS O2	PS 03	PS 04
C 01	1	2	2	2	2	2	2	2	3	2	2	2	1	2	2	3
С 02	3	3	3	2	2	2	2	2	2	2	1	2	1	2	2	3
С 03	2	2	2	2	2	2	2	2	2	2	1	2	1	1	2	3
С 04	2	2	2	3	2	2	2	2	2	2	2	2	1	1	2	3
С 05	1	1	1	1	1	1	2	2	1	1	1	1	1	1	2	3
C 06	2	2	2	2	2	2	2	2	3	2	2	3	1	1	2	3

3. <u>MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes</u> (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. <u>Detailed Syllabus</u>:

• Unit 1:Sets, relations, functions, permutations, combinations. Applications torelations. Logic, Propositional Equivalences, Predicates and Quantifiers Sets, Proof Techniques, Contradiction. Mathematical induction, pigeonhole principle.

Cardinality of sets, finite and infinite sets, countable and uncountable sets, Cantors numbering.

• Unit 2:Group, subgroup/normal subgroup, homorphism/automorphism/isomorphism/ eipmorphism, kernel, cosets, quotient group, product set in a group, center of a group, order/conjugate of an element, commutator.

Coding theory (Application to group theory).

- Unit 3: Ring, Field, Finite field over a prime. Applications to finite fields.
- Unit4: Recurrence relations, generating functions, numeric functions. Applications to recurrence relations.
- Unit 5: Basics of probability theory, birthday attacks. Applications on hash functions.
- Unit6:Graphs, Adjacency, Special Graphs, Isomorphic Graphs, Paths, Cycles and Circuits,
- Connected Graphs, Eulerian Graphs, Hamiltonian Graphs and Planar Graphs.

Reference Books:

1. Thomas Koshy, "Discrete Mathematics with Applications", Elsevier Press, 2004.

2. C.L.LiuandD.P.Mohapatra,"ElementsofDiscreteMathematics:AComputerOrientedApproach," Tata McGraw-Hill Edition, 2017.

3. D.S.Malik and M.K.Sen,"Discrete Mathematical Structures: theory and applications, "Thomson, 2004.

- 4. Joseph Gallian, "Contemporary Abstract Algebra", 9th Edition, CENGAGE publications, 2019.
- 5. Gross and Yellen, "Graph Theory and its Applications", 2nd Edition, Chapman and Hall, 2005.
- 6. Kenneth H. Rosen, "Discrete Mathematics and Its Applications", Sixth Edition, 2006
- 5. <u>Teaching-Learning Strategies in brief(4 to 5sentences)</u>:

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

- Mastery of Computer Science technical foundations
- Recognition of common Computer Science themes and principles
- Recognition of interplay between theory and practice
- Effective problem solving and critical thinking skills
- 6. <u>Assessment methods and weightages in brief</u>(4 to 5sentences):
 - Assignments:10%
 - In-Class Tests:20%
 - Mid Semester Examination:30%
 - End Semester Examination:40%



Computer Programming

Name of the Academic Program	: B.Tech in Computer Science and Engineering
Course Code	: CS1.302
Title of the Course	: Computer Programming
L-T-P	: 3-1-3.
Credits	: 5
(L = Lecture Hours, T = Tutorial H	Iours, P = Practical Hours)

1. Prerequisite Course / Knowledge:

Logical thinking and mathematical concepts at the level of a 10+2 standard student with a math major.

No prior programming experience or computing background is required.

2. Course Outcomes (COs)

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

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

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

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

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

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

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

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

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



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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3	-	3	-	3	-	-	-	-	-	-	-	2	3	3	3
CO 2	3	-	3	-	3	-	-	-	-	-	-	-	2	3	3	3
CO 3	3	3	3	2	3	-	-	-	-	-	-	-	2	2	3	3
CO 4	2	3	3	3	3	-	-	-	-	-	-	-	2	2	3	3
CO 5	2	3	3	3	3	-	-	-	-	-	-	-	2	2	3	3
CO 6	1	1	1	1	3	-	-	-	-	-	-	-	2	3	3	3
CO 7	3	2	2	2	3	-	-	3	3	3	-	-	2	3	3	3
CO 8	1	2	2	2	2	-	-	3	3	3	-	-	2	2	3	3

4. Detailed Syllabus

• Unit 1:

 $_{\odot}$ Basic computer organization, Von Neumann architecture and stored program concept

 $\circ~$ High level programming languages, assemble code, binary instructions, compilers and assemblers

- Programming editing, compilation and execution cycle
- Unit 2:
 - Use of variables as reference to memory locations
 - Basic data types and their representation
 - Operators and precedence levels, expressions
 - Writing straight-line sequence of code
 - Standard I/O Libaries
- Unit 3:
 - Conditional Statements (if-then-else) and Loops (for, while, etc.)
 - o Arrays
 - Functions and parameter passing mechanisms
 - Standard libraries for string manipulation, disk file access etc.
 - Structures, Unions and Enumerations
- Unit 4:
 - Recursion
 - Program stack, scope and lifetime of variables



 \circ $\,$ Pointers, heap memory, dynamic memory management, linked lists and memory leaks

- Unit 5:
 - Preprocessor directives
 - Source code management tools like GIT and use of GDB for program debugging
 - Multi-file programming and Makefiles

Reference Books:

1. K. N. King. 2008. C Programming: A Modern Approach, Second Edition. W.W. Norton & Company.

- 2. Nick Parlante. 2017. Essential C. Independently published.
- 5. Teaching-Learning Strategies in brief

Lectures are conducted in a highly interactive fashion. Programming problems are solved in-class along with students in a collaborative fashion. Sometimes two-three students are given an opportunity to present their programs to the class. At the end of every class, a small homework problem which helps in enhancing the concepts discussed in the class will be released. Students need not submit this homework. Tutorial sessions are used to teach the utilization of tools such as Visual Studio Code, GCC, GDB, GIT, Makefiles, perf, valgrind etc. Lab sessions are used to solve programming assignments and teaching assistants help students in developing program logic, debugging etc. on an individual basis. Faculty conducts office hours once in week. On the rest of the days, teaching assistants conduct office hours. This ensures continuous support to students. Key milestones are defined. Feedback from the students at those milestones are taken. The provided feedback is taken to fine tune the course and provide special support to students who are lagging behind. Five to six programming assignments are designed which gives an indepth understanding of various concepts discussed in the class and their application to new problem scenarios along with proper analysis. Some problems involve evaluating, comparing and contrasting multiple solution approaches.

- 6. Assessment methods and weightages in brief
 - 1. Programming Assignments (5 to 6) : 50 percent
 - 2. Best 2 out of 3 Programming Lab Exam: 2 x 15 = 30 percent
 - 3. Best 2 out of 3 Theory Exams : $2 \times 10 = 20$ percent

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

Real Analysis

Course Code: IMA.303Title of the Course: Real Analysis



L-T-P : 3-1-0. Credits : 4 (L= Lecture hours, T=Tutorial hours, P=Practical hours)

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 realvalued 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.

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	2	2	2	2	3	-	1	-	3	1	3	2	3	3	2	3
CO 2	2	2	2	1	3	-	1	-	2	2	2	3	3	2	1	1
CO 3	1	1	1	1	1	1	1	-	2	2	2	1	1	1	1	1
CO 4	3	2	2	1	2	2	1	-	2	2	2	1	3	3	3	2
CO 5	3	2	2	1	2	2	1	-	2	2	2	1	3	3	3	2
CO 6	1	1	1	1	1	2	1	-	1	1	1	1	1	1	1	1

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

4. Detailed Syllabus:

Unit 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, Multiple integrals,

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).

Unit 4: Analytic function of complex variable, CR Equation, harmonic functions, Laplace equation, applications (7.5 hours);

Unit 5 Integration of a function of a complex variable, M-L inequalities. Cauchy's Integral Theorem. Cauchy's Integral formula. Taylor's and Laurent Expansion, Poles and Essential Singularities, Residues, Cauchy's residue theorem, Simple contour integrals.

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

References:

• Rudin, Walter, *Principles of Mathematical Analysis*, third edition, International Series in Pure and Applied Mathematics. McGraw-Hill Book Co., New YorkAuckland-D[°]usseldorf, 1976

Bartle, Robert G., *The Elements of Real Analysis*, second edition, John Wiley & Sons, New York-London-Sydney, 1976. (for Fourier Series)

•

Ross, Kenneth A., Elementary Analysis. The Theory of Calculus, second edition, in

(7.5 hours)

(9 hours)

(9 hours)





collaboration with Jorge M. L'opez, Undergraduate Texts in Mathematics, Springer, New York, 2013.

- Kreyszig, Erwin. (1983). Advanced engineering mathematics. New York : Wiley,
- Goldberg, Richard R., *Methods of Real Analysis*, second edition, John Wiley & Sons, Inc., New York-London-Sydney, 1976.
- Churchill, Ruel V. and Brown, James Ward, *Complex Variables and Applications*, fourth edition, McGraw-Hill Book Co., New York, 1984

• Ahlfors, Lars V., *Complex Analysis: An Introduction to the Theory of Analytic Functions of One Complex Variable*, third edition. International Series in Pure and Applied Mathematics, McGraw-Hill Book Co., New York, 1978.

5. Teaching-Learning Strategies in brief:

Lectures in the classroom teaching, weekly tutorials involving problem solving and active learning by students and Project-based Learning

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

Digital Systems and Microcontrollers

Name of the Academic Pa	rogram: B.Tech in ECE
Course Code	: S21EC2.101
Title of the Course	: Digital Systems and Microcontrollers (DSM)
L-T-P	: 3-1-3
Credits	: 5
(L= Lecture hours, T=Tu	torial hours, P=Practical hours)

1. Prerequisite Course / Knowledge:

Understanding of basic algebra concepts taught up to the 10+2 level

2. <u>Course Outcomes (COs)</u>:

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

CO-1: Solve problems pertaining to the application of Boolean algebra, number systems, and simplification of logic expressions using Karnaugh maps.

CO-2: Develop a simplified combinational circuit as a solution for a given problem.

CO-3: Analyze a real-world problem to develop a digital design solution using sequential circuits to solve the problem.

CO-4: Describe the working of a basic 8-bit von Neumann architecture processor.



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

CO-6: Design, implement and test a given logic circuit using basic electronic components such as breadboards, ICs etc.

3. <u>Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)</u> - Course Articulation Matrix

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

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

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

Unit 1: Number systems and interconversions (binary, decimal, hexadecimal), postulates of Boolean algebra, binary logic gates, binary functions

Unit 2: Simplification of binary expressions using K-maps, logic function implementation, combinational circuits Unit 3: Latches and flip-flops, types of flip-flops, internal circuit design and operation

Unit 4: Sequential circuits, state diagrams, state tables, state equations, applications of sequential circuits Unit 5: Registers and counters, memory and processor architecture

Reference Books:

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

5. <u>Teaching-Learning Strategies in brief (4 to 5 sentences):</u>

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

6. <u>Assessment methods and weightages in brief (4 to 5 sentences):</u>

Continuous evaluations: Assignments – 10% MCQ Quizzes – 20% Lab reports – 20%



Comprehensive evaluations: Lab exam – 15% End semester exam in Theory – 35%

Title	: Introduction to Linguistics 1
Credits	: 3-0-1-4
Faculty name	: Aditi Mukherjee
Type when	: Monsoon 2021
Prerequisite	: None

COURSE OUTCOME:

CO-1: Students will have a good understanding of linguistic analysis

CO-2: Students will be introduced to different word and sentence level theories

CO-3: It will enable them in building text processing tools and systems

CO-4: They will explore different languages in class working in teams.

CO-5: Using real examples, they will analyselanguage data to understand the concepts.

COURSE TOPICS:

1. Whatislanguage? Differencebetweenhuman language and Animal languages. Natural language, Formal language and Artificial language, Characteristic features of human language, what we know about language.

2. Study of Human language – the field of Linguistics

- 3. Looking at language from synchronic and diachronic points of view
- 4. Areas of Study from structural perspective
- a) Syntagmaticandparadigmaticaspectsoflanguagestructure,
- b) Levelsofstructuralanalysis: Phonetics: Place and manner of articulation of speech sounds, IPA.

Phonology:Phone,phoneme,allophone; Distinctive features;Phonologicalrules;Syllable.

Morphology: Units of word's internal structure, word formation processes, inflectional and derivationalmorphology, compound words and how they are formed.

Syntax: Types of sentences, Sentence structures, Phrase structure grammar.

c) Fromevolutionperspective:HistoricalLinguistics



d) From usage perspective:Sociolinguistics

e) From Psychological perspective: Mechanisms of language acquisition, knowing more than one language

f) Indian Grammatical Tradition: A communication model forlanguagestudy. Paninian grammaticalmodel.

g) WritingSystems:Representing languagethroughgraphiccharacters.

Mapping of Course Outcomes to Program Objectives

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	2	2							1	1					2	2
CO 2	2	2							1	1					2	2
CO 3	2	2							1	1					2	2
CO 4	1	1							3	3					1	1
CO 5	1	1							2	2					1	1

GRADING:

Assignments: 15%,

Mid Sem: 30%, End Sem: 35% and Project: 20%

PROJECT: The students willworkonahands-onproject onlanguageanalysis. In the project they are expected to work with real time data and understand its nature.

