GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT (GITAM)
(Deemed to be University)
VISAKHAPATNAM * HYDERABAD * BENGALURU

Accredited by NAAC with A^+ Grade

CURRICULUM AND SYLLABUS

OF

B.Tech. Computer Science and Engineering (Data Science)

(w.e.f. 2021-22 admitted batch)

Academic Regulations

Applicable for the Undergraduate programmes in the Faculties of **Engineering, Humanities,Management and the Sciences**

https://www.gitam.edu/academic-regulations

Vision and Mission of University

Vision

To become a global leader in higher education.

Mission

To impart futuristic and comprehensive education of global standards with high sense of discipline and social relevance in a serene and invigorating environment.

Vision and Mission of Department

Vision

Excel in computer science and engineering education with international standards for global employment and research.

Mission

- *Create an excellent academic ambience that promotes innovation and research.*
- *Impart quality education through well designed curriculum experiential learning in tune with the changing needs of the industry.*
- *Collaborate with world class academic institutions and software industries for mutual benefit.*
- *Produce competent and socially committed graduates having creative skills and ethical values.*

Program Educational Objectives:

The Program Educational Objectives of the B.Tech. Computer Science and Engineering (Data Science) program are:

1. The graduates will demonstrate proficiency in Data Science leading to successful careers as Data Scientists.
2. The graduates will exhibit commitment to developing sustainable solutions that satisfy the current societal needs.
3. The graduates will adapt to and aid in technological advances by life-long learning and innovation.

Program Outcomes (POs)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

Upon successful completion of B.Tech.(Data Science) Program, student will be able to:

1. identify, formulate and solve engineering problems to provide efficient solutions.
2. design and develop computer-based applications of varying complexities in emerging areas of Computer Science and Engineering.
3. apply the principles and techniques of mathematical and statistical models for data analysis to extract the insights in supporting business and scientific processes.

PROGRAMME STRUCTURE

BTech Programme consists of courses which could be grouped under University Core (UC), Faculty Core (FC), Major/Programme Core (PC), Major/Programme Electives Electives(PE) and University Electives (UE) as the below breakup

Category	Credits	% of Program (in credits)
University Core (UC)	12	8%
Faculty Core (FC)	57	36%
Program Core (PC)	52	32%
Program Electives (PE)	15	9%
Open Electives (OE)	24	15%
Total	**160**	

Courses offered under University Core are common to all undergraduate level programmes offered by GITAM. Courses offered under Faculty core are common to all BTech programmes offered by GITAM and are meant to acquaint the student with general engineering principles in all disciplines of engineering. Based on the chosen BTech Programme, the student shall complete courses under Major Core (specific to be chosen branch of engineering).

Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week. In general,

- **Theory:** A student attending classroom lecture/ tutorial/ skill development activity of 50 minutes duration per week, spread over the entire semester is awarded one credit.
- **Practical:** A student attending a minimum of 100 minutes per week of laboratory session/ practical is awarded - one credit.
- **Project Work:** A student working for 50 minutes of project work per week with 3 hours of work performed independent of the instructor during the entire semester is awarded - one credit
- **Internship:** 8 hours in a day for four weeks is required for earning internship credits.

The list of courses to be taken by Students under **University Core** are listed below

University Core (UC)

Course code	Level	Course title	L	T	P	S	J	C
CSEN1001	1	IT Productivity Tools^	0	0	2	0	0	1*
LANG1001	1	Communication Skills in English - Beginners	0	0	4	0	0	2*
LANG1011	1	Communication Skills in English	0	0	4	0	0	2
LANG1021	1	Advanced Communication Skills in English	0	0	4	0	0	2
CLAD1001	1	Emotional Intelligence & Reasoning Skills (Softskills 1)	0	0	2	0	0	1
CLAD1011	1	Leadership Skills & Quantitative Aptitude (Softskills 2)	0	0	2	0	0	1
CLAD1021	1	Verbal Ability & Quantitative Ability (Softskills 3)	0	0	2	0	0	1
CLAD1031	1	Practicing Verbal Ability & Quantitative Aptitude (Softskills 4)	0	0	2	0	0	1
VEDC1001	1	Venture Development	0	0	0	2	0	2
DOSP10XX	1	Sports 1#	0	0	0	2	0	2*
DOSL10XX	1	Club Activity#	0	0	0	2	0	2*
POLS1001	1	Indian Constitution and History	2	0	0	0	0	2*
PHPY1001	1	Gandhi for the 21st Century	2	0	0	0	0	2*
DOSL10XX	1	Community Service#	0	0	0	0	2	2*
ENVS1001	1	Environmental Studies^	3	0	0	0	0	3*
MFST1001	1	Health and Welbeing#	0	0	2	0	0	1*
CLAD20XX	2	Softskills 5A/5B/5C	0	0	2	0	0	1
CLAD20XX	2	Softskills 6A/6B/6C	0	0	2	0	0	1
FINA3001	3	Personal Financial Planning#	0	0	2	0	0	1*

* Pass/Fail courses

Opt any three courses among the five

^ Online/Swayam/NPTEL Courses

Softskills courses 5 and 6

Course code	Level	Course title	L	T	P	S	J	C
CLAD2001	2	Preparation for Campus Placement - 1 (Softskills 5A)	0	0	2	0	0	1
CLAD2011	2	Preparation For Higher Education (GRE/ GMAT) - 1 (Softskills 5B)	0	0	2	0	0	1
CLAD2021	2	Preparation for CAT/ MAT - 1 (Softskills 5C)	0	0	2	0	0	1
CLAD2031	2	Preparation For Campus Placement - 2 (Softskills 6A)	0	0	2	0	0	1
CLAD2041	2	Preparation For Higher Education (GRE/ GMAT) - 2 (Softskills 6B)	0	0	2	0	0	1

CLAD2051	2	Preparation for CAT/ MAT - 2 (Softskills 6C)	0	0	2	0	0	1

Sports courses

Course code	Level	Course title	L	T	P	S	J	C
DOSP1001	1	Badminton	0	0	0	2	0	2
DOSP1011	1	Chess	0	0	0	2	0	2
DOSP1021	1	Carrom	0	0	0	2	0	2
DOSP1031	1	Football	0	0	0	2	0	2
DOSP1041	1	Volleyball	0	0	0	2	0	2
DOSP1051	1	Kabaddi	0	0	0	2	0	2
DOSP1061	1	Kho Kho	0	0	0	2	0	2
DOSP1071	1	Table Tennis	0	0	0	2	0	2
DOSP1081	1	Handball	0	0	0	2	0	2
DOSP1091	1	Basketball	0	0	0	2	0	2
DOSP1101	1	Tennis	0	0	0	2	0	2
DOSP1111	1	Throwball	0	0	0	2	0	2

Club activity courses

Course code	Level	Course title	L	T	P	S	J	C
DOSL1001	1	Club Activity (participant)	0	0	0	2	0	2
DOSL1011	1	Club Activity (Member of club)	0	0	0	2	0	2
DOSL1021	1	Club Activity (Leader of CLub)	0	0	0	2	0	2
DOSL1031	1	Club Activity (Competitor)	0	0	0	2	0	2

Community service courses

Course code	Level	Course title	L	T	P	S	J	C
DOSL1041	1	Community Services - Volunteer	0	0	0	0	2	2
DOSL1051	1	Community Services - Mobilizer	0	0	0	0	2	2

Faculty Core (FC)

Course code	Level	Course title	L	T	P	S	J	C
MATH1001	1	Single Variable Calculus	2	0	0	0	0	2
MATH1011	1	Several Variable Calculus	2	0	0	0	0	2
PHYS1001	1	Physics	2	1	2	0	0	4
CSEN1011	1	Problem Solving and Programming inC	0	0	6	0	0	3
MECH1021	1	Workshop	0	0	4	0	0	2
MATH1041	1	Discrete Mathematics	2	0	0	0	0	2
MATH1051	1	Graph Theory	2	0	0	0	0	2
CHEM1001	1	Chemistry	2	1	2	0	0	4
EECE1001	1	Basic Electrical and Electronics Engineering	2	1	2	0	0	4

MECH1011	1	Engineering Visualization and Product Realization	0	0	4	0	0	2
CSEN1021	1	Programming with Python	0	0	6	0	0	3
PHYS1011	2	Principles of Quantum Mechanics	3	1	0	0	0	4
	2	Number Theory	2	0	0	0	0	2
	2	Design Thinking	0	0	2	0	0	1
	2	Linear Algebra	2	0	0	0	0	2
	2	Probability and Statistics	3	0	0	0	0	3
	3	Management Basket	3	0	0	0	0	3
	3	Applications of Artificial Intelligence	0	0	2	0	0	1
	4	Capstone Project - Introduction	0	0	0	0	2	2
	4	Internship 1	0	0	0	0	1	1*
	4	Comprehensive Examination	1	0	0	0	0	1*
	3	Project Exhibition	0	0	0	0	1	1*
	2	Internship 2	0	0	0	0	3	3
	4	Capstone Project - Final	0	0	0	0	6	6
	3	Project Exhibition 2	0	0	0	0	1	1*
		Universal Human Values	3	0	0	0	0	3*

* Pass/Fail courses

Program Core for **B.Tech. Computer Science and Engineering(Data Science)**

Course code	Level	Course title	L	T	P	J	S	C
CSEN1051		Digital Logic Circuits	2	1	0	0	0	3
CSEN1081		Descriptive Statistics	3	0	0	0	0	3
CSEN2001		Data Structures	3	0	2	0	0	4
CSEN2011		Computer Organization and Architecture	3	0	0	0	0	3
CSEN2021		Computer Networks	3	0	0	0	0	3
CSEN1101		Operating Systems	3	0	0	0	0	3
CSEN1111		Object Oriented Programming with Java	0	0	4	0	0	2
CSEN2031		Artificial Intelligence	3	0	0	0	0	3
CSEN2061		Database Management Systems	3	0	2	0	0	4
CSEN2071		Design and Analysis of Algorithms	3	0	2	0	0	4
CSEN2081		Artificial Neural Networks	3	0	0	0	0	3
CSEN2111		Data Visualization and exploration with R	3	0	2	0	0	4
CSEN2141		OOSE based Application Development	3	0	2	0	0	4
CSEN2151		Automata Theory and Compiler Design	3	0	0	0	0	3
CSEN2171		Deep Learning	3	0	0	0	0	3
CSEN2201		Big Data Analytics	3	0	0	0	0	3

Program Elective courses for **B.Tech. Computer Science and Engineering (Data Science)**

Course code	Level	Course title	L	T	P	J	S	C
		Adhoc and Sensor Networks	3	0	0	0	0	3
		Advanced Computer Networks	3	0	0	0	0	3
		Advanced Data Structures	3	0	0	0	0	3
		Advanced Operating Systems	3	0	0	0	0	3
		Advances in Internet of Things	3	0	0	0	0	3
		Agile Software Development	3	0	0	0	0	3
		Android Security Internals	3	0	0	0	0	3
		Augmented Reality and Virtual Reality	3	0	0	0	0	3
		Big data Analytics	2	1	0	0	0	3
		Block Chain Technology	3	0	0	0	0	3
		Cloud Based IoT	3	0	2	0	0	4
		Cloud Computing	3	0	0	0	0	3
		Cloud Security	3	0	0	0	0	3
		Computer Graphics	3	0	0	0	0	3
		Cryptography and Network Security	3	0	0	0	0	3
		Cyber Security	3	0	0	0	0	3
		Data Analytics: Descriptive,Predictive, Prescriptive	3	0	0	0	0	3
		Data Warehousing and Mining	2	1	0	0	0	3
		Design Patterns	3	0	0	0	0	3
		Digital Forensics	3	0	2	0	0	4
		Distributed Systems	3	0	0	0	0	3
		E-Commerce	3	0	0	0	0	3
		Edge Computing	3	0	0	0	0	3
		Energy Management for IoT devices	3	0	0	0	0	3
		Ethical Hacking	3	0	2	0	0	4
		Fundamentals of IOS security	3	0	0	0	0	3
		Game Programming	3	0	0	0	0	3
		Human Computer Interaction	3	0	0	0	0	3
		Image Processing	2	1	0	0	0	3
		Information Retrieval Systems	3	0	0	0	0	3
		Information Security	3	0	0	0	0	3
		Internet of Things	3	0	0	0	0	3
		Introduction to Data Science	3	0	2	0	0	4
		Introduction to Pattern Recognition and Machine Learning	3	0	0	0	0	3
		Intrusion Detection and Prevention Systems	3	0	0	0	0	3
		IoT Architectures and Protocols	3	0	2	0	0	4
		IoT for Industries	3	0	0	0	0	3
		IoT Security	3	0	0	0	0	3
		Machine Learning and its Applications	3	0	2	0	0	4

		Natural Language Processing	3	0	0	0	0	3
		Operating System Security	3	0	0	0	0	3
		Parallel Computing	3	0	0	0	0	3
		Secure Software Engineering	3	0	0	0	0	3
		Security for Cyber Physical systems	3	0	0	0	0	3
		Sensor Technology and Instrumentation	3	0	0	0	0	3
		Social Network Analysis	2	1	0	0	0	3
		Software Defined Networks	3	0	0	0	0	3
		Software Engineering	3	0	2	0	0	4
		Software Metrics	3	0	0	0	0	3
		Software Requirements Management	3	0	0	0	0	3
		Software Testing Methodologies	3	0	0	0	0	3
		Threat Intelligence	3	0	0	0	0	3
		Web Application Development and Software Frameworks	3	0	2	0	0	4
		Web Application Security	3	0	0	0	0	3
		Wireless Sensor Networks	3	0	0	0	0	3

CSEN1001: IT Productivity Tools

L	T	P	S	J	C
0	0	2	0	0	1*

This course introduces all software tools that improve the productivity of a student in enhancing his learning experience with all the activities taken up as part of his coursework.

Course Objectives

- to enable the learner, the skill in preparing technical documents of professional quality using docs, sheets and forms.
- to involve the student in designing and creating of websites and acquaint the student with the skill of processing audio, images, documents etc.
- to create awareness in analysing data using pivot tables, query manager etc.
- to create awareness in composing emails, mail merge, e-mail merge etc.
- to provide the exposure to work with collaborative tools.

List of Experiments

1. Create a typical document consisting of text, tables, pictures, multiple columns, with different page orientations.
2. Create a technical paper / technical report consisting of table of contents, table of figures, table of tables, bibilography, index, etc.
3. Compose and send customized mail / e-mail using mail-merge.
4. Create / modify a power point presentation with text, multimedia using templates with animation.
5. Create spreadsheet with basic calculations with relative reference, absolute reference and mixed reference methods.
6. Simple report preparation using filtering tool / advanced filtering commands / pivot tables in spreadsheet application.
7. Analyse the results of a examination studentwise, teacherwise, coursewise, institute-wise.
8. Collecting and consolidating data using collaborative tools like google docs, sheets, forms.
9. Create charts / pictures using online tools like: www.draw.io or smartdraw
10. Create a website of his interest.

Text Books:

1. Katherin Murray, 'Microsoft Office 365 Connect and collaborate virtually anywhere, anytime', Microsoft Press, ISBN: 978-0-7356-5694-9
2. EXCEL 2021 The Comprehensive Beginners to Advanced Users Guide to Master Microsoft Excel 2021. Learn the Essential Functions, New Features, Formulas, Tips and Tricks, and Many More
3. https://drawio-app.com/tutorials/video-tutorials/
4. Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics Fourth Edition ISBN-13: 978-1449319274

References/Online Resources

1. https://www.coursera.org/learn/introduction-to-computers-and-office-productivity-software
2. https://www.coursera.org/projects/analyze-data-pivot-tables-crosstabs-google-sheets
3. https://www.coursera.org/learn/excel-advanced#syllabus
4. https://www.coursera.org/learn/how-to-create-a-website
5. https://support.microsoft.com/en-us/office
6. https://www.diagrams.net/
7. https://edu.google.com/

Course Outcomes

- Create / alter documents / Technical Paper / Project report with text, pictures, graphs of different styles.
- Create / modify power point presentations with text, multimedia and to add animation using / creating templates.
- Perform basic calculations / retrieve data / createpivot tables / chart using a spreadsheet application.
- Create simple diagrams / charts using online tools like: www.draw.io .
- Manage documents, presentations, spreadsheets and websites in collaborative mode.

LANG1001: Communication Skills in English - Beginners

L	T	P	S	J	C
0	0	4	0	0	2*

Communication Skills in English (Beginner) is the first of the three-level courses for a developmental enhancement of learners' communication skills in English. This course focuses on giving learners exposure to factual level of comprehension (listening and reading) and application of the learning (Speaking/Writing) with an awareness for social and personality-based variations in communication. In addition to the LSRW skills, the focus of the course is on schematic thinking skills. This course is activity-based and practice-oriented in terms of procedural knowledge of vocabulary and grammatical structure. This syllabus is carefully developed to enable learners to engage in communication in English avoiding errors and be prepared for next level of learning English.

Course Objectives

- Train learners to listen actively, follow what is spoken in standard English, and answer questions to demonstrate their understanding of the main points of the speech, repeat part of what someone has said to confirm mutual understanding, though occasionally, there may be a need to ask for repetition or clarification. (Bloom's Taxonomy Level/s: 2 & 3)

- Equip learners with the skills to read and comprehend straightforward texts and simple argumentative writing to identify the topic, the desired/relevant information, the main points of the argument, and the major conclusion/s. (Bloom's Taxonomy Level/s: 2 & 4)

- Help learners apply their knowledge and language skills to make mini oral presentations, and produce short coherent written texts using appropriate cohesive devices, suitable vocabulary and grammatical structures. (Bloom's Taxonomy Level/s:3)

- Enable learners to communicate with reasonable accuracy in familiar contexts with adequate fluency and generally good control by equipping them with a repertoire of frequently used vocabulary, structures, and speech patterns. (Bloom's Taxonomy Level/s: 2 & 3)

List of Activities & Tasks for Assessment

1. Listening to others and getting to know their experiences, interests and opinions
2. Introducing oneself: Salutation, basic information, relating to the context
3. Starting a conversation: Salutation, expressing purpose, expressing gratitude
4. Sharing one's experiences, interests and opinions
5. Reading short newspaper articles for gist
6. Picking new words from an article and working on them to know the meaning and usage
7. Using the new (unknown) words in own sentences
8. Sharing news with others - initiate, sustain and conclude
9. Understanding the relevance of intonation to meaning from recorded conversations, and applying the learning in pair work (role play)
10. Writing a summary of a story/personal narrative after listening to it twice and making individual notes
11. Reading graphs, charts and maps for specific information, making note of the important information and talking briefly about it within a small peer group
12. Writing a paragraph about oneself: a brief profile including major successes, failures, and goals. Giving compliments/gratitude to others

13. Writing a paragraph (descriptive, complimentary) about others (Family, friends, role model, etc.)
14. Correcting each other's' drafts: errors in language - word choice, structure, and conventions/etiquette
15. Writing a short structured descriptive/narrative essay in 3 paragraphs, reading others' essays and sharing feedback

References

1. V. Sasikumar, P. Kiranmayi Dutt, Geetha Rajeevan. (2007). Listening and Speaking - Foundation Books Cunninhum, S. & Moor, P. (nd). New Cutting Hedge (Intermediate). Longman
2. Cambrdige Academic English: An Integrated Skills Course for EAP (Intermediate) By Craig Thaine, CUP (2012)
3. Rutherford, Andrea J. (2007). Basic Communication Skills for Technology: Second Edition. Delhi: Pearson Education.
4. McCarthy, M., O'Dell, F., Mark, G. (2005). English Vocabulary in Use. Spain: Cambridge University Press.
5. New Headway Academic Skills: Reading, Writing, and Study Skills Student's Book, Level-1 by Sarah Philpot. OUP
6. Philpot, S. & Curnick, L. (2017). Headway: Academic Skills: Reaing, Writing, and Study Skills. Introductory Level. OUP.
7. Thaine, C. (2012). Cambridge Academic English: An Integrated Skills for EAP . Intermediate. CUP.

Online References

- www.teachingenglish.org.uk
- learnenglishteens.britishcouncil.org
- https://eslflow.com/
- https://www.englishclub.com/
- https://www.oxfordlearnersdictionaries.com/
- https://dictionary.cambridge.org/
- learnenglishteens.britishcouncil.org
- https://freerice.com/categories/english-vocabulary

Course Outcomes

- Listen actively, understand and extract the essential information from short talks/conversations/discussions that are delivered in clear, standard speech. (Bloom's Taxonomy Level/s: 2 & 3)
- Read, understand, and extract specific information from straightforward factual and simple argumentative texts on general topics and subjects of interest. (Bloom's Taxonomy Level/s: 2 & 3)

- Speak clearly with some confidence on matters related to his/her interests and academic work, and make short structured oral presentations on topics of personal interest. (Bloom's Taxonomy Level/s: 3)
- Write short straightforward connected texts on a range of familiar/general topics using appropriate linking devices to achieve a clear sequence of ideas. (Bloom's Taxonomy Level/s: 3)

- Acquire sufficient language competency to express oneself in speech and writing with some confidence, using appropriate vocabulary and simple grammatical structures though lexical limitations and/or difficulty with formulation might be evident at times. (Bloom's Taxonomy Level/s: 2 & 4)

LANG1011: Communication Skills in English

L	T	P	S	J	C
0	0	4	0	0	2

Communication Skills in English (Intermediate) is the second of the three-level graded courses for a developmental enhancement of communication skills in English. Based on the learning outcomes set in the beginner level syllabus, this course focuses on giving learners more exposure to the use of language for communicative purposes and equip them with next level skills (ref. Bloom's taxonomy) and practice in terms of complexity and cognitive engagement. This course also includes inferential level of comprehension (listening and reading) that involves analysis and application of the language skills and decision-making skills while speaking/writing with an awareness for social and personality-based variations in communication. This course emphasizes guided writing through adequate tasks with pre and post context building. The focus is on stimulation and application of critical thinking in addition to schematic thinking for communication in real-life situations.

Course Objectives

- Train learners to actively listen to short audio texts with familiar content; guided activity like question-making and responding to others' questions based on the audio text would help learners engage in transactional dialogue; extended activities like extrapolating/critiquing the responses would help learners enhance their schematic thinking. (Bloom's Taxonomy Level/s: 2 & 4)
- Equip learners with strategies to read actively and critically and understand the writers' viewpoints and attitude by providing reading comprehension tasks using authentic texts such as op-ed articles from newspapers, and reports on contemporary problems. (Bloom's Taxonomy Level/s: 4 & 5)
- Help learners understand various aspects and techniques of effective presentations (group/individual) through demonstration and modelling, and enabling them to develop their presentation skills by providing training in using the tips and strategies given. Learners would be encouraged to observe and express opinion on teacher-modelling. Reflection on issues like anxiety, stage-fear, confidence, and levels of familiarity with topic and audience would be addressed. Practice would be given on tone, pitch, clarity and other speech aspects. Detailed peer feedback and instructor's feedback would cover all the significant aspects. (Bloom's Taxonomy Level/s: 2 & 4)
- Enable learners to become aware of the structure and conventions of academic writing through reading, demonstration, scaffolding activities, and discussion. Corrective individual feedback would be given to the learners on their writing. (Bloom's Taxonomy Level/s: 2 & 3)

List of Tasks and Activities

S. No.	Tasks	Activities
1	Listening to subject related short discussions/ explanations/ speech for comprehension	Pre-reading group discussion, Silent reading (Note-making), Modelling (questioning), Post-reading reflection /Presentation
2	Asking for information: asking questions related to the content, context maintaining modalities	Group role-play in a context (i.e. Identifying the situation and different roles and enacting their roles)

3	Information transfer: Verbal to visual (familiar context), demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation and feedback	Pair work for discussion & feedback, Presentations, question-answer
4	Information transfer: Visual to verbal (unfamiliar context); demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation and feedback	Pre-reading game/modelling, discussion in small groups, individual writing, and feedback
5	Introducing officials to peers and vice versa - Formal context	AV support, noticing, individual performance (3-4), pair work (in context), teacher modelling, group work for Introducing self and others in a formal context
6	Introducing friends to family and vice versa - Informal context	Teacher modelling/AV support, noticing structure & note-taking, Introducing friends and family in an informal context
7	Vocabulary in context: Find clues in a text and use them to guess the meaning of words/phrases. Apply the newly learnt vocabulary in communication (speaking and writing).	Comprehending verbal communication: Identifying the contextual clues in oral and written texts; guessing the meaning of words/phrases in context while reading texts and listening to discussions/talks
8	A five-day journal (diary) writing based on learners reading from newspaper on a single relevant/current social issue. Individual oral presentation and feedback from peers and instructor.	Note-making (group work), Discussion, Feedback
9	Follow the essentials of lectures, talks, discussions, reports and other forms of academic presentations and mak2 individual and group presentations aided with images, audio, video, tabular data, etc.	Making power point presentation aided with images, audio, video, etc. with a small group by listening to academic lectures/talks/ discussions, etc.
10	Self-reflection: Re-reading one's own drafts, identifying errors, correcting the errors, and giving rationalize the changes	Pre-task discussion/modelling, Editing the texts by careful reading and identifying the errors, peer-exchange (Pair work), feedback/consolidation
11	Collaborative work (speaking and writing) in small groups of 3 or 4 learners: discussing a general/discipline-specific topic: creating outline, assigning specific roles to members of the group; and group presentation followed by peer and instructor feedback	Pre-task modelling (peer/teacher), general discussion on structure, group work (collaboration), feedback
12	Independent reading of different text types using appropriate reference sources by adapting suitable reading styles and speed. Focus on active reading for vocabulary: low-frequency collocations and idiomatic expressions.	Brain-storming, mapping of key terms (content specific), reading and note-making (individual), oral questioning, discussion
13	Role-play (specific social and academic situations): planning (making notes), understanding nuances of speaking in context, coordinating with situational clues and fellow speakers/participants	Peer discussion for outline, A-V support, observing (teacher modelling), role play (guided), role-play (free), feedback
14	Writing instructions: Guidelines - Flowcharts - Procedures to be followed	Pre-task reading, pair work, teacher/peer-discussion, feedback
15	Speaking spontaneously on topics of interest and writing short structured essays on the same topics adopting appropriate academic conventions and grammatical accuracy.	Reading for task preparation, note-making, speaking, reflection and corrective peer and teacher feedback

Reference Books

1. P. Kiranmayi Dutt, Geetha Rajeevan. (2007). Basic Communication Skills. Foundation Books. CUP
2. Harmer, J. (1998). How to teach English. Longman
3. Sanjay Kumar & Pushp Lata. (2018). Communication Skills: A Workbook. OUP.
4. Cambridge IGCSE: English as a Second Language Teacher's Book Fourth Edition. By Peter Lucantoni. CUP (2014).
5. Cambrdige Academic English: An Integrated Skills Course for EAP (Upper Intermediate) By Martin Hewings, CUP (2012)
6. Richards, J.C. and Bohlke, D. (2012). Four Corners-3. Cambridge: CUP.
7. Headway Academic Skills: Reading, Writing, and Study Skills Student's Book, Level-2 by Sarah Philpot. OUP
8. Latham-Koenig, C. & Oxenden, C. (2014). American English File. Oxfor: OUP.
9. McCarthy, M. & O' Dell. F. (2016). Academic Vocabulary in Use. Cambridge: CUP

Online Resources

1. https://www.grammarly.com/blog/
2. https://www.nationalgeographic.org/education/
3. https://www.bbc.co.uk/teach/skillswise/english/zjg4scw
4. https://www.englishclub.com/
5. https://www.oxfordlearnersdictionaries.com/
6. https://dictionary.cambridge.org/
7. learnenglishteens.britishcouncil.org
8. https://freerice.com/categories/english-vocabulary
9. http://www.5minuteenglish.com/
10. https://breakingnewsenglish.com/
11. https://www.digitalbook.io/
12. https://librivox.org/

Course Outcomes

- Understand the speaker's point of view in fairly extended talks on general or discipline-specific topics, and follow simple lines of argument in discussions on familiar contemporary issues. (Bloom's Taxonomy Level/s: 3)

- "Read and demonstrate understanding of articles and reports on limited range of contemporary issues in which the writers adopt particular stances. Also provide samples of written communication containing fairly complex information and reasons for choices/opinions/stances. (Bloom's Taxonomy Level/s: 2 & 3)"

- Make short presentations on a limited range of general topics using slides, and engage in small group discussions sharing experiences/views on familiar contemporary issues and give reasons for choices/opinions/plans. (Bloom's Taxonomy Level/s: 3 & 4)

- Write clear, fairly detailed text (a short essay) on a limited range of general topics, and subjects of interest, and communicate clearly through email/letter to seek/pass on information or give reasons for choices/opinions/plans/actions. (Bloom's Taxonomy Level/s: 3)

- Reflect on others' performance, give peer feedback on fellow learners' presentations, responses to writing tasks and reading comprehension questions. (Bloom's Taxonomy Level/s: 5)

LANG1021: Advanced Communication Skills in English

L	T	P	S	J	C
0	0	4	0	0	2

Communication Skills in English (Advanced) is the third of the three-level graded courses for a developmental enhancement of communication skills in English. Based on the learning outcomes set in the upper-intermediate syllabus, this course focuses on giving learners exposure to higher level of skills/input processing (ref. Bloom's taxonomy) and practice in terms of complexity and cognitive engagement. This course includes advanced level of comprehension i.e. anaytical, evaluative and extra-polative processing (listening and reading) and involves problem-solving, logical reasoning and decision-making skills in terms of application of the learning (speaking/writing) with an awareness for social and personality based variations in communication. This course provides opportunities with activity-based practice of advanced oral and written communicative skills besides building awareness on the finer nuances of language use for various purposes. This course emhasizes free writing through meaningfully engaging tasks with a pre and post context building. There is ample scope for application of critical thinking through simulated activities for effective communication in real life situations.