PREFERRED TEXTBOOK:

Language: Nature, Psychology and Grammatical Aspects by Victoria Fromkin, Robert Rodman and Nina Hyams, Cenage Learning (Indian Edition)

REFERENCE BOOKS:

1.LinguisticsbyJeanAitchison,5thedition.London:HodderHeadline,TeachYourselfBooks, 1999.ISBN:0-340-73733-6.Retitledandreprintedwithcorrectionsas:Linguistics:AnIntroduction.2ndedition.London:HodderHeadline,1999.ISBN:0-340-75792-2).Introduction.Introduction.



2. IntroductiontoLanguagebyFromkin,V.A.andRodman,R.,1997.HarcourtBrace.6th edition

Value Education-1

Name of the Academic Program: B. Tech. in ECE, BTech in CSECourse Code: OC3.101Title of the Course: VALUE EDUCATION - IL-T-P: 12-6-0 (Total number of hours)Credits: 2(L= Lecture hours, T=Tutorial hours, P=Practical hours)

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

	PO 1	P(2	C	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	-	-		-	-	-	3	2	3	2	-	-	-	-	-	-	-
CO 2	-	-		-	-	-	3	3	3	3	-	-	-	-	-	-	-
CO 3	-	-		-	-	-	3	3	3	2	-	-	-	-	-	-	-
CO 4	-	-		-	-	-	2	3	3	3	-	-	-	-	-	-	-
CO 5	-	-		-	-	-	3	3	3	2	-	-	-	-	-	-	-



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

4.Detailed Syllabus:

Unit 1: Goal in life - short term and long term goals; Basic aspirations - Happiness and Prosperity; Role of education and human conduct; Self-exploration; Developing a holistic view

Unit 2: Gratitude and the need to acknowledge one's gratefulness; Understanding Self and Other;

Unit 3: Living in harmony at 4 levels: self-self, self-family, self-society, self-nature

Unit 4: Understanding needs of body and self; Right understanding of physical facilities and relationships; Understanding human relationships; Trust and Respect - the foundational values in relationships;

Unit5: Harmony in Society; The sense of safety, justice and peace in society; Nature and Sustainability; Self-reliance and Gandhian thought

Reference Books:

1. R.R. Gaur, R. Sangal, G. P. Bagaria. 2009. A Foundation course in Human Values and Professional Ethics. Excel books, New Delhi.

2. Randy Pausch. 2008. The Last Lecture. Hachette Books.

3. E. F. Schumacher. 1973. Small is beautiful: a study of economics as if people mattered. Blond & Briggs, Britain.

4. P. L. Dhar, R. R. Gaur. 1990. Science and Humanism. Commonwealth Publishers.

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

This is a discussed based course. The instructor shares information on a topic and guides the discussion in the class by asking the right questions. By keeping the objectives in mind, the instructor adopts different techniques including smaller group discussions, role-play/skit, use of video clips or images to 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.)

Linear Algebra

Name of the Academic Program	: BTech in Computer Science
Course Code	:
Title of the Course	: Linear Algebra



L-T-P	: 3-1-0
Credits	:4

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: Explain 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 Cour	se Outcomes (COs) with	Program	Outcomes	(POs)	and Program	Specific
Outcomes (PSOs))						

Outc	omes	5 (PS)	(0s)														
	РО	РО	РО	РО	РО	РО	РО	РО	РО	РО	РО	РО	PSO1	PSO2	PSO3	PSO4	
	1	2	3	4	5	6	7	8	9	10	11	12					
CO1	2	3	1	3	1	1	1	1	2	2	1	3	1	1	1	2	
CO2	1	2	2	2	1	1	1	1	2	2	1	1	3	1	1	2	
CO3	2	3	1	3	1	1	1	1	2	2	1	3	2	1	1	2	
CO4	1	3	2	2	1	1	1	1	2	2	1	1	3	1	2	2	
CO5	1	3	2	3	1	1	1	1	2	2	1	1	3	1	1	3	
CO6	1	2	1	2	2	1	1	1	2	2	1	2	3	2	2	2	

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

Detailed Syllabus:

Unit 1: Vector spaces, subspaces, Linear dependence, Span, Basis, Dimension, Finite dimension vector spaces Linear transformation, Range and Null space of linear transformation, Rank Nullity Theorem, Sylvester's Law, Matrix representation of a linear transformation for finite dimensional linear spaces, Matrix operations, change of basis, Rank of a Matrix, Range and Null Space of a matrix representing a linear transformation. Linear spaces with inner product [inner product example over space of functions: orthogonality and orthogonal functions in L_2 .



Unit 2: System of Linear Equations, Row-echelon form, reduced row-echelon form. Gauss-Jordon elimination, Solution of linear systems using Gauss-Jordon elimination, matrix inversion by Gauss Jordon elimination, Understanding Range Space and Solution Space using Rank-Nullity Theorem.

Unit 3: Eigenvalues and Inner product: Eigenvalues & Eigenvectors, Norms, Inner Products and Projections, Applications like Analysis of Random Walks.

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

Reference Books:

- 1. Linear Algebra, 2nd edition, K. Hoffman and R. Kunze., Publishers, Edition, Year
- 2. Finite Dimensional Vector Spaces, P. Halmos., Publishers, Edition, Year
- 3. Introduction to Linear Algebra, Gilbert Strang., Publishers, Edition, Year
- 4. Linear Algebra Done Wrong, Sergei Treil., Publishers, Edition, Year

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):

In-class Quizes: 15% Assignments: 15% Class Test 1: 10% Class Test 2: 10% Mid Semester Exam: 20% End Semester Exam: 30%

Data Structures and Algorithms

Name of the Academic Program	: B.Tech in Computer Science and Engineering
Title of the Course	: Data Structures and Algorithms
L-T-P	: 3-1.5-3.
Credits	: 4
(L = Lecture Hours, T = Tutorial Hou	rs, $P = Practical Hours$)

1. Prerequisite Course / Knowledge:

CS1.302 - Computer Programming

2. Course Outcomes (COs)

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

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

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

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

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



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

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

4. Detailed Syllabus

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

Reference Books:

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

5. Teaching-Learning Strategies in brief

Lectures are conducted in a highly interactive fashion. The design and implementation of data structures and sorting/searching algorithms is done as an in-class coding exercise. Tutorial sessions are used to teach the



utilization of tools such as Visual Studio Code, Git etc. Lab sessions are used to solve programming assignments and teaching assistants help students in developing program logic, debugging etc. on an individual basis. Faculty conducts office hours once in week. Additionally, teaching assistants conduct office hours. This ensures continuous support to students. Five to six programming assignments are designed which gives an in-depth understanding of various concepts discussed in the class and their application to new problem scenarios along with proper analysis. Some problems involve evaluating, comparing multiple solution approaches.

6. Assessment methods and weightages in brief

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

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

Introduction to Software Systems

Name of the Academic Program : Bachelor of Technology in Computer Science and EngineeringCourse Code: CSETitle of the Course: Introduction to Software SystemsL-T-P:1-0-3Credits:2(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Prerequisite Course / Knowledge: Not applicable.

2. <u>Course Outcomes (COs</u>)(5to8fora3or4creditcourse):

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

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

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

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

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

	Р О 1	P O 2	Р О 3	Р О 4	Р О 5	P O 6	P O 7	P O 8	P O 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
C 01	2								2							
С	3		2		2				2	2		1				



02										
С ОЗ	3		1	3		3	1			

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

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

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

Unit2: Developing web applications-Introduction to HTML, CSS, and Javascript concepts, Datatypes, variables, operators, conditions, loops, functions, function expressions, events, form controls, data structures, javascript libraries, AFrame, Three.js

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

Unit4: SDLC and Databases–SDL Cconcepts, Version Control Systems, Editors, Bugtrackers, Basics of SQL, CRUD;

Reference Material/Books:

1. Mastering Linux Shell Scripting : A practical guide to Linux command-line, Bash scripting, and Shell programming, by Mokhtar Ebrahim, Andrew Mallett. 2ndEdition, 2018.ISBN-13 :978-1788990554

2. Learning Python: Powerful Object-Oriented Programming, by Mark Lutz. 5thEdition, 2013.ISBN-13:978-1449355739

3. JavaScript: The Definitive Guide, by David Flanagan. 7thEdition, 2020.ISBN-13: 978-1491952023

4. Workbook/Gitbook created by the course instructors (<u>https://serciiit.gitbook.io/introduction-to-software-systems</u>/)

5. Teaching-LearningStrategiesinbrief(4to5sentences):

The course is delivered using problem based learning methodology. The major goal of the course is to introduce the students to various software and systems technologies and tools that can facilitate them to develop simple software systems. To achieve this goal, the course is delivered as a combination of lectures and tutorial sessions that provide students with hands-on experience in understanding the problem and implementing solutions using the corresponding software technologies and tools.

6. <u>Assessmentmethodsandweightagesinbrief</u>(4to5sentences):

Mid Semester Exam – 15% End semester Exam – 20% Assignments (3) – 25 % Labs (4 tests) – 20% Others– 20% (In-class Activities, Surprise quiz/test)



Computer Systems Organization

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

Course Code: CS2.201

Title of the Course: Computer Systems Organization

L-T-P: 3-1-0. Credits:4

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

1. Prerequisite Course / Knowledge:

Digital logic circuits and design. Combinational and Sequential Circuits. Fundamentals of Programming.

2. Course Outcomes (COs)

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

CO-1:Explain the Von Neumann Model of Computing. Describe all the steps involved in the execution of a program: composition, compilation, assembly, linking, loading and hardware interpretation of the program instructions. (Cognitive Level: Understand)

CO-2:Describe the instruction set architecture design principles. Show how programming language constructs can be mapped to sequences of assembly language instructions. Analyze and assess any given ISA. (Cognitive Levels: Analyze and Evaluate)

CO-3: Describe processor design architectural approaches. Compare and contrast sequential designs with pipelined designs. Propose new architectural approaches to optimize on performance and hardware costs (Cognitive Levels: Apply, Analyze and Create)

CO-4:Describe the basic functionality of an operating system. Clearly explain the system call interface, its design and implementation. Build systems akin to a bash shell, file server etc. using system calls. (Cognitive Levels: Understand and Apply)

CO-5:Describe the basics of process control and management. (Cognitive Levels: Understand and Apply)

CO-6:Describe the principles of virtual memory management. Analyze various memory management schemes for process isolation and physical memory utilization across multiple processes (Cognitive Levels: Understand, Apply and Analyze)

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

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HYDERABAD

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

4.Detailed Syllabus

- Unit 1:
 - o Basic computer organization, Von Neumann architecture and stored program concept
 - o High level programming languages, assemble code, binary instructions, compilers and assemblers
 - o Programming editing, compilation and execution cycle
- Unit 2:
 - o Instruction Set Architecture Design Principles
 - o CISC vs RISC ISAs
 - o Binary encoding of the instructions
 - o Mapping language constructs such as expressions, if-then-else statements, loops, functions to assembly code
 - o Machine representation of numbers
- Unit 3:
 - o Processor design fundamentals
 - o ALU Design
 - o Single Cycle and Multi Cycle Processor Design
 - o Pipelined Architectures
 - o Hazards in Pipelined Architectures and approaches to resolve them.
- Unit 4:
 - o Introduction to Operating Systems. Bootstrapping Process
 - o System Calls, their design, implementation and application.
 - 0



- Unit 5:
 - o Process Control and Management
 - o Scheduling multiple processes on multiple cores.
 - o Basics of scheduling mechanisms and policies.
- Unit 6:
 - o Physical vs Virtual Memory
 - o Process and memory isolation/protection mechanisms
 - o Virtual memory management
 - o Page replacement algorithms

Reference Books:

- 1. Computer Systems: A Programmer's Perspective. Randal Bryant and David O'Hallaron
- 2. Computer Organization and Design. The Hardware/Software Interface. David A. Patterson and John L. Hennessy.
- 3. Operating Systems: Three Easy Pieces by Remzi H. Arpaci-Dusseau and Andrea C. Remzi H. Arpaci-Dusseau
- 5. Teaching-Learning Strategies in brief

Lectures are conducted in a highly interactive fashion. Use of various system tools such as compilers, assemblers, loaders, linkers, simulators etc. are demonstrated live in the class. Assignments include assembly language programming, digital system design exercises such as Arithmetic and Logic Unit Design, programming using system calls. Most of the ideas introduced in the class are emphasized through these assignments. Teaching Assistants and Faculty conduct office hours every day. Thus students have continuous access to resources to get their doubts clarified and seek any extra help that is required. Some times students are encouraged to come to the board and explain the novel design ideas they came up with while solving assignments or mini-projects.

6.Assessment methods and weightages in brief

- 1. Programming Assignments (5 to 6) :25 percent
- 2. Two Quizes: 2 x 10 percent
- 3. Mid Term: 20 percent
- 4. Final Exam: 35 percent

Title	: Introduction to Linguistics 2: Semantics, Pragmatics and Discourse
Credits	: 3-0-1-4
Faculty name	: Aditi Mukherjee



Type when: Spring 2022Prerequisite: Introduction to Linguistics 1.COURSE OUTCOME:

CO-1: Students will have a good understanding of semantic and contextual analysis of texts

CO-2: Students will be introduced to different semantic and pragmatic theories

CO-3: It will enable them in building text processing tools and systems

CO-4: Other than English, they will explore different languages in class working in teams.