Course Objectives

1. Enable learners to listen actively become aware of tone and attitude in speech, and demonstrate their comprehension of fairly complex lines of argument presented by a variety of speakers in talks/presentations/discussions. (Bloom's Taxonomy Level/s: 2 & 4)

2. Enable learners to become aware of tone and attitude in written texts, and demonstrate their comprehension of fairly complex lines of argument and points of view presented in a variety of texts by equipping them with upper intermediate to advanced level reading skills and strategies. (Bloom's Taxonomy Level/s:2 & 3)

3. Make effective presentations, engage in formal group discussions, and write structured essays/ short reports to highlight the significance of actions/decisions/experiences, and sustain views by providing relevant evidence and argument. (Bloom's Taxonomy Level/s: 3 & 4)

4. Equip learners with the skills and strategies to communicate effectively in speech and writing using the language with a degree of fluency, accuracy and spontaneity, and fairly good grammatical control adopting a level of formality appropriate to the context. Encourage learners to apply their knowledge of language and their communication skills in real life situations. (Bloom's Taxonomy Level/s:3 & 5)

List of Activities & Tasks for Assessment

S.No.	Tasks	Activities	CO
1	Evaluative and extrapolative reading of a long text/short texts on a current topic related to technology and society, identifying and questioning the author's intention, post-reading discussion in small groups, maintaining group dynamics, arriving at a consensus	Pre-reading group discussion, silent reading (Note-making), modelling (questioning), post-reading reflection and brief presentation of thoughts/ideas/opinions on the theme of the text	3
2	Debate in pairs based on listening to two recorded contemporary speeches by well-known leaders in different fields. Peer feedback and instructor feedback.	Pre-recorded audio/video for listening, student checklist for noticing key words/concepts, pre-task orientation (by teacher), pair work, feedback	1
3	Information transfer: Verbal to visual (unfamiliar context); demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation, question-answer(among students), modification and feedback before the final version is done	Pair work for discussion and feedback, presentations, question-answer	2
4	Information transfer: Visual to verbal (unfamiliar context); demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation, question-answer(among students), modification, editing, proofreading, and feedback before the final version is done	Pre-reading game/modelling, discussion in small groups, independent writing and feedback	4
5	Expressing opinion on a short argumentative text (e.g. a journal article or a newspaper editorial) and justifying one's opinion/stance; focus on the use of appropriate conventions of formal and polite speech, and managing bias	Listening to group discussions/debates, reading news-paper articles on the current issues and expressing opinions in favour or against the topic (in GDs, debates or writing argumentative essays).	3
6	Role-play (complex social and academic/professional situations): Focus on significant aspects of delivery including clarity, tone, and use of contextually appropriate vocabulary and conventions, observation, reflective discussion, and self-reflective writing	Reading newspaper/magazine articles/blog posts on current social issues, listening to talks/discussions/debates etc. and participating in role-plays using expressions appropriate to the context.	1
7	Collborative writing in groups of 3 -4 on topics that would require data collection and reading followed by recorded peer-reflection and peer-feedback, group presentation and feedback	Pre-task modelling (peer), general discussion on structure, group work (collaboration), presnetation, peer feedback, Open-class discussion	5
8	Formal Group Discussion on topics of current interest and relevance; focus on effective participation, reflection on control over argument/counter argument, and adherence to the conventions of formal GD	Noticing strategies from AV modelling, teacher scafolding though open-house discussion, Note-making (Group work), Group Discussion (free), post perfromance discussion, Feedback	2

9	Mind-mapping for advanced reading, making correlations across texts, extending author's point of view	Reading texts on abstract topics and comprehending the author's perspective by inferring the unknown words' meaning in the context and making notes using mind-map strategy and presenting it orally.	3
10	Handling question and answer sessions after presentations: justifying arguments, taking counter-arguments, agreeing and disgreeing with rationale	Listening to some lectures, talks, and presentations in the academic seminars and adapting some strategies to handle the Q&A sessions using polite and formal expressions to agree or disagree with the statements.	1
11	Modelling an interview: with a panel of four judges (peers)	Pre-task activity for orientation/strategies (controlled/guided), Model interview (AV support), Group work (role play), interview in pair (one-to-one), Interview in group (many -to-one), oral corrective feedback (peer/teacher)	2
12	Writing a short reflective report of an event - incident/meeting/celebration	Writing a report on meetings/celebrataions/events etc. by actively involving in such events and giving a short oral presentation on the same.	4
13	Speaking on abstract and complex topics beyond his/her own area of interest/field of study, using the language flexibly and effectively.	Reading texts on abstract topics and comprehending the author's perspectives. Similarly, listening to talks and discussions on an abstract topic of other discipline and making short oral presentation by sharing views and opinions.	3
14	Self-relfection on own speech in context(recorded): tone, pitch, relevance, content; extending the reflections/ideas to others	Listening to selected general discussions (audios and videos) and observing the language production. Recording own speech on some general topic and providing a critical review (self-reflection) on it by focusing on the tone, expressions and relevance of the content, etc.	1
15	Collaborative and individual task: planning, preparing (preparing an outline, structure, setting objectives and presenting the plan of action) and executing a mini-project, and submitting a brief report on the same peer and instructor feedback after the planning stage and on completion of the mini project	Pre-task modelling (peer/teacher), general discussion on structure, group work (collaboration), oral corrective, task distribution, presentation, feedback	5

Reference Books

1. Latham-Koenig, C. & Oxenden, C. (2014). American English File-5. Oxford: OUPRichards,
2. J.C. and Bohlke, D. (2012). Four Corners-4. Cambridge: CUP.
3. Cambrdige Academic English: An Integrated Skills Course for EAP (Advanced) By Martin Hewings and Craig Thaine, CUP (2012)

4. Berlin, A. (2016). 50 Conversation Classes: 50 Sets of Conversation Cards With an Accompanying Activity Sheet Containing Vocabulary, Idioms and Grammar. Poland: CreateSpace Independent Publishing Platform
5. Zemach, D. E., Islam, C. (2011). Writing Paragraphs: From Sentence toParagraph. Germany: Macmillan Education.
6. Stewart, J. P., Fulop, D. (2019). Mastering the Art of Oral Presentations: Winning Orals, Speeches, and Stand-Up Presentations. United Kingdom: Wiley.
7. Kroehnert, Gary. (2010). Basic Presentation Skills. Sidney: McGraw Hill.
8. Cunninghum, S. & Moor, P. (nd). Cutting Edge (Advanced) With Phrase Builder. Longman Publishers. CUP
9. McCarthy, M & O'Dell, F. (2017). English Idioms in Use (Advanced). Cambridge: CUP.

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4. https://www.englishclub.com/
5. https://www.oxfordlearnersdictionaries.com/
6. https://dictionary.cambridge.org/
7. learnenglishteens.britishcouncil.org
8. https://freerice.com/categories/english-vocabulary
9. http://www.5minuteenglish.com/
10. https://breakingnewsenglish.com/
11. https://www.digitalbook.io/
12. https://librivox.org/

Course Outcomes

- Listen to extended lectures, presentations, and discussions on a wide range of contemporary issues and demonstrate understanding of relatively complex lines of argument. (Bloom's Taxonomy Level/s: 2)
- Make presentations using suitable AV aids and engage in formal group discussions on a wide range of topics of contemporary interest, demonstrating awareness of standard/widely accepted conventions. (Bloom's Taxonomy Level/s: 3)
- Read and demonstrate understanding of the writer's stance/viewpoint in articles and reports on a wide range of contemporary issues and discipline-specific subjects. (Bloom's Taxonomy Level/s: 2 & 4)
- Write analytical essays on a wide range of general topics/subjects of interest, and engage in written communication (emails/concise reports) to exchange relatively complex information, giving reasons in support of or against a particular stance/point of view. (Bloom's Taxonomy Level/s: 3 & 4)
- Complete a mini project that necessitates the use of fairly advanced communication skills to accomplish a variety of tasks and submit a report in the given format. (Bloom's Taxonomy Level/s: 4 & 5)

CLAD1001: Emotional Intelligence & Reasoning Skills (Soft Skills 1)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

Emotional intelligence is a set of skills that are thought to contribute to the appraisal of emotions in oneself and others. It can also help contribute to the effective regulation of emotions as well as feelings (Salovey & Mayer, 1990). In terms of emotional intelligence, self-awareness and self-management have to do with our ability to relate to ourselves. Social awareness and relationship management have to do with our ability to relate to others. Similarly, the ability to solve questions on Analytical Reasoning and Data Sufficiency is a critical area tested in almost all competitive examinations and admission tests. Upon completion, students should be able (1) to deal with their own emotions as well as the emotions of others and relate better with both. Using better knowledge of EI, students will also be able to set more meaningful goals for themselves, choose suitable time management techniques that work best for them and work in teams more effectively. (2) to apply different concepts, ideas and methods to solve questions in reasoning and data sufficiency

Course Objectives:

1. Use EI to relate more effectively to themselves, their colleagues and to others. Apply self awareness and self assessment (SWOT) to better understand and manage their own emotions. Apply social awareness to empathize with others and build stronger relationships with others.
2. Set meaningful goals based on their strengths and weaknesses and apply time management techniques, such as Q4 organizing to put first things first.
3. Manage conflicts and work in teams in an emotionally intelligent manner.
4. Solve questions on non-verbal and analytical reasoning, data sufficiency and puzzles

Unit	Topics	Hours
1	Self Awareness & Self Regulation: Introduction to Emotional Intelligence, *Self Awareness:* Self Motivation, Accurate Self Assessment (SWOT Analysis), Self Regulation: *Self Control, Trustworthiness & Adaptability*	3
2	Importance, Practising Social Awareness, Building Relationships, Healthy and Unhealthy Relationships, Relationship Management Competencies- Influence, Empathy, Communication, Types of Conflicts, Causes, Conflict Management	3
3	Social Media: Creating a blog, use of messaging applications, creating a website to showcase individual talent, creation of a LinkedIn Profile	2
4	Goal Setting & Time Management: Setting SMART Goals, Time Wasters, Prioritization, Urgent Vs Important, Q2 Organization	3
5	Teamwork: Team Spirit, Difference Between Effective and IneffectiveTeams, Characteristics of High Performance Teams, Team Bonding, Persuasion, Team Culture, Building Trust, Emotional Bank Account	4
6	Verbal Reasoning: Introduction,Coding-decoding, Blood relations, Ranking, Directions, Group Reasoning	6
7	Analytical Reasoning: Cubes and Dices, Counting of Geometrical figures	3
8	Logical Deduction: Venn diagrams, Syllogisms, Data Sufficiency, Binary logic	4
9	Spatial Reasoning: Shapes, Paper Cutting/Folding, Mirror images, Water images and Rotation of figures	2
	Total Hours	30

Course Outcomes

- Students will be able to relate more effectively to themselves, their colleagues and to others
- Students will be able to set their short term and long term goals and better manage their time
- Students will be able to manage conflicts in an emotionally intelligent manner and work in teams effectively
- Students will be able to solve questions based on non-verbal and analytical reasoning, data sufficiency and puzzle

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

CLAD1011: Leadership Skills & Quantitative Aptitude
(Soft Skills 2)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

Communication Skills is having the ability to convey information to others so that messages are understood and outcomes delivered. Some essential qualities of Communication Skills include understanding the needs of others, clearly communicating messages, adapting the communication style, and using a range of communication methods. Presentation Skills is having the ability to confidently deliver an engaging message to a group of people which achieves the objectives. Some essential qualities of Presentation Skills include a thorough preparation of content, structuring content logically, managing nerves, engaging your audience, delivering presentation objectives, positively influencing the audience, and responding to audience needs. Tackling questions based on numbers, arithmetic, data interpretation and puzzles requires the application of different rules and concepts of numerical computation, numerical estimation, and data estimation.

Course Objectives:

1. Learn and apply, through different individual and group activities, different ideas and skills to communicate in a positive and impressive manner.
2. Apply the goal setting process (based on SWOT) and Q2 organizing for effective time management.
3. Apply different concepts in numbers, numerical computation and numerical estimation to solve questions that often appear in various competitive examinations and admission tests.
4. Apply different concepts for tackling questions based on data interpretation, progression and series that are frequently given in various competitive examinations and admission tests.

Unit	Topics	Hours
1	Communication Skills: *The Communication Process*, Elements of Interpersonal Communication, *Non-Verbal Communication:* Body Language, Posture, Eye Contact, Smile, Tone of Voice, *Barriers to Communication.* Effective Listening Skills: Active Listening, Passive Listening, Asking Questions, Empathizing, Being Non Judgemental, Being Open Minded, Mass Communication: Design of Posters, Advertisements, notices, writing formal and informal invitations	5
2	Focus on Audience Needs, Focus on the Core Message, Use Body Language and Voice, Start Strongly, Organizing Ideas & Using Visual Aids: SPAM Model, Effective Opening and Closing Techniques, Guy Kawasaki's Rule (10-20-30 Rule), Overcoming Stage Fear, Story Telling	3
3	Problem Solving & Decision Making: Difference Between the Two, Steps in Rational Approach to Problem Solving: Defining the Problem, Identifying the Root Causes, Generating Alternative Solutions, Evaluating and Selecting Solutions, Implementing and Following-Up, Case Studies	3

4	Group Discussion: Understanding GD, Evaluation Criteria, Nine Essential Qualities for Success, Positive and Negative Roles, Mind Mapping, Structuring a Response, Methods of Generating Fresh Ideas	4
5	Number Theory: Number System, Divisibility rules, Remainders and LCM & HCF	3
6	Numerical Computation and Estimation - I : Chain Rule, Ratio Proportions, Partnerships & Averages, Percentages, Profit-Loss & Discounts, Mixtures, Problems on Numbers & ages	6
7	Data Interpretation: Interpretation and analysis of data in Tables, Caselets, Line-graphs, Pie-graphs, Box-plots, Scatter-plots and Data Sufficiency	3
8	Mental Ability: Series(Number, Letter and Alphanumeric), Analogy(Number, Letter and Alphanumeric) and Classifications	3
	Total Hours	30

Course Outcomes

- Students will be able to communicate 'one-on-one' and 'one-on-many' confidently using both verbal and non-verbal messages and deliver impressive talks/ presentations to a group both with and without the use of PPTs and create posters, advertisements, etc.
- Students will be able to apply the the rational model of problem solving and decision making in their problem solving and decision making efforts.
- Students will be able to solve questions based on numbers and arithmetic given in various competitive examinations
- Students will be able to solve questions based on data interpretation, progressions and series.

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

CLAD1021: Verbal Ability & Quantitative Ability (Soft Skills 3)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

Vocabulary is an important part of verbal ability. An understanding of word formation, prefixes, suffixes and roots is necessary to remember and use a vast repository of words. Approaching words through word families and other ways of groupings is an effective way of gaining mastery over vocabulary. Understanding and getting acquainted with the different rules and exceptions in the use of grammar and structure, especially from the relevant examination point of view, is crucial to cracking questions given in many competitive tests. Similarly, improving reading comprehension skills and test taking abilities in this area takes time and effort, especially given the fact that most students do not possess strong reading habits. In so far as quantitative aptitude is concerned, students need to develop a strong foundation on the basic mathematical concepts of numerical estimation, geometry, mensuration, data sufficiency, etc. to be able to crack different round 1 tests of major recruiters and admission tests of top Indian and foreign universities.

Course Objectives:

1. List and discuss the different word formation methods, word denotation, connotation, collocation, etc. and introduce selected high frequency words, their antonyms, synonyms, etc
2. Apply different advanced reading skills to solve questions based on author's tone, main ideas and sub-ideas, inferences, parajumbles, etc. that are frequently asked in various competitive exams and admission tests.
3. Solve different types of questions based on vocabulary, such as word analogy; structure, grammar and verbal reasoning; introduce common errors and their detection and correction.
4. Solve questions on numerical estimation, mensuration, data sufficiency based on quantitative aptitude. This includes questions on time and work, time and distance, pipes and cisterns, lines and angles, triangles, quadrilaterals, polygons and circles, 2 & 3 dimensional mensuration.

1. **Vocabulary Builder:** Understanding Word Formation, Prefixes, Suffixes and Roots, Etymology, Word Denotation, Connotation and Collocation, Synonyms and Antonyms

2. **Reading Comprehension:** Advanced Reading Comprehension: Types of RC passages, Types of Text Structures, Types of RC Questions: Distinguishing Between Major Ideas and Sub Ideas, Identifying the Tone and Purpose of the Author, Reading Between the Lines and Beyond the Lines, Techniques for Answering Different Types of Questions

3. **Para Jumbles:** Coherence and Cohesion, Idea Organization Styles, Concept of Mandatory Pairs and Its Application: Transitional Words, Antecedent-Pronoun Reference, Article Reference, Cause and Effect, Chronological Order, General to Specify, Specify to General, Idea-Example, Idea-Explanation, Etc.

4. **Grammar Usage:** Rules Governing the Usage of Nouns, Pronouns, Adjectives, Adverbs, Conjunctions, Prepositions and Articles

5. **Numerical Computation and Estimation - II:** Time and Work, Pipes and Cisterns, Time and Distance, Problems on Trains, Boats and Streams, Races and Games of Skill, Simple Interest & Compound Interest

6. **Geometry:** Lines and Angles, Triangles, Quadrilaterals & Polygons, and Circles

7. **Mensuration:** 2-Dimensional Mensuration (Triangles, Quadrilaterals and Circles), 3-Dimensional Mensuration (Cubes, Cuboids, Cylinder, Cone, Sphere)

Course Outcomes:

1. List and discuss word formation methods, selected high frequency words, their antonyms, synonyms, etc.
2. Analyze reading passages and quickly find out the correct responses to questions asked, including para jumbles, by using reading skills like skimming, scanning, reading between the lines, etc.
3. Solve different types of questions based on vocabulary, structure, grammar and verbal reasoning
4. Solve questions on numerical estimation, mensuration, data sufficiency based on quantitative aptitude

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

CLAD1031: Practicing Verbal Ability & Quantitative Aptitude (Soft Skills 4)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

A sound knowledge of the rules of English grammar, structure and style and its application in detecting errors in writing are important areas of Verbal Ability frequently tested as a part of the written test in many competitive examinations and admission tests of major recruiters and universities respectively. This module focuses on all important areas of grammar and structure commonly asked in major tests, such as GMAT, CAT, XLRI, CRT, etc. Similarly, in the area of Quantitative Aptitude, different kinds of questions are asked from Combinatorics (Permutations & Combinations, Probability], Cryptarithmetic & Modular Arithmetic (Cryptarithmetic, Application of base system (7, 24), Clocks (Base 24), Calendars (Base 7), and Mental Ability (Number series, Letter series & Alpha numeric series, Analogies (Numbers, letters), Classifications, Algebra (Exponents, Logarithms, Problems related to Equations, Special Equations, and Statistics) . This module focuses on all these areas by building on what the students already learnt in their earlier studies.

Course Objectives:

1. Apply the rules of grammar to solve questions in Error Detection, Sentence Correction and Sentence Improvement.
2. Apply the rules of structure to solve questions in Error Detection, Sentence Correction and Sentence Improvement, Fill-in-blanks and Cloze Passages.
3. Explain methods of solving problems in Combinatorics (Permutations & Combinations, Probability], Cryptarithmetic & Modular Arithmetic (Cryptarithmetic, Application of base system (7, 24), Clocks (Base 24), Calendars (Base 7)]
4. Explain how to solve questions in Mental Ability (Number series, Letter series & Alpha numeric series, Analogies, Numbers, letters, Classifications] and Algebra (Exponents, Logarithms, Problems related to Equations, Special Equations, Statistics)

1. Error Detection: Pronouns, Conjunctions, Prepositions and Articles
2. Error Detection: Tenses and their Uses
3. Sentence Correction: Subject-Verb Agreement, Antecedent-Pronoun Agreement, Conditional Clauses
4. Sentence Correction: Modifiers (Misplaced and Dangling) & Determiners, Parallelism & Word Order, and Degrees of Comparison
5. Combinatorics: Permutations & Combinations, Probability

6. Crypt arithmetic & Modular Arithmetic: Crypt arithmetic, Application of Base System (7, 24), Clocks (Base 24), Calendars (Base 7)

7. Algebra: Exponents, Logarithms, Word-problems related to equations, Special Equations, Progressions, Statistics

Course Outcomes:

1. Identify and correct errors in English grammar and sentence construction
2. Identify and correct errors in Structure, Style and Composition
3. Solve problems in Combinatorics, Cryptarithmetic, and Modular Arithmetic
4. Solve problems in Mental Ability and Algebra

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

VEDC1001: Venture Development

L	T	P	S	J	C
0	0	0	2	0	2

Course Description

In this course, you will discover your deeper self in terms of how you might contribute to society by creating exciting new products and services that can become the basis of a real business. Your efforts, creativity, passion, and dedication to solving challenging problems are the future of our society, both in your country and worldwide.

The course is divided into four sections:

1. Personal discovery of your core values and natural skills
2. Ideation and improving the impact
3. Business model design for the innovation
4. Presenting your idea in a professional manner suitable for a new venture pitch

Each section has key frameworks and templates for you to complete, improving your idea step by step until the final presentation.

First, you will discover your personal values and emerging areas of knowledge that are the foundations of any successful company. Next, you will learn how to develop insight into the problems and desires of different types of target customers and identify the design drivers for a specific innovation. Then, you will learn specific design methods for new products and services. And as important as the product or service itself, it is a strategy for monetizing the innovation – generating revenue, structuring the operating costs, and creating the operating profit needed to support the business, hire new employees, and expand forward.

This project is intended to be for teams of students. Innovation and entrepreneurship are inherently team-based. This course will give you that entrepreneurial experience.

This is the beginning of what might be the most important journey of personal and career discovery so far in your life, one with lasting impact. This is not just a course but potentially an important milestone in your life that you remember warmly in the years to come.

Course Objectives

Students will have the opportunity to:

- Discovery who you are – Values, Skills, and Contribution to Society
- Understand how creativity works and permeates the innovation process
- Learn the basic processes and frameworks for successful innovation.
- Gain experience in actually going through the innovation process.
- Conduct field research to test or validate innovation concepts with target customers.
- Understand innovation outcomes: issues around business models, financing for start-ups, intellectual property, technology licensing, corporate ventures, and product line or service extensions.

Course Materials

- Meyer and Lee (2020), Personal Discovery through Entrepreneurship, The Institute for Enterprise Growth, LLC. Boston, MA., USA
- Additional readings

- Additional videos, including case studies and customer interviewing methods.

Expectations of you in the classroom: Each student is expected to be prepared to discuss the readings/exercises assigned for each class. It's not optional! Students will be randomly asked to discuss and summarize the material. Your learning – and your success—in this course are heavilydependent upon your willingness to participate actively in class discussion. Your class participation will be assessed on the quality and consistency of your effort in each and every class.

Late assignments: Late assignments are subject to grade penalty. Lateness will only be considered for grading if prior notice was given to the instructor before the due date.

Presentation: Achieving success with an innovative idea requires you to package and present the idea in a crisp, creative, and powerful manner. The activity of presenting helps you to internalize your idea -- as you talk about it and obtain feedback – and improve upon it. There would be two major presentations during the course, plus a series of other smaller unscheduled presentations of work in progress or course material. Prepare, practice, and succeed!

Time spent outside of class: The course is hands-on and requires students to conduct field research through direct interactions with people (interviews/surveys) and online/in the library. Specifically, the course requires that students conduct studies with potential target users and stakeholders. You must be prepared to go out of your comfort zone to dig for information. You will need to search for information online and arrange to meet or talk to relevant people who may have the information you need.

Group Project Overview

This is a semester length project and the cornerstone component of the course. The group project will give you the opportunity to apply the course concepts to a real situation. You will learn about the entrepreneurship for your own business or your work in organizations. Even if you are not going to be an entrepreneur, you need to know how to identify the opportunities, who to persuade people, and how to create economic and social values in many different contexts.

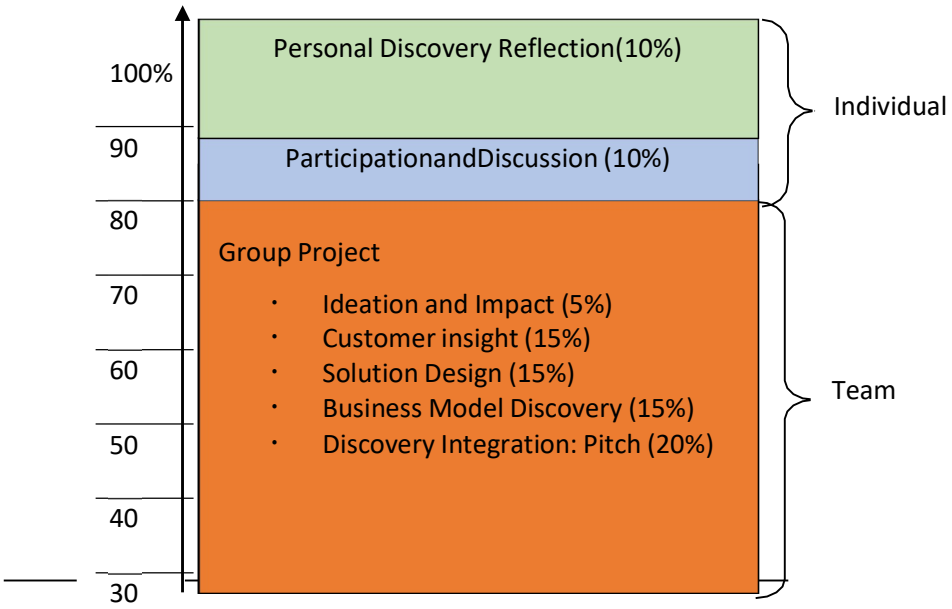
Talking to customers is one of the most important steps in investigating your business because your entrepreneurial vision must correspond to a true market opportunity. With your group, select 5-6 potential customers willing to be interviewed. They should represent a cross-section of our target market and should provide information that helps you refine your opportunity. This is not a simple survey: you are seeking in-depth understanding of the lifestyle and behaviors of your customer that can help you shape your opportunity. Please remember, you are not simply looking to confirm you have a great idea, but to shape your idea into a great opportunity. You will maximize your chances for success and your ability to execute your business cost-effectively by making early (rather than later) changes to your concept.
"Design" is fun, particularly when you merge customer insight with your own creativity. Enjoy! In this book, we provide structured methods to be an active listener and learner from customers as well as a product or service designer.

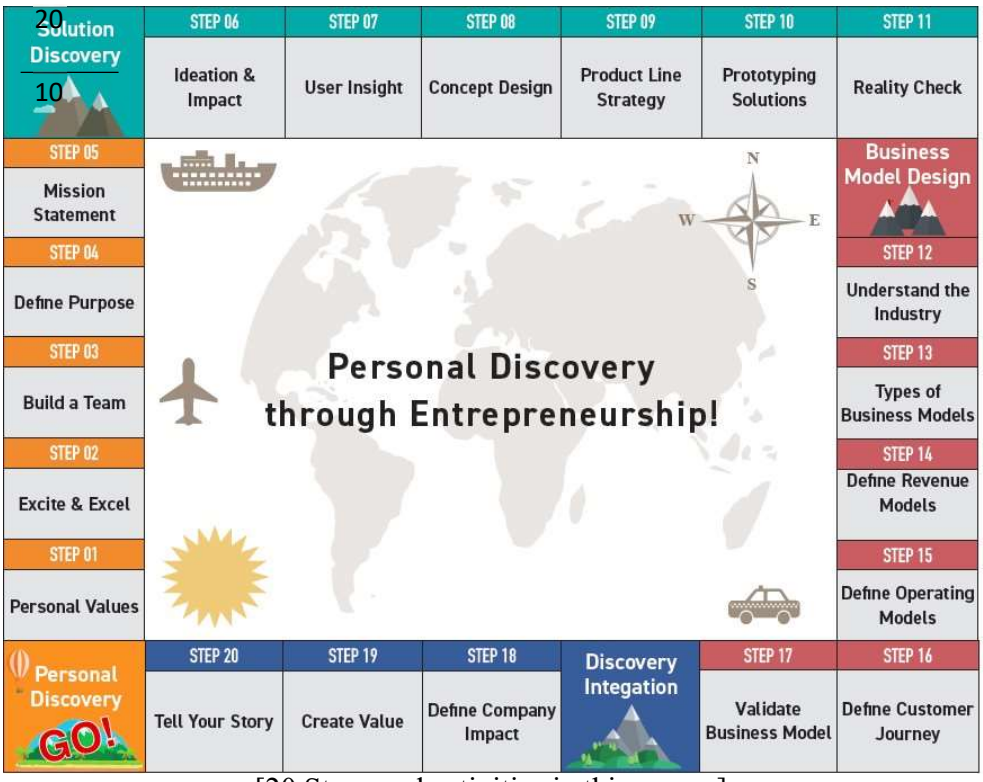
Business modeling is not as hard as it might sound. This is the design of your business – how it charges customers, what is spent producing and selling products or services, and the money that can be made for each unit sold. We keep it simple – so should you.

For the final outcome, you will be required to come up with Pitch that can used as the basis for actually starting a company based on an impactful innovation. Once again, we provide a specific format and tools for creating a compelling Pitch. We also want you to think about an exciting proposition that is more than just making money, but rather, one that helps society. This will give

you innovation and venture concept greater lift with customers – and it will also make you feel better, deep inside.

Project Components and Grading





[20 Steps and activities in this course]

Deliverables

There are a number or different deliverables for the course that follow the templates presented in the book, as applied to your own venture idea. Do your best to keep up with the timeline of the

class; do not fall behind! Later templates build on the learnings from prior templates. Make the most of your team! Everyone needs to pitch in. In no case, should one person be taking the lead on all templates.Rather,different team members should take the lead on specific deliverables. Coordinate well. Let your teacher know if a team member is not carrying his or her load.

Specific Deliverables

Ideation and Impact Hand-in Package: 5% of total grade
clearly written, with a one-page explanation for the team's decision

- Problem to Solve Templates, Step 4, Page 62 and 63
  (with a page of additional explanation if needed)
- Idea Impact Template, Step 6, Page 69 (with a page of explanation)

Customer Interviews and Insight Hand-in Package: 15%
(1st Round of Customer Interviews)

- Customer Interviews Template, Step 7, Pages 75-78,plus add additional template forms for each additional customer interview. The more, the better.
- Idea Reshaping Template, Step 7, Pages 84 and 85. Integration into overall conclusions. How have you improved your original idea through customer research?
- Latent Needs Template, Step 7, Page 93 – what are the frustrations of users that are not solved by current products or services?
- Full Use Case Template, Step 7, Page 99 – how do you customers' needs change over the full use case, and what innovative ideas can you propose at each step of the way?

Concept Design (and Test) Hand-in Package: 15%

- Customer Value Proposition Template: Step 8, Page 107. This becomes the landing point for what you learned in your customer interviews.
- Competitive Analysis Template: Step 8, Page 109. (Use the Web or actual stores/dealers)
- Product Vision and Subsystem Design Templates:Step 10, Pages 121 and 126 (You can add additional pages with design illustration and explanations of your bubble chart)
- Reality Check Survey Template and Results: Step 11, Page 141, 143-144
  (You can use more than 2 pages for reporting the results.)

Business Model Design Hand-in Package: 15%

- Industry Analysis Templates: Step 12, Pages 153 and 154
- Illustrate the Business Model Template: Step 13, Page 170
  (Use different colours or line patterns to show the flows of product, money, and information)
- Revenue Model Template: Step 14, Page 177
- Operating Model Template: Step 15, Page 187
- Customer Journey Template: Step 16, Page 195
- Validating the Business Model Template: Step 17, Pages 199 and 200

Discovery Integration Hand-in Package: 20%

- Business and Social Vision Impact Statement Template: Step 18, Page 210.
- Per Unit Profitability Template: Step 19, Page 229
- Your Venture Story Pitch: Step 20(PowerPoint)
- Overall Pitch Design Template:Page 264

Assemble the templates from all your work above, plus any others that you found particularly meaningful, and from these, create your Team's Innovation Pitch.The book has lists specific templates that fit for each part of the final presentation.

Do not just regurgitate the templates in your pitch; rather, take the key points from them to create your own, unique presentation. The templates help you think – but most are toocomplex to present to outside people who have not taken the course. Therefore, design thispitch as if you presenting to a new set of investors.

And don't forget to add an attractive title page with your team members names and email addresses!You can also add an Appendix at the very back with particularly interesting information, such as industry data or the results of your customer interviews and Reality Check.

Individual Innovation Assignments

You will be required to submit two Reflection Journalsas well as a maximum two pages double spaced Synthesis, Integration and Application paper by email at the Week 4 and Week 14 respectively. Please note, this exercise is not about regurgitating the course concepts.

(1) Personal Discovery Reflection Journal (10%)

At the beginning of this semester, you will have a time to think about your self (who you are, what you are good at, what areas you want to contribute on) using a couple of templates. After that sessions, you will have a quiet moment to think about yourself, yourcareer, and your happiness in your life. Please write 2-page reflectional journal what you feel and learning through the personal discovery sessions.

(2) Insight Learning Reflection Journal (10%)

At the end of this semester, you are to prepare a short reflection of impressive sessions aswell as related activities outside the classroom. Specially, (1) reflect on the key points from lectures, reading, discussion, guest speakers, and interviews, (2) apply this to your own situation, and (3) outline ways that you intend to use this knowledge in the future.