CO-5: Using real examples, they will analyse conversational data to understand the concepts.

COURSE TOPICS:

SEMANTICS

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

PRAGMATICS

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

DISCOURSE

Structure of text and coherence. Local coherence and global structure. Conversation analysis. Coreference. Anaphora, Cataphora, Endophora. Discourse connectives and relations.

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

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

РО	PO1	PO1	PO1	PSO1	PSO2	PSO3	PSO								
1	2	3	4	5	6	7	8	9	0	1	2	1501	1502	1505	4



CO1	2	2								2	2
CO2	2	2								2	2
CO3	2	2								2	2
CO4						3	3				
CO5						2	2				

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

TEXT BOOKS:

John Saeed (2009) Semantics

Geoffrey Leech (1983) Semantics: the Study of Meaning

SUGGESTED READINGS:

JohnLyons (1995). Linguistic Semantics.

Cruse Alan (2004). Meaning in Language: An Introduction to Semantics and Pragmatics. Part 2 and Part 4.

Levinson, Stephen C. (1983). Pragmatics.

Brown, G and Yule, G. (1983). Discourse Analysis.

Cutting Joan (2002). Pragmatics and Discourse: A resource book for students.

GRADING:

Assignments: 15%,

Mid Sem: 30%,

End Sem: 35%

Seminar: 20%

Title of the Course	: Computational Linguistics 1
Faculty Name	: Radhika Mamidi
Name of the Academic Program	: CLD
Course Code	: CL3.101
L-T-P	: 3-1-0
Credits	: 4
(L=Lecture hours, T=Tutorial hours,	

P=Practical hours)


1.Prerequisite Course / Knowledge:

Introduction to Linguistics-1

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

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

CO-1 Use computational methods to analyse language at morpho-syntactic levels

CO-2 Develop requisite skills for text and speech problem solving

CO-3 Develop computational resources and tools for Indian languages with different language structures

CO-4 Perform theoretical research at phonology, morphology and syntax levels

CO-5 Apply CL/NLP techniques for real world applications by using real time data

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3	2	2	1	1	3	1	2	2	1	1	2	3	1	2	3
CO 2	3	3	2	3	3	3	1	2	2	1	1	2	3	1	2	3
CO 3	3	2	2	3	3	3	3	2	2	3	1	1	3	1	3	3
CO 4	3	2	2	3	3	3	1	2	2	1	1	2	3	1	3	3
CO 5	2	2	2	1	1	3	1	2	3	3	1	3	3	1	2	3

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

4.Detailed Syllabus:

Unit 1: What is CL and where does it apply? Issues and challenges; Language processing pipeline for text processing: Structural Analysis at various levels – word (POS, morphology), phrase (chunk), sentence (syntactic parsing). Word meaning: Lexical Semantics, Dealing with Ambiguities (WSD/WTD)



Unit 2: Morph analysis: Morph analysers and word generators; Recap of basic units in word formation: morphemes, allomorphs. Word formation: Affixation, suffixation, prefixation, infixation; Nonconcatenative, Compounding, Morphotactics; Constraints on affixes; Morphophonology; Types of word formation processes (function based): inflectional, derivational; Developing morph analysers and generators: finite state automata, paradigmtables, add-delete rules; Word Meaning: Lexical semantics, Hypernymy, hyponymy, synonymy, antonymy, lexicon and lexicography; machine readable dictionaries, WordNet, ConceptNet, VerbNet etc.

Unit 3: Shallow parsing and sentence analysis: Words and their arrangements in a sentence. POS Tagging Word classes, Parts of Speech, POS tagging, Rule based parts of speech taggers, Statistical parts of speech taggers, Annotating POS tagged data, Issues in tagging, Definingtagset for your languages. Shallow parsing (arrangement of words in a sentence) Local Word Grouping (LWG) Grouping functional words such as prepositions/postpositions and auxiliaries with the content words (nouns, verbs); Chunking: Forming minimal phrases; Multi-Word Expressions (MWEs): Named entities (NEs), Idioms, compounds. Types of named entities; compositionality in MWEs.

Unit 4: Syntactic Parsing: Analysing the structure of a sentence, grammatical approaches; Constituency Analysis:Constituents/ phrases; Deriving sentences using phrase structure rules (CFG); Constraints on rules; Subcategorization; verb argument structure. Representing phrase structures: X-bar schema, Complements and Adjuncts; Syntactic operations: Substitution, adjunction and movement. Syntactic phenomena: Passive, Raising, Control; Dependency Analysis: Dependency structures: Head – modifier relations. Paninian grammar – a dependency framework – relations in Paninian grammar: karaka, tadarthya, hetuetc; Vibhakti - relation marker; karaka vibhakti mapping, karaka chart; Parsing approaches: English parsers, Hindi/IL parsing using Paninian framework.

Unit 5: Speech Processing:Introduction to speech processing: Speech production; Speech perception; Speech analysis; Speech Recognition; Speech Synthesis

Reference Books:

- 1. Jurafsky& Martin, 2000; Speech and Language Processing, Pearson Education
- 2. Bharati et al., 1995; Natural Language Processing: A Paninian Perspective
- 3. Fundamentals of Speech Recognition by <u>Lawrence Rabiner</u>, <u>Biing-Hwang Juang</u>
- 4. The Oxford Handbook of Computational Linguistics. 2003. RuslanMitkov (ed)

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

This is a mix of theory and project based. The focus is on using the methods taught in class to extend to Indian languages



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

How the students are able to connect the linguistic concepts by using computational techniques to analyse and generate data at the level of sound, word and sentence. The course will have a project content where students will study and solve a problem using real language data. The focus is on individual as well as collaborative learning.

Type of Evaluation	Weightage (in %)
Assignments	15%,
Seminar	10%
Project	25%,
Midsem Exam	15%,
Endsem Exam	35%

Probability and Statistics

Name Of the Faculty: Pawan Kumar

Course: CSE

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

Course Code: MA6.101

Title of the Course: Probability and Statistics

L-T-P: 3-1-0. Credits: 4

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

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 theaxioms 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 theirapplications.

CO-6. Outline a proof of stated theorem and writethelogically derived proof.

3. Mapping of Course Outcomes	(COs) with Program	Outcomes (POs) a	and Program Specific
Outcomes (PSOs) - Course Artici	ulation Matrix		

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	1	3	1	1	-	-	-	-	2	2	-	3	3	-	-	3
CO 2	1	3	1	3	1	-	-	-	2	2	-	3	3	-	-	3
CO 3	1	3	1	3	1	-	-	-	2	2	-	3	3	-	-	3
CO 4	1	3	2	3	1	-	-	-	2	2	-	3	3	-	-	3
CO 5	2	3	2	3	1	-	-	-	2	2	-	3	3	-	-	3
CO 6	1	3	1	1	-	-	-	-	2	2	-	3	3	-	-	3

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

4. Detailed Syllabus:

Unit 1: Discrete Random Variables:Probability mass function, expectation and variance. Bernoulli distribution, Geometric distribution, Binomial distribution. Derivation of mean and variance. Sampling with and without replacement. Hypergeometric distribution and Poisson distribution. Derivation of the Poisson distribution as limiting form of Binomial. Derivation of mean and variance. Bounding probabilities, tail sum



formula, Markov's inequality and Chebyshev's inequality. Probability generating functions and moment generating functions. (9 hours)

Unit 2: Continuous Random Variable: Probability density function, cumulative distribution function, expectation, mean and variance. Moment generating functions and uniqueness theorem. Chebyshev's inequality. The uniform distribution on (a, b), the normal distribution. Mean and variance of the normal distribution. The Cauchy distribution. The exponential distribution, moments, memoryless property, hazard function. Gamma distribution, moments, Chi-square distribution. (9 hours)

Unit 3: Multivariate Distributions: Cumulative distribution function method for finding the distribution of a function of random variable. The transformation rules. Discrete bivariate distributions, marginal and conditional distribution and multinomial distribution. Continuous bivariate distributions, marginal and conditional distributions, independence of random variables. Covariance and correlation. Mean and variance of linear combination of two random variables. The joint Moment generating function (MGF) and MGF of the sum. The bivariate normal distribution, marginal and conditional distributions, conditional expectation and variance, joint MGF and marginal MGF. Linear combinations of independent random variables. Means and variances. Sequences of independent random variables and the weak law of large numbers. The central limit theorem, normal approximation to the binomial distribution. (9 hours)

Unit 4: Statistical Inference and Random Processes: Point Estimation, Interval Estimation, Hypothesis Testing, Linear Regression, Bayesian Inference. Point Processes, Poisson Process, Discrete Time Markov Chains. (9 hours)

References:

- Sheldon Ross, Introduction to Probability Models, Academic Press, 2010.
- Online resource: <u>https://www.probabilitycourse.com/</u>
- A first course in Stochastic Models, H. C. Tijms, Wiley, 2003.
- Introduction to Probability and Statistics for Engineers and Scientists, S. Ross, 5th Edition, Academic Press, 2014.

5.Teaching-Learning Strategies in brief:

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

6. Assessment methods and weightages in brief:

Assignments in theory: 15 marks, Mid Semester Examination-1: 25 marks, Mid Semester Examination-2: 30 marks, End Semester Examination: 30 marks



Faculty Name	: Dipti Misra Sharma
Name of the Program	: CLD
Course Code	: CL2.203
Credits	: 4
L - T - P	: 2-1-0
(L - Lecture hours, T-Tutoria	al hours, P - Practical hours)
Semester, Year	: Monsoon 2022
(Ex: Spring, 2022)	
Pre-Requisites	: None

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Course Outcomes

The course intends to familiarise students with the social dynamics of language in use.

- 1. 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.
- 2. 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.
- 3. 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.
- 4. The course should give them the confidence to be able to esign and develop computational models in real case scenario.
- 5. The students will be working on real data projects in teams which will give them an experience of working as teams to solve a real problem.

Course Topics

1. Language Variation: Sociolinguistics and sociology of language, Variation in language, Linguistic variables and social variables. Speech Communities, Language, Dialects and Varieties. Standard language and Standardization, Regional and social dialects. Register, styles. Dialectology.

2. Language Contact: Bilingualism/Multilingualism, borrowing, code mixing/switching, pigdinization and creolization, convergence, language maintenance/shift, language acquisition in a multilingual setting. Diglossia with or without bilingualism.

3. Social stratification of language. Inherent variability. Sociolinguistic variables: indicator, marker, stereotype. Style shifting. Hypercorrection. Language variation and language change. Social motivation for sound change.



Sociolinguistic devices for effective communication. Communicative competence. Politeness strategies. Pronouns of power and solidarity.

- 4. Language and Culture : Directions of influence. The Whorfian hypothesis
- 5. Critical Sociolinguistics. Language and power. Language and social attitudes: gender, race, education.
- 6. Language planning: codification and elaboration.

Preferred Text Books

• Ronald Wardaugh : Introducing Sociolinguistics

:

• R. A. Hudson : *Sociolinguistics*

:

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:

• Suzanne Romaine : Language in Society

Reference Books

J.B. Pride and J. Holmes (ed) : Sociolinguistics

- Paolo Giglioli (ed) : Language and Social Context
- Robert Bayley and Ceil Lucas (ed) : Sociolinguistic Variation

E-book Links

- 1. http://staffnew.uny.ac.id/upload/132107096/pendidikan/Book+for+Sociolinguistics.pdf
- 2. <u>https://pdfcoffee.com/cambridge-textbooks-in-linguistics-r-a-hudson-sociolinguistics-cambridge-university-press-1996pdf-3-pdf-free.html</u>

Grading Plan

(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	No
Mid SemExam	20



Quiz-2	10
End Sem Exam	25
Assignments	15
Project	20
Seminar	10
Other Evaluation	None

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

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	Х															
CO 2				Х												
CO 3																
CO 4		Х														
CO 5			Х													
CO 6									X							

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

There will be regular classes with interactive sessions to cover the theory. Since actual learning happens through practical work, each student will take up a project which will involve some field work, literature survey and working with real data. Classic research papers will be distributed for the students to read critically and present them in class. So, the idea is that learning happens through listening and discussions (classes), reading (seminar papers) and working with data (project). For each topic some assignment will be given for the students to get a better grip on the topic.



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

Title of the Course	: Computational Linguistics 2
Faculty Name	: Radhika Mamidi
Name of the Academic Program	: CLD
Course Code	: CL3.202
L-T-P	:3-1-0
Credits	: 4

(L=Lecture hours, T=Tutorial hours,

P=Practical hours)

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

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3	2	3	1	1	3	1	2	2	1	1	2	3	1	2	3
CO 2	3	3	3	3	3	3	1	2	2	1	1	2	3	1	2	3
CO 3	3	2	3	3	3	3	3	2	2	3	1	1	3	1	3	3
CO	3	2	3	3	3	3	1	2	2	1	1	2	3	1	3	3



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

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

4.Detailed Syllabus:

Unit 1: Background for studying word meaning and sentence meaning, sentence meaning and propositional content; sense and reference; referent, extension, prototype, stereotype; deixis and definiteness; predicates, referring expressions, universe of discourse; properties of sentences - analytic, contradiction, entailment; properties of predicates - reflexive, symmetry,transitive. Word meaning and sentence meaning, content word and grammatical word, contextual variation; Speaker meaning vs Sentence meaning. Building resources using Lexical semantic relations - Synonymy, Antonymy, Hyponymy, Troponymy, Meronymy; Metaphor and Metonymy; Polysemy and Homonymy; Semantic fields; Lexical ambiguity; Building dictionaries; Ontologies.