Course Schedule

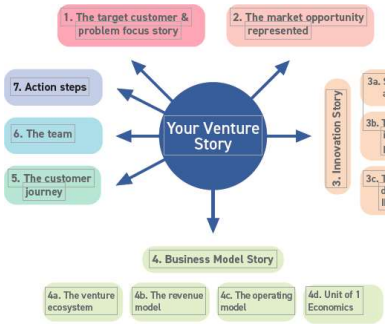
Week	Session	Topics and Steps	Key CONCEPTS Introduced in Class	Class Focus Activity
1	1	**Course Overview**	1. Why is entrepreneurship important? 2. What is Personal Discovery through Entrepreneurship? 3. Four Stages; Personal Discovery, Solution Discovery, Business Model Discovery, Discovery Integration 4. Preparation (finding interesting areas)	**Lecture and Discussion**
	2	**Personal Discovery** (Step 01, Step 02)	1. Personal Values 2. Strength and Weakness	Individual: · Work with the templates provided on pages: · Core values: 22, 23 · Skills: 27, 28, 29, 30, 31 · Societal Contribution: 33, 34
2	3	**Find Teammates** (Step 03)	1. Review Problem Area Template at the beginning of the book to find classmates who want to work on the same problem area. 2. Findteammates (1) Shared values (2) Levels of commitment (3) Skills and experiences (Same or Different?)	Problem template: Page 9 · Talk to your classmates and find teammates. See who wants to work on in the same problem space, with a shared vision of solutions, and complementary skill sets. · Sit back and assess: Team templates on Pages 44, 45, and 46. · Prepare to present your team, the problem it is going to tackle, and its collective skills.
	4	**Define Purpose** (Step 04) **Create Mission** (Step 05)	1. Methods for defining and refining a venture's purpose 2. Defining a Venture's Purpose 3. Creating a Vision Statement	Team: · Purpose and Mission Templates: Pages 49 and 52 · Be prepare to present to the class. · Personal Discovery Reflection Journal Due

Week	Session	Topics and Steps	Key CONCEPTS Introduced in Class	Class Focus Activity
3	5	**Ideation & Impact** (Step 06)	Ideation Methods · An in-class ideation exercise	Team: · Problem to Solve Templates, Step 4, Page 62, and 63
	6		Increasing the Impact of an Idea. (The Eat-Your-Coffee Video – a good example of ideation)	Team: · Idea Impact Template, Step 6, Page 69
4	7	**User Insights Frameworks** (Step 07)	· Identifyand find the right target users. · Interview style and methods · The Customer Interview template.	Team: · Customer Interviews Template, Step 7, Pages 75 · Edit interview template for your project.
	8		Laddering methods for interviews	Team: · Latent Needs Template, Step 7, Page 93
5	9	**User Insights Customer Interviews** (Step 07)	· Finding latent needs · Field work check-in	Team: · Latent Needs Template, Step 7, Page 93 · Field work – customer interviewing
	10		· Think about innovation across the entire use case · Field work check-in	Team: · Full Use Case Template, Step 7, Page 99 · Field work – customer interviewing
6	11	**User Insights Interpreting Results** (Step 07)	· Interpreting customer interview results · Field work check-in	Team: · Field work – customer interviewing · Also talk to retailers/dealers if appropriate
	12		· Idea Reshaping based on Customer Interviews · Field work check-in	Teams prepare results of results from customer interviews and how the original ideas have been reshaped& improved.
7	13	**User Insights Interpreting Results** (Step 07)	· Customer Research Reports · Implications for product and service design	· Teams prepare PPTs for class presentation · **Customer Insight Template Hand-in Package**
	14			

Week	Session	Topics and Steps	Key CONCEPTS Introduced in Class	Class Focus Activity
8	15	**Concept Design** (Step 08)	· Defining Customer Value · Understanding Customer Value Proposition	Team: · Customer Value Proposition · Template: Step 8, Page 107 · Draft the CVP
	16		· Presentation and review of CVPs	Team: · Complete CVP
9	17	**Competitive Analysis and Positioning** (Step 08)	· Understanding of Competitive Matrix · Competitive positioning: creating your separate space	Team: · Identify major competitors, and dimensions for analysis · Template: Step 8, Page 109
	18		· Presentations of Competitive Analyses and Positionings	Team: · Perform the competitive analysis and present results, including positioning
10	19	**Product Line Strategy** (Step 09)	· Product line framework: good, better, best on underlying platforms, plus application to Services.	Team: · Identify good, better, best variations based on the underlying concept. · Product line template: Page 115
	20	**Product Visioning Subsystem Design, and Prototype Sketch** (Step 10)	· The structured bubble chart, showing implementation options and the team's choices · Prototype sketching (The Bluereo Video is a good example of iterative prototyping driven by customer discovery.)	Team: · Prototype sketch, and for Web apps, a wireframe. For physical products, an initial bill of materials. · Underlying bubble chart showing your decision process. · Product Vision and Subsystem Design Templates: Step 10, Pages 121 and 126
Week	**Session**	**Topics and Steps**	**· Key CONCEPTS Introduced in Class**	**Team or Individual Activity**
11	21	**Reality Check** (Step 11)	· The purpose of the Reality Check, testing the product concept, channel preferences, and much other.	Team: · Reality Check Survey Template and Results: Step 11, Page 141, 143-144

	22		・ Guidance on the number or additional customers for the reality check survey ・ How to analyze and interpret the results	・ Customize the Reality Check template for your venture. ・ Do a quick round of customer surveying. Aim for 12 more interviews.
12	23	**Industry Analysis** (Step 12)	・ Team reports on Reality Check Results ・ Examine major components of an Industry Analysis ・ Review Templates	Team: ・ Prepare and present the results of your reality check, plus any pivots you wish to make. ・ **Concept Design (and Test) Hand-in Package** ・ Industry Analysis Templates: Step 12, Pages 153 and 154s
	24	**Business Model** (Step 13)	・ Defining the Business Model: ・ Lecture on basic structure and different types. ・ Illustrating it as the flow of product, money, and information.	Team: ・ Business Model Illustration Template, Step 13, Page 170

Week	Session	Topics and Steps	· Key CONCEPTS Introduced in Class	Team or Individual Activity
13	25 26	**Business Model** (Steps 14, 15, 16, 17)	· Revenue and Expenses · The key decision points in the Revenue Model · The key decision points in the Operating Model · Designing the Customer Journey · Validating the Business Model (The Polka Dog Bakery Video: an example of creating a new retail experience, plus new products.)	Team · Step 14, Page 177 · Step 15, Page 187 · Step 16, Page 195 · Step 17, Pages 199 and 200 · Validate the Revenue and Operating Model by trying to have phone calls with a few Sellers and Manufacturers to validating pricing, channels, and costs.
14	27	**Impact Visioning** (Step 18)	· Develop clear statements for business and societal impact. · Look at good existing examples of companies that do both.	Team: · Start integrating your research and templates towards the final presentation, provided in Step 20, Page 264 · **Business Model Design Hand-in Package**
	28	**Creating Value** (Step 19)	· Develop a project of the profitability in make low volumes for a product, a service, and a Web app. · Discuss applications of the framework to your venture.	Team: · Develop and present Unit of 1 Economics Template, Step 19, Page 229 · Keep working on the Final presentation

Week	Session	Topics and Steps	Key CONCEPTS Introduced in Class	Team or Individual Activity
15	29 30	**Tell Your Story**	· Presentation Format and Style · Format: (1) Title Slide with names and contact information (2) The Target Customer and the Problem to be Solved (3) The Market Opportunity (4) The Innovation Story (5) The Business Model Story (6) The Customer Journey (7) The Team (8) The Proposed Action Steps. (9) Appendices (if needed or desired) · If you have built a prototype during the class, please bring it and show it to us! (The Fortify Video is a good example of how a good technical idea can translate into a business model, and next, into a well-funded venture.)	Team: · The PPT Presentation  · Practice, practice, practice! · Not too many words on one slide · Use pictures · Use template to develop your thinking, but try to create slides that are not just the templates.
Final Course Deliverables			Due on the Monday after the weekend of the final class meeting.	**Team: Your Venture PPTs** **Individual: Insight Learning Reflection Journal**

Course Outcomes

5. Identify one's values, passions, skills and their will to contribute to society
6. Formulate an idea and validate it with customers
7. Demonstrate prototyping and analyze the competition for the product
8. Create business models for revenue generation and sustainability of their business
9. Come up with a pitch that can used as the basis for actually starting a company based on an impactful innovation and societal impact

DOSP1001: Badminton

L	T	P	S	J	C
0	0	0	2	0	2*

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

Course Outcomes:

1. Learn to play Badminton
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Badminton - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Badminton: Grips - Racket, shuttle
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Badminton Gameplay: Service, Forehand, Backhand
7. Preparatory Drills and Fun Games
8. Game Variations: Singles/ Doubles/ Mixed

Reference:

1. Handbook of the Badminton World Federation (BWF)

DOSP1011: Chess

L	T	P	S	J	C
0	0	0	2	0	2*

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

Course Outcomes:

1. Learn to play Chess
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Chess - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Chess: Pieces & functions, basic play
4. Chess board moves & terminology
5. Chess Gameplay: Openings, castling, strategies & tactics
6. Preparatory Drills and Fun Games
7. Game Variations & Officiating

Reference:

1. International Chess Federation (FIDE) Handbook

DOSP1031: Football

L	T	P	S	J	C
0	0	0	2	0	2*

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

Course Outcomes:

1. Learn to play Football
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Football - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Kicking, heading, ball control, Keeping
4. Movement, throwins, tackling, defense, scoring, defense
5. Gameplay- Formations, passing, FKs, CKs, PK, tactics
6. Preparatory Drills and Fun Games
7. Game Variations: Small sided games, 7v7, 11v11

Reference:

1. FIFA Laws of the Game

DOSP1041: Volleyball

L	T	P	S	J	C
0	0	0	2	0	2*

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

Course Outcomes:

1. Learn to play Volleyball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Volley - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Striking, Ball control, Lifting
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Jumps, strikes, layoffs, attack, defense

Reference:

1. FIVB - Official Volleyball Rules

DOSP1051: Kabaddi

L	T	P	S	J	C
0	0	0	2	0	2*

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

Course Outcomes:

1. Learn to play Kabaddi
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Kabaddi - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Raiding, catching
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Chain system movement

Reference:

1. Amateur Kabaddi Federation of India (AKFI) - Official Rules
2. Rules of Kabadddi - International Kabaddi Federation

DOSP1091: Basketball

L	T	P	S	J	C
0	0	0	2	0	2*

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

Course Outcomes:

1. Learn to play Basketball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Basketball - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Passing, Receiving, Dribbling
4. Sports Specific fitness and warmup drills
5. Stances and footwork: Jumps, dribbles, catching, throws
6. Preparatory Drills and Fun Games
7. Gameplay: Shots, throws, movements, attack, defense

Reference:

1. FIBA Basketball Official Rules

DOSP1111: Throwball

L	T	P	S	J	C
0	0	0	2	0	2*

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

Course Outcomes:

1. Learn to play Throwball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Throwball - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Throwing, Receiving
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Shots, throws, movements, control

Reference:

1. World Throwball Federation - Rules of the Game

DOSL1001: Club Activity – Participant

L	T	P	S	J	C
0	0	0	2	0	2*

This course recognizes student participation in multiple activities organized by various student organizations that pursue specific co-curricular and extra-curricular interests. These activities allow students to engage in and identify and pursue their personal interests and hobbies.

Course Objectives

- Create opportunities for students to participate in a variety of non-academic experiences
- Interact with and learn from peers in a setting without an external performance pressure
- Allow exploration of interesting activities and reflection about these experiences
- Learn to manage time effectively

List of Student Club Activities

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multi media, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities

1. Participation in various club based activities
2. Weekly reflection paper
3. Portfolio (on social media using an instagram account)
4. Two learning papers (one per semester)

Text Books

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes

Upon successful completion of the course, student will be able to

- Identify personal interest areas
- Learn from diverse perspectives and experiences
- Gain exposure to various activities and opportunities for extra-curicular activities
- Learn to manage time effectively
- gain confidence

DOSL1011: Club Activity – Member of the Club

L	T	P	S	J	C
0	0	0	2	0	2*

This course encourages and acknowledges student members' work in organizing events and activities organized by various student organizations that pursue specific co-curricular and extra-curricular interests. These activities allow students to actively learn from the process of conceptualizing and organizing such activities as part of a team.

Course Objectives

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

List of Student Club Activities

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multi media, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities

1. Be a member of a club and organize activities in that particular interest area
2. Learn from diverse perspectives and experiences
3. Learn to design and execute extra-curicular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

Text Books

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes

Upon successful completion of the course, student will be able to

- Be a member of a club and organize activities in that particular interest area
- Learn from diverse perspectives and experiences
- Learn to design and execute extra-curicular activities
- Develop management skills through hands on experience
- Explore different managerial roles and develop competencies

DOSL1021: Club Activity – Leader of the Club

L	T	P	S	J	C
0	0	0	2	0	2*

This course encourages and recognizes student members' work in leading the student organizations through various leadership roles. As leaders they work not just to organize events and activities in specific co-curricular and extra-curricular interests, but also lead the teams that form the core members of the clubs. These activities allow students to learn and practice leadership and management skills through real world experience.

Course Objectives

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

List of Student Club Activities

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multimedia, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities

1. Be the leader of the club and implement the charter, vision and mission of the club
2. Learn from diverse perspectives and experiences
3. Learn to lead the team, design and execute extra-curicular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

Text Books

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes

Upon successful completion of the course, student will be able to

- Be the leader of the club and implement the charter, vision and mission of the club
- Learn from diverse perspectives and experiences
- Learn to lead the team, design and execute extra-curricular activities
- Develop management skills through hands on experience
- Explore different managerial roles and develop competencies

DOSL1031: Club Activity – Competitor

L	T	P	S	J	C
0	0	0	2	0	2*

This course encourages and recognizes student members' work in leading the student organizations through various leadership roles. As leaders they work not just to organize events and activities in specific co-curricular and extra-curricular interests, but also lead the teams that form the core members of the clubs. These activities allow students to learn and practice leadership and management skills through real world experience.

Course Objectives

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

List of Student Club Activities

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multimedia, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities

1. Be the leader of the club and implement the charter, vision and mission of the club
2. Learn from diverse perspectives and experiences
3. Learn to lead the team, design and execute extra-curicular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

Text Books

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes

Upon successful completion of the course, student will be able to

- Be the leader of the club and implement the charter, vision and mission of the club
- Learn from diverse perspectives and experiences
- Learn to lead the team, design and execute extra-curricular activities
- Develop management skills through hands on experience
- Explore different managerial roles and develop competencies

POLS1001: Indian Constitution and History

L	T	P	S	J	C
2	0	0	0	0	2*

Course Description:
This course analyzes the basic structure and operative dimensions of the Indian Constitution. It explores various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian Constitution. The course also deals with various challenges faced by the constitution and its coping mechanisms. Broadly, the students would understand and explain the working of different institutions and political debates ensuing from the operation of the Indian constitution in action.

Course Objectives:
1. To introduce constitutional history of India.
2. To explain the process of making Indian constitution
3. To analyze Fundamental of Rights, Duties and other principles in constitution
4. To create familiarity with political developments which shaped the constitution.

Course Outcomes:

On the successful completion of the course students would be able to:

1. Demonstrate an understanding of the Constitution of India and how constitutional governance is carried out in India
2. Interpret knowledge of the Fundamental Rights and Duties of the Citizens as well as the Obligation of the state towards its citizens
3. Correlate familiarity with key political developments that have shaped the Constitution and amended it from time to time.
4. Equip themselves to take up other courses in law after having done a foundation course on Indian Constitution

Unit I: India as a Nation **6 hrs**

Khilani, S. (2004). *Introduction, The Idea of India*, Chapter 1. New Delhi: Penguin Books, pp. 1-15.
Rowat, D. (1950). 'India: The Making of a Nation', *International Journal, 5*(2), 95-108. doi:10.2307/40194264
Brass, P. (2018). 'Continuities and Discontinuities between pre- and post-Independence India', Chapter 1. *The Politics of Idea since independence*, New Delhi: Cambridge University Press. pp. 1-30.

Module Learning Outcomes

1. Understand ideas of India
2. Explain the story behind making constitution and its future.
3. Articulate the differences between pre and post-colonial governments.

Unit 2: Understanding the Constitution **6 hrs**

Mehta, U.S. (2011). 'Constitutionalism' in *The Oxford Companion to Politics in India*, (ed) by Nirja Gopal Jayal, and Pratap Bhanu Mehta, New Delhi: Oxford University Press. pp. 15-27.
Austin, G. (2016), 'The Constituent Assembly: Microcosm in Action' in *The Indian Constitution: Cornerstone of a Nation*, New Delhi: Oxford University Press, pp. 1-25.
Beteille, Andre (2008): "Constitutional Morality," *Economic and Political Weekly,* Vol 43, Issue No 40
Prahladan, Vivek (2012): "Emergence of the Indian Constitution," *Economic and Political Weekly*, Vol 47, Issue No 07.

Module Learning Outcomes
Understand the concept of constitutionalism. Demonstrate strength or weakness of constitutional morality in India
Evaluate constituent assembly debates in framing Indian Constitution.

Unit 3: The Preamble, Fundamental Rights and Directive Principles of State Policy 6 hrs

Bhakshi, P.M. (2011). 'Preamble' in *The Constitution of India*, New Delhi: Universal Law. Pp. 1-5.
Laxmikanth, M. (2017). 'Chapter IV: Preamble of the Constitution' in *Indian Polity*, Chennai: McGraw Hills.
Kumar, Virendra (2007): "Basic Structure of The Indian Constitution: Doctrine of Constitutionally Controlled Governance [From Kesavananda Bharati to I.R. Coelho]" *Journal of the Indian Law Institute*, Vol 49, No 3, pp 365-398.
Austin, G (2016), ' ' in *The Indian Constitution: Cornerstone of a Nation*, New Delhi: Oxford University Press, pp.63-105.
Reddy, S (1980). Fundamental Ness of Fundamental Rights and Directive Principles in the Indian Constitution. *Journal of the Indian Law Institute*, 22(3), pp. 399-407.
Bhatia, Gautam (2017): "The Supreme Court's Right to Privacy Judgement," *Economic and Political Weekly*, Vol 52, Issue No 44

Module Learning Outcomes

1. Explain the relationship between 'Preamble' and 'The constitution'.
2. Interpret the key concepts of preamble
3. Analyzes the dynamic nature of Indian constitution
4. Understanding Fundamental Rights
5. Evaluate Directive Principles of State Policy
6. Interpret case studies on Fundamental Rights.

Unit 4: Citizenship **6 hrs**

Jayal, N.G. (2019). 'Reconfiguring citizenship in contemporary India' in *South Asia Journal of South Asian Studies*, pp.33-58.
Roy, Anupama. (2010). 'Chapter I: Enframing the citizen in contemporary times' in *Mapping Citizenship in India*, New Delhi: Oxford University Press.
Das, Veena (2010): "State, Citizenship and the Urban Poor," *Citizenship Studies,* Vol 15, pp 319-333.
Valerian Rodrigues

Module Learning Outcomes

1. Explain different dimensions of citizenship in Indian context
2. Evaluate the basis of citizenship
3. Compare 'claim' and 'status'of citizenship

Unit 5: Separation and Distribution of Powers 6 hrs

Pal, Ruma. (2016). 'Separation of Powers' in *The Oxford Handbook of the Indian Constitution*, (ed) by Sujit Choudhry, Madhav Khosla, and Pratap Bhanu Mehta, Delhi: Oxford University Press.
Bakshi, P. (1956). 'Comparative Law: Separation of Powers in India'. *American Bar Association Journal, 42*(6), 553-595.
Rao, P. (2005). 'Separation of Powers in a Democracy: The Indian Experience'. *Peace Research, 37*(1), 113-122.
Kumar, Ashwani (2019): "Constitutional Rights, Judicial Review and Parliamentary Democracy," *Economic and Political Weekly*, Vol 51, Issue 15
Tillin, Louise. (2015). 'Introduction' in *Indian Federalism*. New Delhi: Oxford University Press. pp. 1-30.
Chakrabarty, Bidyut and Rajendra Kumar Pandey. (2008). *Federalism' in Indian Government and Politics*, New Delhi: Sage Publications. pp. 35-53.
Arora, B. and Kailash, K. K. (2018). 'Beyond Quasi Federalism: Change and Continuity in Indian Federalism', in *Studies in Indian Politics*, pp. 1-7.
Agrawal, Pankhuri (2020): "COVID-19 and dwindling Indian Federalism," *Economic and Political Weekly,* Vol 55, Issue No 26

Module Learning Outcomes

1. Explain the importance of separation of powers in a democracy
2. Understand the relation between three organs of the government
3. Evaluate the system of 'checks and balances'
4. Understand the difference between unitary and federal political systems
5. Critically analyze the Indian model of Federalism
6. Evaluate the distribution of responsibilities between union and state governments.

Recommended Readings:

De, Rohit. (2018). *A People's Constitution – The Everyday Life of Law in the Indian Republic*, USA: Princeton University Press.
Granville Austin, *The Indian Constitution: Cornerstone of a Nation*, Oxford University Press, Oxford, 1966.
Lahoti, R.C. (2004). *Preamble: The Spirit and Backbone of the Constitution of India*. Delhi: Eastern Book Company.
Rajeev Bhargava (ed), *Ethics and Politics of the Indian Constitution*, Oxford University Press, New Delhi, 2008.
Subhash C. Kashyap, *Our Constitution*, National Book Trust, New Delhi, 2011.
Tillin, Louise. (2015). *Indian Federalism*. New Delhi: Oxford University Press.
Zoya Hassan, E. Sridharan and R. Sudarshan (eds), *India's Living Constitution: Ideas, Practices, Controversies*, Permanent Black, New Delhi, 2002.

PHPY1001: Gandhi for the 21st Century

L	T	P	S	J	C
2	0	0	0	0	2*

Course Description
This course provides the students with basic knowledge on Gandhi's early life, transformations in South Africa and his entry into India's national movement. While going through the social-political, economic and educational philosophies of Gandhi, the course analyses how his ideologies are relevant even in the 21st century.

Course Objectives

The objectives of the course are;
1. To provide the students with the basic knowledge on Gandhi's life and his philosophies
2. To understand the early influences and transformations in Gandhi
3. To analyse the role of Gandhi in India's national movement
4. To apply Gandhian Ethics while analysing the contemporary social/political issues
5. To appreciate the conflict resolution techniques put forward by Gandhi and its significance in the current scenario.

Module I : MK Gandhi: Childhood and Education
M K Gandhi, Formative Years (1869-1893): Early childhood - study in England - Indian influences, early Western influences.

Module II: From Mohan to Mahatma-South African Experiences
Gandhi in South Africa (1893-1914): South African Experiences - civil right movements in South Africa - invention of Satyagraha - Phoenix settlement- Tolstoy Farm - experiments in Sarvodaya, education, and sustainable livelihood.

Module III: Gandhi and Indian National Movement
Gandhi and Indian National Movement (1915-1947): Introduction of Satyagraha in Indian soil -non-cooperation movement - call for women's participation - social boycott - Quit-India movement - fighting against un-touchability - Partition of India- independence.

Module IV: Gandhi and Sustainable Development
Gandhian Constructive Programs-Eleven Vows-Sarvodaya-Seven Social Sins-Gandhian Economics and Sustainable Development

Module V: Gandhi and Contemporary Issues
Conflict Resolution Techniques of Gandhi-Ecological Challenges and Gandhian solutions-Gandhian Ethics-An Analysis

Learning Outcomes
1. To understand the life of Gandhi
2. To understand the role of Gandhi in Indian national movement
3. To analyse the origin and significance of Satyagraha
4. To understand the eleven vows of Gandhi which he followed through-out his life.

5. To examine the significance of constructive programs today

Course Outcomes

After the successful completion of the course the students will be able to;
1. Understand the life of Gandhi
2. Appreciate the role of Gandhian non-violence and Satyagraha in India's freedom struggle.
3. Critically examine the philosophy of Gandhi on Education, Sarvodaya, and Satyagraha
4. Analyse the contemporary significance of Gandhian constructive programmes and eleven vows
5. Examine the possible solutions for some of the contemporary challenges like environmental issues, moral degradation and ethical dilemmas.

References

1. Gandhi, M K. (1941). *Constructive Programme*. Ahmadabad: Navjivan Publishing House
2. Gandhi, M. K. (1948). *The Story of My Experiments with Truth*. Ahmadabad: Navjivan Publishing House
3. Gandhi, M K. (1968). *Satyagraha in South Africa*. Ahmadabad: Navjivan Publishing House.
4. Khoshoo, T N (1995). *Mahatma Gandhi: An Apostle of Applied Human Ecology*. New Delhi:TERI
5. Kripalani, J.B. (1970). *Gandhi: His Life and Thought*. New Delhi: Publications Division.
6. Narayan, Rajdeva (2011). *Ecological Perceptions in Gandhism and Marxism*. Muzaffarpur: NISLS
7. Pandey, J. (1998). *Gandhi and 21st Century*. New Delhi: Concept.
8. Weber, Thomas (2007).Gandhi as Disciple and Mentor. New Delhi: CUP

DOSL1041: Community Services - Volunteer

L	T	P	S	J	C
0	0	0	0	2	2*

This course recognizes student participation in Community service activities organized by various student organizations and other Government and non-government organizations that exist for providing service to communities. These activities allow students to develop empathy, citizenship behavior and community values.

Course Objectives

- To help students develop empathy and citizenship behavior
- Enable students to develop an altruistic attitude and community development sensibility
- Allow exploration of community service activities and reflect about these experiences
- Learn to work in small and large teams for achieving community objectives

List of Community Service Activities

1. Community Health Services
2. Swachh Bharat Abhiyan and other Cleanliness drives
3. Tree Plantation and similar environmental conservation initiatives
4. Rain water harvesting awareness and implementation
5. Fundraising and visits to Orphanages, Old-age homes, etc.
6. Health and disease awareness programs
7. Working with NGOs
8. Disaster mitigation and management training and relief work
9. Rural Upliftment projects
10. Campus awareness and action projects (cleanliness, anti-ragging, blood donation, etc)
11. Community investigations and surveys for development research
12. Educational support for underprivileged (remedial classes, coaching, training, etc)
13. Service camps
14. Advocacy and information literacy initiatives
15. Other activities serving local communities

List of Activities

1. Participation in various community service activities
2. Weekly reflection paper
3. Portfolio (on social media using an instagram account)
4. Two learning papers (one per semester)

Text Books

1. Soul of a citizen: living with conviction in Challenging times (author: Paul Rogat Loeb)
2. Community Services intervention: Vera Lloyd

References

1. A path appears: Transforming lives, creating opportunities (Nicholas Kristof and Sheryl WuDunn)
2. The story of My Experiments with Truth (author: M. K. Gandhi)

Course Outcomes

- Experience of volunteering in a variety of Community service activities
- Gaining empathy for lesser privileged sections of society by experience
- Understanding the process of generating community awareness
- Understanding Disaster management and relief through training and experience
- Developing environmental and sustainability awareness

DOSL1051: Community Services - Mobilizer

L	T	P	S	J	C
0	0	0	0	2	2*

This course recognizes student leadership in mobilizing community service activities as members of various student organizations or other Government and non-government organizations that exist for providing service to communities. These activities allow students to develop leadership, management skills, empathy, citizenship behavior and community values.

Course Objectives

- To help students understand leadership in a community environment
- Enable students to develop an altruistic attitude and community development sensibility
- Allow deep understanding of community service through practical experience
- Learn to lead small and large teams for achieving community objectives

List of Community Service Activities

1. Community Health Services
2. Swachh Bharat Abhiyan and other Cleanliness drives
3. Tree Plantation and similar environmental conservation initiatives
4. Rain water harvesting awareness and implementation
5. Fundraising and visits to Orphanages, Old-age homes, etc.
6. Health and disease awareness programs
7. Working with NGOs
8. Disaster mitigation and management training and relief work
9. Rural Upliftment projects
10. Campus awareness and action projects (cleanliness, anti-ragging, blood donation, etc)
11. Community investigations and surveys for development research
12. Educational support for underprivileged (remedial classes, coaching, training, etc)
13. Service camps
14. Advocacy and information literacy initiatives
15. Other activities serving local communities

List of Activities

1. Organizing and leading teams in various community service activities
2. Fortnightly reflection paper
3. Portfolio (on social media using an instagram account)
4. Two learning papers (one per semester)

Text Books

1. Soul of a citizen: living with conviction in Challenging times (author: Paul Rogat Loeb)
2. Community Services intervention: Vera Lloyd

References

1. A path appears: Transforming lives, creating opportunities (Nicholas Kristof and SherylWuDunn)
2. The story of My Experiments with Truth (author: M. K. Gandhi)
3. List of student run and and other Government and non-government community serviceorganizations organizations

Course Outcomes

- Experience of mobilizing and executing Community service activities
- Providing opportunities for community service volunteering for other fellow students
- Understanding the process of mobilizing cash, kind and volunteer support
- Building leadership and management skills
- Building empathy and citizenship behavior

ENVS1001: Environmental Studies

L	T	P	S	J	C
3	0	0	0	0	3*

The course enables the students to adapt eco-centric thinking and actions rather than human-centric thinking on natural resources, their utilization and conservation. The course also focuses on the importance of ecosystems, biodiversity and their degradation led to pollution. This course helps in finding solutions through application of control measures to combat pollution and legal measures to achieve sustainable development.

Course Objectives

1. To impart knowledge on natural resources and its associated problems.
2. To familiarize learners about ecosystem, biodiversity, and their conservation.
3. To introduce learners about environment pollution.
4. To acquaint learners on different social issues such as conservation of water, green building concept.
5. To make learners understand about the present population scenario, its impacts and role of informational technology on environment and human health.
6. To make learners understand about the importance of field visit.

Course Outcomes

After the completion of the course student will be able to

1. List different natural resources and their uses
2. Summarize the structure and function of terrestrial and aquatic ecosystems.
3. Identify causes, effects, and control measures of pollution (air, water & soil).
4. Function of green building concept.
5. Adapt value education

UNIT – I **Multidisciplinary nature of environmental studies & Natural Resources:** No of Hours: 10

Multidisciplinary nature of environmental studies Definition, scope and importance. Need for public awareness. Natural resources and associated problems. Uses and over exploitation of Forest resources, Water resources, Mineral resources, Food resources, Energy resources. Role of an individual in conservation of natural resources.

Activity:

1. Planting tree saplings
2. Identification of water leakage in house and institute-Rectify or report
3. Observing any one day of a week as Car/bike/vehicle free day.

UNIT – II **Ecosystem and biodiversity** No of Hours: 10

Ecosystem: Structure components of ecosystem: Biotic and Abiotic components. Functional components of an ecosystem: Food chains, Food webs, Ecological pyramids, Energy flow in the ecosystem (10% law), Ecological succession.

Biodiversity: Definition, Biogeographical classification of India, Values of biodiversity: consumptive use, productive use, social, ethical, aesthetic. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching, man wildlife conflicts. Conservation of biodiversity: In – situ and Ex-situ

Activity"

1. Visit to Zoological Park-Noting different ecosystem
2. Biodiversity register- Flora and fauna in the campus

UNIT – III **Environmental Pollution** No of Hours: 10

Definition Causes, effects, and control measures of: -Air pollution. Water pollution. Soil pollution. Marine pollution. Noise pollution. Nuclear hazards. Solid waste Management: Causes, effects, and control measures. Role of an individual in prevention of pollution. Pollution case studies.

Activity

1. Visit to treatment plant and documentation.
2. Documentation of segregation of solid waste-Dry and Wet

Learning Outcomes:

After completion of this unit, the student will be able to

UNIT – IV **Social Issues and the Environment** No of Hours: 10

From Unsustainable to Sustainable development Urban problems related to energy. Water conservation, rainwater harvesting, watershed management. Environmental ethics: Issues and possible solutions. Green building concept.

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.

Activity:

1. Observing zero hour at individual level-documentation.
2. Eco friendly idols.
3. Rainwater harvesting-creating storage pits in nearby area.

UNIT – V **Human Population and the Environment and Environment Protection Act and Field work** No of Hours: 10

Population growth, variation among nations. Environment and human health. HIV/AIDS, Human rights. Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health. Environment Legislation. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Environmental Protection Act, Issues involved in enforcement of environmental legislation.

Activity:

1. Visit to a local polluted site-industry/agriculture
2. Identifying diseases due to inappropriate environmental conditions

Text Book(s)

1. Erach Bharucha. Textbook of environmental studies for undergraduates courses-Universities Press, India Private Limited. 2019.
2. Kaushik A and Kaushik C.P. Perspectives in Environmental Studies. New Age International Publishers Edition-VI. 2018.
3. Dave D Katewa S.S. Textbook of Environmental Studies, 2nd Edition. Cengage Learning India. 2012.

Additional Reading

1. Benny Joseph. Textbook of Environmental Studies 3rd edition, McGraw Hill Publishing company limited. 2017.

Reference Book(s):

1. McKinney M.L., Schoch R.M., Yonavjak L. Mincy G. Environmental Science: Systems and Solutions. Jones and Bartlett Publishers. 6th Edition. 2017.
2. Botkin D.B. Environmental Science: Earth as a Living Planet. John Wiley and Sons. 5th edition. 2005.

Journal(s):

1. https://www.tandfonline.com/loi/genv20
2. https://library.lclark.edu/envs/corejournals

Website(s):

https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf

From Climate Science to Action | Coursera

	Programme Objectives (POs)												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2												2		
CO2		2				1							2		
CO3			1						1					1	
CO4				2							2				1
CO5	1													1	
CO6					2							1			1

1-Low, 2-Medium and 3-High Correlation

MFST1001: Health & Wellbeing

L	T	P	S	J	C
0	0	2	0	0	1*

The course provides the students a better understanding of the role of a proper diet in maintenance of human health. This course emphasizes the composition of the food, and will help to understand how to exercise, the role of sports and physical fitness in development of a good health. The course also focuses on the importance of emotional well-being and mindfulness. This course helps in teaching the role of yoga in maintenance of physical balance.

Course Objectives

- To provide an understanding of the relationship between food and nutrition
- To emphasize the role of exercise, sports and physical fitness in obtaining a good health
- To explain about the mindfulness and emotional well being
- To teach the role of yoga and meditation in maintaining the body balance

UNIT-I

Understand the relationship between Food and Nutrition and how food composition affects nutritional characteristics. Knowledge about regulatory principles in determining diets and recommended daily allowances. Understand how to create personalised diet/nutrition plans.

UNIT-II

Understand how exercise, activity and sports helps in developing good health. Experiential exposure to the role of proper, specific nutritional interventions along with structured activities on developing proper physical health. Practical exercises and assignments in sports and exercise regimes.

UNIT-III

Introduction to emotional wellbeing and mindfulness. Teaching of mindfulness practices to reduce stress, increase relaxation and improve mental wellbeing.

UNIT-IV

Introduction to Yoga theory and how Yoga helps in maintaining balance in the body. Practice of Yoga and meditation to improve overall emotional and physical balance. Practical yoga exercises and meditation techniques

Course outcomes:

By the end of the course, student will

- Learn the role of nutrition and diet in maintaining a good health
- Will understand how the exercise, sports and physical activities will improve health
- Will learn mindfulness practices for reducing stress
- Will know the importance of yoga and meditation

CLAD2001: Preparation for Campus Placement-1

(Soft Skills 5A)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

The course addresses all relevant areas related to campus placements and readies them to ace their upcoming/ ongoing recruitment drives. Specifically, it focuses on students' career preparedness, interview skills, test preparedness, etc.

Course Objectives:

Prepare the students for their upcoming/ ongoing campus recruitment drives.

1. Career Preparedness: Resume & Cover Letter Writing, Interview Skills: Elevator Pitch, Making the First Impression, Being Other-Oriented, Being Positive and Curious, communicating with Confidence and Poise, Frequently Asked Questions & How to Answer Them, Pitfalls to Avoid, Etc. Etiquette: Hygiene, Courtesy, Culture differences, Workplace, use of cell phone, Profanity, Slang, Protocol.

2. Verbal Ability: Practising Reading Comprehension, Error Detection, Sentence Completion, MCQs, FIBs, Para jumbles, Cloze Test, Critical Reasoning.

3. Quantitative Aptitude: Number Systems, Algebra, Geometry, Data Handling, Data Sufficiency, Word Problems

4. Reasoning: Logical and Verbal Reasoning

Course Outcomes:

1. Write a power resume and covering letter
2. Answer interview questions with confidence and poise
3. Exhibit appropriate social mannerisms in interviews
4. Solve placement test questions on verbal ability, quantitative aptitude and reasoning

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

CLAD2011: Preparation for Higher Education (GRE/ GMAT)-1 (Soft Skills 5B)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

1. The course offers a special track for students who aspire to go abroad in pursuit of their higher education for which a GRE/ GMAT score is a prerequisite. It covers all four topical areas of these tests and includes fully solved mock tests as well.

Course Objectives:

1. Prepare the students to solve questions from all four broad areas of GRE/ GMAT
2. Orient the students for GRE/ GMAT through mock tests

1. Verbal Reasoning: Reading Comprehension, Sentence Equivalence, Text Completion, Sentence Correction, Critical Reasoning

2. Quantitative Reasoning: Arithmetic, Algebra, Geometry, Data Analysis

3. Analytical Writing Assessment: Issue/ Argument

4. Integrated Reasoning

Course Outcomes:

1. Solve questions from all four broad areas of GRE/ GMAT
2. Practice answering several mock tests

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

CLAD2021: Preparation for CAT/ MAT - 1
(Soft Skills 5C)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

The course offers a special track for UG students who aspire to go for higher education in business management in India for which cracking CAT/ MAT/ other related test is mandatory. It covers all four topical areas of these tests and includes fully solved mock tests as well.

Course Objectives:

1. Prepare the students to solve questions from all four relevant areas of CAT/ XAT/ MAT, etc.
2. Orient the students for CAT/ XAT, etc. through mock tests

1. Quantitative Ability: Arithmetic, Algebra, Geometry, Mensuration, Calculus, Trigonometry

2. Data Interpretation: Data Interpretation and Data Sufficiency

3. Logical Reasoning: Data Management, Deductions, Verbal Reasoning and Non-Verbal Reasoning
4. Verbal Ability: Critical Reasoning, Sentence Correction, Para Completion, Para Jumbles, Reading Comprehension

Course Outcomes:

1. Solve questions from all four relevant areas of CAT/ MAT as listed above
2. Practice test-cracking techniques through relevant mock tests

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay

2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

CLAD2031: Preparation for Campus Placement-2

(Soft Skills 6A)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

This course builds on the previous course and focuses on all four major areas of campus placements, including career preparedness, mock interviews, verbal ability, quantitative aptitude and logical reasoning.

Course Objectives:

1. To comprehensively prepare all eligible and aspiring students for landing their dream jobs.
2. To sharpen the test-taking skills in all four major areas of all campus drives

1. Career Preparedness II: Mock Interviews, Feedback and Placement Readiness

2. Verbal Ability II: Practising Reading Comprehension, Error Detection, Sentence Completion, MCQs, FIBs, Para jumbles, Cloze Test, Critical Reasoning

3. Quantitative Aptitude II: Number Systems, Algebra, Geometry, Data Handling, Data Sufficiency, Word Problems

4. Reasoning II: Logical and Verbal Reasoning

Course Outcomes:

1. Demonstrate career preparedness and confidence in tackling campus interviews
2. Solve placement test questions of a higher difficulty level in verbal ability, quantitative aptitude and logical reasoning.
3. Practice test-taking skills by solving relevant questions accurately and within time.

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay

2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

CLAD2041: Preparation for Higher Education (GRE/ GMAT)-2

(Soft Skills 6B)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

1. The course offers a special track for students who aspire to go abroad in pursuit of their higher education for which a GRE/ GMAT score is a prerequisite. It covers all four topical areas of these tests at a higher difficulty-level and includes fully solved mock tests as well.

Course Objectives:

1. Prepare the students to solve higher level questions from all four broad areas of GRE/ GMAT
2. Orient the students for GRE/ GMAT through mock tests

1. Verbal Reasoning II: Reading Comprehension, Sentence Equivalence, Text Completion, Sentence Correction, Critical Reasoning

2. Quantitative Reasoning II: Arithmetic, Algebra, Geometry, Data Analysis

3. Analytical Writing Assessment II: Issue/ Argument

4. Integrated Reasoning II

Course Outcomes:

1. Solve higher level questions from all four broad areas of GRE/ GMAT
2. Practice answering several mock tests

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

CLAD2051: Preparation for CAT/ MAT - 2
(Soft Skills 6C)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

The course offers a special track for UG students who aspire to go for higher education in business management in India for which cracking CAT/ MAT/ other related test is mandatory. It covers all four topical areas of these tests at a higher level of difficulty and includes fully solved mock tests as well.

Course Objectives:

1. Prepare the students to solve all types of questions from all four relevant areas of CAT/ XAT/ MAT, etc.

1. Quantitative Ability II: Arithmetic, Algebra, Geometry, Mensuration, Calculus, Trigonometry
2. Data Interpretation II: Data Interpretation and Data Sufficiency
3. Logical Reasoning II: Data Management, Deductions, Verbal Reasoning and Non-Verbal Reasoning
4. Verbal Ability II: Critical Reasoning, Sentence Correction, Para Completion, Para Jumbles, Reading Comprehension

Course Outcomes:

1. Solve higher difficulty level questions from all four relevant areas of CAT/ MAT as listed above
2. Practice test-cracking techniques through relevant mock tests

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

FINA3001: Personal Financial Planning

L	T	P	S	J	C
0	0	2	0	0	1*

Course Overview

Personal Financial Planning is one of the most significant factors in our lives. It is essential that funds are available as and when required at various stages of life. Unavailability of funds at critical stages of our life leads to financial distress and leads to many medical and non-medical problems. There are certain planned and unplanned events in our life. On the one hand, education of our children, their marriage, our retirement etc. are some of the planned events of our life, but at the same time, some medical urgency, accident or death of an earning member might be some unplanned events. Many of these events are beyond our control, but the availability of funds can be planned to avoid any financial distress. In other words, we cannot stop the rain but can plan for an umbrella.
This course looks at the many challenges an individual faces in a complex financial environment and the rising uncertainties of one's life. It focuses on achieving long-term financial comfort of individual and family through goal setting, developing financial and life strategies, acquiring personal financial planning knowledge and managing risk throughout one's life.

Course Objectives:

1. To build students' ability to plan for long-term financial comfort of individual and family through goal setting, developing financial and life strategies.
2. To provide students with knowledge on terms, techniques to evaluate investment avenues.
3. To build the skill set of the student to enable them to file their tax returns.

Course Outcome:

1. Describe the financial planning process and application of time value of money
2. Application of life and non-life insurance products in financial planning
3. Understand the investment avenues and analysis of investment returns
4. Understand the retirement planning and its application
5. Describe and analysis the Tax Planning

Unit 1: Basics of Financial Planning

Financial Planning Meaning, Need, Objectives, Financial Planning Process, Time Value of Money and its application using excel (NP)

Unit 2: Risk and Insurance Management

Need for insurance, Requirement of insurance interest, Role of insurance in personal finance, Steps in insurance planning, Life and Non-life insurance products, Life insurance needs analysis (NP)

Unit 3: Investment Products and Measuring Investment Returns

Investment Products: Small Saving Instruments, Fixed Income Instruments, Alternate

Investments, Direct Equity
Measuring Investment Returns: Understanding Return and its concept, Compounding concept, Real vs Nominal Rate of Return, Tax Adjusted Return, Risk-Adjusted Return (NP)

Unit 4: Retirement Planning
Introduction to the retirement planning process, estimating retirement corpus, Determining the retirement corpus, Retirement Products (NP)

Unit: 5 Tax Planning
Income Tax: Income tax principles: Heads of Incomes, Exemptions and Deductions, Types of Assesses, Rates of Taxation, Obligations for Filing and Reporting, Tax aspects of Investment Products, Wealth Tax

Text Books

1. National Institute of Securities Management (NISM) Module 1 & XA
2. Madhu Sinha, Financial Planning, 2 Edition, McGraw Hill India
3. Simplified Financial Management by Vinay Bhagwat, The Times Group

Reference Books

1. Personal Financial Planning (Wealth Management) by S Murali and K R Subbakrishna, Himalaya Publishing House.
2. Mishra K.C., Doss S, (2009). Basics of Personal Financial Planning 1e. National Insurance Academy, New Delhi: Cengage Learning.
3. Risk Analysis, Insurance and Retirement Planning by Indian Institute of Banking and Finance.

PHYS1001: PHYSICS

L	T	P	C
3	0	2	4

This course is designed with fundamentals of electromagnetism and properties of materials for advanced courses in their respective engineering branches. It introduces electromagnetic theory with relevant mathematical tools, optical fibres and their propagation characteristics, properties of dielectric and magnetic materials. It also introduces principles of semiconductors and some widely used semiconductor devices for various applications.

Course Objectives

- To introduce mathematical principles to estimate forces, fields and waves.
- To familiarize students with electromagnetics in modern communication systems.
- To impart knowledge concerning the electrical behaviour of dielectric materials.
- To demonstrate the properties of magnets.
- To introduce semiconductor physics and devices.

UNIT I: Basics of Electromagnetics 9 L

Electrostatic field: Coulomb's law and Gauss 'law, derivation of Coulombs law from Gauss' law, applications of Gauss' law (line charge, thin sheet of charge and solid charged sphere), Gauss' law of electrostatics in dielectric medium, divergence and curl of electric fields, electric potential, relation between potential and force, Poisson's and Laplace equations.

Magnetostatic field: Biot–Savarts' law, divergence and curl of magnetic fields, Faraday's and Ampere's laws in integral and differential form, displacement current, continuity equation, Maxwell's equations.

Learning Outcomes:

- apply Coulomb's and Gauss' laws to electric field configurations from charge distributions (L3)
- apply the Biot-Savarts' law to derive magnetostatic field distributions (L3)
- use vector calculus to describe electromagnetic phenomena(L2)
- relate the law of conservation of charge to continuity equation(L3)
- illustrate the Maxwell's equations, Maxwell's displacement current and correction of Ampere's law(L2)

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT II: Fiber Optics 7 L

Introduction, advantages of optical fibers, principle and structure, acceptance angle, numerical aperture, modes of propagation, classification of fibers, fiber optic communication, importance of V-number, fiber optic sensors (Temperature, displacement and force), applications.

Learning Outcomes:

After completion of this unit, the student will be able to

- apply the principle of propagation of light in optical fibers(L3)
- explain the working and classification of optical fibers(L2)
- analyse propagation of light through optical fibers based on the concept of modes (L4)
- summarize applications of optical fibers in medical, communication and other fields(L2)

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT III: Dielectric, Magnetic and superconducting Materials 10 L

Dielectric materials: Introduction, electric polarization, dielectric polarizability, susceptibility and dielectric constant, types of polarizations (qualitative treatment only). Magnetic materials: Introduction, magnetic dipole moment, magnetization, magnetic susceptibility and permeability, origin of permanent magnetic moment, classification of magnetic materials, Weiss theory of ferromagnetism (qualitative), domain theory, hysteresis, soft and hard magnetic materials.

Superconductivity: definition –Meissner effect –type I & II superconductors –BCS theory (qualitative) –high temperature superconductors –Josephson effects applications.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the concept of dielectric constant and polarization in dielectric materials (L2)
- interpret dielectric loss, Lorentz field and Claussius-Mosotti relation (L2)
- classify the magnetic materials(L2)
- explain the phenomenon of hysteresis for a ferromagnetic material and summarize the properties of hard and soft magnetic materials (L2)
- understand the concept of superconductivity (L2)

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT IV: Semiconductor Physics 8 L

Introduction, origin of energy band, intrinsic and extrinsic semiconductors, mechanism of conduction in intrinsic semiconductors, generation and recombination, carrier concentration in intrinsic semiconductors, variation of intrinsic carrier concentration with temperature, n-type and p-type semiconductors, carrier concentration in n-type and p- type semiconductors, Drift and diffusion currents in semiconductors.

Learning Outcomes:

After completion of this unit, the student will be able to

- outline the properties of semiconductors(L2)
- interpret expressions for carrier concentration in intrinsic and extrinsic semiconductors(L2)
- assess the variation of carrier concentration in semiconductors with temperature (L5)

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT V: Semiconductor Devices 8 L

Zener Diode, Tunnel diode, Hall effect and its applications, magnetoresistance, p-n junction layer formation and V-I characteristics, direct and indirect band gap semiconductors, construction and working of photodiode, LED, solar cell.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the drift and diffusion currents and formation of junction layer (L2)
- state Einstein's relations(L1)
- explain Hall effect and its applications(L3)
- illustrateandinterprettheV-Icharacteristicsofap-njunctiondiode(L2)
- describe applications of p-n junction diodes in photodiodes, LEDs and solar cells (L3).

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

Text Book(s)

1. David J.Griffiths, “Introduction to Electrodynamics”, 4/e, Pearson Education, 2014.
2. Charles Kittel, “Introduction to Solid State Physics”, Wiley Publications, 2011.
3. M. N. Avadhanulu, P.G. Kshirsagar, “A Text book of Engineering Physics”, 11/e, S. Chand Publications, 2019.

Reference book(s)

1. Principles of Physics, 10ed, ISV, Jearl Walker, David Halliday, Robert Resnick, Wiley India.
2. Gerd Keiser, “Optical Fiber Communications”, 4/e, Tata Mc Graw Hill, 2008.
3. S.O.Pillai, “Solid StatePhysics”, 8/e, New Age International, 2018.
4. S.M. Sze, “Semiconductor Devices-Physics and Technology” , Wiley, 2008.

Journal(s):

1. https://aapt.scitation.org/doi/abs/10.1119/1.3317450
2. https://aapt.scitation.org/doi/full/10.1119/1.5144798
3. https://aapt.scitation.org/doi/abs/10.1119/1.1511591

PHYSICS LABORATORY

List of Experiments

1. To determine the magnetic field along the axis of a circular coil carrying current.
2. To determine the numerical aperture of a given optical fiber and hence to find its acceptance angle
3. To determine magnetic susceptibility by Quincke’s tube method
4. To determine the Hall coefficient using Hall effect experiment
5. To determine the resistivity of semiconductor by Four probe method
6. To determine the energy gap of a semiconductor.
7. To study the characteristics of PN Junction diode.
8. To study magnetic hysteresis loop (B-H curve).
9. To determine the dielectric constant of a substance by resonance method.
10. To determine hysteresis loss by CRO.
11. To study the characteristics of Photodiode
12. To study the characteristics of Solar Cell
13. To study the characteristics of Zener diode
14. To study the resonance of LCR circuit

Text Book:

1. S. Balasubramanian, M.N. Srinivasan “A Text book of Practical Physics”- S Chand Publishers,2017

PHYS1031: MECHANICS AND PROPERTIES OF MATTER

L	T	P	C
3	1	0	4

This course is designed for students of Aerospace, Civil and Mechanical Engineering. It introduces fundamentals of elasticity and thermal properties – the essentials for understanding the behaviour of materials. Mechanics of solids is taught to acquaint them with the behaviour of rigid objects. An introduction to sensors will be useful for all the branches as an application of modern technology.

Course Objectives

- To acquaint the basic concepts of sound waves and principles in acoustic design.
- To introduce the concepts of elasticity, strain hardening and failure in materials and impart the relation between stress and strain.
- To impart the phenomenon of heat transfer so as to understand a wide variety of practical engineering problems.
- To demonstrate the use of Newton's laws of motion for understanding the mechanics of a particle.
- To explain the working principle and construction of different types of sensors.

UNIT-I Mechanics: 10 Hours

Basic laws of vectors and scalars; Rotational frames; Conservative and non-conservative forces; F = - grad V; Central forces; Elliptical, parabolic and hyperbolic orbits; Noninertial frames of reference; Centripetal acceleration; Harmonic oscillator; Damped harmonic motion; Forced oscillations and resonance. Degrees of freedom.

Learning Outcomes:

After completion of this unit, the student will be able to

- Explain forces and moments in mechanical systems using scalar and vector techniques L2
- interpret the equation of motion of a rigid rotating body (torque on a rigid body) L3
- apply the Newton's second law for inertial and non inertial frame of reference L3
- summarize harmonic motion in undamped, damped and forced oscillations L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT-II Elasticity 8 Hours

Concepts of elasticity and plasticity, stress and strain, Hooke's law, different moduli of elasticity, Poisson's ratio, strain energy, stress-strain diagram, elastic behavior of a material, factors affecting elasticity, relation between different moduli of elasticity, determination of elastic moduli.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the basic concepts of elasticity, plasticity, strain hardening and failure in materials L2
- determine graphically a material's mechanical properties in terms of its one dimensional stress-strain curve L2
- derive the generalized Hooke's law by recognizing the basic stress-strain response of isotropic materials L3
- Define several elastic constants and determine the relationship between them L1
- evaluate strain energy under different loadings L3

Pedagogy tools: Blended learning,Case let, video lectures, self-reading

UNIT - III Thermal Properties 10 Hours

Transfer of heat energy; Thermal expansion of solids and liquids; Expansion joints -bimetallic strips; Thermal conduction, convection and radiation and their fundamental laws; Heat conductions in solids; Thermal conductivity - Forbe's and Lee's disc method: theory and experiment; Applications (qualitative only): heat exchangers, refrigerators, ovens and solar water heaters.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the process of thermal expansion in solids and liquids L3
- distinguish fundamental laws related to conduction, convection and radiation of heat L1
- determine the thermal conductivity of a material by Forbes and Lee's disc method L4
- summarize the working of heat exchangers, refrigerators, ovens and solar water heaters L2

UNIT - IV Acoustics 8 Hours

Characteristics of sound waves; Weber-Fechner Law; Absorption coefficient, determination of absorption coefficient; Reverberation time; Sabine's formula, derivation of Sabine's formula using growth and decay method; Intensity of sound; Acoustics of buildings, Acoustic requirements of a good auditorium.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the basic concepts in acoustics and describe Weber-Fechner Law L2
- determine absorption coefficient and reverberation time L3
- derive Sabine's formula using growth and decay method L4
- solve problems involving the intensity of a sound wave L4
- summarize the principles of acoustics in designing an acoustically good auditorium L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT– V: Sensors 9 Hours

Sensors (qualitative description only); Different types of sensors and applications; Strain and pressure sensors- Piezoelectric, magnetostrictive sensors; Fibre optic methods of pressure sensing; Temperature sensor - bimetallic strip, pyroelectric detectors; Hall-effect sensor; Smoke and fire detectors.

Learning Outcomes:

After completion of this unit, the student will be able to

- describe the principle of strain and pressure sensors L1
- explain the principle and working of magnetostrictive and piezoelectric sensors L3
- illustrate the fibre optic methods of pressure sensing L3
- infer the functioning of temperature sensors like bimetallic strip and pyroelectric detectors L2
- outline the principle and working of Hall-effect sensor, smoke and fire detectors L2

Text Book(s)

1. D.Kleppner and Robert Kolenkow"An Introduction to Mechanics- II" Cambridge University Press,2015.
2. M.N. Avadhanulu & T.V.S. Arun Murthy, S Chand A Textbook of Engineering Physics, Volume-I 2018.
3. Ian R Sinclair, Sensor and Transducers 3/e,Elsevier (Newnes), 2001.

Reference Book(s)

1. M K Varma, "Introduction to Mechanics"-Universities Press, 2015
2. Prithwiraj Purkait, Budhaditya Biswas and Chiranjib Koley, Chapter 11 Sensors and Transducers, Electrical and Electronics Measurements and Instrumentation, 1/e., McGraw Hill Education (India) Private Limited, 2013.

Course Outcomes:

After completion of this course, the student will be able to

- describe the fundamental principles of acoustics with emphasis on physical mechanisms, law and relationships L1
- apply the concepts of strain, internal force, stress and equilibrium to deformation of solids L3
- explain the fundamental theory for the analysis of heat transfer processess in solids and liquids and to apply basic principles of heat transfer in design of refrigerators and heaters L4
- estimate forces and moments in mechanical systems using scalar and vector techniques L4
- outline the basic principle and operation of different types of sensors L2

PHYS1011: PRINCIPLES OF QUANTUM MECHANICS

L	T	P	C
3	1	0	4

This course is designed with principles of Quantum mechanics for advanced courses in their respective engineering branches. It introduces Quantum mechanics with relevant mathematical tools and provides a basis for further study of quantum mechanics. It also introduces basics of Qubits for Quantum computing applications.

Course Objectives

- To introduce the basic principles of quantum mechanics.
- To introduce wave equation and significance of wave function.
- To teach solving the Schrödinger's equation for spinless particles moving in one-dimensional potential.
- To develop an understanding of concepts of angular momentum.
- To introduce Dirac bra-ket formalism and the concept of QUBITs.

UNIT – I: Introduction to Quantum Physics (10 Hours)

Introduction, Classical Mechanics vs Quantum Mechanics, Planck's quantum theory (qualitative), Photo-electric effect. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them, Wave-particle duality, Heisenberg uncertainty principle: ground state energy of hydrogen atom.

Learning Outcomes:

After completion of this unit, the student will be able to

- Get a grasp on the elementary aspects of energy and momentum of a photon and de Broglie wavelength of a particle.
- Know about the uncertainty principle for position and momentum and for energy and time.
- To study the basic principles of quantum mechanics

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT – II: Properties of Matter Waves (8 Hours)

Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization.

Learning Outcomes:

After completion of this unit, the student will be able to

- understand the significance of Schrodinger's time independent wave equation.
- explain the operator formulation of quantum mechanics.
- learn the concept of wave function

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT – III: Quantum Tunneling (8 Hours)

One dimensional infinitely rigid box-energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical tunnelling in one dimensional rectangular potential

barrier, 1D linear harmonic oscillator (no derivation required, only eigen function, eigen values and zero-point energy).

Learning Outcomes:

After completion of this unit, the student will be able to

- Derive wave functions with reflection and transmission coefficients
- The concept of quantum mechanical tunneling
- solve time-independent Schrödinger equation for simple potentials

Pedagogy tools: Blended learning,Case let, video lectures, self-reading

UNIT - IV Quantum Properties of Electrons (9 Hours)

Electron angular momentum, angular momentum operator, Space quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect, Stark Effect, Gyromagnetic Ratio and Bohr Magneton (qualitative)

Learning Outcomes:

After completion of this unit, the student will be able to

- understand spin magnetic moment and total angular momentum
- relate the eigenvalue problems for energy, momentum and angular momentum explain the idea of spin
- explain the interaction between spin of electron and magnetic field
- understand the interaction between electron and electric field

Pedagogy tools: Blended learning,Case let, video lectures, self-reading

UNIT – V: Qubits for Quantum Computing (10 Hours)

Introduction to Dirac Bra-Ket notation, Introduction to Pauli spin matrices, Quantum Superposition, Interference, Quantum Measurement, Decoherence, Entanglement, Bloch sphere, Qubits, and multiple qubits, Qubits Vs classical bits, representation of a qubit probability.

Learning Outcomes:

After completion of this unit, the student will be able to

- apply Bra-Ket notation in obtaining eigen values
- understand quantum entanglement
- describe the fundamentals of the quantum computing

Pedagogy tools: Blended learning,Case let, video lectures, self-reading

Textbook(s):

1. Quantum Mechanics, G. Aruldhas, 2ndEdn. 2002, PHI Learning of India.
2. Quantum Mechanics, Satya Prakash, 2016, Pragati Prakashan.
3. Quantum Computing for Everyone, Chris Bernhardt, 2019, The MIT Press,

Reference Book(s):

1. Introduction to Quantum Mechanics, D.J. Griffith, 2ndEd. 2005, Pearson Education.
2. Quantum Computing: An Applied Approach, Jack D. Hidary, 2019,

Springer Journal(s):

1. https://aapt.scitation.org/doi/full/10.1119/1.4897588
2. https://aapt.scitation.org/doi/full/10.1119/1.3639154

Websites:

1. https://www.intechopen.com/online-first/73811
2. https://www.quantum-inspire.com/kbase/what-is-a-qubit/

PHYS1021: PHYSICS OF SEMICONDUCTING DEVICES

L	T	P	C
3	1	0	4

This course is designed with fundamentals of electromagnetism and properties of materials for advanced courses in their respective engineering branches. It introduces electromagnetic theory with relevant mathematical tools, optical fibers and their propagation characteristics, properties of dielectric and magnetic materials. It also introduces principles of semiconductors and some widely used semiconductor devices for various applications.

Course Objectives

- To introduce nature light and its properties.
- To familiarize students with different semiconductors and its energy band gaps.
- To introduce semiconductor physics and devices.
- To impart knowledge about the semiconducting optical devices.
- To demonstrate the properties of different semiconducting optical devices.

UNIT I Elements of light (8 hours)

Nature of light, Light sources, Black body, Colour temperature, Units of light, Radio metric and photometric units, Light propagation in media and waveguides, Electro-optic effects. Overview of luminescence: Photoluminescence, Cathodoluminescence, Electroluminescence, Injection-luminescence.

Learning Outcomes:

After completion of this unit, the student will be able to

- Understanding the dual nature of light L2
- Understanding different law for energy spectrum emitted by black body. L3
- To explain the concepts of electro-optics effects L1
- To summarize the overview of different luminescence L2

UNIT II: Semiconductor Materials (10 hours)

Free electron theory of metals, Density of states in 1D, 2D, and 3D, Bloch's theorem for particles in a periodic potential, Energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Occupation probability, Fermi level, Effective mass.

Learning Outcomes:

After completion of this unit, the student will be able to

- Outline the properties of semiconductors L2
- Know the bands structure of metals and semiconductors L3
- Understand the electronic structure of interfaces between different types of materials L2
- To determine the different band gaps of direct and indirect band gap materials L5
- To explain the occupation probability and Fermi level variation in different electronic materials L1

UNIT III: Light-semiconductor interaction (10 hours)

Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Einstein coefficients, Population inversion, application in semiconductor Lasers; Transition rates (Fermi's golden rule), Optical loss and gain; Photovoltaic effect.

Learning Outcomes:

After completion of this unit, the student will be able to

- To summarize the optical transition in bulk semiconductors L2
- To explain the concepts of absorption, spontaneous emission and stimulated emission L1
- To outline the population inversion in semiconductor lasers L2
- To evaluate the transition rates and optical loss and gain in materials L5

UNIT IV: Solar cells and Photovoltaic devices: (9 hours)

Charge carrier generation and recombination, p-n junction model and depletion capacitance, Current voltage characteristics in dark and Light, Device Physics of Solar Cells, Principle of solar energy conversion, Conversion efficiency, Type of solar cells in use: Dye Sensitized Solar Cells, Thin film solar cells.

Learning Outcomes:

After completion of this unit, the student will be able to

- Outline the properties of semiconductors L2
- Know about the interaction of light with materials and its optical properties L3
- Illustrate and interpret the voltage and current characteristics of p-n junction diodes model L1
- Explain the conduction mechanism in semiconducting and optical devices. L5
- To describe the applications of p-n junction diodes in types of solar cells L3

UNIT V: Semiconductor devices (8 hours)

Radiative recombination devices: Light-emitting diodes (LED), Organic Light Emitting Diodes (OLED) and its types, Photoelectric devices: Photodiodes. Photoconducting devices: Photodetectors and photoconductors, Photoresistors, Photo transistors, Stimulated emission devices: Injection laser diodes, Quantum cascade lasers.