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

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

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

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



Reference Books:

- 1. Jurafsky& Martin, 2000; Speech and Language Processing, Pearson Education
- 2. James R. Hurford& Brendan Heasley (1983). SEMANTICS a course book. Cambridge University Press.
- 3. Judith Greene (1986). Language Understanding a cognitive approach. Open University Press.
- 4. Lyons, John. (1977). Semantics. Cambridge University Press.
- 5. Levinson, Stephen C. (1983). Pragmatics. Cambridge University Press. Leech, Geoffrey. (1983). Principles of Pragmatics. Longman.
- 6. Brown, G and Yule, G. (1983). Discourse Analysis. Cambridge University Press. Cutting, Joan (2002). Pragmatics and Discourse: A resource book for students.
- 7. Allen, James. (1994). Natural Language Understanding. Pearson.

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

This is a mix of theory and project based. The focus is on using the methods taught in class to extend to real time situations and uses.

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

How the students are able to connect the linguistic concepts by using computational techniques to analyse and generate data at the level of semantics and pragmatics. The course will have a project content where students will study and solve a problem using real language data. The focus is on individual as well as collaborative learning.

Type of Evaluation	Weightage (in %)
Assignments	15%,
Seminar	10%
Project	25%,
Midsem Exam	15%,
Endsem Exam	35%

Data and Applications



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

1. Prerequisite Course / Knowledge:

Data Structures

2. Course Outcomes (COs)

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

CO-1. State data requirements for an application.

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

CO-3: Comprehend relational data model 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.

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

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



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

- Unit 1: Data, Database, Database System (3 hours)
- Unit 2: Data models, Conceptual Data Modeling, ER Models (5 hours)
- Unit 3: Relational Data Model, Relational Algebra, Tuple Relational Calculus (6 hours)

Unit 4: SQL, Constraints, Triggers, Database Connectivity, Applications (3 hours)

Unit 5: Normalization, Relational Database Design (4 hours)

• Four mini projects related to the above syllabus will be done by students.

References :

- Elmasri & Navathe, Fundamentals of Database Systems, 6th Edition, Pearson Education, 2013
- Abraham Silberschatz, Henry F.Korth, S.Sudarshan, Database system concepts, fifth edition, Mc Graw Hill, 2006

5. Teaching-Learning Strategies in brief:

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

6. Assessment methods and weightages in brief :

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

Automata Theory

Name	of 1	the Academic 1	Program:	B.Tech.	in Computer	Science and	Engineering	
a	$\mathbf{\alpha}$	1	00	11 000				

Course Code	: CS1.302						
Title of the Course	: Automata Theory						
L-T-P	: 3-1-0.						
Credits	: 2						
(L= Lecture hours, T=Tutorial hours, P=Practical hours)							

1. Prerequisite Course / Knowledge: Data structures, Elementary Formal Logic <u>2. Course</u> <u>Outcomes (COs</u>)



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

CO-1. Develop an understanding of the core concepts of Automata theory such as Deterministic Finite Automata, Non-deterministic Finite Automata, Regular Languages, Context Free Languages, Push down Automata, the basics of Turing Machines

CO-2. Design 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. <u>Mapping of Course Outcomes (COs) with Program Outcomes (POs) and</u> Program Specific Outcomes (PSOs) – Course Articulation Matrix

	Р О 1	P O 2	P O 3	Р О 4	Р О 5	P O 6	P O 7	P O 8	Р О 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
C 01	2	2	1	1	1	1	-	-	2	2	1	2	3	1	1	3
С 02	2	2	3	1	2	-	-	-	2	2	1	2	3	1	1	3
С 03	2	2	3	1	1	-	-	-	2	2	1	2	3	1	1	3
C 04	1	2	2	1	1	1	-	-	2	2	2	1	2	1	1	3

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

4. Detailed Syllabus:

Unit 1: Introduction, Finite State Machines, Deterministic Finite Automata (DFA), Non deterministic Finite Automata (NFA), Equivalence of NFA and DFA, Regular Expressions, Regular Languages, Closure

properties of regular languages, Pumping Lemma, Grammars, Left and Right-linear grammars



Unit 2: Context Free Grammar (CFG), Chomsky Normal Form, Push Down Automata (PDA), Equivalence of CFG and PDA, Context Free Languages (CFL), Deterministic PDA and Deterministic CFL, Pumping Lemma for context free languages

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

References:

• M. Sipser, Introduction to the Theory of Computation, Third Edition, Cengage Learning 2012.

• J.E. Hopcroft, R. Motwani and J. Ullman, Introduction to Automata Theory, Languages and Computation, Third Edition, Pearson, 2006.

5. <u>Teaching-Learning Strategies in brief:</u>

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. <u>Assessment methods and weightages in brief</u>:

Homework: 25% Quiz 1: 20% Quiz 2: 20% Final exam: 35%

Algorithm Analysis and Design

Title of the course	: Algorithm Analysis and Design
Faculty Name	: Suryajith Chillara
Course Code	: CS1.301
Credits	:4
L - T - P	:3-0-0
(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 Course Outcomes

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

CO-1: Demonstrate the ability to fully understand the analysis of various known algorithms.

CO-2: Identify problems where various algorithm design paradigms can possibly be applied.

CO-3: Understand the notions of computational intractability and learn how to cope with hardness.

CO-4: Understand the notion of approximation and randomized algorithms. If time permits, intro to quantum algorithms.

Detailed syllabus:

- 1. Basic graph algorithms
- 2. Greedy algorithms
- 3. Divide and Conquer
- 4. Dynamic Programming
- 5. Network flows
- 6. NP and computational 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)



	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	1	2	2	2	1	1	1	2	1	1	1	2	3	1	1	3
CO 2	2	3	2	2	1	1	1	2	2	2	1	3	3	2	2	3
CO 3	2	3	1	2	1	1	1	2	2	2	1	3	3	2	2	3
CO 4	2	3	1	2	2	1	1	2	2	1	1	3	3	1	1	3

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

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

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

and also solve problems that are based on simple extensions of concepts described in the lectures.

Design and Analysis of Software Systems

Name of the Academic Prog	gram : <u>Bachelor of Technology in Computer Science and Engineering</u>							
Course Code	:							
Title of the Course	: Design & Analysis of Software Systems							
L-T-P:	Credits: 4							
(L=Lecture hours, T=Tutorial hours, P=Practical hours)								



1.Prerequisite Course / Knowledge:Intro to Software Systems

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

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

CO-1: Understand the process of building software, through a live project

CO-2:Inculcate software engineering knowledge, skills, and technologies needed to build software

CO-3: Understand the structured approach and disciplined process (iterative) to develop software

CO-4: Learn the steps in building a reasonably complex piece of usable that is maintainable

CO-5: Enhance written and oral communication skills, needed for software engineering

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

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

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

4.Detailed Syllabus:



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

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



Reference Books:

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

<u>5.Teaching-Learning Strategies in brief</u> (4 to 5 sentences):

The proposed course provides an introduction to software engineering concepts and techniques to undergraduate students using project based methodology. Students work in a small teams to deliver a software system that are proposed by real industrial clients. The course content and project introduces



various software technologies, process and project management skills that are needed for the delivery of software in a team setting.

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

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

CS Program Outcomes (POs)

PO1 Engineering knowledge: Use concepts from varied disciplines including Computer Science, Electronics, Mathematics, and the Sciences, to engineer and develop systems

of varying scale.

PO2 Problem analysis: Identify, formulate and analyze complex engineering problems

reaching substantial conclusions using first principles of Mathematics, Natural Sciences

and Engineering Sciences.

PO3 Design/Development of solutions: Identify and bring to fore the necessary concepts from Computer Science and arrive at creative ways to solve problems that take into account the societal, cultural, and ethical considerations.

PO4 Conduct investigations of complex problems: Interpolate and extrapolate based on existing knowledge base and self-learning skills to investigate the dynamics of complex problems and find solutions.



PO5 Modern tool usage: Demonstrate requisite hands-on skills to work with a variety of software packages, libraries, programming languages, and software development environment tools useful in engineering large scale systems

PO6 The engineer and society: Make judicious use of resources and understand the impact of technology across the societal, ethical, environmental, and economicaspects.

PO7 Environment and sustainability: Find technological solutions by considering the environmental impact for sustainable development

PO8 Ethics: Practice principles of professional ethics and make informed decisions after a due impact analysis.

PO9Individual and team work:Work efficiently in individual and team-oriented projects of varying size, cultural milieu, professional accomplishments, and technological backgrounds.

PO10Communication: Effectively communicate and exchange ideas and solutions to any individual including peers, end-users, and other stakeholders.

PO11 Project management and Finance: Apply the principles of project management in general and software project management in particular with focus on issues such as the life cycle, scoping, costing, and development.

PO12 Life-long learning: Exhibit the aptitude for independent, continuous, and life-long learning required to meet their professional and career goals.

Program Specific Outcomes (PSOs)

PSO1Exhibit 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

PSO2Perform gap analysis in terms of systems and technologies and prepare roadmaps for incorporating state-of-theart 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

PSO4Demonstrate knowledge and skills at the required depth and breadth to excel in post-graduate and research programs

Machine, Data and Learning

Name of the Academic Program: B.Tech	h. in Computer Science and Engineering
Course Code	:
Title of the Course	: Machine, Data and Learning
L-T-P	: 3-1-0
Credits	: 4

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

1. Prerequisite Course / Knowledge:



Data Structures, Computer Programming

2. <u>Course Outcomes (COs</u>)

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

CO-1. Understand basic ML concepts such as Underfitting, Overfitting and Bias-Variance tradeoff CO-2. Gain hands-on experience of applying these concepts to example problems

CO-3. Understand local search techniques with focus on Genetic algorithms CO-4. Understand the basics of Probability and Utility theory

CO-5. Usage of these concepts in the context of formal models such as Decision theoretic models and Bayesian networks CO-6. Understand Decision tree learning and notion of Information Gain

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	PO 9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3	PSO 4
CO 1	3	3	3	2	2	3	-	-	3	2	2	2	1	2	2	1
CO 2	2	2	3	1	1	3	-	-	3	2	1	2	1	2	2	1
CO 3	2	1	3	1	1	3	-	-	3	2	1	2	1	2	2	1
CO 4	2	2	3	2	2	3	-	-	3	2	2	2	1	2	2	1
CO 5	3	3	3	2	1	3	-	-	3	2	1	2	1	2	2	1
CO 6	3	2	3	2	1	3	-	-	3	2	1	2	1	2	2	1

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

4. Detailed Syllabus:

Unit 1: Overview of AI and ML

Unit 2: Basic ML concepts including Data and generalization, Overfitting, Underfitting, Bias-variance tradeoff



Unit 3: Local Search Techniques, Genetic Algorithms Unit 5: Basics of Probability and Utility Theory Unit 6: Decision Theory, Markov Decision Process, Modeling observation errors

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

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

5. <u>Teaching-Learning Strategies in brief</u>:

The course lectures will cover the core concepts while assignments will provide ample scope to implement and understand many of the concepts in more detail. Learning of theoretical concepts and problem solving will be enabled via quizzes, mid and final exams.

6. Assessment methods and weightages in brief :

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

Title of the Course	:Digital Signal Analysis
Course Code:	
Faculty Name	: Anil Kumar Vuppala
Name of the Academic Program	: B. Tech. in CSE
L-T-P : 2-1-0	
Credits: 2	
Prerequisite Course / Knowledge:	

No prerequisite as it is a core course for CLD program.

Course Outcomes (COs):

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

CO-1 : Introduce the fundamentals of digital signal representation and processing to undergraduate students of CLD/CS/CSD.

CO-2: Introduce the advantage of a transformed domain representation.

CO-3: Application of basic signal processing to speech signals.

<u>Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes</u> (PSOs)



	РО 1	P O 2	P O 3	РО 4	РО 5	РО 6	РО 7	P O 8	РО 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
C O 1	3	2	1	1	1	1	1	1	2	1	1	2	-	3	-	-
C O 2	3	2	1	1	1	1	1	1	2	1	1	2	-	3	-	-
C O 3	3	2	2	1	1	1	1	1	2	1	1	2	-	3	-	-

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

Mapping with PSOs, where applicable.

Detailed Syllabus:

Unit 1: Basics of Fourier series and transform, sampling and quantisation, different types of signals and systems.

Unit 2: Z-transform, FIR and IIR systems. Introduction to digital filter design.

Unit 3: Application of concepts using speech signals.