Learning Outcomes:

After completion of this unit, the student will be able to

- describe applications of light emitting diodes and its radiative recombination process L2
- explain the concepts of photoconductive devices and its applications in different devices L3
- to define the concepts of Photodetectors and photoconductors, Photoresistors, Photo transistors, L1
- to access the variation of stimulated emission in injection and quantum lasers L5

Text Books:

1. Schubert, E., Light-Emitting Diodes, 2/e, Cambridge: Cambridge University Press, 2006.

2. Physics of Solar Cells: From Basic Principles to Advanced Concepts, 3rd Edition Peter Würfel, UliWürfel (2016) Wiley.
3. Solid State Physics, Neil W. Ashcroft, N. David Mermin (2003) Cengage Learning India

Reference Books:

1. Quantum Cascade Lasers by Vasilios N. Stavrou: https://www.intechopen.com/books/5389.
2. Optoelectronic materials and device concepts; Manijeh Razeghi, SPIE, 1991
3. Introduction to Organic Electronic and Optoelectronic Materials and Devices; Sun and Dalton, CRC Press, 2008.
4. Semiconductor Physics and Devices, 3ed, An Indian Adaptation, S. M. Sze, M. K. Lee, Wiley India.
5. Semiconductor optoelectronics; Jasprit Singh, McGraw-Hill, 1995.

Course Outcomes

After completion of this unit, the student will be able to

- Outline the properties of semiconductors L2
- explain the occupation probability and Fermi level variation in different electronic materials L1
- Know about the interaction of light with materials and its optical properties L3
- Explain the conduction mechanism in semiconducting and optical devices. L5

PHYS1041: MECHANICS AND MODERN PHYSICS

L	T	P	C
3	1	0	4

This course designed for students of Biotechnology to impart principles of Newtonian mechanics will help the students in understanding the oscillatory behavior of materials. It also introduces fundamentals of quantum mechanics – the essentials for understanding the behavior of properties of materials. Fundamentals of optics and electromagnetism in understanding the use in spectroscopy. An introduction to sensors will be useful for all the branches as an application of modern technology.

Course Objectives

- To impart knowledge on damped and forced oscillations.
- To familiarize students with the concepts of quantum mechanics
- To impart knowledge concerning the wave properties of electromagnetic waves
- To familiarize the students about the Maxwell's equations and its propagation
- To outline the principles and working of few common sensing devices

UNIT - I Fundamentals of Dynamics and Oscillations 10 Hours

Fundamentals of Dynamics: Reference frames. Inertial frames; Galilean transformations; Galilean invariance. Review of Newton's Laws of Motion.

Oscillations: SHM, Simple Harmonic Oscillations. Differential equation of SHM and its solution. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor

Learning Outcomes:

After completion of this unit, the student will be able to

- Differentiate between inertial and non-inertial frames of reference
- Solve the differential equation of simple harmonic oscillator
- Distinguish between forced and damped oscillators
- Estimate the resonance and its properties
- Describe the Newton's laws of motion

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - II Modern Physics (Quantum Physics) 8 Hours

Introduction, matter waves and its properties, Davisson-Germer experiment, GP Thomson experiment, Heisenberg's uncertainty principle, Schrodinger's time independent wave equation, physical significance of wave function, particle in a one-dimensional infinite well, rectangular potential barrier (transmission coefficient), band theory of solids (qualitative), distinction between metals, insulators and semiconductors, introduction to Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstien statistics.

Learning Outcomes:

After completion of this unit, the student will be able to

- Get a grasp on the elementary aspects of energy and momentum of a photon and de Broglie wavelength of a particle.
- Know about the uncertainty principle for position and momentum and for energy and time.

- Understand the significance of Schrodinger's time independent wave equation and apply it to a restricted particle.
- Derive wave functions with reflection and transmission coefficients.
- Differentiate between the Maxwell-Bolzmann, Fermi-Dirac and Bose-Einstien statistics

Pedagogy tools: Blended learning,Case let, video lectures, self-reading

UNIT – III: Optics 10 Hours

Interference: Introduction, interference in thin films due to reflected light: interference in parallel-sided film and wedge-shaped film, Newton's rings. Diffraction: Introduction; Fraunhofer diffraction at single slit (qualitative only), diffraction due to N-slits (diffraction grating) (qualitative only), determination of wavelength of light with a plane transmission grating.

Polarisation: Introduction; Double refraction –double refraction in calcite crystal, negative and positive crystals, Nicol's prism, Retarders (quarter and half¬wave plates).

Learning Outcomes:

After completion of this unit, the student will be able to

- Develop the ability to determine the conditions for constructive and destructive interference
- Figure out the position and intensity variation of the dark fringes in single-slit diffraction (Fraunhoffer Diffraction).
- Acquire a basic understanding of diffraction gratings with dispersive nature.
- Comprehend the concepts and meaning of Polarization.
- Know about polarization of light, polarizer and methods of producing polarized light.

Pedagogy tools: Blended learning,Case let, video lectures, self-reading

UNIT – IV: Maxwell`s equations and Electromagnetic wave propagation 8 Hours

Maxwell's equations (both differential and integral forms) and its physical significance, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization of EM waves.

Learning Outcomes:

After completion of this unit, the student will be able to

- Relate the Maxwell's equation in differential and integral forms
- Interpret the behavior of plane electromagnetic waves in vacuum
- Summarize the significance of Maxwell's equations
- Evaluate the energy density of electromagnetic wave
- Describe the wave propagation in vacuum and medium

Pedagogy tools: Blended learning,Case let, video lectures, self-reading

UNIT - V Sensors 9 Hours

Sensors (qualitative description only); Different types of sensors and applications; Strain and pressure sensors -Piezoelectric, magnetostrictive sensors, ultrasonic sensors; Fibre optic methods of pressure sensing; Temperature sensor -bimetallic strip, pyroelectric detectors; Hall-effect sensor; Smoke and fire detectors

Learning Outcomes:

After completion of this unit, the student will be able to

- Illustrate the principle of strain and pressure sensors

- explain the principle and working of magnetostrictive and piezoelectric sensors
- Evaluate the fibre optic methods of pressure sensing
- Infer the functioning of temperature sensors like bimetallic strip and pyroelectric detectors
- State the principle and working of Hall-effect sensor, smoke and fire detectors

Pedagogy tools: Blended learning,Case let, video lectures, self-reading

Textbook(s):

1. Mechanics, D.S. Mathur, S.Chand and Company Limited, 2000.
2. A Text Book of Optics, 25/e, Brij Lal, M N Avadhanulu & N Subrahmanyam, 2012, S. Chand Publishing.
3. Ian R Sinclair, Sensor and Transducers 3rd eds, 2001, Elsevier (Newnes)
4. David J. Griffiths, "Introduction to Electrodynamics"-4/e, Pearson Education,2014
5. M.N. Avadhanulu, P.G. Kshirsagar, A Textbook of Engineering Physics, S.Chand, 2014.

Reference Book(s):

1. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
2. Prithwiraj Purkait, Budhaditya Biswas and Chiranjib Koley, Chapter 11 Sensors and Transducers, Electrical and Electronics Measurements and Instrumentation, 1st eds., 2013 McGraw Hill Education (India) Private Limited.
3. Elements of Properties of Matter, D. S. Mathur, S. Chand Publishing

Journal(s):

1. https://aapt.scitation.org/doi/abs/10.1119/1.3317450
2. https://aapt.scitation.org/doi/full/10.1119/1.3639154

CHEM1001: CHEMISTRY

L	T	P	C
3	0	2	4

This course enables the students to gain knowledge on various aspects of Water and its treatment, electrochemical energy systems, Construction of batteries, renewable energy sources, Semiconductors, Steel, Cement and Polymers, Corrosion and its control, nano-materials, Analytical instruments and applications. The knowledge gained in this course can be applied to the latest developments in technology.

Course objectives

- To impart knowledge on various aspects of water and its treatment.
- To study about electrochemical energy systems, renewable energy sources, solar cells and their applications.
- To gain knowledge on materials such as steel, cement and polymers
- To create awareness on corrosion and its control.
- To introduce different types of nano-materials.
- To expose the students to latest instrumental techniques such as scanning electronic microscope (SEM) & transmission electron microscope (TEM).

Unit-1: Water and its treatment **9L**

Water and its treatment: Introduction – hardness of water – Causes of hardness - Types of hardness: temporary and permanent – expression and units of hardness. Estimation of hardness of water by complexometric method. Potable water and its specifications. Steps involved in treatment of water – Disinfection of water by chlorination and ozonization- industrial water treatment- Boiler feed water and its treatment -internal conditioning– Calgon and Phosphate conditioning. External treatment of water – Ion exchange process. Desalination of water – Reverse osmosis.

Learning outcomes:

After the completion of the Unit I, the student will be able to

- list the differences between temporary and permanent hardness of water. (L-1)
- explain the principles of reverse osmosis. (L-2)
- compare the quality of drinking water with BIS and WHO standards. (L-2)
- illustrate problems associated with hard water. (L-2)
- demonstrate the Industrial water treatment processes. (L-2)

Unit-2: Electrochemical Energy Systems **9L**

Battery Technology: Basic concepts, battery characteristics, classification of batteries, Important applications of batteries, Classical batteries-dry/Leclanche cell, Modern batteries-zinc air, Lead-acid storage battery, lithium cells- Lithium ion cell, Li MnO_2 cell. Fuel cells- Introduction - classification of fuel cells – hydrogen and oxygen fuel cell, propane and oxygen fuel cell- Merits of fuel cell. **Renewable energy sources – Types of renewable energy sources. Semiconductors:** Definition, types of semiconductors: doping- n type and p – type semiconductors and applications.- **Solar cells:** Introduction, harnessing solar energy, Photovoltaic cell, solar water heaters.

Learning outcomes:

After the completion of the Unit II, the student will be able to

- define electrode potential. (L-1)

- explain Nernst's equation. (L-2)
- illustrate difference between primary and secondary cells. (L-2)
- summarize the applications of solar energy. (L-2)
- construct different cells. (L-3)

Unit-3: Engineering materials and Polymer Chemistry 8L

Steel – Types of Steel, chemical composition – applications of alloy steels

Cement: Portland cement, constituents, Manufacture of Portland Cement, chemistry of setting and hardening of cement (hydration, hydrolysis, equations).

Polymer Chemistry: Concept of polymerization – Types of Polymerization, Chain growth polymerization – mechanisms of free radical and cationic polymerizations, Thermoplastic resins and Thermosetting resins: examples- Polyethylene, Styrene, Nylon 6,6 and Bakelite. and applications, Conducting polymers:– Examples – and applications.

Learning outcomes:

After the completion of the Unit IV, the student will be able to

- classify the types of steel. (L-2)
- illustrate the chemical reactions involved in the manufacturing of cement. (L-2)
- identify preparation and properties of polymers. (L-3)
- distinguish between thermoplastic and thermo setting resins. (L-4)

Unit-4: Corrosion and its control 8L

Corrosion and Its Prevention: Electrochemical theory of corrosion, Corrosion due to dissimilar metal cells (galvanic cells), Corrosion due to differential aeration cells, Uniform corrosion, pitting corrosion and stress corrosion cracking, Effect of pH, temperature and dissolved oxygen on corrosion rate. Corrosion prevention and control by cathodic protection- protective coatings-paints.

Learning outcomes:

After the completion of the Unit III, the student will be able to

- explain theories of corrosion. (L-2)
- classify different corrosion methods. (L-2)
- summarize the various factors affecting corrosion. (L-2)
- identify different organic coatings. (L-3)
- apply the principles of corrosion control. (L-3)

Unit-5: Nanomaterials and Analytical Instrumental Techniques 8L

Nanomaterials: Introduction to nanomaterial: nanoparticles, nanocluster, carbon nanotube (CNT) and nanowires. Chemical synthesis of nanomaterials: sol-gel method. Characterization: Principle and applications of scanning electron microscope (SEM) and transmission electron microscope (TEM)

Analytical Instrumental Techniques

Review of electromagnetic spectrum, Quantization of energy. Absorption of radiation: Beer-Lambert's law. Principle and applications of pH metry, potentiometry, conductometry, IR and UV-spectroscopy with examples.

Learning outcomes:

After the completion of the Unit V, the student will be able to

- classify nanomaterials. (L-2)

- explain the synthesis and characterization methods of nano materials. (L-2)
- describe the principles of different analytical techniques. (L-3)
- compare the principles of SEM and TEM. (L-4)

Course outcomes

After the completion of the course, the student will be able to

- list the important purification methods of water. (L-1)
- illustrate the principles and applications of batteries, solar energy. (L-2)
- explain the importance of materials such as steel, cement and polymers
- identify different protective coatings. (L-3)
- analyze the importance of nano materials and the principles of SEM and TEM. (L-4)

Text Books:

1. P.C. Jain and M. Jain, Engineering Chemistry, 15/e, Dhanapat Rai & Sons, Delhi (2014).
2. B.K. Sharma, Engineering Chemistry, Krishna Prakashan, Meerut.
3. O G Palanna, Engineering Chemistry, Tata McGraw Hill Education Private Limited, (2009).

Reference Books:

1. Sashi chawla, A Textbook of Engineering Chemistry, Dhanapath Rai and sons, (2003)
2. B.S Murthy and P. Shankar, A Text Book of NanoScience and NanoTechnology, University Press (2013).
3. S.S. Dara, A Textbook of Engineering Chemistry, S.Chand & Co, (2010)
4. N.Krishna Murthy and Anuradha, A text book of Engineering Chemistry, Murthy Publications (2014).
5. K. Sesha Maheshwaramma and Mridula Chugh, Engineering Chemistry, Pearson India Edn services, (2016).

CHEMISTRY LABORATORY

The course enables the students to gain knowledge on various, instrumental methods of analysis, measurements of physical parameters, volumetric analysis, preparation of polymers, analysis of water, and chromatographic separation techniques.

Course objectives

- To familiarize the students with the basic concepts of Chemistry lab.
- To train the students on how to handle the instruments.
- To demonstrate the digital and instrumental methods of analysis.
- To expose the students in practical aspects of the theoretical concepts.

List of experiments

1. Determination of Mohr's salt by potentiometric method
2. Determination of strength of an acid by pH metric method
3. Determination of conductance by conductometric method
4. Determination of viscosity of a liquid
5. Determination of surface tension of a liquid
6. Determination of sulphuric acid in lead-acid storage cell
7. Determination of chromium (VI) in potassium dichromate

8. Determination of copper in a copper ore
9. Determination of Zinc by EDTA method.
10. Estimation of active chlorine content in Bleaching powder
11. Preparation of Phenol-Formaldehyde resin
12. Preparation of Urea-Formaldehyde resin
13. Thin layer chromatography
14. Preparation of TiO2/ZnO nano particles
15. SEM analysis of nano materials

Course Outcomes:

After the completion of the laboratory course, the student will be able to

- explain the functioning of the instruments such as pH, Conductometric and Potentiometric methods. (L-2)
- identify different ores (Cr & Cu) and their usage in different fields (industry, software devices, electronic goods). (L-3)
- experiment with the physical parameter of organic compounds. (L-3)
- compare the viscosities of oils. (L-4)
- list the preparation of polymers and nano materials. (L-4)

Text Books

1. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B Vogel's Quantitative Chemical Analysis 6/e, Pearson publishers (2000).

2. N.K Bhasin and Sudha Rani Laboratory Manual on Engineering Chemistry 3/e, Dhanpat Rai Publishing Company (2007).

MATH1001 - SINGLE VARIABLE CALCULUS

L	T	P	C
2	0	0	2

This course is designed to impart knowledge on differentiation and integration of function, emphasizing their inter-relationship and applications to engineering.

Course Objectives:

- To familiarize the students in the concepts the derivatives and its underlying concepts like limits and continuity.
- To explain the concept of derivative and calculation of extreme values of extreme values of various functions.
- To impart knowledge on integration for the computation of areas, arc lengths.
- To demonstrate various techniques of integrations.

Unit I: Limits and continuity of single and several variables (6 hours)

Limit of a Function and Limit Laws, The Precise Definition of a Limit, One-Sided Limits, Continuity (Without proofs). Functions of Several Variables, Limits and Continuity in Higher Dimensions (Without proofs)

Learning Outcomes:

At the end of this unit, the student will be able to

- define and calculate limits and one-sided limits of single variables
- define and calculate limits of several variables.
- define continuity and determine whether a function is continuous of single and several variables.

Unit II: Derivatives and applications (7 hours)

The Derivative as a Function, Differentiation Rules, The Chain Rule, Extreme Values of Functions on Closed Intervals, Monotonic Functions (Without proofs)

Learning Outcomes:

At the end of this unit, the student will be able to

- know the definition of derivative and how to use the most common rules of derivatives
- apply various rules to obtain the derivatives of different functions.
- find the extreme values of various functions.

Unit III: Integrals and applications (7 hours)

The Definite Integral, The Fundamental Theorem of Calculus, Indefinite Integrals and the Substitution Method, Definite Integral Substitutions and the Area between Curves, Arc Length (Without proofs)

Learning Outcomes:

At the end of this unit, the student will be able to

- know about anti-derivative and the Fundamental Theorem of Calculus and its applications
- apply concept of integration to evaluate geometric area and solve other applied problems
- apply substitution to compute definite integrals.

Unit IV: Techniques of integration (6 hours)

Using basic Integration Formulas, Integration by Parts, Trigonometric Integrals, Trigonometric Substitutions, Integration of Rational Functions by Partial Fractions (Without proofs)

Learning Outcomes:

At the end of this unit, the student will be able to

- evaluate integrals using integration by parts.
- evaluate indefinite and definite integrals using by the method of substitution.
- evaluate integrals of trigonometric and rational functions.

Textbook:

1. Joel Hass, Christopher Heil, Maurice D. Weir, Thomas' Calculus, Fourteenth edition, Pearson Addison Wesley (2018).

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.
3. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.
4. Hyghes-Hallett, Gleason, McCallum et al. Single Variable Calculus (6th Edn) John Wiley and Sons New York, 2013.

Course Outcomes:

At the end of the course, the student will be able to

- determine limit, one sided limit, continuity of single and several variable functions.
- solve problems in a range of mathematical applications using the derivative or the integral.
- apply the fundamental theorem of calculus.
- evaluate integrals using various techniques.

MATH1011- SEVERAL VARIABLE CALCULUS

L	T	P	C
2	0	0	2

This course is designed to impart knowledge on calculus of functions of more variables which are useful in modelling and analyzing physical phenomena involving continuous change of variables or parameters and have applications across all branches of engineering.

Course Objectives:

- To teach basic concepts of partial derivatives.
- To explain the evaluation of double integrals and its applications.
- To demonstrate the evaluation and applications of triple integrals.
- To acquaint the knowledge of line and surface integrals and applications.

Unit I: Partial derivatives and applications (7 hours)

Partial Derivatives of a Function of Two Variables and More Than Two Variables, Second-order Partial derivatives, The Chain Rule for Functions of Two and Three variables, Extreme Values and Saddle Points, Lagrange Multipliers, Taylor's Formula for Two Variables (Without proofs)

Learning Outcomes:

At the end of this unit, the student will be able to

- find partial derivatives of various functions
- apply chain rule for functions of two and three variables
- evaluate maxima and minima of functions

Unit II: Double integrals (6 hours)

Double and iterated Integrals over Rectangles, Double Integrals over General Regions, Area by Double Integration : Area of bounded region in a plane, Double Integrals in Polar Form. (Without proofs)

Learning Outcomes:

At the end of this unit, the student will be able to

- evaluate double integrals of functions of several variables in two dimensions in Cartesian and polar coordinates.
- calculate the areas bounded by a region using double integration techniques.

Unit III: Triple integrals (5 hours)

Triple Integrals in Rectangular Coordinates: Triple Integrals, Volume of a Region in Space, Finding limits of integration, Triple Integrals in Cylindrical and Spherical Coordinates. (Without proofs)

Learning Outcomes:

At the end of this unit, the student will be able to

- find limits of integration
- evaluate multiple integrals in Cartesian, cylindrical and spherical geometries.
- find volumes using triple integrals.

Unit IV: Integrals and Vector fields (8 hours)

Vector Fields and Line Integrals: Line Integrals of Vector Fields, Line Integrals with Respect to dx, dy, or dz, Work Done by a Force over a Curve in Space, Green's Theorem in the Plane: Tangential form, Using Green's Theorem to Evaluate the Line Integral and Verification, Surface Integrals: Surface Integrals of Vector Fields, Stokes' Theorem (Without proofs)

Learning Outcomes:

At the end of this unit, the student will be able to

- find the work done in moving a particle along the path over a force field.
- find the rate of flow of a fluid across a surface.
- apply Green's and Stokes' theorem in evaluation of line, surface and volume integrals.

Textbook:

1. Joel Hass, Christopher Heil, Maurice D. Weir, Thomas' Calculus, Fourteenth edition, Pearson Addison Wesley (2018).

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.
3. Hyghes-Hallett, Gleason, McCallum et al. Multivariable Variable Calculus (6th Edn) John Wiley and Sons New York, 2013.
4. James Stewart. Multivariate Calculus, Concepts and Contexts. (3rd Edn) Thomson/Brooks/Cole, Canada, 2005.

Course Outcomes:

At the end of the course, the student will be able to

- utilize functions of several variables in optimization.
- employ the tools of calculus for calculating the areas.
- calculate volumes using multiple integrals.
- determine the work done and rate of flow of a fluid using vector calculus

MATH 1021: TRANSFORM TECHNIQUES

L	T	P	C
2	0	0	2

Preamble

This course is designed to impact the knowledge on (Laplace, Fourier) transforms and applications of these transforms on differential equations.

Course Objectives:

- To introduce and explain the concepts of Laplace transforms and properties.
- To demonstrate the evaluation of Laplace transforms of special functions and additional properties.
- To impart knowledge on obtaining Fourier series
- To introduce and explain the concepts of Fourier transforms and properties.
- To explain the evaluation of Fourier transforms of various function and then applications to boundary value problem.
- To demonstrate and understand the transform techniques using available software

Unit-1: Laplace transforms (5 hrs)

Introduction, transforms of elementary functions, properties of Laplace transforms, Transforms of derivatives, transforms of Integrals, Multiplication by t^n, Division by t.

Learning Outcomes:

After completion of this unit student able to

- find Laplace transform of a function (L3).
- examine the properties of Laplace transforms(L4).
- determine Laplace transform of functions like transforms of Integrals, Multiplication by t^n, Division by t (L4).

Unit-2: Applications of Laplace transforms (5 hrs)

Evaluation of integrals by Laplace transforms, Inverse transforms, Solution of Differential equations.

Learning Outcomes:

After completion of this unit student able to

- find the inverse Laplace transform of a function(L3)
- Solve ordinary differential equations by using Laplace transformation technique(L3).

Unit-3: Fourier Series (6 hrs)

Introduction, Conditions for a Fourier expansion, Functions having points of discontinuity, Change of interval.

Learning Outcomes:

After completion of this unit student able to

- find the Fourier series of a given function (L3)

- find the Fourier series by changing the given interval (L3)

MATH1031: DIFFERENTIAL EQUATIONS

L	T	P	C
2	0	0	2

Preamble

This course is designed to impact the knowledge on ordinary, partial differential equations and their applications.

Course Objectives:

- To familiarize the students with the basic concepts of ordinary differential equations.
- To demonstrate the evaluation and applications of first order differential equations.
- To explain the evaluations of linear homogeneous and non-homogeneous differential equations.
- To familiarize the students with the basic concepts of partial differential equations.
- To explain the concepts of first order partial differential equations.
- To demonstrate the evaluation of differential equations using math software

Unit-1: First Order Ordinary Differential Equations (5 hrs)

Order and Degree of an Ordinary Differential Equation(ODE),ODE's of first order and first degree, Variable separable method, Linear Equations, Bernoulli's Equations.

Learning Outcomes:

- apply various methods to solve first order and first degree differential equations (L3).
- distinguish between linear and non linear differential equations (L4).
- solve linear differential equations (L3).

Unit-2: Linear Ordinary Differential Equations of High Order (6 hrs)

Definitions, Complete Solution, Operator D, Complimentary function, Inverse operator, Rules for finding particular integral (e^{ax}, sinbx/cosbx, x^m& $e^{ax}v(x)$)

Learning Outcomes:

- classify the solutions of linear differential equations of higher order (L3)
- identify the essential characteristics of linear differential equations with constant coefficients (L3)
- solve the linear differential equations with constant coefficients by appropriate methods (L3)

Unit-3: Applications of Linear Ordinary Differential Equations of Higher Order (5 hrs)

Method of Variation of Parameters, Simple Harmonic Motion, Oscillations of a Spring

Learning Outcomes:

- solve the linear differential equations with Method of Variation of Parameters (L3)

- Solve application problems such as Simple Harmonic Motion and Oscillations of a string using linear ordinary differential equations of higher order (L3).

Unit-4:Introduction to Partial Differential Equations (5 hrs)

Introduction, Formation of Partial Differential Equation(PDE), Solutions of a PDE, Equations solvable by direct integration, Linear equations of the first order.

Learning Outcomes:

- find the partial differential equation (L3).
- find the solution of a partial differential equation (L3).
- solve PDE by direct integration (L3)

Unit-5: Partial Differential Equations of Second Order (5 hrs)

Homogeneous linear equations with constant coefficients, Rules for finding the complementary function and particular integral,Working procedure to solve the equations.

Learning Outcomes:

- apply a range of techniques to find solutions of PDEs (L3)
- identify the basic properties of PDEs (L3)
- find the solutions of homogenous and non-homogenous linear partial differential equations (L3).

Text Books:

1. Simmons, G.F., Differential Equations with Applications and Historical Notes, Second Edition, McGraw-Hill, Inc., 1991.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

References:

1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984
2. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.
3. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018.

Course Outcomes:

- form and find the solution of an ordinary differential equation (L3).
- apply the concept of differential equations to solve real world problems (L3).
- evaluate linear homogeneous and non homogeneous differential equations (L4)
- form and find the solution of a partial differential equations of first order (L3).
- evaluate second order partial differential equations (L4).
- evaluate solution of differential equations using computational tool (L4)

MATH1041: DISCRETE MATHEMATICS

L	T	P	C
2	0	0	2

Preamble :

Discrete Mathematics introduces students to the mathematics of networks, social choice, and decision making . This course provides students with a hands-on exploration of the relevancy of mathematics in the real world. This course reflects the rigor taught in many entry-level mathematics courses.

Course Objectives:

- To introduce basics of mathematical logical operators and connectives
- To impart knowledge on normal forms and rules of inference.
- To impart knowledge on partially ordered and total ordered sets.
- To familiarize closed form solution of linear recurrence relations by various methods.
- To impart knowledge on basic concepts of algebraic structures.
- To write program structures, and understand when programming is most applicable

Unit-1: Logic Operators and Connectives (5 hrs)

Negation, conjunction, disjunction, conditional and bi-conditional, well formed formulae, tautologies, equivalence of formulae, duality, tautological implications.

Learning outcomes:

After completion of this unit, student will be able to

- construct the truth table for given expressions (L3)
- identify tautologies, Contradiction or at least satisfiable and solve the decision problem. (L3)
- find equivalence formulas (L3)

Unit-2: Mathematical logic (5 hrs)

Conjunctive and disjunctive normal forms- principal disjunctive and conjunctive normal forms, Rules of inference for propositional calculus (Rule P, Rule T and CP rule).

Learning Outcomes:

After completion of this unit, student will be able to

- implement logic for mathematical proofs (L4)
- apply inference theory to verify the consistence of data (L3)

Unit-3: Sets and Relations (5 hrs)

Basic concepts of set theory, Power set, relations, properties of binary relations in a set, Equivalence relations, composition of binary relations, Partial ordering, Partially ordered set.Hasse diagram.

Learning Outcomes:

After completion of this unit, student will be able to

- identify different types of sets and relations (L3)
- test the given set is an equivalence relation or not (L4)

Unit-4: Recurrence relations (5hrs)

Recurrence relations, solving linear recurrence relations by characteristic roots method, system of recurrence relations.

Learning Outcomes:

After completion of this unit, student will be able to

- construct recurrence relations of the sequences (L3)
- solve homogeneous linear recurrence relations (L3)
- solve complementary function and particular integral for non-homogeneous linear recurrence relations (L3)

Unit-5: Algebraic Structures (6 hrs)

Algebraic Structures-Semi group, Monoid ,Groups, subgroups, cosets((definition and examples) Lagrange's theorem on finite groups

Learning Outcomes:

After completion of this unit, student will be able to

- test the given algebraic structure is a group or not (L3)
- identify different types of groups (L2)
- understand the significance and applications of Lagrange's theorem (L3)

Text Books:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 1997.
2. Kenneth H. Rosen, Discrete Mathematics and Applications, Seventh edition, Tata McGrawHill,2012.

Reference books:

1. Bhishma Rao, Mathematical Foundations of Computer Science, SciTech Publications (India) Pvt Ltd.
2. Discrete Mathematical Structures,Sixth edition-Kolman,Busby,Ross

Course Outcomes:

Upon successful completion of this course the student should be able to

- Check the validity of a statement formula (L2)
- analyze the concepts in set theory and relations (L3)
- find a general solution of recurrence equation (L3)
- build the algebraic structures (L3)
- Apply Lagrange's theorem on finite groups (L3)
- Convert problem solving strategies to procedural algorithms (L3)

MATH1051: GRAPH THEORY

L	T	P	C
2	0	0	2

Preamble

This course introduces basic concepts in Graph Theory, including properties and characterization of graph/trees and graph theoretic algorithms, which are widely used in Mathematical modelling and has got applications across Computer Science and other branches in Engineering.

Course Objectives:

- To introduce basics of group theory and its applications
- To impart knowledge on basic concepts of paths and circuits
- To impart knowledge on Trees, spanning trees, shortest spanning trees
- To familiarize in the matrix representation of graphs
- To transform scientific problems into generic computational models

Unit-1: Basics of graphs (5 hrs)

Finite and Infinite Graphs, Incidence and Degree, Isolated Vertex, Pendant Vertex, and Null Graph, complete graph, Bi-partite and complete Bi-partite graphs.

Learning Outcomes:

After completion of this unit, student will be able to

- understand the basic terminology of the graph theory (L2).
- find the vertex of the graph and identify the types of vertices of the graph(L3).

Unit-2: Matrix representation of graphs: (5hrs)

Adjacency Matrix, Incidence Matrix, Path Matrix(Definition and examples),

Learning Outcomes:

After completion of this unit, student will be able to

- identify the types of matrix representation of graph (L3)
- Find a path matrix of a connected graph (L3)

Unit-3: Paths and circuits (6 hrs)

Paths, and Circuits, Connected Graphs, Disconnected Graphs, and Components, Euler Graphs,Hamiltonian graphs(Definition,examples and without proofs)

Learning Outcomes:

After completion of this unit, student will be able to

- identify different types of paths and their properties (L3)
- construct Euler and Hamiltonian graphs (L3)

Unit-4: Trees (5 hrs)

Trees and their properties, spanning trees, minimal spanning trees,
Kruskal's algorithm for finding a minimal spanning tree,

Learning Outcomes:

After completion of this unit, student will be able to

- construct the spanning trees from graphs (L3)
- build minimal spanning tree by Kruskal's algorithms (L3)

Unit 5: Applications of Trees and Fundamental circuits (5 hrs)

Preorder, in order and post order traversals, Prefix and Postfix notations of an arithmetic expression, parsing trees.

Learning Outcomes:

After completion of this unit, student will be able to

- Identify tree traversals (L3)
- construct parsing trees for algebraic expressions (L3)

Text Book:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 1997.
2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice Hall of India, 2006.

Reference Book:

1. Bhishma Rao, Mathematical Foundations of Computer Science, SciTech Publications (India) Pvt Ltd.
2. Kenneth H. Rosen, Discrete Mathematics and Applications, Seventh edition, Tata McGrawHill,2012.

Course Outcomes:

Upon successful completion of this course the student should be able to

- analyse the concepts in graph theory (L4)
- apply graph theory concepts in core subjects such as data structures and network theory effectively (L3)
- Identify different types of paths (L3)
- Construct minimum spanning tree using some algorithms (L3)
- Identify tree traversals (L3)
- Solve the graphical problems which are accessed in available software (L3)

MATH1061 - INTRODUCTION TO MATHEMATICS I

L	T	P	C
2	0	0	2

This course is designed to provide an introduction to the mathematics required for basic physics, engineering mathematics, and introductory engineering courses.