Reference Books:

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

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

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

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

Assignments -- 20%



Quiz

-- 30% End exam -- 50%

Title of the Course	: Language Typology and Universals					
Faculty Name	: Radhika Mamidi					
Name of the Academic Program	: CLD					
Course Code	: CSL1.204					
L-T-P	: 3-1-0					
Credits	: 4					
(L=Lecture hours, T=Tutorial hours,						

P=Practical hours)

1.Prerequisite Course / Knowledge:

Introduction to Linguistics-1 and 2

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

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

CO-1 Analyse language at morpho-syntactic and semantic levels

CO-2 Discuss he similarities and differences between languages

CO-3 Demonstrate understanding of language development and language loss in humans

CO-4 Demonstrate understanding of different language families

CO-5 Build knowledge and do research and be able to build NLP applications in mother tongue

<u>3.Mappingof Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes</u> (PSOs) – Course Articulation Matrix

	PO	PO1	PO1	PO1	PSO	PSO	PSO	PSO								
	1	2	3	4	5	6	7	8	9	0	1	2	1	2	3	4
CO 1		3		2					3						2	2
CO 2		2		3					3						3	3
CO 3		2		2			3								2	2



CO 4	2	2			3			2	2
CO 5	2	2						3	3

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

4.Detailed Syllabus:

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

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

- Unit 3:GREENBERG'S BASIC WORD ORDER TYPOLOGY: Implicational universals and their role in restricting
- possible language types; absolute universals and tendencies; Post-Greenbergian research and reformulation
- of word order typology. CHOMSKYAN APPROACH TO LANGUAGE UNIVERSALS: Language learnability,

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

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

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



phonological oppositions; Syllable types; Phonotactic constraints; Phonological Processes; Language acquisition and dissolution. Phonological universals. MORPHOLOGICAL STRUCTURE: Language types-Analytic, Agglutinative, Synthetic and Polysynthetic: derivational and inflectional categories and types of affixes; Morphological encoding of number, person, gender, tense, aspect and modal features, agreement and case marking; Parts of speech categories.

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

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

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

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

Reference Books:

- 1. Campbell, Lyle. 1998. Historical Linguistics. MIT Press.
- 2. Comrie, Bernard. 1981. Language Universals and Linguistic Typology. Oxford : Basil Blackwell.
- 3. Aitchison Jean. 1976. The Articulate Mammal. London: Hutchinson. Chapters 1-5.
- 4. Subbarao K.V. 2012. South Asian Languages: A Syntactic Typology. Cambridge University Press. Chapters 1,2,5,6 and 8.
- 5. Masica, Colin P.1979. Defining a Linguistic Area. Chicago and London: The University of Chicago Press.
- 6. Emeneau, Murray (1956), "India as a Linguistic Area", Language32 (1): 3–16.
- 7. Jakobson, Roman. 1968. Child Language, Aphasia and Phonological Universals. The Hauge: Muoton.

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

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

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



Type of Evaluation	Weightage (in %)
Assignments	20%,
Seminar	10%
Graded Exercises	10%,
Midsem Exam	20%,
Endsem Exam	40%

Title of the Course	: Introduction to NLP
Faculty Name	: Manish Shrivastava
Name of the Program	: B.Tech. in Computer Science and Engineering
Course Code	: CS7.401
Credits	: 4
L - T - P	: 3-1-0
(L - Lecture hours,	
T-Tutorial hours, P - I	Practical hours)

Semester, Year	: Spring, 2022
(Ex: Spring, 2022)	
Pre-Requisites	: None

:

:

Course Outcomes

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

- I. Demonstrate the knowledge of stages and fundamental building blocks of NLP
- II. Apply NLP machine learning algorithms for classification, representation, and parsing
- III. Demonstrate the knowledge of Dense vector representation for NLP
- IV. Explain the concepts behind distributed semantics
- V. Discuss the approaches to global and contextual semantic representation
- VI. Apply the above concepts for fundamental NLP tasks.

Course Topics

Unit 1: Stages of NLP: from lexical to semantic. Fundamental Language processing: Tokenization, Language modeling, Text classification,



- Unit 2: Morphology, POS Tagging, Chunking, Discriminative vs generative modes, HMM and CRF
- Unit 3: Syntax parsing: Constituency and Dependency, PCFG, projectivity Arc-eager

Unit 4: Distributed semantics: SVD, Word2Vec, RNN, LSTM,

Unit 5: Contextual Distributed semantics: ElMO, BERT

Preferred Text Books :Christopher D. Manning and Hinrich Schütze. 1999. Foundations of Statistical Natural Language Processing. MITPress.

Reference Books :

Jurafsky, Dan, and James H. Martin. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition. Upper Saddle River, N.J.: Prentice Hall, 2000.

E-book Links

Grading Plan

(The table is only indicative)

:

:

Type of Evaluation	Weightage (in %)
Quiz	10
Mid SemExam	10
End Sem Exam	20
Assignments	20
Project	40

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



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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
C 01	1	3	3	2	2	2	1	-	1	1	1	3	3	3	3	2
C O2	3	3	3	3	3	1	1	1	3	3	3	3	3	3	2	3
C 03	3	3	3	3	3	-	-	-	2	2	2	3	3	3	2	3
C 04	3	3	3	3	3	-	-	-	2	2	2	3	3	3	2	3
C 05	3	3	3	3	3	-	-	-	2	2	2	3	3	3	2	3
C O6	3	3	3	3	3	1	1	1	3	3	3	3	3	3	3	3

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

Lectures by integrating ICT into classroom teaching, weekly tutorials involving problem solving and active learning by students and Project-based Learning by doing fourassignments and a project. Evaluation based on personal viva to judge deeper understanding.

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

Intro to Human Sciences

Name of the Academic Programs: B.Tech. in CSE, B.Tech in ECETitle of the Course: Introduction to Human Sciences



Course code L-T-P Credits : HS8.102 : 3-1-0 : 4

1. Prerequisite Course / Knowledge: Nil

2. Course Outcomes (COs)

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

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

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

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

CO4: Analyze crucial normative elements and descriptive frameworks in human sciences inquiry

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

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

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

	PO1	PO2	PO3	PO4	PO5	PO6	PÔ7	P08	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	3	1	1	3	2	3	1	1	-	3	1	1	2	3
Ċ02	2	2	3	3	2	3	2	3	1	3	1	3	1	1	2	3
ĊO3	2	2	2	3	1	3	2	3	1	2	1	1	1	1	2	3
CO4	1	2	2	3	1	2	2	3	2	2	-	2	1	2	1	3
Ċ05	2	2	3	3	1	2	3	3	1	1	1	3	1	2	2	2
CO6	2	2	3	3	1	3	3	3	2	2	1	2	1	1	3	2

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

4. Syllabus:

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

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



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

Reference books:

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

5. Teaching-Learning Strategies in brief:

Each module will have one faculty giving six lectures of 90 mins each Through discipline specific modes of understanding and everyday examples, class lectures will enable students to connect and ponder about themselves, the society and cultures that surrounds them. The teaching-learning strategy emphasises the merits of avoiding simplistic solutions to complex problems and instead ask meaningful questions that enrich debates about how we produce, distribute, consume, reflect, represent, and govern ourselves. Lectures impress upon students the need to critically reflect on issues that are impacted by technology, the historical and social context of the world they live in, the literary and philosophical ideas that permeate human thought and psychological principles of human behaviour.

6. Assessment methods and weightages in brief:

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

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

Value Education-2

Name of the Academic Program	: B. Tech. in ECE, BTech in CSE
Course Code	: OC3.101
Title of the Course	: VALUE EDUCATION - 2
L-T-P	: 12-6-0 (Total hours)
Credits	: 2
(L= Lecture hours, T=Tutorial hours	, P=Practical hours)

1.Prerequisite Course / Knowledge: -NIL-



2. Course Outcomes (COs) :

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

CO-1: Apply the basic framework of universal human values to understand oneself

CO-2: Explain the relation of self with family, society and nature

CO-3: Explain the concept of living in harmony at all the levels

CO-4: Demonstrate the right understanding of relationships and Right utilization of physical facilities

CO-5: Realise the long-term goal of being happy and prosperous

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-	-	3	2	3	2	-	-	-	-	-	-	-
CO2	-	-	-	-	-	3	3	3	3	-	-	-	-	-	-	-
CO3	-	-	-	-	-	3	3	3	2	-	-	-	-	-	-	-
CO4	-	-	-	-	-	2	3	3	3	-	-	-	-	-	-	-
СО5	-	-	-	-	-	3	3	3	2	-	-	-	-	-	-	-

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

4.Detailed Syllabus:

Unit 1: Revisiting goal in life - short term and long term goals; Basic aspirations - Happiness and Prosperity; Role of education and human conduct; Self-exploration; Developing a holistic view

Unit 2: Self-reflection and reflecting on relationships; understanding value-based life

Unit 3: Living in harmony at 4 levels: self-self, self-family, self-society, self-nature

Unit 4: Harmony in Society; Broadening one's perceptions;

Unit5: Nature and Sustainability; Our role in protecting Nature;

Reference Books:

1. R.R. Gaur, R. Sangal, G. P. Bagaria. 2009. A Foundation course in Human Values and Professional Ethics. Excel books, New Delhi.

2. Randy Pausch. 2008. The Last Lecture. Hachette Books.



3. E. F. Schumacher. 1973. Small is beautiful: a study of economics as if people mattered. Blond & Briggs, Britain.

4. P. L. Dhar, R. R. Gaur. 1990. Science and Humanism. Commonwealth Publishers.

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

This is a discussed based course. The instructor shares information on a topic and guides the discussion in the class by asking the right questions. By keeping the objectives in mind, the instructor adopts different techniques including smaller group discussions, role-play/skit, use of video clips/films or images to analyse and some activities to keep the students engaged in class throughout. Talks by experts who made a difference are also organised for the batch.

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

This is a Pass/Fail course. The assessment methods include submissions of assignments and term papers. Critical thinking is expected from watching relevant short films or by reading assigned books. The classroom participation is also taken into consideration for evaluation. There are a few community-based activities and projects also. Participation in them is also important.

Weightage for each kind of assessment may be given

Title of the Course		: Advanced Natural Language Processing							
Fculty Name		: Manish Shrivastava							
Name of the Program		: BTech III year, Computational Linguistics Dual Degree III year							
Course Code		: CS7.501							
Credits		: 4							
L - T - P		: 3-1-0							
(L - Lecture hours, T-Tuto	orial hours,								
P - Practical hours)									
Semester, Year		: Monsoon, 2022							
(Ex: Spring, 2022)									
Pre-Requisites	: None								
Course Outcomes	:								
After completion of th	nis course succe	essfully, the students will be able to $-$							

- I. Demonstrate the knowledge of Advanced building blocks of NLP
- II. Apply NLP machine learning algorithms for Machine Translation, Summarization
- III. Demonstrate the knowledge of Dense and contextual representation for NLP



- IV. Explain the concepts behind Deep Learning models
- V. Discuss the approaches to global and contextual semantic representation
- VI. Apply the above concepts for fundamental NLP tasks.

Course Topics

- A. Distributed Semantics
 - o Contextual Distributed Semantics
- B. Models such as ELMO, BERT, ERNIE and their derivatives
- C. Statistical Machine Translation methods

:

- o Early Neural Machine Translation models
- D. Extractive and Abstractive Summarization
- o Neural Summarization Methods
- E. Reinforcement learning for NLP

Preferred Text Books :

None. Mostly research papers.

Reference Books :

Statistical Machine Translation by Philip Koehn

Deep Learning by Ian Goodfellow

E-book Links

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

:

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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



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Project	40
Term Paper	10
Other Evaluation	

Mapping of Course Outcomes to Program Objectives:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	1	3	3	2	2	2	1	-	1	1	1	3	3	3	3	2
CO 2	3	3	3	3	3	1	1	1	3	3	3	3	3	3	2	3
CO 3	3	3	3	3	3	-	-	-	2	2	2	3	3	3	2	3
CO 4	3	3	3	3	3	-	-	-	2	2	2	3	3	3	2	3
CO 5	3	3	3	3	3	-	-	-	2	2	2	3	3	3	2	3
CO 6	3	3	3	3	3	1	1	1	3	3	3	3	3	3	3	3

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

Lectures by integrating ICT into classroom teaching, weekly tutorials involving problem solving and active learning by students and Project-based Learning by doing fourassignments and a project. Evaluation based on personal viva to judge deeper understanding.

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

Operating Systems and Networks

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

1.Prerequisite Course / Knowledge:


Programming languages, Digital Logic Design, Computer Organization

2.Course Outcomes (COs)

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

CO-1. Extend the concepts of layering and modularity to build new software systems

CO-2. Develop appropriate scheduling/synchronization/memory management/ virtual memory/protection module for a new task-specific operating system.

CO-3: Implement an application on the top of given operating system in an efficient manner based on process and thread framework available in the given operating system.

CO-4. Architect the given system on the top of operating systems by exploiting the system calls of the given operating system services as far as possible.

CO-5. Develop a network-based application by exploiting networking related system calls.

3. Mapping of Course Outcomes (COs)	with Program	Outcomes (PC	Os) and Program	Specific	Outcomes
(PSOs) – Course Articulation Matrix		·		-	

	Р	Р	Р	Р	Р	Р	Р	Р	Р	Р	Р	Р	Р	Р	Р	Р
	0	0	0	0	0	0	0	0	0	0	0	0	S	S	S	S
	1	2	3	4	5	6	7	8	9	10	11	12	0	0	0	0
													1	2	3	4
C 0 1	3	2	1	1	2	-	-	-	3	2	2	3	3	2	1	2
C O 2	3	3	3	2	2	-	1	-	2	2	2	3	2	1	2	2
C O 3	3	3	3	2	2	2	1	-	3	2	2	3	3	2	1	2
C O 4	2	2	3	2	2	3	2	-	3	2	2	2	3	3	2	3
C O 5	3	2	1	1	2	-	-	-	3	2	2	3	3	2	1	2

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



- Unit 1: Introduction, 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
- 2. Computer Networks (5th Edition) Andrew S. Tanenbaum, David J. Wetherall Prentice Hall, 2013
 - 3. Wlliam Stallings, Operating Systems, Prentice-Hall, 2018.
 - 4. Charles Crowley, Operating systems: A design oriented approach, Tata McGraw-Hill, 2017.
 - 5. Tanenbaum, A., Modern Operating Systems, Prentice-Hall, Second Edition (latest edition, 2015.

5. Teaching-Learning Strategies in brief

Lectures by integrating ICT into classroom teaching, weekly tutorials involving problem solving and active learning by students 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

Science-1

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

<u>1.Prerequisite Course / Knowledge</u>: NA <u>2.Course Outcomes (COs)</u> (5 to 8 for a 3 or 4 credit course): Outcomes of the Second Half (Introduction to Biology): After completion of this course successfully, the students will be able to

CO-1: Analyse the aims, methodology of science and technology, and their impact on society

CO-2: Explain Special Theory of Relativity and compute its consequences for typical scenarios of relevance



CO-3: Demonstrate familiarity with Lagrangian and Hamiltonian formulations of mechanics, by formulating the equations of motion from basic principles for mechanical systems

CO-4: Explain connections between thermodynamics and statistical mechanics and their use in modern chemical computations

C0-5: Infer the stability of molecules using the concepts of hybridization and molecular orbital theory

CO-6: Recognize the role of symmetry in nature

CO-7: Demonstrate problem solving skills upto a level that allows application to research topic of their interest

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	2	2	2	1	1	2	1	2	2	1	1	1
CO2	2	2	2	2	1	1	2	1	1	1	1	2	0	3	2	1
CO3	2	2	1	2	1	1	2	1	1	1	1	2	0	3	2	1
CO4	2	2	1	2	1	1	2	1	1	1	1	2	1	3	2	1
CO5	2	2	1	2	1	1	2	1	1	1	1	2	1	3	2	1
CO6	2	2	1	2	1	1	2	1	1	1	1	2	2	2	2	2
CO7	2	2	1	2	1	1	2	1	1	1	1	2	1	1	1	2

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

4.Detailed Syllabus:

Unit 1: Mathematical modeling in sciences, (i) geometry and linear algebra, (ii) change and calculus and (iii) chance and probability. Simple models can have complicated behavior: logistic map demonstrates deterministic chaos

Unit-2: Forms in nature. Scales of length, time and energy in nature.



Unit 2: Special theory of relativity: postulates, Lorentz Transformation, Length Contraction, Time dilation, Doppler effect, relative velocity determination, twin paradox, relativistic momentum and energy. Space time graphs, and relativity of simultaneity.

Unit 3: Review of Newtonian Mechanics and its difficulties / failures. Introduction to Lagranian and Hamiltonian formulations, and application to mechanical problems.

Unit 5: Need for Quantum Mechanics. Schrodinger equation for time-dependent and time-independent scenarios. Application to atoms and molecules; provide qualitative picture of orbital hybridization to explain the molecular structures

Unit 6: Review of Thermodynamics and introduction Statistical Mechanics and applications to problems of relevance. Lasers. Fermi statistics, band-gap in semiconductors.

Reference Books:

- 1. "Concepts in Modern Physics" A Beizer (6th Edition)
- 2. "Classical dynamics of particles and systems" by Stephan Thornton and Jerry Marion (5th editioon)
- 3. "Physical Chemistry" Atkins and de Paula (8th Edition)

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

The objective of the course is to give the CSE/ECE students a good understanding of the concepts in Modern Physics and modern chemistry. To familiarize the students with available web-based resources, and problem solving (whenever possible with scientific programming).

6.Assessment methods and weightages in brief (4 to 5 sentences): Assignments – (20%), Class notes (10%) Preannounced and surpise In-class quizzes (25%), End semester exam (35%)

Science-2

NAME OF FACULTY: Marimuthu Krishnan + Nita Parekh Name of the Academic Program:B. Tech. (CSE) Course Code: SC1.111 Title of the Course: Science II L-T-P: 3-1-0 (L= Lecture hours, T=Tutorial hours, P=Practical hours) Credits: 4



1.Prerequisite Course / Knowledge:NA

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

The course is divided into two halves:

First Half: Computing in Sciences

Second Half: Introduction to Biology

Outcomes of the First Half (Computing in Sciences):

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

CO-1: Outline the uses of Monte Carlo to evaluate multidimensional integrals that appear in theoretical natural sciences

CO-2: Describe numerical algorithms and pseudocodes to solve ordinary and partial differential equations that appear in theoretical natural sciences

CO-3: Apply computational methods to find numerical solutions to scientific problems

Outcomes of the Second Half (Introduction to Biology):

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

CO-1: Familiarize themselves with basic terms and terminology in biology, various biological entities and their function, DNA, RNA, proteins, and enzymes, cell and its functionality,

CO-2: appreciate that biology is very quantitative and how sequence analysis using algorithms can help in understanding the evolution, function of genes and proteins

CO-3: carry out a mini-project to learn how to go from sequence to structure, function and disease association

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

Forthe First Half (Computing in Sciences):

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



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

Forthe Second Half (Introduction to Biology):

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

4.Detailed Syllabus:

Syllabus of the First Half (Computing in Sciences):

Unit 1: Monte Carlo method: Its application in solving large dimensional integrals seen in statistical mechanics and quantum mechanics

Unit 2: Solving linear systems: Huckel molecular orbital approximation for band structure in metallic bonding

Unit 3: Algebra of matrices: Singular-Value Decomposition (SVD), Hessian matrix in normal mode analysis, and spectral decomposition

Unit 4:Differential equations in sciences: Prey predator model, dynamics from Newton Laws, molecular dynamics simulation

Unit 5:Stochastic differential equations: Diffusion, bistability of cellular processes

Unit 6:Partial Differential equations in sciences: Heat equation and wave equation

Syllabus of the Second Half (Introduction to Biology):

Unit 1: Introduction: Classification of Living Organisms, Origin of Life and Evolution, Biomolecules – Nucleotides, Amino Acids, Proteins, Enzymes

Unit 2: Cell Biology: Structure and Function - Prokaryotic and Eukaryotic Cells, Cell Cycle – Cell division – Mitosis, Meiosis, DNA Replication, Transition, Translation – Central dogma, DNA amplification, sequencing, cloning, restriction enzymes



Unit 3: Genetics: Mendelian Genetics – Genetic Disorders, Mendelian Inheritance Principles, Non-Mendelian Inheritance, Clinical Perspective

Unit 4:Macromolecules: DNA, Proteins – Structure, Function, Analysis, Carbohydrates – Features, Structure, Metabolism, Kreb cycle

Unit 5:Biological data analysis: Biological Data – sequence, structure, expression, etc., Sequence Data Analysis – alignment, database search, phylogeny, Applications

Reference Books:

1. Molecular Biology of the Cell by Alberts, Johnson, Lewis, Morgan, Raff, Roberts, Walter

2.Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox

3.Reading the Story in DNA: A Beginners Guide to Molecular Evolution by Lindell Bromham

4. An Introduction to Computational Physics by Tao Pang

5. Molecular Modelling - Principles and Applications by A. R. Leach

<u>5.Teaching-Learning Strategies in brief</u> (4 to 5 sentences):

The objective of the course is to give the CSE students a flavour of biological sciences and scientific computing. To familiarize the students with available web-based resources (databases and tools) for biological sequence analysis and extract meaningful information. Whenever possible, after a theory lecture to follow up with analysis of real sequence data. Give the student small programming tasks in biological data analysis to be able to appreciate the role of computing in biological data analysis. Applications of computational and mathematical models in natural sciences are also discussed.

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

Assignments – (10%), Class Quizzes + Mid-term evaluation (20%), Final exam (20%)

Basics of Ethics

Name of the Academic Program	ns : B.Tech. in CSE, B.Tech in ECE
Title of the Course	: Basics of Ethics
Course code	: HS0.203
L-T-P	: 3-1-0
Credits	: 2

1. Prerequisite Course / Knowledge: Nil

2. Course Outcomes (COs)

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



CO1: Explain the philosophical nature of the basic concepts and principles of ethics

CO2: Analyze ethical arguments for logical validity, soundness, and informal fallacies

CO3: Demonstrate the knowledge of conceptual challenges involved in normative inquiry in the ethical domain

CO4: Develop skills to formulate fundamental nuances in ethical justification and explanations

CO5. Identify the various kinds of normative elements that constitute ethical frameworks

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

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

	PO1	PO2	PO3	PO4	PÔ5	PO6	PÓ7	P08	P09	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	3	1	1	3	2	3	1	1	-	3	1	1	2	3
Ċ02	2	2	3	3	2	3	2	3	1	3	1	3	1	1	2	3
ĊO3	2	2	2	3	1	3	2	3	1	2	1	1	1	1	2	3
Ċ04	1	2	2	3	1	2	2	3	2	2	-	2	1	2	1	3
Ċ05	2	2	3	3	1	2	3	3	1	1	1	3	1	2	2	2
Ċ06	2	2	3	3	1	3	3	3	2	2	1	2	1	1	3	2

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

4. Detailed Syllabus:

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



Reference books:

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

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

6. Assessment methods and weightages in brief:

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

Course descriptions of Elective Courses

Title of the Course	: Information Retrieval and Extraction
Course Code	: CS4.406
Name of the Faculty	: Vasudeva Varma
Name of the Academic Program	: B.Tech. in Computer Science and Engineering
L-T-P	:3-1-1.
Credits	: 4
(I = I ecture hours T = Tutorial hour	s



P=Practical hours)

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

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO4
CO 1	3	3	3	3	3	1	1	-	2	2	2	2	3	3	2	2
CO 2	3	3	3	3	3	1	1	1	2	2	2	2	3	3	2	2
CO 3	3	3	3	3	2	1	1	1	2	2	2	2	3	3	2	2
CO 4	3	3	3	3	2	1	1	-	3	2	2	2	3	3	2	2
CO 5	3	3	3	3	2	1	1	-	3	2	2	2	3	3	2	2

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

4. Detailed Syllabus:

Unit 1: Introduction to Information retrieval, Information Extraction and Information Access systems. (6 hours)

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

Unit 3: Web Information Retrieval (4.5 hours)



Unit 4 Natural Language Processing in IR (7.5 hours)

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

Unit 6: Information Extraction (4.5 Hours)

Unit 7: IR Applications (12 Hours)

References :

- Introduction Information Retrieval Chris Manning et al (the Stanford IR Book) (ISBN-13: 978-0521865715)
- Search Engines: IR in Practice Bruce Craft et al (ISBN-13: 978-0136072249)
- 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	: Speech Signal Processing
Faculty Name	: Anil Kumar Vuppala
Course Code	: EC5.408
L-T-P	: 3-1-0
Credits	:4
Name of the Academic	Program <u>:</u> B. Tech. in ECE
Prerequisite Course / Ki	nowledge:



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)

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

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

Mapping with PSOs, where applicable.

Detailed Syllabus:



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

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

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

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

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

Reference Books:

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

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

It is an introduction to speech processing course, so regular software oriented assignments are given to understand the concepts. Surprise class tests are conducted based on assignments to test the seriousness in assignment solving. As 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):

Quizzes	30%
Assignments	25%
Project	20%
End Viva	25%

Title of the Course	: Intro to Cognitive Science
Course code	: CS9.426
Faculty	: Dr Vishnu Sreekumar
Tas	: NancyHada and KumarNeelabh



Day/Time:MondaysandThursdays:2:00pm-3:25pm.VirtualOfficeHours:Byappointment(pleaseemail).E-mail:vishnu.sreekumar@iiit.ac.in

First point of contact - TA emails: nancy.hada@research.iiit.ac.in; kumar.neelabh@research.iiit.ac.in

Course Information

<u>Course Description</u>: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

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

Course Structure

This course will be delivered fully in-person in a physical classroom unless COVID restrictions make us move online (Microsoft Teams).