Course Objectives:

- To explain the concepts of Trigonometry.
- To explain the basic concepts of differentiation and differential equations
- To teach the evaluation of definite and indefinite integrals.

Unit- I : **3 hrs**

Representations for Scalars, Vectors, Matrices and Tensors.
Coordinate systems: cartesian and polar coordinate systems.

Learning Outcomes:

At the end of this unit, the student will be able to

- Describe representational forms (L1)
- Understand the basis of coordinate systems (L1)

3 hrs

Unit- II : Trigonometry

Trigonometric functions, periodicity, trigonometric ratio of compound angles, multiple and sub multiple angles, transformations, brief introduction of inverse trigonometric, hyperbolic and inverse hyperbolic functions.

Learning Outcomes:

At the end of this unit, the student will be able to

- identify trigonometric functions and their properties (L3)
- apply the trigonometric ratio techniques of compound angles, multiple and sub multiple angles in calculations (L3)
- find inverse trigonometric and hyperbolic functions (L3)

8 hrs

Unit- III : Differential Calculus

Limits and Continuity: Definition of right hand limit, left hand limit, standard limits

1) $\lim_{x \to a} \frac{x^n - a^n}{x - a}$ 2) $\lim_{\theta \to 0} \frac{\sin\theta}{\theta}$ 3) $\lim_{n \to 0} \left(1 + n\right)^{\frac{1}{n}}$ 4) $\lim_{x \to 0} \frac{e^x - 1}{x}$

5) $\lim_{x \to 0} \frac{a^x - 1}{x}$

(without proofs)**,** definition of continuity and simple illustrations.

Differentiation: Introduction, definition, differentiation of a function at a point and on an interval, derivative of a function, differentiation of sum, difference, product and quotient of functions, differentiation of algebraic, exponential, logarithmic functions, composite, implicit, parametric, hyperbolic, inverse hyperbolic functions, logarithmic differentiation, derivatives of first and second order.

Learning Outcomes:

After completing this unit, the student will be able to

- find derivative of sum, difference, product and quotient of functions (L3)
- apply differentiation techniques in different forms of functions (L3)
- calculate the derivatives of simple functions (L4)

8 hrs

Unit IV: Integration

Indefinite Integrals: Integration as the inverse process of differentiation, standard forms, properties of integrals, integration by the method of substitution covering algebraic, trigonometric, exponential functions, integration by parts, logarithmic functions, inverse trigonometric functions.

Definite Integrals: Definition of a definite integral and its properties (without proof), formulae

$\int_0^{\pi/2} Sin^n\theta\, d\theta$, $\int_0^{\pi/2} \cos^n\theta\, d\theta$ $\int_0^{\pi/2} \cos^n\theta\, Sin^m\theta\, d\theta$

Of and (without proofs).

Learning Outcomes:

After completing this unit, the student will be able to

- find integrals of special functions (L3)
- apply partial fractions technique on evaluation of integrals of rational functions (L3)
- solve definite integrals in trigonometric functions (L3)
    - solve simple integrals (L3)
    - apply substitution and by parts techniques in evaluation of integrals (L3)
    - find logarithmic, inverse trigonometric functions (L3)

10 hrs

Unit V: Introduction to differential equations and Multivariable calculus

Linear first order differential equations with constant coefficients, linear second order differential equations with constant coefficients (Definitions only). Only basic concepts of Partial differentiation. Only basic concepts of Differential forms: gradient, divergence and curl. Introduction to line, surface and volume integrals (without problems) illustrated with Stokes, Gauss, and Green's theorems (Only statements).

Learning Outcomes:

- solve problems involving trigonometric functions (L3)
- understand the principles of differential and integral calculus (L3)
- solve first order linear differential equations with constant coefficients (L3)
- solve first order linear differential equations with constant coefficients (L3)
- understand the basic concepts of vector calculus (L1)

Course Outcomes:

After the completion of the course the student should be able to

- solve problems involving trigonometric functions (L3)
- understand the principles of differential and integral calculus (L3)
- solve first order linear differential equations with constant coefficients (L3)
- solve first order linear differential equations with constant coefficients (L3)
- understand the basic concepts of vector calculus (L1)

Text Books:

1. Text book for Intermediate Mathematics, Board of Intermediate Education, AP, Volumes IA, IB & IIA, 2018.
2. NCERT class XI and XII (part 1) Mathematics text books.

References:

1. V. Venkateswara Rao, N. Krishna Murthy, B.V.S. Sharma, Intermediate Mathematics, S.Chand & Company Ltd., Volume I & II.
2. Chandrika Prasad, A first Course in Mathematics.
3. Text book for Intermediate Mathematics, Deepti Publications.

MATH1071 - INTRODUCTION TO MATHEMATICS II

L	T	P	C
2	0	0	2

This course is designed to provide an introduction to the mathematics required for basic physics, engineering mathematics, and introductory engineering courses.

Course Objectives:

- To describe the basic concepts of matrices
- To introduce complex numbers and their properties.
- To teach the technqiues based on partial fractions
- To explain the concepts of straight lines and circles

Unit I: Matrices **8hr**

Matrices, determinants, definition, types of matrices, algebra of matrices, properties of determinants of 2 X 2, 3 X 3 matrices, inverse of a matrix, solving simultaneous linear equations in two and three variables using matrix inverse method, Cramer's rule and Gauss Jordan method. Eigenvalues and Eigenvector of matrices.

Learning Outcomes:

At the end of this unit, the student will be able to

- find determinants of matrices (L3)
- apply crammer"s rule for solving linear equations (L3)
- find inverse of a matrix (L3)

Unit- II : Complex Numbers **6 hrs**

Complex number as an ordered pair of real numbers, representation of $z \equiv (a, b)$ in the form $(a + ib)$ conjugate complex numbers, modulus and amplitude of a complex number, geometrical representation of a complex number, Argand diagram.

Learning Outcomes:

- solve arithmetic problems involving complex numbers (L3)
- find the conjugate, modulus and amplitude of a complex number (L3)
- describe the relationship between a complex number and Argand plane (L3)

Unit III: Partial Fractions **6 hrs**

Introduction, resolving $g(x)$ into partial fractions when $g(x)$ contains non repeated linear factors, repeated linear factors, repeated and non-repeated irreducible quadratic factors.

Learning Outcomes:

After completing this unit, the student will be able to

- find a fractional function and resolve it into partial fractions (L3)
- make use of resolving techniques of repeated and non repeated linear factors (L3)
- apply this technique in evaluation of integrals (L3)

Unit IV: Co-ordinate Geometry **14 hrs**

Straight lines: Recapitulation of general equation of a straight line, forms of equation of a straight line: slope intercept form, intercept form, point -slope form, two point form, normal form $x \cos \alpha + y \sin \alpha = p$, point of intersection of two straight lines, line passing through the point of intersection of two given lines, condition for concurrency of three straight lines, angle between two intersecting lines, condition for perpendicularity and parallelism, length of the perpendicular from a point to a straight line, distance between two parallel lines (without proofs).

Circles: Equation of a circle, standard form, centre and radius, equation of a circle with a given line segment as diameter, equation of a circle through three non collinear points, parametric equations of a circle, position of a straight line in the plane of the circle.

3D Geometry: Equation of a plane, Intersection of two planes, Equation of a sphere in spherical and cartesian coordinates, Intersection of a plane and a sphere.

Learning Outcomes:

After completing this unit, the student will be able to

- identify the equation to straight line in different forms(L3)
- find the length of permutation from a point to a straight line(L3)
- find the equation of a circle passing through three non collinear points(L3)

Course Outcomes:

After the completion of the course the student should be able to

- describe the properties of matrices (L3)
- describe the properties of complex numbers (L3)
- illustrate straight line and circle properties(L3)

Text Books:

1. Text book for Intermediate Mathematics, Board of Intermediate Education, AP, Volumes IB, IIA & IIB, 2018.
2. NCERT class XI and XII (part 1 & 2) Mathematics text books.

References:

1. V. Venkateswara Rao, N. Krishna Murthy, B.V.S. Sharma, Intermediate Mathematics, S. Chand & Company Ltd., Volume I & II.
2. Chandrika Prasad, A first Course in Mathematics.
3. Text book for Intermediate Mathematics, Deepti Publications.

DIFFERENCE EQUATIONS

L T P C
2 0 0 2

Preamble: Difference equations is the study of equation which involves the difference of a discrete function. In this course, the student can form a difference equation, solving linear higher order difference equations using analytical techniques, simultaneous linear difference equations and also find the solution of linear higher order difference equations and simultaneous difference equations using Z-transforms.

Course Objectives:

1. Student is able to know how to find the order of a difference equation and complementary function of a difference equation.
2. Student is able to know how to find the particular solution of a difference equation and also find the solutions of simultaneous linear difference equations.
3. Student is able to know how to find Z-transforms a discrete function using properties and using to basic theorems.
4. Student is able to know how to find the inverse Z-transforms a function and also using convolution theorem.
5. Student is able to know how to find the solution of a difference equation using Z-transforms

UNIT-I: (Difference equations-I) (5 hrs)

Introduction, definition of order, and solution of difference equation, formation of difference equations, linear difference equations, complementary function, rule for finding complementary function.

Learning outcomes:

- Student will be able to know how to find the order of a difference equation and complementary function of a difference equation.

UNIT-II: (Difference equations-II) (5 hrs)

Particular integrals, Rule for finding particular integrals, simultaneous linear difference equations.

Learning outcomes:

- Student will be able to know how to find the particular solution of a difference equation and also find the solutions of simultaneous linear difference equations.

UNIT-III: (Z-transforms) (5 hrs)

Introduction, Definition, some standard Z-transforms, linear property, damping rule, Shifting U_n to the **right and to the left, Multiplication by n, two basic theorems.**

Learning outcomes:

Student will be able to know how to find Z-transforms a discrete function using properties and using to basic theorems.

UNIT-IV: (Inverse Z-transforms) (5 hrs)

Convergence of Z-transforms, evaluation of inverse Z-transforms, properties, convolution theorem.

Learning outcomes:

Student will be to know how to find the inverse Z-transforms a function and also using convolution theorem.

UNIT-V: (Applications of Z-transforms) (5 hrs)

Solving difference equations and simultaneous linear difference equations with constant coefficients by Z-transforms.

Learning outcomes:

Student will be able to know how to find the solution of a difference equation using Z-transforms.

Text Book:

1. "Higher Engineering Mathematics" by B.S. Grewal published by Khanna Publishers

Reference books:

1. Advanced Engineering mathematics by Irvin Kreyszig

Course Outcomes:

1. Able to find the order of a difference equation and complementary function of a difference equation.
2. Able to find the particular solution of a difference equation and also find the solutions of simultaneous linear difference equations.
3. Able to find Z-transforms a discrete function using properties and using to basic theorems.
4. Able to find the inverse Z-transforms a function and also using convolution theorem.
5. Able to find the solution of a difference equation using Z-transforms

NUMERICAL TECHNIQUES

L	T	P	C
2	0	0	2

Preamble
This course is designed to enhance problem solving skills of engineering students using a powerful problem-solving tool namely numerical Techniques. The tool is capable of handling large systems of equations, nonlinearities and complicated geometries that are common in engineering practice but often impossible to solve analytically.

Course Objectives:

- To familiarize the students with numerical solutions of nonlinear and systems of linear equations.
- To get exposed to finite differences and interpolation.
- To demonstrate the numerical differentiation and integration.
- To explain the numerical solutions of ordinary differential equations

Unit-1: (6 hours)
Solution of algebraic and transcendental equations: Regula-falsi method and Newton-Raphson method. **Solution of linear system of equations**-Iterative methods: Gauss Jacobi method, Gauss Seidel method, and finding the eigenvalues of a matrix by Power method.
Learning Outcomes:
At the end of this unit, the student will be able to

- find approximate roots of an equation by using different numerical methods (L3).
- solve system of linear equations using various techniques (L3).
- find eigenvalues of a matrix (L3).

Unit-2: (5 hours)
Interpolation: Difference operators (shifting, delta, del) and difference tables, Newton's forward and backward interpolation formulae, Divided difference formula, and Lagrange's interpolation formula.
Learning Outcomes:
At the end of this unit, the student will be able to

- find a function using various methods (L3).

Unit-3: (5 hours)
Numerical Differentiation: Derivatives using forward, and backward difference formulae.
Numerical Integration: Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule.
Learning Outcomes:
At the end of this unit, the student will be able to

- find differentiation of a function by using different numerical methods (L3)
- find integration of a function by using different numerical methods (L3)

Unit-4: (5 hours)

Numerical solutions of ordinary differential equations-1: Picard's method, Taylor's series method, Euler's method, and Modified Euler's method.

Learning Outcomes:

At the end of this unit, the student will be able to

- solve first order differential equation using various methods (L3).

Unit-5: (5 hours)

Numerical solutions of ordinary differential equations-2: Runge-Kutta method (second and fourth order), Predictor-Corrector methods-Adams-Bashforth and Milne's methods.

Learning Outcomes:

At the end of this unit, the student will be able to

- solve first order differential equation using predictor-corrector methods (L3).

Text Book(s):

1. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.

References:

1. M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 5/e, New Age International(P) Limited, 2007.
2. S.S. Sastry, Introductory methods of Numerical Analysis,4/e,PHI Learning Publications,2009.
3. H.C Saxena, Finite Differences and Numerical Analysis, Chand and Company Pvt. Ltd., New Delhi.

Course Outcomes:

At the end of the course, the student will be able to

- analyze how root finding techniques can be used to solve practical engineering problems (L4).
- apply various interpolation techniques to solve practical problems (L3).
- apply numerical differentiation and integration whenever and wherever routine methods are not applicable (L3).
- solve differential equations using various numerical methods (L3).
- know the strengths and weaknesses of the various methods and be able to decide which ones are appropriate for a particular problem (L3)

OPERATIONS RESEARCH

L	T	P	C
2	0	0	2

Preamble:
Operations Research (OR), also known as management science, has become an indispensable tool in scientific management. Operations Research focuses on developing and analyzing strategic and tactical levels to aid in decision-making and decision-making on the operational level. The essential tools of OR are algorithms, procedures that create and improve solutions to a point at which optimal or, at least, satisfactory solutions have been found.

Course Objectives: This course is designed to:

- introduce the fundamentals of Operations Research to the students at the undergraduate level
- solve different types of optimization problems of various categories and applying modern methodologies in the area of optimization
- help students to develop a deep understanding of the classical and numerical optimization techniques and problem-solving capabilities

Unit – I **4 hours**

Linear Programming: Formulation of LPP, convex sets and their properties, slack and surplus variables, Basic solution, Basic feasible solution, non-degenerate and degenerate basic feasible solutions, optimal solution, General, Standard, and Canonical form of LPP.

Learning Outcomes :

After completion of this unit, the student will be able to:

- understand the problem of linear programming problem (L2)
- understand the definitions of Basic solution(BS), Basic Feasible Solution(BFS), Non-degenerate BFS, Degenerate BFS, and optimal solution of LPP (L2)
- know convex sets and some essential theoretical concepts about convex sets (L2)
- writing standard and canonical forms of LPP (L3)

Unit – II **8 hours**

Simplex Method: Simplex method, Degeneracy in LPP, Artificial variables techniques-Two Phase method, Big M-method.

Learning Outcomes:

After completion of this unit, the student will be able to:

- prepare simplex table (L4)
- apply the simplex algorithm for finding the optimal solution of given LPP (L2)
- know the cases of existence of degeneracy in LPP (L4)
- solving LPP by artificial variable techniques like II-phase and Big M-methods (L3)

Unit – III **5 hours**

Duality: Duality in linear programming, primal-dual relationships, weak duality theorem, strong duality theorem, and dual simplex method.

Learning Outcomes:

After completion of this unit, the student will be able to:

- find the relation between primal and dual problems (L3)
- know the advantage of writing the dual problem (L4)
- apply dual simplex method (L2)
- know the properties of duality (L4)

Unit – IV **4 hours**

Integer Programming: Gomory's cutting plane method, Branch and Bound method for solving integer linear programming problems.

Learning Outcomes :

After completion of this unit, the student will be able to:

- understand the problem of Integer programming problem (L2)
- apply the technique of cutting plane methods (L2)
- apply Gomory's cutting plane method to solve ILPP (L2)
- apply branch and bound method to solve ILPP (L2)

Unit – V **5 hours**

Sensitivity Analysis: Introduction to sensitivity analysis, variations in the price vector, variations in the requirement vector, addition of a new decision variable to the existing problem.

Learning Outcomes :

After completion of this unit, the student will be able to:

- understand the meaning of sensitivity analysis (L2)
- apply sensitivity analysis to find variations in price vector (L2)
- find variations in requirement vector (L3)
- find the extent to which an additional decision variable can be introduced to the problem (L3)

Course outcomes:

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

- understand the linear programming problem, its formation, and basic definitions of solutions
- understand the simplex method, which is a very efficient algorithm to solve a linear programming problem
- understand the dual primal relationship, properties of duality, and the dual simplex algorithm
- find integer solutions to LPP by cutting plane methods
- find variations in price and requirement vectors and retaining optimality

Text Books:

1. Operations Research by S.D.Sarma, Kedarnath, Ramnath and company, 15th edition, 2008.
2. Operations Research An Introduction by Hamdy A. Taha, 8th edition, Pearson, 2007.

Reference Books:

1. Linear Programming by R K Gupta, Krishna Prakashan Mandir, 13th edition 2014.
2. Operations Research Theory and Applications by J K Sharma, 4th edition, Macmillan Publishers India Ltd, 2009.

COMPLEX VARIABLES

L T P C
2 0 0 2

Preamble

This course is designed to familiarize the students with complex analysis, nature of a series, evaluation of integrals using Cauchy's theorem.

Course Objectives

- To explain the concept of complex functions and analytic functions.
- To explain the concept of conformal mapping.
- To explain the concept of Cauchy's theorem and residue theorem.
- To explain the convergence of series such as Taylor's and Laurent.
- To explain the concept of Cauchy's theorem and residue theorem.

MODULE – I **6 hours**

Functions of a Complex variable: Limit and continuity, Differentiation, Analytic functions, Cauchy-Riemann equations, harmonic functions, finding harmonic conjugates- applications to flow problems.

After completion of this unit student able to

- Identify continuous and differentiable complex functions (L3)
- apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic (L3)
- give an account of the concepts of analytic function and harmonic function and to explain the role of the Cauchy-Riemann equations(L3).

Module - II **5 hours**

Geometrical representation of f(z) – Some standard transformations – Bilinear transformation - Conformal mappings. Special conformal transformations ($w = z^2$, $w= z+1/z$, $w = e^z$, $w= \cosh z$) .

Learning Outcomes:

After completion of this unit student able to

- To know the geometrical representation of an analytical functions(L2)
- explain the concept of conformal mapping, describe its relation to analytic functions, and know the mapping properties of the elementary functions(L3)

MODULE – III **5 hours**

Complex Integration: Integration of complex functions - Cauchy's theorem - Cauchy's integral formula.

Learning Outcomes:

After completion of this unit student able to

- define and evaluate complex contour integrals(L3);
- give an account of and use the Cauchy integral theorem, the Cauchy integral formula and some of their consequences(L3);

MODULE – IV **5 hours**

Series representation of analytic functions
convergent series of analytic functions, Laurent 's and Taylor series, zeros and singularities of an analytic function

Learning Outcomes:
After completion of this unit student able to

- analyze simple sequences and series of functions with respect to uniform convergence, describe the convergence properties of a power series, and determine the Taylor series or the Laurent series of an analytic function in a given region (L3);
- Determining the nature of the singularities and calculating residues (L2)

MODULE – V **5 hours**
Calculus of residues – Residue- Cauchy Residue theorem – Calculation of residues (All theorems without proof).

Learning Outcomes:
After completion of this unit student able to

- make use of the Cauchy residue theorem to evaluate certain integrals (L3)

Text Book:

1. B.S.Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers, New Delhi, 2012.

Reference Books:

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics Narosa Publishing House, New Delhi, 2014.
2. N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, 8th Edition, Lakshmi Publications, New Delhi, 2012.

Course Outcomes

1. Make use of differentiation and integration of complex functions in engineering problems (L3)
2. Concept of conformal mappings (L3).
3. Use Cauchy's theorem and Cauchy's integral formula to evaluate the line integrals (L3)
4. Apply Taylor's and Laurent's series to expand complex functions and know about the convergence region (L3).
5. Evaluation of integrals using Residue theorem(L3).

NUMBER THEORY

L	T	P	C
2	0	0	2

PREAMBLE

This course is designed to explain the basics and applications of number theory for the students of Computer Science. The core courses of these branches encounter with concepts like prime factorization, modular arithmetic, and quadratic reciprocities in number theory. The first unit of the course provide a strong platform for such encounters and the other units focuses on applications of number theory.

Course Objectives

- To teach basic concepts of number theory focusing on Computational aspects.
- To teach the concepts of factorization of integers.
- To teach Format's theorem and quadratic residues.
- To explain Chines remainder theorem and Euclidean algorithm.
- To explain polynomial arithmetic.

Unit 1 **(5 hrs)**

Basic Concepts in Number Theory: Topics in elementary number theory, Divisibility, Greatest Common Divisor

Learning Outcomes:

After completion of this unit, student will be able to

- develop the basics of number theory: (L3)
- perceive the concept of divisibility: (L5)

Unit 2 **(5 hrs)**

Euclidean Algorithm, Factorization of integers, Congruence, Modular arithmetic**,** some applications to factorizing, finite fields

Learning Outcomes: After completion of this unit, student will be able to

- understand the basics modular arithmetic: (L3)
- know some concepts on factorization: (L5)

Unit 3 **(5 hrs)**

Quadratic residues, Fermat's theorem, Euler ϕ function, Cauchy 's theorem

Learning Outcomes:

After completion of this unit, student will be able to

- learn some theorems on number theory: (L3)
- perceive the concept of quadratic residues (L5)

Unit 4 **(5 hrs)**

Chinese Remainder theorem, Primality testing algorithm, Euclid's algorithm for integers

Learning Outcomes:

After completion of this unit, student will be able to

- learn some theorems on number theory: (L3)
- apply primality testing algorithm (L5)

Unit 5 **(5 hrs)**

Polynomial Arithmetic, Primitive roots, Legendre symbol, Jacobi symbol

Learning Outcomes:

After completion of this unit, student will be able to

- learn polynomial arithmetic: (L3)
- perceive the Legendre and Jacobi symbols (L5)

Text Book

1. Elementary Number Theory | 7th Edition by David Burton, Mc Graw Hill Education

References

1. Basic Number Theory by S.B. Malik,S. Chand publishers

LINEAR ALGEBRA

L	T	P	C
2	0	0	2

Preamble

This course is designed to gain knowledge in the concepts of Linear Algebra focusing on basics of matrices, vector spaces and singular value decomposition to understand the basic concepts of Linear Algebra in the applications of image processing and machine learning.

Course Objectives:

- To familiarize with theory of matrices and tools for solving system of linear equations
- To impart knowledge on Eigen values and Eigen vectors.
- To teach basic concepts of vector spaces and their properties.
- To explain the concepts of inner product spaces.
- To familiarize with concept of singular value decomposition and its applications.

Unit-1: Fundamentals of Matrices: (5 hours)

Introduction to Matrices and Rank of a matrix, Echelon form, solving system of linear equations.

Learning Outcomes:

At the end of this unit, the student will be able to

- Reduce given matrices to Echelon form, (L3)
- solve the system of linear equations (L3)

Unit-2: Eigen values and Eigen vectors: (5 hours)

Eigen values and Eigen vectors, positive definite matrices, Linear dependence and Linear independence.

Learning Outcomes:

At the end of this unit, the student will be able to

- calculate Eigen values and Eigen vectors(L4)
- examine the definiteness of the matrix (L3)

Unit-3: Vector Spaces: **(6 hours)**

Vector space, linear combination of vectors, linear span, basis and dimension, linear Transformation.

Learning Outcomes:

At the end of this unit, the student will be able to

- examine whether a set of vectors form a basis(L3)
- analyze properties of a linear transformations(L4)

Unit-4: Inner Product Spaces (5 hours)

Inner Product Spaces, examples of inner product spaces, norm and length of a vector cauchy-schwarz's inequality.

Learning Outcomes:

At the end of this unit, the student will be able to

- understand an inner product(L3)
- apply Cauchy-Schwartz's inequality(L3)

Unit-V: **Singular value decomposition** **(5 hours)**

Singular values, computing singular value decomposition and Introduction to principal component analysis.

Learning Outcomes:

At the end of this unit, the student will be able to

- singular value decomposition and computing. (L4)
- understand singular value decomposition and principal Component analysis(L5).

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal.
2. Linear Algebra, Schaum's Outline,4^{th} edition, Seymour Lipchutz,Marc Lipson

Reference Books:

1. Advanced Engineering Mathematics, 7th Edition, Peter V. O'Neil.
2. Advanced Engineering Mathematics, 2nd Edition, Michael. D. Greenberg.
3. Introduction to linear algebra, 5th Edition, Gilbert Strang.
4. Applied Mathematics (Vol. I & II) , by P. N. Wartikar& J. N. Wartikar.
5. Digital Image Processing, R C Gonzalez and R E Woods.

Course Outcomes:

At the end of the course the student will be able to

- solve the system of linear equations (L3)
- calculate Eigen values and Eigen vectors(L4)
- Finding the basis(L4)
- learn Singular value decomposition and principal Component analysis (L5)

PROBABILITY THEORY AND RANDOM VARIABLES

L	T	P	C
2	0	0	2

Preamble

To expose the students to the basics of probability theory and random processes essential for their subsequent study of analog and digital communication.

Course Objectives:

- To know about various random life length models and their uses in finding the reliability of different electronic devices.
- To learn about basic properties and characteristics of various random processes with reference to signal and trunk processes.

Unit 1: Probability **5 hours**

Axioms of probability theory. Probability spaces. Joint and conditional probabilities. Bayes' Theorem- Independent events.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand events and how to assign probabilities to outcomes (L3)
- Solve applications involving probabilities (L4)

Unit 2: Random Variable **5 hours**

Random variables and random vectors. Distributions and densities. Independent random variables. Functions of one and two random variables.

Learning Outcomes:

At the end of this unit, the student will be able to

- evaluate moments and cumulative distribution functions for both discrete and continuous random variables (L3)
- characterize functions of random variables (L5)

Unit 3: Multiple Random Variables **6 hours**

Vector random variables, joint distribution and density functions, properties, conditional distribution and density, statistical independence, distribution and density of a sum of random variables, central limit theorem.

Learning Outcomes:

At the end of this unit, the student will be able to

- describe conditional and independent events and conditional random variables (L3)
- describe independent events and independent random variables and their sums (L3)

Unit 4: Expected Value of a Function of Random Variables **6 hours**

Joint moments about the origin, joint central moments, jointly Gaussian random variables - two random variables case, N random variable case.

Learning Outcomes:

At the end of this unit, the student will be able to

- characterize jointly multiple discrete and continuous random variables (L5)

- describe N Random variables independent events and independent random variables and their sums (L3)
- characterize jointly multiple discrete and continuous random variables (L5)

Unit 5: Random Process **6 hours**

Temporal characteristics - the random process concept, stationarity and statistical independence, correlation functions, Gaussian random processes, Poisson random process.

Learning Outcomes:

At the end of this unit, the student will be able to

- explain basic concepts of a random process, calculate the mean, variance, autocorrelation, and power spectral density of a stationary random process (L3)
- apply the knowledge of random variables in real life situations (L5)

Text Book(s)

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw Hill, 2002.
2. Athanasios Papoulis, S. Unnikrishnan Pillai, Probability, Random Variables and Stochastic Processes, 4/e, Tata McGraw Hill, 2002.

References

1. Simon Haykin, Communication Systems, 4/e, Wiley Student Edition, 2006.
2. Henry Stark, John W. Woods, Probability and Random Processes with Application to Signal Processing, 3/e, Pearson Education, 2002.

Course Learning Outcomes:

Upon successful completion of this course, the student should be able to

- Analyze the outcomes of random experiments and develop the concept of random variables and obtain probabilities through them (L3)
- define single random variables in terms of their PDF and CDF, and calculate moments such as the mean and variance (L3)
- explore the random experiments specified by multiple random variables and study the Distribution of them (L4)
- apply the fundamentals of probability theory and random processes to practical engineering problems, and identify and interpret the key parameters that underlie the random nature of the problems (L5)

RANDOM PROCESSES

L	T	P	C
2	0	0	2

Preamble

This course is designed to impart knowledge on random processes needed in applications such as signal processing, digital communications, speech processing, data modelling, etc.

Course Objectives:

1. To familiarize the students in the concepts of probability and random variables.
2. To study Random Processes, its types, distribution, and density functions.
3. To study Gaussian and Poisson processes.
4. To apply random process to signal processing in communication systems.
5. To apply skills in analysing random phenomena which occur in Electrical and Electronics Engineering applications.

Unit-1: Random Processes: (6 hours)

Temporal characteristics - the random processes concept, Classification of random processes, stationarity and statistical independence. Time averages and Ergodicity.

Learning Outcomes:

At the end of this unit, the student will be able to:

- solve the problems on multiple random variables, joint distribution and statistical independence, (L1)
- understand the classifications of random processes and concepts such as strict stationarity, wide-sense stationarity (L2)
- apply the concept on time averages and ergodicity (L3)

Unit-2: Correlation and Covariance functions: (5 hours)

Auto correlation, Cross correlation, Properties. Covariance functions. Gaussian random processes, Poisson random processes:

Learning Outcomes:

At the end of this unit, the student will be able to:

- know the definition of auto correlation and its application(L1)
- to understand about the correlation functions(L2)
- demonstrate the specific applications to Poisson and Gaussian processes and representation of low pass and band pass noise models (L2)

Unit-3: Density functions : (5 hours)

Probability density and joint probability density functions, Properties.

Learning Outcomes:

At the end of this unit, the student will be able to:

- know about joint probability density functions and its applications (L1)
- apply concept of joint density functions in random process (L3)
- apply the probability models and function of random variables based on single & multiple random variables (L3)

Unit-4:Spectral densities functions - I : (5 hours)

Spectral characteristics, the power density spectrum: Properties, relationship between power density spectrum and autocorrelation function

Learning Outcomes:

At the end of this unit, the student will be able to:

- understand the concept of power density functions (L2)
- apply substitution to compute power density function properties (L3)
- apply the concepts of power density functions and auto correlation (L3)

Unit-5 Spectral densities functions-II : (5 hours)

Cross-power density spectrum, Properties, relationship between cross power spectrum and cross-correlation function.

Learning Outcomes:

At the end of this unit, the student will be able to:

- develop an appreciation of the role of random processes in system modelling (L1)
- apply the concepts of filtering and prediction of a random process (L3)
- apply the specialised knowledge in random processes to solve practical engineering problems. (L3)

Course Outcomes:

At the end of the course, the student will be able to:

- solve the problems on multiple random variables, joint distribution and independence
- solve the problems Gaussian and Poisson processes
- understand the concept of random processes and determine covariance and spectral density of stationary random processes
- characterize the random signals in communication systems with their autocorrelation and power spectral density functions

Textbook (s)

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw Hill, 2002.

References

1. Athanasios Papoulis, S. Unnikrishnan Pillai, Probability, Random Variables and Stochastic Processes, 4/e, Tata McGraw Hill, 2002.
2. Simon Haykin, Communication Systems, 4/e, Wiley Student Edition, 2006.
3. Henry Stark, John W. Woods, Probability and Random Processes with Application to Signal Processing, 3/e, Pearson Education, 2002.

OPTIMIZATION METHODS

L	T	P	C
2	0	0	2

Preamble:

Optimization is the art of finding the best result under given conditions. In this fast-expanding world, an engineer has to use many Optimization methods, as it is the most significant in decision-making, design, manufacturing, maintenance, planning, and scheduling.