Student Expectations

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

- 2. communicate via email
- 3. complete basic internet searches
- 4. download and upload documents to the course site on Moodle
- 5. read documents online
- 6. view online videos
- 7. participate in online discussions
- 8. complete quizzes/tests online



- 9. upload documents to a Dropbox/Moodle
- 10. 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.
- o 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:

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

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

- 16. Attend lectures and participate in class discussions (CO-1, CO-2, CO-3, CO-4, CO-5)
- 17. Debate sessions (CO-1, CO-2, CO-3, CO-5)
- 18. Quiz 1, Quiz 2, mid-semester, and end-semester exams (CO-1, CO-2, CO-3, CO-5)
- 19. 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



	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
C O 1	2	2	3	2	1	2	1	2	1	1	-	2	2	1	1	3
C O 2	1	2	1	3	1	1	1	1	1	1	1	2	1	2	1	3
C O 3	3	2	2	2	-	2	1	1	1	1	2	2	2	1	2	3
C O 4	1	3	2	1	-	1	1	2	1	2	-	2	1	2	2	3
C O 5	2	2	1	3	2	1	1	1	2	3	-	2	2	1	1	3

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

List of topics and activities

- **20. Introduction**
- **21. Evolution of Cognitive Science**
- 22. A free-form discussion on consciousness
- 23. Empirical approaches in cognitive science
- 24. Brain: Organization; Intro to sensation and perception
- 25. Sensory systems
- 26. Perception and Perceptual Learning, Cross-modal interactions
- 27. Vision
- 28. Attention
- 29. Learning
- **30. Development**
- 31. Memory
- **32.** Language and Cognition



33. Knowledge Representation

34. Special topics: e.g. Music, mind, and technology

35. Several debate sessions with student debate teams

Grading Policies

Graded Course Activities

Description	Percentage
Quiz 1(10 marks)	10%
Quiz 2 (10 marks)	10%
Debate reaction paper or debate team participation (20 marks)	20%
Mid-Sem exam(20 marks)	20%
End semester exam (40 marks)	40%
Total (100 marks)	100

Quizzes

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

Mid-semester exam (20 marks)

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

End semester exam (40 marks)

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

Debate participation (20 marks = 10 marks for presenting + 10 marks for a short report)



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

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

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

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

For debate team students (each person writes this separately without discussion with other team members, plagiarism software will be used to check your work), your short report should contain the following:

The paper will first summarize the problem (2 marks), and then summarize the arguments made by both sides (3 marks), and then will provide the student's OWN opinion about where they stand on the debate and what arguments were convincing to them (5 marks).

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

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

Submission window for the short report: Nov 1-10

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

You are welcome to make multiple submissions within this window.

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



Term Paper or debate reaction papers for non-debate team students (20 marks)

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

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

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

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

You are welcome to make multiple submissions within this window.

Participation

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

Complete Assignments

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

Late or missing assignments will affect the student's grade.

Late Work Policy

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

Viewing Grades on Moodle

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



Letter Grade Assignment

Final grades assigned for this course will be based on the percentage of total points earned and are assigned as follows:

Letter Grade	Percentage
А	[92,100]%
A-	[84,92)%
В	[76,84)%
В-	[68,76)%
С	[60,68)%
C-	[52,60)%
D	[45,52)%
F	< 45%

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

Course Policies

Netiquette Guidelines

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

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

- 1. Do not dominate any discussion.
- 2. Give other students the opportunity to join in the discussion.



- 3. Do not use offensive language. Present ideas appropriately.
- 4. Be cautious in using Internet language. For example, do not capitalize all letters since this suggests shouting.
- 5. Avoid using vernacular and/or slang language. This could possibly lead to misinterpretation.
- 6. Never make fun of someone's ability to read or write.
- 7. Share tips with other students.
- 8. Keep an "open-mind" and be willing to express even your minority opinion. Minority opinions have to be respected.
- 9. Think and edit before you push the "Send" button.
- 10. Do not hesitate to ask for feedback.
- 11. Always assume good intentions and ask for clarification. Communication online is difficult without facial and gestural cues.

Adapted from:

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

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

Build Rapport

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

Inform Your Instructor of Any Accommodations Needed

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

Statement of Policy

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



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

Commit to Integrity

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

IIIT Hyderabad Academic Honesty Policy & Procedures

Student Academic Disciplinary Procedures

- (1) Academic misconduct is an act in which a student:
- (a) Seeks to claim credit for the work or efforts of another without authorization or citation;
- (b) Uses unauthorized materials or fabricated data in any academic exercise;
- (c) Forges or falsifies academic documents or records;
 - (d) Intentionally impedes or damages the academic work of others;
- (e) Engages in conduct aimed at making false representation of a student's academic performance; or
- (f) Assists other students in any of these acts.

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

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



TITLE : A Linguistic Introduction to Sanskrit FACULTY NAME : Peter M. Scharf COURSE CODE: CREDITS: 4 TYPE-WHEN : 2019 Winter-spring PRE-REQUISITE : None

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

DESCRIPTION : "The Sanskrit language, whatever be its antiquity, is of a wonderful structure; more perfect than the Greek, more copious than the Latin, and more exquisitely refined than either," Sir William Jones said in his third anniversary address to the Asiatic Society of Bengal on 15 January 1787, and Arthur Schopenhauer wrote in 1819, "Sanskrit literature will be no less influential for our time than Greek literature was in the fifteenth century for the Renaissance." With a continuous production of literature in all disciplines from mathematics and medicine to philosophy and poetry for more than three millennia and more than seven million extant manuscripts, Sanskrit contains the largest body of literature in the world prior to the invention of the printing press. The language itself transparently reveals a rich morphological structure that lent itself to analysis by a linguistic tradition unmatched in its sophistication until its discovery inspired modern linguists to broaden and extent the application of its principles.

1.Prerequisite Course / Knowledge:

None

2.Course Outcomes (COs):

At the end of the course students will be expected to have the ability to read simple Sanskrit containing the common grammatical forms covered, with the help of a dictionary. An additional semester course will complete the survey of basic Sanskrit grammar.

CO-1: To develop the ability to read simple Sanskrit with the help of a dictionary.

CO-2: It gives an insight into the linguistically rich language.

CO-3: Helps students appreciate the classical language and its grammar



CO-4: It will help students to formulate a research problemaround Sanskrit language using computer programming skills they already have.

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

	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PS O 1	PS O 2	PS O 3	PS O 4
C O 1	2	2	2	2											2	2
C O 2	2	2	2	2											2	2
C O 3	2	2	2	2											2	2
C O 4	2	2	2	2											2	2
••••																

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

COURSE TOPICS : The course surveys basic Sanskrit grammar in a linguistically explicit manner accompanied by traditional oral practice and exercises consisting of readings adapted from ancient Indian narratives.



Week Topic

- Week 1 Ch. 1, Introduction to Sanskrit language and literature;
- Ch. 2, The Sounds of Sanskrit, and

Ch. 3, Devanagari script

- Week 2 Ch. 4, Sandhi
- Week 3 Ch. 5, Verbs: present and past indicative active and middle of verbs of classes 1, 4, 6, and 10
- Week 4 Ch. 6, Nouns: masculine and neuter a-stem
- Week 5 Ch. 7, Nouns: feminine long a-stem; a-stem adjectives
- Week 6 Ch. 8, Imperative and optative moods a-stem verbs
- Week 7 Ch. 9, Mono and polysyllabic fem. long i/u-stem nominals
- Week 8 Ch. 10, Present stem of verbs of classes 5, 8, and 9
- Week 9 Ch. 11, i/u-stem nominals
- Week 10 Ch. 12, Vocalic-r-stem nominals
- Week 11 Ch. 12, Present stem of verbs of classes 2, 3, and 7
- Week 12 Ch. 12, continued
- Week 13 Ch. 13, Consonant stem nominals
- Week 14 Ch. 14, Passive voice of the present system
- Week 15 Review

PREFERRED TEXT BOOKS:

Scharf, Peter M. 2010. *Šabdabrahma: a first-year Sanskrit text*. Providence: The Sanskrit Library.

***REFERENCE BOOKS:**

***PROJECT:**

GRADING PLAN:

Type of Evaluation	
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Weightage (in %)



HYDERABAD

Mid Sem-1 Exam	12%
Mid Sem-2 Exam	12%
End Sem Exam	25
Assignments (Weekly homework)	25%
Quizzes (Weekly)	25%

REMARKS:Format and assignments

Generally, I will introduce new material during the first class each week and assign daily home practice, which we will quiz regularly, and weekly exercises which we will and go over together in the second class each week. Mid-terms and the final exam will follow the format of weekly exercises. Because learning a language involves the cumulative acquisition of knowledge and skills, regular attendance and keeping up with assignments will be essential.

Title of the course:	<u>Computational Social Science</u>
Faculty Name:	Ponnurangam Kumaraguru
Course Code:	CS9.435
Credits	4
L - T - P:	3-0-1

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

Name of the Program : Applicable to all Programs on campus including, CSE, CLD, CHD, CND, both at UG & Masters level.

Semester, Year : Spring, 2022

:

(Ex: Spring, 2022)

Pre-Requisites	: Any UG3, UG4, M.Tech., MS, and Ph.D. student should be able to take it

Course Outcomes

• C0-1: Students will describe the opportunities and challenges that the digital age creates for social sciences research.



- C0-2: Students will evaluate modern social research from the perspectives of both social science and data science.
- C0-3: Students will create research proposals that blend ideas from social science and data science.
- C0-4:Students will be able to summarize and critique research papers in Computational Social Science
- C0-5: Students will conduct, develop, and practice the techniques needed to conduct their proposed research, through course project.

Course Topics

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

Module 1: Social Research

- Computational Social Science 101
 - o What is Computational Social Science?

:

- o Is Computational Social Science = or ¹ Computer Science + Social Science?
- o Why study Computational Social Science?
- o Challenges with only Computer Science or Social Science
- o Does Social Media data == Computational Social Science? Class debate.
- Social Science vs. Data Science
- Prediction vs. Causality Read / Listen / Watch:
- Hanna Wallach. 2018. Computational social science ≠ computer science + social data. Commun. ACM 61, 3 (March 2018), 42–44. DOI:https://doi.org/10.1145/3132698

https://cacm.acm.org/magazines/2018/3/225484-computational-social-sciencedata/fulltext computer-science-social-

- Lazer D, Pentland A, Adamic L, Aral S, Barabasi AL, Brewer D, Christakis N, Contractor N, Fowler J, Gutmann M, Jebara T, King G, Macy M, Roy D, Van Alstyne M. Social science. Computational social science. Science. 2009 Feb 6;323(5915):721-3. doi: 10.1126/science.1167742. PMID: 19197046; PMCID: PMC2745217. <u>https://pubmed.ncbi.nlm.nih.gov/19197046/</u>
- Coded Bias
 - o Trailer <u>https://youtu.be/jZl55PsfZJQ</u>
 - o Full documentary <u>https://www.netflix.com/title/81328723</u>

Module 2: Modeling & Causal Inference

- Linear Regression, Model building, Hypothesis testing
- Causal Inference
- Running Experiments Lab, Real-world
- Read / Listen / Watch:



- Blumenstock et al. 2015. Predicting Poverty and Wealth from Mobile Phone Metadata. Science. <u>https://www.unhcr.org/innovation/wp-</u> <u>content/uploads/2016/11/blumenstock-</u> <u>science-2015.pdf</u>
- o Lazer, David and Kennedy, Ryan and King, Gary and Vespignani, Alessandro, Google Flu Trends Still Appears Sick: An Evaluation of the 2013-2014 Flu Season (March 13, 2014). Available at SSRN:

https://ssrn.com/abstract=2408560 or http://dx.doi.org/10.2139/ssrn.2408560

- M. R. Khan, J. Manoj, A. Singh and J. Blumenstock, "Behavioral Modeling for Churn Prediction: Early Indicators and Accurate Predictors of Custom Defection and Loyalty," 2015 IEEE International Congress on Big Data, 2015, pp. 677-680, doi: 10.1109/BigDataCongress.2015.107.
- o Chapter 3 of Mostly Harmless Econometrics: An Empiricist Companion

Module 3: Mass Collaborations

- Human Computation
 - o Galaxy Zoo

§ Lintott, Chris J, Kevin Schawinski, Anže Slosar, Kate Land, Steven Bamford, Daniel Thomas, M. Jordan Raddick, et al. 2008. "Galaxy Zoo: Morphologies Derived from Visual Inspection of Galaxies from the Sloan Digital Sky Survey." Monthly Notices of the Royal Astronomical Society 389 (3):1179–89. https://doi.org/10.1111/j.1365-2966.2008.13689.x

https://watermark.silverchair.com/mnras0389-1179.pdf

§ Kuminski, Evan, Joe George, John Wallin, and Lior Shamir. 2014.

"Combining Human and Machine Learning for Morphological Analysis of Galaxy Images." Publications of the Astronomical Society of the

Pacific 126 (944):959-67. https://doi.org/10.1086/678977.

- o Crowd-coding of political manifestos
 - Benoit, Kenneth, Drew Conway, Benjamin E. Lauderdale, Michael Laver, and Slava Mikhaylov. 2016. "Crowd-Sourced Text Analysis: Reproducible and Agile Production of Political Data." American Political Science Review 110 (2):278–95. <u>https://doi.org/10.1017/S0003055416000058</u> https://kenbenoit.net/pdfs/Crowd_sourced_data_coding_APSR.pdf
- Open Calls
 - o Netflix Prize

§ Netflix. 2009. "Netflix Prize: View

Leaderboard." http://www.netflixprize.com/leaderboard.