Course Objectives: This course is designed to:

- introduce various optimization methods for solving real-world problems
- find optimal solutions to transportation, assignment, and sequencing problems
- know project planning and scheduling
- study the network analysis techniques through CPM and PERT

Unit – I **6 hours**

Transportation Problem: Introduction and LP formulation of Transportation Problem, feasible solution, basic feasible solution, finding Initial basic feasible solutions by North West corner rule, Least-cost entry method, Vogel's approximation method, Transportation Algorithm (MODI Method) to find an optimal solution.

Learning Outcomes:

After completion of this unit, the student will be able to:

- understand the problem of transportation problem (L2)
- find initial BFS by various methods (L3)
- apply MODI method for finding optimal transportation cost (L3)

Unit – II **5 hours**

Assignment Problems: Introduction to Assignment Problem, Mathematical formulation, Hungarian Method for finding optimal solution, unbalanced assignment problem, Travelling Salesman Problem.

After completion of this unit, the student will be able to:

- understand the problem of assignment problem(L2)
- apply the technique of solving the assignment problem using the Hungarian Method (L3)
- find an optimal solution to unbalanced assignment problem (L3)
- find the optimal route for the salesman (L3)

Unit – III **4 hours**

Sequencing Problem: Introduction, Basic terminology, Algorithms to obtain optimal solutions for sequencing problems with n jobs and two machines and n jobs and k machines.

Learning Outcomes:

After completion of this unit, the student will be able to:

- find optimal job sequencing (L3)
- find the optimal sequence for processing n jobs through two machines (L3)
- convert k machine problem into two machine problem (L4)
- find the optimal sequence for processing n jobs through k machines (L3)

Unit – IV **4 hours**

Network Analysis in Project planning: Project, Project Planning, Project Scheduling, Project Controlling, Work breakdown structure, Network Techniques, terms used in network-activity, event, path, network, dummy activity, looping, Fulkerson's rule, network diagram, and activity on node diagram.

Learning Outcomes :

By the end of this unit, the student will be able to:

- understand the problem of network models (L2)
- know the terms activity, node, labeling (L3)
- know the rules to draw the network diagram (L3)
- construct network diagram (L2)

Unit – V **7 hours**

PERT and CPM: Critical path method (CPM), Measure of activity, Critical path analysis, the four floats, subcritical and supercritical activities, slack, Programme evaluation and review technique (PERT), time estimates, frequency distribution curve for PERT

Learning Outcomes:

After completion of this unit, the student will be able to:

- know the technique of Critical Path Method (CPM) (L3)
- know the technique of PERT (L3)
- find time estimates (L3)
- estimate the probability of completing the project (L2)

Course outcomes:

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

- apply MODI method for finding optimal transportation cost
- apply Hungarian Method for solving assignment problems and finding an optimal route to the salesman
- understand the process of finding optimal sequencing for processing jobs on machines
- understand the network terminology and construction
- apply CPM and PERT techniques for project management

Text Books:

1. Operations Research by S.D.Sarma, Kedarnath, Ramnath and company, 15th edition, 2008.
2. Operations Research An Introduction by Hamdy A. Taha, 8th edition, Pearson, 2007.

Reference Books:

1. Linear Programming by R K Gupta, Krishna Prakashan Mandir, 13th edition 2014.
2. Operations Research Theory and Applications by J K Sharma, 4th edition, Macmillan Publishers India Ltd, 2009.

COMPUTATIONAL METHODS

L T P C
3 0 0 3

Preamble:
It is designed for the students for the basic understanding of techniques for numerical solution of algebraic equations, differentiation, integration used to solve engineering application problems.

Course Objectives:

- Develop the mathematical skills in the areas of numerical methods.
- Focus on the theory and applications of numerical methods in many engineering subjects which require solutions of linear systems, finding eigenvalues, eigenvectors, interpolation, and applications, solving ODEs, PDEs.
- Help in the foundation of computational mathematics for postgraduate courses, specialized studies, and research.
- Train in developing the codes for implementing the numerical methods using any programming languages.
- Formulate a mathematical model for a given engineering problem

UNIT I 9 hours

Mathematical Modeling of Engineering Problems:
Approximations: Accuracy and precision, round-off and truncation errors, error problem with example problems. **Roots of Equations:** Formulations of linear and non-linear algebraic equations, solution with bisection, Newton-Raphson and Secant methods. Application to practical problems. **Algebraic Equations**: Formulation of linear algebraic equations from engineering problems, solution of these problems by Gauss elimination method, pitfalls of elimination and techniques for improving the solutions, Gauss Seidel iteration for solving sparse equations by avoiding storage of zero coefficients in matrix, convergence of iteration methods. LU decomposition methods for symmetric (Chelosky) matrices.

Learning Outcomes:

After completion of this unit the student will be able to

- Find the root for linear and non-linear algebraic equations by using iterative methods. (l1)
- Estimate the true error and approximate error between the iterations of the mathematical procedure. (l5)
- Formulate system of linear equations from engineering problem and solve using any of the numerical procedure(l6)

UNIT II 9 hours

Eigenvalues and Eigenvectors Problems: Formulation of equations to column, truss, spring-mass and friction problems. Solutions for the largest and smallest eigenvalues and corresponding eigenvectors. **Interpolation Methods:** Polynomial interpolation, Lagrange

interpolation polynomials with equi- spaced data. **Regression or Curve Fitting:** Linear regression by least squares method.

Learning Outcomes:

After completion of this unit the student will be able to

- Interpolate a polynomial with any given data(L4)
- Fit a curve using linear regression(L3)
- Calculate Eigenvalues and corresponding Eigenvectors for a given system of equations.(L3)

UNIT III **8 hours**

Initial Value Problems: Ordinary differential equations, Euler, Heun's and Ralston methods. Runge- Kutta method of 2nd and 4th order, application to vibration and heat transfer problems. **Boundary Value Problems:** Linear and nonlinear ordinary differential equations, boundary value problems over semi-infinite domain, solution of nonlinear equations by finite difference method.

Learning Outcomes:

After completion of this unit the student will be able to

- Solve ODE's with R-K 2^{nd} and 4^{th} order methods. (L3)
- Interpret the boundary conditions for initial value and boundary value problems. (L2)
- Appreciate the merits of various numerical methods for solving ODE's.(L5)

UNIT IV **8 hours**

Laplace Equations: Finite difference discretization of computational domain, different types of boundary conditions, solution to elliptic equations. **Parabolic Transient Diffusion Equations:** Explicit and implicit formulation, Crank Nicolson Method.

Learning Outcomes:

After completion of this unit the student will be able to

- Classify the given partial differential equation.(l2)
- Discretize the given domain by finite difference method for both elliptic and parabolic pde's. (l3)
- Apply the boundary conditions for any given problem satisfying the physics of the problem.(l2)

UNIT V **8 hours**

Numerical Integration: Trapezoidal, Simpson's 1/3 and 3/8 rule and Gauss quadrature method.

Learning Outcomes:

After completion of this unit the student will be able to

- Solve the integration problem by using numerical methods. (l3)
- Understand the application of simpson's $1/3^{rd}$ and $3/8^{th}$ methods.(l2)

List of Computational Exercises:

1. Determine the real root for a given polynomial equation by (i) Bisection, (ii) Newton-Raphson until the approximate error falls below 0.5%.
2. Solve the system of simultaneous linear equations by

(i) Naïve -Gauss elimination
(ii) Gaussian elimination with partial pivoting
(iii) Gauss -Seidal method.
(iv) LU decomposition

3. Implement power method to find Eigenvalues and Eigenvectors for Spring mass system
4. Solve the parabolic partial differential equations by using explicit, implicit and semi-implicit methods
5. Solve the elliptic partial differential equations by finite difference techniques.
6. Finding the integral for a second-order polynomial using Gauss quadrature formula.
7. Solve numerical differentiation problems using Runge-Kutta 2^{nd} and 4^{th} order methods.
8. Find the integral by numerical methods such as Trapezoidal and Simpson's rule.

Course Outcomes:

At the end of the course, the student will be able to:

- Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
- Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- Analyse and evaluate the accuracy of common numerical methods.
- Implement numerical methods using any programming language (matlab, scilab, python…)
- Write efficient, well-documented code and present numerical results in an informative way.

Text Book(s)

1. S.P. Venkateshan, P. Swaminathan, Computational Methods in Engineering, 1/e, Ane Publisher, 2014.
2. S.C. Chapra, R.P. Canale, Numerical Methods for Engineers, 6/e, Tata McGraw-Hill, 2012.

Reference

1. S.K. Gupta, Numerical Methods for Engineers, 1/e, New Age International, 2005.

PROBABILITY AND STATISTICS

L	T	P	C
3	0	0	3

Course Objectives:

- To familiarize the students with the foundations of probability and statistical methods
- To impart concepts in probability and statistical methods in engineering applications.

Unit I: Data Science and Probability **10 hrs**

Data Science: Statistics introduction, Population vs Sample, collection of data, primary and secondary data, types of variable: dependent and independent Categorical and Continuous variables, data visualization, Measures of central tendency, Measures of dispersion (variance).

Probability: Probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem (without proof).

Learning Outcomes:

At the end of this unit, the student will be able to

- summarize the basic concepts of data science and its importance in engineering (L3)
- analyze the data quantitatively or categorically , measure of averages, variability (L4)
- define the terms trial, events, sample space, probability, and laws of probability (L3)
- make use of probabilities of events in finite sample spaces from experiments (L3)
- apply Baye's theorem to real time problems (L3)

Unit II: Random Variable and Probability Distributions **8 hrs**

Random variables (discrete and continuous), probability density functions, probability distribution - Binomial, Poisson and normal distribution-their properties (mathematical expectation and variance).

Learning Outcomes:

At the end of this unit, the student will be able to

- explain the notion of random variable, distribution functions and expected value(L3)
- apply Binomial and Poisson distributions to compute probabilities, theoretical frequencies (L3)
- explain the properties of normal distribution and its applications (L3)

Unit III: Correlation, Regression and Estimation **8 hrs**

Correlation, correlation coefficient, rank correlation, regression, lines of regression, regression coefficients, principle of least squares and curve fitting (straight Line, parabola and exponential curves). **Estimation:** Parameter, statistic, sampling distribution, point estimation, properties of estimators, interval estimation.

Learning Outcomes:

At the end of this unit, the student will be able to

- identify different trends in scatter plots, strengths of association between two numerical variables (L3)
- make use of the line of best fit as a tool for summarizing a linear relationship and predicting future observed values (L3)
- estimate the value of a population parameter, computation of point and its interval (L3)

Unit IV: Testing of Hypothesis and Large Sample Tests **8 hrs**

Formulation of null hypothesis, alternative hypothesis, the critical region, two types of errors, level of significance, and power of the test. **Large Sample Tests**: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems

Learning Outcomes:

At the end of this unit, the student will be able to

- identify the difference between one- and two-tailed hypothesis tests (L3)
- analyze the testing of hypothesis for large samples (L4)

Unit V: Small Sample Tests **6 hrs**

Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), $\chi 2$ - test for goodness of fit, $\chi 2$ - test for independence of attributes.

Learning Outcomes:

At the end of this unit, the student will be able to

- analyze the testing of hypothesis for small samples (L4)
- test for the Chi-square goodness of fit and independence of attributes (L4)

Text Books:

1. Miller and Freunds, Probability and Statistics for Engineers,7/e, Pearson, 2008.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

References:

1. S. Ross, A First Course in Probability, Pearson Education India, 2002.
2. W. Feller, An Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.

Course Outcomes:

Upon successful completion of this course, the student should be able to

- classify the concepts of data science and its importance (L3)
- apply discrete and continuous probability distributions (L3)
- explain the association of characteristics through correlation and regression tools (L3)
- identify the components of a classical hypothesis test (L3)
- infer the statistical inferential methods based on small and large sampling tests (L4)

MECH1011: ENGINEERING VISUALIZATION AND PRODUCT REALIZATION

L	T	P	C
0	0	4	2

The course enables the students to convey the ideas and information graphically that come across in engineering. This course includes projections of lines, planes, solids sectional views, and utility of drafting and modelling packages in orthographic and isometric drawings.

Course Objectives

- Create awareness of the engineering drawing as the language of engineers.
- Familiarize how industry communicates, practices for accuracy in presenting the technical information.
- Develop the engineering imagination essential for successful design.
- Train in 2D and 3D modeling softwares.
- Teach assembly of simple components and their animation.
- Teach basic 3D printing software for preparation of simple components

Manual Drawing: (8 P hours)

Introduction to Engineering graphics: Principles of Engineering Graphics and their significance-Conventions in drawing-lettering - BIS conventions. Dimensioning, sectioning and datum planes

Free hand sketching (4 P hours)

Free hand sketching of isometric & orthographic views and interpretation of drawings.

Computer Aided Drafting (12 P hours)

Introduction to CAD software: Basic drawing and editing commands: line, circle, rectangle, erase, view, undo, redo, snap, object editing, moving, copying, rotating, scaling, mirroring, layers, templates, polylines, trimming, extending, stretching, fillets, arrays, dimensions. Dimensioning principles and conventional representations.

Assemble drawings (12 P hours)

Constraints and assembly drawings. Engineering animation including motion curves, coordinating multiple moving parts under joint-constraints and the notion and impact of lighting and camera.

3D printing (8 P hours)

introduction to 3D printing software. slicing, grading and rendering of simple geometries using software

Project by group of students in the following themes (12 P hours)

IC engine model and 3D printed mini model
Belt drive for a bike
Four-wheel drivable ATV robot
Toy making - Carrom board, chess board & pieces model toy train, avengers
Buildings, bridges dams etc.
Wind turbine model
Design of Programmable Intelligent Controllers – PIC
Design of Printed Circuit Boards
Arduino Board Design and 3D Printing of Enclosures for Arduino Boards
Design of Radar and 3D Printing of Radar Models
Design of Mini Motherboards

Course Outcomes

After completing the course, the student will be able to

- utilize Engineering visualization as Language of Engineers. (L3)
- prepare drawings as per international standards. (L3)
- create 2D and 3D models using CAD packages. (L3)
- use 3D printing software and create model for printing of simple objects

MECH1021: WORKSHOP

L	T	P	C
0	0	4	2

This course enables the students to familiarize with the basic fabrication practices and to explore the various devices, tools and equipment used. Hands-on exercise is provided in various trade sections. Essentially student should understand the labor involved, machinery or equipment necessary, time required to fabricate and should be able to estimate the cost of the product or job work which are fundamental tasks for engineering plans.

Course Objectives

- Explain tools used in carpentry, fitting and sheet metal and practice procedure of doing experiments.
- Make the students to learn types of basic electric circuit connections and PCBs.
- Provide training to prepare FRP composites.
- Train the students on preparing 3D plastics using injection molding.
- Demonstrate on utilizing 3D printer for printing 3D objects

List of Jobs

1. Wood Working - Cross halving Joint/Dove Tail Joint/End Bridle Joint (Any two)
2. Sheet Metal working - Taper tray/conical funnel/Elbow pipe (Any Two) (including soldering).
3. Fitting- V fit/Dove Tail fit/ Semicircular fit (Any Two)
4. Electrical Wiring -Parallel and series connection
5. Electrical Wiring -Two-way switch connection
6. Electrical Wiring- Wiring of lighting systems
7. Injection molding-Make any two plastic components using injection molding machine.
8. 3D printing Demonstartion

Text Books

1. P. Kannaiah, K. L. Narayana, 'Workshop Manual', 2/e, Scitech Publications, India, 2007.
2. B. L Juneja , 'Workshop Practice ', 1/e, Cengage Learning ,Delhi, 2015

Additional Reading

1. K Mallick, 'Fiber-Reinforced Composites: Materials, Manufacturing, and Design', 3/e, CBC Press, New York, 2007.

Course Outcomes:

After completion of this lab the student will be able to

- Summarize application of different power tools (L1)
- Develop different parts with metal sheet/wood working/fits in real time applications. (L3)
- Demonstrate electrical circuits in various applications. (L2)
- Prepare models using injection molding m/c . (L3)
- Familiarize with 3D printer operations (L1)

MECH1031: DESIGN THINKING

L	T	P	J	S	C
0	0	2	0	0	1.0

Course Pre-requisite(s):Engineering Visualization and Product Realization

Design is a realization of a concept or idea into a configuration, drawing or product. Design Thinking is the cognitive and practical process by which design concepts are developed by designers. Innovation is a new idea or a new concept. Product development is the creation of a new or different product that offers new benefits to the end-user. This course introduces design thinking in product innovation.

Course Objectives

1. To familiarize the product design process
2. To introduce the basics of design thinking
3. To bring awareness on idea generation
4. To familiarize the role of design thinking in services design

Topic	Type
Each member of the group has to ask (vocally) the group members different questions about a product that they would like to design. Write down the questions and answers and submit as a word or pdf document.	Exercise
Each member of the group must ask (vocally) the group members questions about the product chosen in the previous experiment. This helps to gain indepth insights as well as new findings and information in order to grasp the problem or situation holistically or simply to find relevant questions for an interview. Write down the questions and answers and submit as a word or pdf document	Exercise
Identify relevant factors of influence that constitute the basis for a new or improved product or offer; then analyze it in a targeted manner. ➢ Make sure that you are sufficiently creative in the analysis process, because the focus is on technical “details”. ➢ Boost the efficiency of the analysis process by avoiding empty runs. ➢ Make use of a standardized procedure in order to examine the problem and solution space again with the help of data.	Exercise
➢ Do research, talk with people, and have empathy to formulate profound stories. ➢ Summarize the results from the “understand” and “observe” phases and discuss with the team. ➢ Highlight unexpected results and generate new perspectives. ➢ In general, share insights, ideas, and results (solutions) with others.	Exercise
➢ Explore untapped market opportunities. ➢ Provide differentiated and new offers based on the user needs. ➢ Adapt a strategy to new market needs by understanding the competitive edge. ➢ Establish the right vision for the design challenge or a road map for stepby-step implementation and control mechanisms.	Exercise
➢ Find out at an early stage whether the basic need is satisfied and the product attracts interest on the market. ➢ Find out through iterative testing whether the user need is met with a minimally functional product and how the product should be enhanced. ➢ Find out through user feedback how much demand there is for the product before developing further details and features. ➢ Minimize the risk of investing in a solution for which there is little demand on the market, thus saving time, money, and energy.	Exercise

➢ Perform a true A/B test or several variants of a prototype in the form of a multi-variants test or as split testing. ➢ Do a quantitative evaluation. ➢ Carry out a qualitative survey and evaluate the number and content of feedbacks. ➢ Compare individual variants of a function or a prototype (e.g. buttons, visuals, arrangement).	Exercise
➢ Collect and appraise experiences made in the project in a structured manner. ➢ Learn from experience and make use of it in the next project. ➢ Facilitate a positive attitude toward mistakes and appreciate progress. ➢ Identify and document the findings; make them applicable and usable.	Exercise
Case Studies : Example : Software Prototyping, Additive Manufacturing; Design of Arduino Boards for various applications etc	Exercise

Texbook(s)	**Topics**
1. Pahl, Beitz, Feldhusen, Grote,'Engineering Design: a systematic approach',3rd,Springer Science & Business Media,London,2007,978-1846283185	All Exercises
2. Christoph Meinel,Larry Leifer,Hasso Plattner,'Design Thinking Understand – Improve – Apply',1st,Springer,Berlin, Heidelberg,2011,978-3-642-13756-3	All Exercises

Additional Reading(s)	**Topics**
1. Marc Stickdorn, Jakob Schneider,'This is Service Design Thinking: Basics, Tools, Cases',1st,WILEY,United States,2012,978-1-118-15630-8	All Exercises

Journal(s)	**Topics**

Website(s)	**Topics**

Course Outcomes(COs)

1 Innovate new methods in product development
2 2 Apply Design Thinking in developing the new designs
3 Select ideas from ideation methods in new product development
4 Use Design Thinking in developing software products
5 Apply principles of Design Thinking in service design

CSEN1011 - PROBLEM SOLVING AND PROGRAMMING WITH C

L	T	P	C
0	0	6	3

The course is designed to enable the student to write programs for problem solving. After an introduction to program logic design using algorithms and flowcharts, converting the logic into programs is taught. The features of structured programming are explained with the C programming language as an example. This course lays the foundation both for developing program logic and for writing programs in C according to the developed logic.

Course Objectives:

1. Familiarize the student with the steps involved in writing and running a compiled program.
2. Enable the student to build program logic with algorithms and flowcharts.
3. Explain with the features and constructs of C programming such as data types, expressions, loops, functions, arrays, pointers, and files.
4. Demonstrate the handling of variables and input-output operations in C.
5. Train the student to convert program logic into C language code using a top-down approach.

Module I: Introduction to Computer Problem-Solving 12 P

Introduction, the Problem-Solving Aspect, Top-Down Design, Introduction to the idea of an algorithm, Introduction to Flowchart using Raptor tool.

Introduction to C Language – Structure of a C Program, Keywords, Identifiers, Data Types (int, float, char, unsigned int) and Variable declaration, Constants, Input / Output function. Operators, Expressions, Precedence and Associativity, Expression Evaluation, Type conversions.

Exercises: Construct a flowchart and write a program to

- Develop a calculator to convert time, distance, area, volume and temperature from one unit to another.
- Calculate simple and compound interest for various parameters specified by the user
- To enter marks of five subjects and calculate total, average and percentage.
- Calculate net salary of employee given basic,da,hra,pf and lic
- retrieve remainder after division of two numbers without using mod operator
- Convert an upper-case character to a lower-case character.
- Swap two numbers
- Enter two angles of a triangle and find the third angle.
- Check Least Significant Bit (LSB) of a number
- Input any number from user and check whether nth bit of the given number is set (1) or not (0)(hint: Use bitwise operators)

Learning Outcomes

After completion of this unit the student will be able to

- Develop algorithms and basic flowcharts for performing Input, Output and Computations (L3)
- Interpret the structure of C program and various key features of C (L2)
- Translate mathematical expressions to C notation using operators (L2).

Module II: Control Structures 15 P

- **Control Structures:** Selection Statements (making decisions) – if, if-else, nested if, else if ladder and switch statements. Repetition statements (loops)-while, for, do-while statements, Nested Loops.
- Unconditional statements-break, continue, goto.
- Pointers – Pointer variable, pointer declaration, Initialization of pointer, accessing variables through pointers, pointers to pointers, pointers to void.

Exercises: Construct a Flowchart and Write a Program to

- Check whether the triangle is equilateral, isosceles, or scalene triangle.
- Check whether entered year is a leap year or not
- Find minimum among three numbers.
- Check whether a number is divisible by 5 and 11 or not.
- Check whether a number is positive, negative or zero using switch case.
- Design a calculator that performs arithmetic operations on two numbers using switch case
- Find Roots of a Quadratic Equation
- Find factorial of a number
- Check whether number is a palindrome or not
- Check whether number is perfect or not
- Convert a decimal number to binary number
- To find the sum of the series [1-X^2/2!+X^4/4!- .....].
- Print following patterns

```
*
*
* *
* * *
* * * *
```

```
A
B B
C CC
D D D D
E E E EE
```

```
1
2 3
4 5 6
7 8 9 10
```

- Calculate the greatest common divisor of two numbers
- Generate first n numbers in the Fibonacci series
- Generate n prime numbers
- Swap two numbers using pointers.
- Performs all the five arithmetic operations using Pointers.

Learning Outcomes:

After completion of this unit the student will be able to

- Construct C programs using various conditional statements (L3).

- Develop C programs using loops and nested loops (L6).
- Demonstrate the usage of pointers (L3).

Module III: Functions 15 P

Functions-Designing Structured Programs, user defined function- function definition, function prototype, function call, Types of functions. Parameter Passing by value, parameter passing by address, Recursive functions. Dynamic Memory allocation Functions, pointers to functions. Storage classes-auto, register, static, extern.

Exercises: Write a program using functions to

- Print even and odd numbers in a given range
- Find power of a number
- Return maximum of given two numbers
- To print all strong numbers between given interval using functions.
- Check whether a number is prime, Armstrong or perfect number using functions.
- Demonstrate call by value and call by reference mechanisms.
- Find power of any number using recursion.
- Generate Fibonacci series using recursion
- Find product of two numbers using recursion
- Find the sum of digits of a number. Number must be passed to a function using pointers.
- Find GCD (HCF) of two numbers using recursion.
- Find LCM of two numbers using recursion.

Learning Outcomes:

After completion of this unit the student will be able to

- understand the concept of subprograms and recursion (L2).
- apply the in-built functions to develop custom functions for solving problems (L3).
- make use of parameter passing mechanisms (L3).
- infer the effect of storage classes on variables (L2).

Module IV: Arrays and Strings 15 P

Arrays – Declaration and Definition of Array, accessing elements in array, Storing values in array, linear search, binary search, bubble sort, Two – dimensional arrays, multidimensional arrays. Arrays and Pointers, Pointer Arithmetic and arrays, array of pointers, Passing array to function. Strings – Declaration and Definition of String, String Initialization, unformatted I/O functions, arrays of strings, string manipulation functions, string and pointers.

Exercises: Write a program to

- Find minimum and maximum element in an array
- Implement linear search.
- Sort an array in descending order.
- Given a two-dimensional array of integers and a row index, return the largest element in that row.
- Find transpose of a matrix.
- Perform multiplication of two matrices
- Count total number of vowels and consonants in a string.
- Reverse the given string without using String handling functions.
- Sort strings in dictionary order

- To perform addition of two matrices.
- Read an array of elements of size ‘n’ and find the largest and smallest number using functions
- find total number of alphabets, digits or special character in a string using function

Learning Outcomes:

After completion of this unit the student will be able to

- develop programs for storing and managing collections of items using arrays (L3).
- make use of the in-built functions to manipulate strings (L3).
- solve problems related to arrays and strings (L3).

Module V: Structures and Files 15 P

Structures–Declaration, initialization, accessing structures, operations on structures, structures containing arrays, structures containing pointers, nested structures, self-referential structures, arrays of structures, structures and functions, structures and pointers, unions.

Files – Concept of a file, Opening and Closing files, file input / output functions (standard library input / output functions for text files)

Exercises: Write a program to

- Store information of a student using structure
- Add two complex numbers by passing structures to a function
- Store information of 10 students using structures
- Store Employee information using nested structure
- Read file contents and display on console.
- Read numbers from a file and write even and odd numbers to separate file.
- Count characters, words and lines in a text file.

Learning Outcomes:

After completion of this unit, the student will be able to:

- develop programs using structures and unions for storing dissimilar data items (L6).
- compare the utilization of memory by structures and unions (L5).
- make use of files and file operations to store and retrieve data (L3).

Text Books(s)

1. B. A. Forouzan and R. F. Gilberg, Computer Science: A Structured Programming Approach Using C, 3/e, Cengage Learning

Reference Book(s)

1. Jeri R Hanly, Elliot B Koffman, Problem Solving and Program Design in C, 7/e, Pearson Education, 2012.
2. B.W. Kernighan and Dennis M. Ritchie, The C Programming Language, 2/E, Pearson education, 2015.
3. B. Gottfried, Programming with C, 3/e, Schaum’s outlines, McGraw Hill (India), 2017.
4. P. Dey and M Ghosh, Programming in C, 2/e, Oxford University Press, 2011.

Course Outcomes:

After completion of this course the student will be able to

- Build logic for solving a problem and translate it into a program. (L3).
- Define variables and construct expressions using C language (L1).
- Utilize arrays, structures and unions for storing and manipulating data (L3).
- Develop efficient, modular programs using functions (L3).
- Write programs to store and retrieve data using files (L3).

Additional Exercises:

- Given numbers x, y, and target, return whichever of x and y is closer to the target. If they have the same distance, return the smaller of the two
- There are three friends Ram, Raheem and Robert. Ram's age is 20, Raheem is aged three times more than his friend Ram. After 8 years, he would be two and a half times of Ram's age. After further 8 years, how many times would he be of Rams age? Robert's age is 25 now. Now program your computer to determine the final ages of all the three people after 16 years and also show who is elder.
- Given an actual time and an alarm clock time, both in "military" format (such as 0730 for 7:30am), print how many more minutes before the alarm rings. But if the time is after the alarm, print "Alarm already went off".
- Let there be a scenario where you and your friend are going to a restaurant. You have lunch there every fourth day, and he has his lunch there every sixth day. How many days before you meet again for lunch at the same restaurant?
- Two friends Suresh and Ramesh have **m** red candies and **n** green candies respectively. They want to arrange the candies in such a way that each row contains equal number of candies and also each row should have only red candies or green candies. Help them to arrange the candies in such a way that there are maximum number of candies in each row.
- On a chessboard, positions are marked with a letter between a and h for the column and a number between 1 and 8 for the row. Given two position strings, return true if they have the same colour.
- Given two strings s0 and s1, return whether they are anagrams of each other.
- Write a program to encrypt and decrypt a password which is alphanumeric
- Given a string, return the string with the first and second half swapped. If the string has odd length, leave the middle character in place.
- Given an array of integers, return the second-largest element.
- Given lists of integers people, jobs, profits. Each person i in people have people[i] amount of strength, and performing job j requires jobs[j] amount of strength and nets profits[j] amount of profit. Given that each person can perform at most one job, although a job can be assigned to more than one person, return the maximum amount of profit that can be attained.
- Mr. Roxy has arranged a party at his house on the New Year's Eve. He has invited all his friends - both men and women (men in more number). Your task is to generate the number of ways in which the invitees stand in a line so that no two women stand next to each other. Note that the number of men is more than the number of women and Roxy doesn't invite more than 20 guests. If there are more than 20 guests or an arrangement as per the given constraints is not possible, print 'invalid'.
- Two friends have entered their date of birth and they want to know who is elder among them. Make a structure named Date to store the elements day, month and year to store the dates.

Case Study:

- Create a structure containing book information like accession number, name of author, book title and flag to know whether book is issued or not. Create a menu in which the following functions can be done: Display book information, Add a new book, Display all the books in the library of a particular author, Display the number of books of a particular title, Display the total number of books in the library, Issue a book (If we issue a book, then its number gets decreased by 1 and if we add a book, its number gets increased by 1)
- Ranjan is maintaining a store. Whenever a customer purchases from the store, a bill is generated. Record the customer name, amount due, the amount paid, mobile number with purchased items in file. At the end of day print the total income generated by store.
- Contact Management System- Create structure to store Contact information like name,gender,mail,phone number and address. Users can add new contact and can also edit and delete existing contact. (Hint: Use Files to store data)

CSEN1021 - PROGRAMMING WITH PYTHON

L	T	P	C
0	0	6	3

Course Objectives:

- To elucidate problem solving through python programming language
- To introduce function-oriented programming paradigm through python
- To train in development of solutions using modular concepts
- To teach practical Python solution patterns

Module I: Introduction to Python 12 H

Python – Numbers, Strings, Variables, operators, expressions, statements, String operations, Math function calls, Input/output statements, Conditional If, while and for loops.

Exercises:

- Accept input from user and store it in variable and print the value.
- Use of print statements and use of (.format)for printing different data types.
- Take 2 numbers as user input and add, multiply, divide, subtract, remainder and print the output (Same operations on floating point input as well)
- Conversion of one unit to another (such as hours to minutes, miles to km and etc)
- Usage of mathematical functions in python like math.ceil, floor, fabs, fmod, trunc, pow, sqrt etc.
- Building a mathematical calculator that can perform operations according to user input. Use decision making statement.
- Accepting 5 different subject marks from user and displaying the grade of the student.
- Printing all even numbers, odd numbers, count of even numbers, count of odd numbers within a given range.
    - Compute the factorial of a given number. b) Compute GCD of two given numbers. c) Generate Fibonacci series up to N numbers.
- Check whether the given input is a) palindrome b) strong c) perfect
- Compute compound interest using loop for a certain principal and interest amount

Learning Outcomes:

After completion of this unit the student will be able to

- solve simple problems using control structures, input and output statements. (L3)
- develop user defined functions (recursive and non-recursive). (L3)

Module II: Functions **15H**

User defined Functions, parameters to functions, recursive functions. Lists, Tuples, Dictionaries, Strings.