§ Bell, Robert M., Yehuda Koren, and Chris Volinsky. 2010. "All Together



Now: A Perspective on the Netflix Prize." Chance 23 (1):24–24. <u>https://doi.org/10.1007/s00144-010-0005-</u>2.

o Foldit: Protein-folding game

- Hand, Eric. 2010. "Citizen Science: People Power." Nature News 466 (7307):685–87. https://doi.org/10.1038/466685a.
- Distributed Data collection
 - o eBird: Bird data from birders

§ Kelling, Steve, Daniel Fink, Frank A. La Sorte, Alison Johnston, Nicholas

E. Bruns, and Wesley M. Hochachka. 2015. "Taking a Big Data Approach to Data Quality in a Citizen Science Project." Ambio 44 (Suppl 4):601–11. <u>https://doi.org/10.1007/s13280-015-0710-4.</u>

o Photocity

§ Tuite, Kathleen, Noah Snavely, Dun-yu Hsiao, Nadine Tabing, and Zoran

Popovic. 2011. "PhotoCity: Training Experts at Large-Scale Image

Acquisition Through a Competitive Game." In Proceedings of the 2011 Annual Conference on Human Factors in Computing Systems, 1383–92. CHI '11. New York: ACM. https://doi.org/10.1145/1978942.1979146 https://dl.acm.org/doi/pdf/10.1145/1978942.1979146

- § Agarwal, Sameer, Yasutaka Furukawa, Noah Snavely, Ian Simon, Brian Curless, Steven M. Seitz, and Richard Szeliski. 2011. "Building Rome in a Day." Communication of the ACM 54 (10):105-
- 12. https://doi.org/10.1145/2001269.2001293.
 - How to develop our own (including around course project) Mass Collaborations?
 - o Opportunities
 - o Methods
 - o Challenges

Module 4: Ethics

• Studies of concern

o Experiment on 700,000 Facebook users

Kramer, Adam D. I., Jamie E. Guillory, and Jeffrey T. Hancock. 2014.

"Experimental Evidence of Massive-Scale Emotional Contagion Through Social Networks." Proceedings of the National Academy of Sciences of the USA 111 (24):8788–90. <u>https://doi.org/10.1073/pnas.1320040111</u>

- o Tastes, Ties, and Time study on Facebook users
- § Wimmer, Andreas, and Kevin Lewis. 2010. "Beyond and Below Racial Homophily: ERG Models of a Friendship Network Documented on Facebook." American Journal of Sociology 116 (2):583-
- 642. http://www.jstor.org/stable/10.1086/653658.



§ Lewis, Kevin, Marco Gonzalez, and Jason Kaufman. 2012. "Social

Selection and Peer Influence in an Online Social Network." Proceedings of the National Academy of Sciences of the USA 109 (1):68–

72. https://doi.org/10.1073/pnas.1109739109.

o Web Censorship

§ Burnett, Sam, and Nick Feamster. 2015. "Encore: Lightweight

Measurement of Web Censorship with Cross-Origin Requests."

In Proceedings of the 2015 ACM Conference on Special Interest Group on Data Communication, 653–67. SIGCOMM '15. London:

ACM. https://doi.org/10.1145/2785956.2787485 https://dl.acm.org/doi/pdf/10.1145/2785956.2787485

Narayanan, Arvind, and Bendert Zevenbergen. 2015. "No Encore for

Encore? Ethical Questions for Web-Based Censorship

Measurement." Technology Science,

December. http://techscience.org/a/2015121501/.

 Jones, Ben, and Nick Feamster. 2015. "Can Censorship Measurements Be Safe(R)?" In Proceedings of the 14th ACM Workshop on Hot Topics in Networks, 1:1–1:7. HotNets-XIV. New York:

ACM. https://doi.org/10.1145/2834050.2834066.

- Crime prediction using Social data, Tracking immigrants through their phone apps
- Institutional Review Board / Ethics Committee Expectations, Why is it necessary?
- Informed consent, Privacy, Risk

Module 5: Biases in CSS Research

- Biases & inaccuracies at the source of the data
- Biases & inaccuracies during processing
- Biases in social data
- Inferences from biased data
- Read / Listen / Watch:
 - o danah boyd & Kate Crawford (2012) CRITICAL QUESTIONS FOR BIG DATA, Information, Communication & Society, 15:5, 662-679, DOI: 10.1080/1369118X.2012.678878



o Daniel Gayo-Avello. 2011. Don't turn social media into another 'Literary Digest' poll. Commun. ACM 54, 10 (October 2011), 121–128.

DOI:https://doi.org/10.1145/2001269.2001297

- o McFarland DA, McFarland HR. Big Data and the danger of being precisely inaccurate. Big Data & Society. December 2015. doi:10.1177/2053951715602495
- o <u>https://en.wikipedia.org/wiki/Weapons_of_Math_Destruction</u>
- o Ricardo Baeza-Yates. 2018. Bias on the web. Commun. ACM 61, 6 (June 2018), 54–61. DOI:https://doi.org/10.1145/3209581
- o Hargittai E. Potential Biases in Big Data: Omitted Voices on Social Media. Social Science Computer Review. 2020;38(1):10-24. doi:10.1177/0894439318788322
- Olteanu Alexandra, Castillo Carlos, Diaz Fernando, Kıcıman Emre. Social Data: Biases, Methodological Pitfalls, and Ethical Boundaries. Frontiers in Big Data. VOLUME 2, 2019 DOI=10.3389/fdata.2019.00013 https://www.frontiersin.org/article/10.3389/fdata.2019.00013

Preferred Text Books :

1. Salganik, Matthew J., Bit by Bit: Social Research in the Digital Age, Princeton University Press, 2018. Free Online Version: <u>https://www.bitbybitbook.com/en/1st-ed/preface/</u>

Reference Books

E-book Links

https://www.bitbybitbook.com/en/1st-ed/preface/

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https://www.nature.com/collections/cadaddgige/https://www.researchgate.net/profile/Joshua-Angrist/publication/51992844_Mostly_HarmlessEconometricsAn Empiricist%27s_Companion/links/00b4953344a9a0cb13000000/Mostly-Harmless-Econometrics-An-Empiricists-Companion.pdf

Grading Plan

(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quizzes	
	20.0



Assignments + Activities	30.0
Project report + Blog + Video	20.0 [15 + 2.5 + 2.5]
Project	30.0
Other Evaluation	

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

	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	PO 10	PO 11	PO 1 2	PS O 1	PS O 2	PS O 3	PS O 4
C O 1	3	1	-	-	-	3	-	-	-	3	-	1	3	-	-	3
C O 2	3	1	-	-	3	3	-	-	3	3	-	1	3	-	-	3
C O 3	3	3	-	-	-	3	1	3	3	3	-	1	3	3	-	3
C O 4	3	1	-	-	-	-	-	-	3	3	-	1	3	1	-	3
C O 5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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

Learning



- Lectures
- Reading research papers
- Class participation: questions, discussions
- Online discussion: Teams Learning by doing
- Course project
- Real world issues
- Interdisciplinary approach
- Real world implementation

POTENTIAL GUEST LECTURES:

- 1. Prof. Mathew Salganik, Princeton University
- 2. (Soon to be Dr.) Ashwin Rajadesingan, University of Michigan
- 3. Dr. Hemank Lamba, Dataminr

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

Title of the Course:	Indian Grammatical Tradition
Course Code:	
L-T-P	3-1-0
Credits	2
(L= Lecture hours, T=Tuto	orial hours,
P=Practical hours)	
Name of the Academic Prog	gram CLD

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

Basic concepts of linguistics and basic understanding of computational modeling of language

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

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

CO-1: Develop an understanding of the basic concepts of Panini's grammar



CO-2: Applyconcepts from Indian grammatical traditions to modern languages

CO-3: Get familiar with the Universal Dependency Grammar (UDG) scheme and be able to compare it with Paninian Dependency Grammar (PDG).

CO-4: Develop and understanding of how language encodes and conveys meaning.

CO-5: Computationally model modern languages based on PDG.

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

	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PS O 1	PS O 2	PS O 3	PS O 4
C O 1	3	2										2	3	2	2	2
C O 2	2	2										2	3	1	1	2
C O 3	2	2										2	1	1	2	2
C O 4	2	2										2	1	1	2	2
C O 5	2	2										2	1	1	2	2
•																
•																



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

4.Detailed Syllabus:

Unit 1: Pānini's grammar – Basic properties, organization – components and levels

Unit 2:Basic concepts

- i) Morphology prakriti and pratyaya vibhag (subanta and tinganta),
- ii) Syntax and semantics vibhakti and karaka, samas, saamarthy

Unit 3: Concepts of

- i)Tatparya and Vivaksha
- ii) sphota, pravitti nimitta
- iii) aakaaMkshaa, yogyataa, sannidhi

Unit 4: Relation between phrase structure grammar and dependency grammar

Unit 5: Modelling a computational grammar based on Panini's grammar

Reference Books:

- 1. Paul Kiparsky (2002) On the Architecture of Pāņini's Grammar*
- 2. George Cardona (1997) Pāņini: A Survey of Research (pg 210-225)
- 3. Akshar Bharati et al NLP, A Paninian Perspective

<u>5.Teaching-Learning Strategies in brief</u> (4 to 5 sentences):

The course will be taught through lectures in an interactive manner. The students will also be asked to read papers/book chapters and present in class for further discussion. The students will also be given projects to work on which will involve annotating corpora and developing models for different levels of linguistic analysis.

<u>6.Assessment methods and weightages in brief</u> (4 to 5 sentences):

- HA 10
- Seminar 15
- Project 20



Mid Sem 25

End Sem 30

Title of the Course:	<u>Topics in Speech to Speech Translation (SSMT)</u>				
Faculty Name:	Anil Kumar Vuppala				
Course Code:					
L-T-P	3-1-0				
Credits	4				
Name of the Academic Program <u>B. Tech. in CSE and ECE</u>					
Prerequisite Course / Knowledge:					
Suggested to have a Speech Signal Processing course or NLP course.					
Course Outcomes (COs):					
After completion of this course successfully, the students will be able to					
CO-1 :Explaining the need for speech to speech translation					
CO-2: Explaining ASR, MT and TTS systems.					
CO-3: Applying AI models for ASR, MT and TTS.					
CO-4: Analyzing the discourse role in SSMT.					

- **CO-5: Explaining the issues in speech to speech translation.**
- **CO-6: Designing speech to speech translation systems.**


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

	P	Р	Р	Р	Р	Р	P	Р	Р	PO	PO	PO	PS	PS	PS	PS
	0	0	0	0	0	0	0	0	0	10	11	12	01	02	03	O4
	1	2	3	4	5	6	7	8	9							
C O 1	2	2	1	1	1	1	1	1	2	1	1	2	-	3	-	-
C O 2	3	2	1	1	1	1	1	1	2	1	1	2	-	3	-	-
C O 3	3	2	2	1	1	1	1	1	2	1	1	2	-	3	-	-
C O 4	3	2	2	1	1	2	1	1	2	1	1	2	-	3	-	-
C O 5	2	3	2	2	1	2	2	1	2	1	1	3	-	3	-	-
C O 6	2	3	3	3	2	2	2	1	3	2	2	3	-	3	-	-

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

Mapping with PSOs, where applicable.

Detailed Syllabus:

Unit 1: Introduction to SSMT with demos. Automatic speech recognition introduction and state of the art approaches.



- Unit 2: Machine translation introduction and state of the art approaches.
- **Unit 3: TTS introduction and state of the art approaches.**

Unit 4: Role of discourse and prosody in SSMT.

Unit-5: Corpus standards. Need for human in the loop of SSMT and research issues in SSMT.

Reference Books:

1. Speech and Language Processing (3rd ed. draft) by **Dan Jurafsky and James H. Martin**

2. Machine Translation by Bonnie Jean Dorr, MIT press.

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

It is topics course in speech to speech translation. Indian government has taken Speech to speech translation in Indian languages as mission project. There is a need to generate manpower in this new are which is combination of NLP and Speech domains. This is mainly project oriented course. After demonstration of necessary topics like Machine translation, ASR and TTS projects will be given.

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

Quiz 20% Assignments 30% Project 50%

List of Electives

Advanced Algorithms Advanced Computer Networks Advanced Data Systems Advanced NLP (100) Advanced Optimization: Theory and Applications Advances in Robotics & Control Algorithms and Operating Systems Analog IC Design



Applied Electromagnetics Behavioral Research & Experimental Design Behavioral Research: Statistical Methods CMOS Radio Frequency Integrated Circuit Design **Cognitive Neuroscience** Cognitive Science and AI Compilers Computational Linguistics II: Comp Semantics and Discourse parsing **Computer Vision** Data Analytics I **Data Foundation Systems** Data Systems Design for Social Innovation Design for Testability **Differential Equations Digital Image Processing Digital VLSI Design Distributed Data Systems Distributed Systems Distributing Trust and Block Chains Eco-Informatics** Environmental Science & Technology Fairness, Privacy and Ethics in AI **Flexible Electronics** FPGA based Accelerator Design **Functional Analysis** Green Buildings Hydro Informatics ICTs for Development Information Security Audit and Assurance Internals of Application Servers Intro to UAV Design Introduction to Game Theory Introduction to Neural and Cognitive Modeling Introduction to Neuroeconomics Introduction to NLP Linear Partial Differential Equations and Variational Calculus Mechatronics System Design **Mobile Robotics**



HYDERABAD

Modern Complexity Theory **Multivariate Analysis** Music, Mind, and Technology **Online Privacy Optical Remote Sensing Optimization Methods** Principles of Information Security Principles of Programming Languages Principles of Semiconductor Devices Quantum Algorithms Radar Systems **Real-Time Systems Research in Information Security Robotics: Dynamics and Control Robotics: Planning and Navigation** Signal Detection and Estimation Theory Social Science Perspective on HCI Software Engineering **Spatial Data Sciences Spatial Informatics** Statistical Methods in AI System and Network Security Technology Product Entrepreneurship **Time Frequency Analysis** Topics in Applied Optimization Topics in Deep Learning Topics in Machine Learning **Topics in Signal Processing** Topics in Software Engineering **Topics in Software Foundations** Wireless Communications