Exercises:

- Create a function which accepts two inputs from the user and compute ${}^{n}C_{r}$
- Recursive function to compute GCD of 2 numbers
- Recursive function to find product of two numbers
- Recursive function to generate Fibonacci series
- Program to print a specified list after removing the 0th, 4th and 5th elements. Sample List : ['Red', 'Green', 'White', 'Black', 'Pink', 'Yellow'] Expected Output : ['Green', 'White', 'Black']
- Program to get the difference between the two lists.
- Program to find the second smallest number and second largest number in a list.
- Given a list of numbers of list, write a Python program to create a list of tuples having first element as the number and second element as the square of the number.
- Given list of tuples, remove all the tuples with length K.
  Input : test_list = [(4, 5), (4,), (8, 6, 7), (1,), (3, 4, 6, 7)], K = 2
  Output : [(4,), (8, 6, 7), (1,), (3, 4, 6, 7)]
  Explanation : (4, 5) of len = 2 is removed.
- Program to generate and print a dictionary that contains a number (between 1 and n) in the form (x, x*x).
  Sample Input: (n=5) :
  Expected Output : {1: 1, 2: 4, 3: 9, 4: 16, 5: 25}
- Program to remove a key from a dictionary
- Program to get the maximum and minimum value in a dictionary.
- Program to perform operations on string using unicodes ,splitting of string,accessing elements of string using locations
- Program for Counting occurrence of a certain element in a string, getting indexes that have matching elements.For ex -.In Rabbit count how many times b has occurred . Example-I have to go to a doctor and get myself checked. Count the number of occurrences of ‘to’.
- Program for replacing one substring by another For example - Rabbit - Replace ‘bb’ by ‘cc’
- Program to Acronym generator for any user input (ex-input is Random memory access then output should be RMA).Example - Random number (RN)
- Python function that accepts a string and calculates the number of uppercase letters and lowercase letters.
- Program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings
- Sample List : ['abc', 'xyz', 'aba', '1221'] Expected Result : 2

Learning Outcomes:
After completion of this unit the student will be able to

- understand the concept of subprograms and recursion (L2).
- apply the in-built functions to develop custom functions for solving problems (L3).
- make use of parameter passing mechanisms (L3).
- develop user defined functions (recursive and non-recursive). (L3)
- summarize the features of lists, tuples, dictionaries, strings and files. (L2)

Module III: Files and Packages **15 H**

Files—Python Read Files, Python Write/create Files, Python Delete Files.
Pandas -- Read/write from csv, excel, json files, add/ drop columns/rows, aggregations, applying functions.
Exercises

- read an entire text file.
- read the first n lines of a file.
- append text to a file and display the text.
- Read numbers from a file and write even and odd numbers to separate files.
- Count characters, words and lines in a text file.
- To write a list to a file.
- Given a CSV file or excel file to read it into a dataframe and display it.
- Given a dataframe, select rows based on a condition.
- Given is a dataframe showing the name, occupation, salary of people. Find the average salary per occupation.
- To convert Python objects into JSON strings. Print all the values.
- Write a Pandas program to read specific columns from a given excel file.

Learning Outcomes:
After completion of this unit the student will be able to

- read data from files of different formats and perform operations like slicing, insert, delete, update(L3).
- Ability to define and use of Packages(L2).

Module IV: Operations in database with suitable libraries **15 H**

SQLite3: CRUD operations (Create, Read, Update, and Delete) to manage data stored in a database. Matplotlib -- Visualizing data with different plots, use of subplots. User defined packages, define test cases.
Exercises
Special commands to sqlite3 (dot-commands)
Rules for "dot-commands"
Changing Output Formats
Querying the database schema
Redirecting I/O
Writing results to a file
Reading SQL from a file
File I/O Functions
The edit() SQL function
Importing CSV files
Export to CSV

Export to Excel
Reference - https://www.sqlite.org/cli.html
Matplotlib can be practiced by considering a dataset and visualizing it.
It is left to the instructor to choose appropriate dataset.

Learning Outcomes:
After completion of this unit the student will be able to
- visualize the data (L4).
- Understanding the various operations performed with SQLite3. (L2)
- make use of SQLite3 operations to store and retrieve data (L3).

Module V: Regular Expressions **15 H**

Regular expression: meta character, regEx functions, special sequences, Web scrapping, Extracting data.

Exercises

Write a Python program to check that a string contains only a certain set of characters (in this case a-z, A-Z and 0-9).
Write a Python program that matches a string that has an a followed by zero or more b's
Write a Python program that matches a string that has an a followed by one or more b's
Write a Python program that matches a string that has an a followed by zero or one 'b'
Write a Python program that matches a string that has an a followed by three 'b'
Write a Python program to find sequences of lowercase letters joined with an underscore
Write a Python program to test if a given page is found or not on the server.
Write a Python program to download and display the content of robot.txt for en.wikipedia.org.
Write a Python program to get the number of datasets currently listed on data.gov
Write a Python program to extract and display all the header tags from en.wikipedia.org/wiki/Main_Page

Learning Outcomes:
After completion of this unit, the student will be able to:
- make use of Web scrapping operations (L3).
- Use regular expressions to extract data from strings.(L3)

Text Books(s)
1. Programming with python, T R Padmanabhan, Springer
2. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University Press

Reference Book(s)
1. Programming with python, T R Padmanabhan, Springer
2. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University Press
3. Python for Data Analysis, Wes McKinney, O.Reeilly

Course Outcomes:
- After completion of this course the student will be able to
- Define variables and construct expressions (L1).
- Utilize arrays, storing and manipulating data (L3).
- Develop efficient, modular programs using functions (L3).
- Write programs to store and retrieve data using files (L3).

APPLICATIONS OF ARTIFICIAL INTELLIGENCE

L T P C
0 0 2 1

The surge in the production of data has led to the development of various technologies. The term "Artificial Intelligence (AI)" has become ubiquitous in everyday applications from virtual assistants to self-driving cars. Several applications such as Healthcare, Finance, Bioinformatics etc. are benefitting from the advances in the domain. The global market for artificial intelligence is going to face a phenomenal growth over the coming years with organizations across the world capitalizing on the disruptive technologies that AI is offering. This course introduces the recent applications of AI namely, Virtual Assistants, Computer Vision, along with trending topics such as Deep Learning and Reinforcement Learning. The idea of the course is to introduce the basic concepts of AI as well as latest trends in the domain. This course is envisaged to provide a basic understanding on latest developments of AI to all disciplines engineering undergraduates.

Course Objectives:

- Provide introduction to basic concepts of artificial intelligence.
- Explore applications of AI
- Explore the scope, advantages of intelligent systems
- Experiment with different machine learning concept
- Exposure to AI-intensive computing and information system framework

Week-1: 2 L

Introduction to Artificial intelligence: Basics of AL Agents and Environment, The Nature of Environment.

List of Experiment(s):

1. Implementation of toy Problems (8-Puzzle,Wumpus World, Vacuum-clean Example, etc)

Week-2: 2 P

Applications of AI: Game Playing, [Deep Blue in Chess, IBM Watson in Jeopardy, Google's Deep Mind in AlphaGo]

List of Experiment(s):

1. Implementation of (Sudoku, Crossword Puzzle, or WumpusWorld, etc)

Learning Outcomes:

The student will be able to:

- Understand the basics in AI.
- Recognize various domains in AI.

Week-3: 2 P

Conceptual introduction to Machine Learning: Supervised, Unsupervised, and Semi-Supervised Learning.

List of Experiment(s):

1. Supervise - Perform Data Labelling for various images using object recognition

Week-4: 2 P

Reinforcement Learning, Introduction to Neural Networks, Deep Learning.

List of Experiment(s):

1. Explore the effect of different hyperparameters while implementing a Simple Fully Connected Neural Network. (https://playground.tensorflow.org)

Learning Outcomes:
The student will be able to:

- Define machine learning and forms of learning
- Identify types of Neural Networks

Week-5: 2 P
Image Processing & Computer Vision: Introduction to Image processing, Image Noise, Removal of Noise from Images, Color Enhancement, Edge Detection.
List of Experiment(s):

1. Lobe.ai - Build custom models using the visual tool for Object recognition and sentiment analysis that can convert facial expressions into emoticons

Week-6: 2 P
Segmentation. Feature Detection & Recognition. Classification of images. Face recognition, Deep Learning algorithms for Object detection & Recognition.
List of Experiment(s):

1. Teachable Machine Brain.JS In Browser Object Recognition through
2. Haar Cascade Object detection for Eye and Face in Python using Open CV

Learning Outcomes:
The student will be able to:

- Identify the concepts of image processing
- Implement the methods in computer vision

Week-7: 2 P
Conceptual introduction to Natural Language Processing: Speech Recognition & Synthesis: Speech Fundamentals, Speech Analysis, Speech Modelling.
List of Experiment(s):

1. Sentiment Analysis and Polarity detection

Week-8: 2 P
Speech Recognition, Speech Synthesis, Text-to-Speech, Sentiment Analysis, Segmentation and recognition.
List of Experiment(s):

1. Text to Speech recognition and Synthesis through APIs

Learning Outcomes:
The student will be able to:

- Understand the basics of Speech Processing
- Describe natural language processing and concepts for converting speech to different forms

Week-9: 2 P
Introduction to o Chatbot, Architecture of a Chatbot. NLP in the cloud, NL Interface, How to Build a Chatbot, Transformative user experience of chatbots, DesigningElements of a chatbot, Best practices for chatbot development. NLP components. NLP wrapper to chatbots. Audiobots and Musicbots.
List of Experiment(s):

1. Building a Chatbot using IBM Watson visual studio
2. Building a Chatbot using Pandora bots
3. Build a virtual assistant for Wikipedia using Wolfram Alpha and Python

Learning Outcomes:
The student will be able to:

- Understand basic architecture of chatbots.
- Implement chatbots for various applications.

Week-10: 2 P

Smart Applications: Smart Manufacturing, Smart Agriculture, Smart Healthcare, Smart Education, Smart Grids, Smart Transportation andAutonomous Vehicles, Smart Homes, Smart Cities

List of Experiment(s):

1. Build a smart application specific to the domain of the student.

Learning Outcomes:

The student will be able to:

- Understand the application of intelligence in various domains
- Correlate Artificial Intelligence to advanced applications

Text Books(s)

1. Tom Markiewicz& Josh Zheng, Getting started with Artificial intelligence, Published by O'Reilly Media,20l7
2. Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach.

Reference Book(s)

1. Aurtlien Giron. Hands on Machine Learning with Scikit-Learn and TensorFlow concepts,Tools, and Techniques to Build intelligent Systems , Published by O'Reilly Mcdia,20l 7
2. Build an AI Assistant with wolfram alpha and Wikipedia in python.https://medium .com/@salisuwy/build-an-ai-assistant-with-wolfram-alpha-and-wikipedia-in-python-d9bc8ac838fe.
3. Joseph Howse, Prateek Joshi, Michael Beyeler - Opencv Computer Vision Projects withPython-Publishing (201 6).
4. Curated datasets on kaggle https://www.kaggle.com/datasets.

Course Outcomes:

- Able to grasp the concepts of artificial intelligence, machine learning, natural language processing, image processing
- Recognize various domains in which Al can be applied
- Implement the methods in processing an image:
- Implement simple of chatbots
- identify smart applications:

PROBABILITY AND STATISTICS

L	T	P	C
3	0	0	3

Course Objectives:

- To familiarize the students with the foundations of probability and statistical methods
- To impart concepts in probability and statistical methods in engineering applications.

Unit I: Data Science and Probability **10 hrs**

Data Science: Statistics introduction, Population vs Sample, collection of data, primary and secondary data, types of variable: dependent and independent Categorical and Continuous variables, data visualization, Measures of central tendency, Measures of dispersion (variance).

Probability: Probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem (without proof).

Learning Outcomes:

At the end of this unit, the student will be able to

- summarize the basic concepts of data science and its importance in engineering (L3)
- analyze the data quantitatively or categorically , measure of averages, variability (L4)
- define the terms trial, events, sample space, probability, and laws of probability (L3)
- make use of probabilities of events in finite sample spaces from experiments (L3)
- apply Baye's theorem to real time problems (L3)

Unit II: Random Variable and Probability Distributions **8 hrs**

Random variables (discrete and continuous), probability density functions, probability distribution - Binomial, Poisson and normal distribution-their properties (mathematical expectation and variance).

Learning Outcomes:

At the end of this unit, the student will be able to

- explain the notion of random variable, distribution functions and expected value(L3)
- apply Binomial and Poisson distributions to compute probabilities, theoretical frequencies (L3)
- explain the properties of normal distribution and its applications (L3)

Unit III: Correlation, Regression and Estimation **8 hrs**

Correlation, correlation coefficient, rank correlation, regression, lines of regression, regression coefficients, principle of least squares and curve fitting (straight Line, parabola and exponential curves). **Estimation:** Parameter, statistic, sampling distribution, point estimation, properties of estimators, interval estimation.

Learning Outcomes:

At the end of this unit, the student will be able to

- identify different trends in scatter plots, strengths of association between two numerical variables (L3)
- make use of the line of best fit as a tool for summarizing a linear relationship and predicting future observed values (L3)
- estimate the value of a population parameter, computation of point and its interval (L3)

Unit IV: Testing of Hypothesis and Large Sample Tests **8 hrs**

Formulation of null hypothesis, alternative hypothesis, the critical region, two types of errors, level of significance, and power of the test. **Large Sample Tests**: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems

Learning Outcomes:

At the end of this unit, the student will be able to

- identify the difference between one- and two-tailed hypothesis tests (L3)
- analyze the testing of hypothesis for large samples (L4)

Unit V: Small Sample Tests **6 hrs**

Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), $\chi 2$ - test for goodness of fit, $\chi 2$ - test for independence of attributes.

Learning Outcomes:

At the end of this unit, the student will be able to

- analyze the testing of hypothesis for small samples (L4)
- test for the Chi-square goodness of fit and independence of attributes (L4)

Text Books:

1. Miller and Freunds, Probability and Statistics for Engineers,7/e, Pearson, 2008.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

References:

1. S. Ross, A First Course in Probability, Pearson Education India, 2002.
2. W. Feller, An Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.

Course Outcomes:

Upon successful completion of this course, the student should be able to

- classify the concepts of data science and its importance (L3)
- apply discrete and continuous probability distributions (L3)
- explain the association of characteristics through correlation and regression tools (L3)
- identify the components of a classical hypothesis test (L3)
- infer the statistical inferential methods based on small and large sampling tests (L4)

EECE1001: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

L	T	P	C
2	1	2	4

This course introduces the fundamental principles and building blocks of electrical and electronics engineering. The first three units cover the electric circuit laws, theorems, and principles of electrical machines. The last two units cover semiconductor devices and their applications.

Course Objectives:

- To impart the analysis and design aspects of DC networks in electrical and electronic circuits
- To explain the basic concepts of AC networks used in electrical and electronic circuits.
- To demonstrate the importance and operating principles of electrical machines (transformers, motors and generators)
- To impart the knowledge about the characteristics, working principles and applications of semiconductor diodes, Metal Oxide Semiconductor Field Effect Transistors (MOSFETs).
- To expose basic concepts and applications of Operational Amplifier and configurations.

Unit I: 7L

DC Circuits: Basic circuit elements and sources, Ohms law, Kirchhoff's laws, series and parallel connection of circuit elements, Node voltage analysis, Mesh current analysis, Superposition, Thevenin's and maximum power transfer theorem.

Learning Outcomes

After completion of this unit the student will be able to

- state Ohms law and Kirchhoff's Laws (L1).
- calculate equivalent resistance of series and parallel connections in a circuit (L1).
- able to calculate voltage and current using voltage and current division methods (L2).
- determine the current, voltage and power in the given electrical circuit (L4).
- apply various theorems to analyze an electric circuit (L3).

Unit II: 8L

AC Circuits: Alternating voltages and currents, AC values, single phase RL, RC, RLC series circuits, power in AC circuits, Power Factor, three phase systems-Star and Delta Connection-Three phase power measurement.

Learning Outcomes:

After completion of this unit, the student will be able to

- describe AC voltages and currents (L1).
- analyse Series RL, RC and RLC circuits (L4).
- Learn calculations of power factor and power measurement (L2)
- Understand star and delta connections in three phase systems (L3).

Unit III: 9L

Electrical Machines: Construction, working principle and application of DC machines, Transformers, single phase and three phase Induction motors, special machines-Stepper motor, Servo motor and BLDC motor.

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand working principle of dc machines (L1).
- demonstrate principle operation of transformer (L3).
- discuss about open and short- circuit tests of transformer (L2).
- explain the working principle of three phase induction motor (L5).
- gain knowledge on applications as special machines, stepper motor (L1).
- Identify and choose servo motor and BLDC motor applications (L2).

Unit IV: **8L**

Semiconductor Devices: p-n Junction diode - Basic operating principle, current-voltage characteristics, rectifier circuits (half-wave, full-wave, rectifier with filter capacitor), Zener diode as Voltage Regulator; Metal oxide semiconductor field effect transistor (MOSFET): Operation of NMOS and PMOS FETs, MOSFET as an amplifier and switch.

Learning Outcomes:

After completion of this unit, the student will be able to

- describe the device structure and physical operation of a diode (L1).
- discuss V-I characteristics of diodes (L2).
- explain the use of diode as switch and in electronic circuits (L2).
- describe the construction and operation of n-channel and p-channel MOSFETs (L1).
- explain the use of MOSFET as an amplifier and bidirectional switch(L2).

Unit V: **8L**

Operational Amplifiers: The Ideal Op-amp, The Inverting Configuration, The closed loop gain, Effect of Finite open-loop gain, The Noninverting Configuration, The closed loop gain, Characteristics of Non-Inverting Configuration, Difference amplifiers, A Single Op-amp difference amplifier. Adders, subtractors, integrators, differentiators, filter circuits using Opamps,

Learning Outcomes:

After completion of this unit the student will be able to

- list the characteristics of an ideal Op Amp (L1).
- design the Inverting and Noninverting configurations of Op-Amp(L2).
- construct a single Op-amp difference amplifier (L3).
- List several applications of opamps

Basic Electrical and Electronics Engineering Laboratory

List of Experiments:

1. Verification of Kirchhoff's Laws.
2. Verification of DC Superposition Theorem.
3. Verification of Thevenin's Theorem.
4. Verification of Maximum power transfer Theorem.
5. Load test on DC generator.
6. Load test on single phase transformer.
7. Measurement of voltage, current and power factor of single phase RL, RC series circuits.
8. Measurement of voltage, current and power factor of single phase RLC series circuit.
9. Measurement of power in a three phase circuit.
10. Current Voltage Characteristics of a p-n Junction Diode/LED.
11. Diode Rectifier Circuits.

12. Voltage Regulation with Zener Diodes.
13. Design of a MOSTFET amplifier and MOSFET inverter/NOR gate
14. Inverting and Non-inverting Amplifier Design with Op-amps.
15. Simulation experiments using PSPICE

(a) Diode and Transistor Circuit Analysis.
(b) MOSFET Amplifier design.
(c) Inverting and Noninverting Amplifier Design with Op-amps.

Text Book(s):

1. D. P. Kothari, I. J. Nagrath, Basic Electrical and Electronics Engineering, 1/e, McGraw Hill Education (India) Private Limited, 2017.
2. B. L. Theraja, Fundamentals of Electrical Engineering and Electronics, 1/e, S. Chand Publishing, New Delhi, 2006.
3. Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits 6/e, Oxford University Press, 2014.

References:

1. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, Pearson Education, 2011.
2. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008.
3. R. K. Rajput, Basic Electrical and Electronics Engineering, University Science Press, New Delhi, 2012.

Course Outcomes:

After completion of this course, the student will be able to

- predict and analyse the behaviour of an electrical circuit (L3).
- analyse the performance quantities such as losses, efficiency and identify applications of DC machines (L4).
- explain the use of transformers in transmission and distribution of electric power and other applications (L2).
- demonstrate the operation and applications of various electronic devices (L2).
- construct Inverting and Noninverting configurations of Op-amp (L3).

INTERNSHIP I

L T P C J
0 0 0 1 1

Prerequisite: Completion of minimum of four semesters

Course Objectives:
The course is designed to expose the students to expected industry skills and industry environment and to take up onsite assignment as trainees or interns.

Expected Course Outcome:

At the end of this internship the student should be able to:

1. Have an exposure to industrial practices and to work in teams
2. identify skill set required to participate activity in real-time projects relevant to the industry
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. formulate technical background required to participate in Internship 2

Contents: 1 **Week**

One week of work at industry site. Supervised by an expert at the industry.

Mode of Evaluation: Internship Report, Presentation and Project Review

INTERNSHIP II

L T P C J
0 0 0 0 13

Prerequisite: Completion of minimum of six semesters

Course Objectives:
The course is designed to expose the students to industry environment and to take up onsite assignment as trainees or interns.

Expected Course Outcome:

At the end of this internship the student should be able to:

1. Have an exposure to industrial practices and to work in teams
2. Communicate effectively
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. Develop the ability to engage in research and to involve in life-long learning
5. Comprehend contemporary issues
6. Engage in establishing his/her digital footprint

Contents: 1 **Week**

Four weeks of work at industry site. Supervised by an expert at the industry

Mode of Evaluation: Internship Report, Presentation and Project Review

COMPREHENSIVE EXAMINATION

L T P J C
1 0 0 0 1

Prerequisite: Completion of minimum of six semesters

Course Objectives:
1. Designed to test the students on the electronics and communication engineering concepts, and tools, and the process of identifying and solving engineering problems.

Course Outcomes
The students will be able to
1. Apply knowledge of mathematics, science, and engineering
2. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health care and safety, manufacturability, and sustainability

Module:1 Networks, Signals and Systems
Network solution methods: nodal and mesh analysis; Network theorems: superposition, Thevenin and Norton‟s maximum power transfer; ye-Delta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2-port network parameters: driving point and transfer functions; State equations for networks and Network Synthesis (RL,RC,LC and RLC Synthesis): Positive real functions, hurwitz polynomial, foster and cauer forms. Continuous-time signals: LTI System & Properties,Fourier series and Fourier transform representations, sampling and aliasing concepts and applications; Discrete-time signals: discrete time Fourier transform (DTFT), DFT, FFT, Z-transform. Interconnection of systems; Filter design concepts, phase and group delay concepts

Module:2 Electronic Devices and Circuits
Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJT, LED, photo diode and solar cell; MOS Transistor Theory: nMOS, pMOS Enhancement Transistor, ideal I-V characteristics, MOS capacitor, C-V characteristics, DC transfer Characteristics of CMOS inverter.

Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Special diodes, Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, tuned amplifiers, power and operational; Simple opamp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and op-amp configurations; Function generators, 555 timers, open and closed loop applications of Comparators, Voltage Regulators, regulator protection methods, noise analysis of electronic circuits, PLLs and Data converters

Module 3: Digital Circuits
Number systems; Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip-flops, counters, shift- registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microcontroller (8051): architecture, programming, memory and I/O interfacing.

Module:4 Electromagnetics
Electrostatics; Maxwell‟s equations: differential and integral forms and their interpretation boundary conditions, wave equation, Poynting vector; Plane waves and properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth; Transmission lines: equations, characteristic impedance, impedance matching, S-parameters, Smith chart; Waveguides: modes, boundary conditions, cut-off frequencies, Rader range equvation, Friss formula; Antennas: antenna types, radiation pattern, gain and directivity, return loss, antenna arrays; Wave Propagation, Antenna design considerations - Microstrip and Horn antennas. Basics of radar; Properties and characteristics of light sources (Laser and LED) and detectors; Light propagation in optical fibers.

Module 5: Control Systems
Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; Closed loop control system design by Nichols plot , PID controller design, Lag, lead and lag-lead compensation, States space models, states space equations and solutions, states space methods for controller designs and non-linear control systems and its applications.

Module 6: Communications
Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem. Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; inter-symbol interference and its mitigation; Wireless Communication: Structure of a Wireless Communication Link, Modulation Techniques: QPSK, MSK, GMSK. Basics of TDMA, FDMA and CDMA.

Mode of Evaluation: 12 Quizzes with Multiple Choice Questions. Best 10 quizzes are considered for computing 100M. Student shall score atleast 80% in atleast 8 quizzes to be considered for grading

CAPSTONE PROJECT – INTRODUCTION

L	T	P	S	J	C
0	0	0	0	2	2

Course Objectives:

To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Course Outcome:

At the end of the course the student will be able to

1. Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
2. Perform literature search and / or patent search in the area of interest.
3. Conduct experiments / Design and Analysis / solution iterations and document the results.
4. Perform error analysis / benchmarking / costing
5. Synthesis the results and arrive at scientific conclusions / products / solution
6. Document the results in the form of technical report / presentation

Course Logistics

Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.

1. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.
2. Can be individual work or a group project, with a maximum of 3 students.
3. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.
4. Carried out inside or outside the university, in any relevant industry or research institution.
5. Publications in the peer reviewed journals / International Conferences will be an added advantage

Mode of Evaluation: Periodic reviews, Presentation, Final oral viva, Poster submission

HSMCH102 - UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY

L T P C
2 1 0 3

Human Values Courses: During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

OBJECTIVE: The objective of the course is four fold:

1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

COURSE TOPICS: The course has 28 lectures and 14 practice sessions in 5 modules:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I.
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'.
2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility.
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).
4. Understanding the characteristics and activities of 'I' and harmony in 'I'.
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.

6. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available tome. Identifying from one's own life.

Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature.
3. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.
4. Holistic perception of harmony at all levels of existence.
5. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order

4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order:
   a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
   b. At the level of society: as mutually enriching institutions and organizations
7. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

READINGS: Text Book

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference Books

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Lectures hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor

encourages the student to connect with one's own self and do self- observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations.

Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials)would also provide support to a student in performing actions commensurate to his/her beliefs. It is
intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty.

Teacher preparation with a minimum exposure to at least one 8- day FDP on Universal Human Values is deemed essential.

ASSESSMENT:
This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:
Assessment by faculty mentor: 10 marks
Self-assessment: 10 marks
Assessment by peers: 10 marks
Socially relevant project/Group Activities/Assignments: 20 marks Semester End Examination: 50 marks
The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

OUTCOME OF THE COURSE: By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to- day settings in real life, at least a beginning would be made in this direction.

This is only an introductory foundational input. It would be desirable to follow it up by

a) faculty-student or mentor-mentee programs throughout their time with the institution
b) Higher level courses on human values in every aspect of living. E.g. as a professional

PROJECT EXHIBITION I

L	T	P	S	J	C
0	0	0	0	1	1

Course Objectives:

To provide platform for the student to exhibit their project work to

a) Excite interested students in continuing/initiating in the work of interest
b) Attract startups/industry to commercialize the project work
c) acquire comments on improving the quality of the work from other students/academicians/industry

Mode of Evaluation: Poster submission, Viva-Voce Examination

PROJECT EXHIBITION II

L	T	P	S	J	C
0	0	0	0	1	1

Course Objectives:

To provide platform for the student to exhibit their project work to

a) Excite interested students in continuing/initiating in the work of interest
b) Attract startups/industry to commercialize the project work
c) acquire comments on improving the quality of the work from other students/academicians/industry

Mode of Evaluation: Poster submission, Viva-Voce Examination

Course Code	Course Title	L	T	P	S	J	C
19ECS201	**FUNDAMENTALS OF DIGITAL LOGIC CIRCUITS**	3	0	0	0	0	3
Course Owner	Department of Computer Science and Engineering	Syllabus version				1.0	
Course Pre-requisite(s)	Nil	Contact hours				45	
Course Co-requisite(s)	Nil	Approved on: April 1, 2022					
Alternate Exposure	Nil						

Digital logic circuits are the basic building blocks of modern computers. To understand the working of computers,one needs to know how numbers are represented and processed using digital logic circuits. This course first teaches number representation in computers and Boolean algebra. After covering minimization of expressions and basic logic gates, the design of combinational and sequential circuits that perform a specific function are discussed. The aim of the course is to provide the student with an understanding of how data is represented and processed at thehardware level. This course acts as a foundation for a course on Computer Architecture and Organization.

Course Objectives

1. Facilitate the student to represent numbers in different number systems and convert numbers from onenumber system to another.
2. Introduce logic gates and theorems and properties of Boolean algebra.
3. Familiarize the student with techniques for minimization expression and establish its necessity.
4. Demonstrate the design of combinational and sequential logic circuits.

UNIT - I Number Systems **LTP 9 0 0**

Positional representation of numbers, Decimal, Octal, Hexadecimal number systems, General radix 'r' system, Conversions, Complements, Binary codes, Arithmetic with signed and unsigned numbers (addition, subtraction), Introduction to error detection and error correction.

Learning Outcomes:

After completion of this unit, the student will be able to

- Explain different number systems(L2) — L2
- Solve the number system conversion problems (L3) — L3
- Apply arithmetic operations on signed and unsigned binary numbers (L3) — L3
- Explain basic error detection and correction methods(L2) — L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - II **LTP 9 0 0**

Boolean Algebra and Logic Circuits:

Axiomatic definition of Boolean Algebra, Basic theorems and Properties of Boolean Algebra, Boolean Functions, Minterms and Maxterms, Canonical and Standard Forms, Digital logic gates, Synthesis using AND, OR and NOT gates, NAND and NOR logic networks.

Learning Outcomes:

After completion of this unit, the student will be able to

- Summarize the properties of Boolean algebra — L2
- Solve expressions in the canonical and standard forms — L3
- Construct logic circuits with logic gates — L3
- Construct any Boolean function using Universal gates — L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - III Gate-Level Minimization: **LTP 9 0 0**

Learning Outcomes:

After completion of this unit, the student will be able to

- Illustrate the representation of Boolean expression as a K-map — L2
- Translate the Boolean expression into its minimal form using K-maps — L2
- Translate the given expression into its minimal form using QMC method — L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - IV COMBINATIONAL LOGIC: LTP 9 0 0

Design procedures, Adders, Subtractors, Multiplexers, Demultiplexers, Encoders, Decoders, Priority encoder, Code converters, seven segment display, Magnitude comparator, Decimal adder (BCDadder), Binary Multiplier.

Learning Outcomes:

After completion of this unit, the student will be able to

- Explain the working of basic combinational circuits L5
- Distinguish between the functions of different combinational circuits L4
- Build combinational circuits to perform a required function L6

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - V SEQUENTIAL CIRCUITS: LTP 9 0 0

Flip Flops, Basic latch, R-S flip flop, D flip flop, T flip flop, JK flip flop, Registers,Shift registers, Synchronous and Asynchronous (ripple) counters, BCD counter (synchronous and asynchronous), Ring counter, Johnson counter, Registers and Shift Registers.

Learning Outcomes:

After completion of this unit, the student will be able to

- Distinguish between combinational circuits and sequential circuits L2
- Explain the working of different flip-flops L5
- Design registers and counters to perform a given function L6

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

Textbook(s):

1. M Morris Mano, Michael D. Ciletti Digital Design, 5/e, Pearson Education, 2011

Additional Reading

Reference Book(s):

1. Z.V. Kohavi, Switching Theory and Finite Automata, 2/e, McGraw Hill, 1978
2. Stephen Brown & Zvonko Vranesic, Fundamental of digital logic with Verilog Design, 2/e, Tata McGrawHill,2007

Course Outcomes:

After successful completion of the course the student will be able to:

1. Interpret a given number in different number systems (L2).
2. Design logic circuits using gates to perform a Boolean function (L6).
3. Solve Boolean expressions into their simplified form (L3)
4. Explain the working of combinational and sequential circuits (L5)
5. Design a combinational or sequential circuit to perform a given function (L6)

	Programme Outcomes (POs)												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	1	1						2				2	1	
CO2	1	2	1						2				2	1	
CO3	2	2	1						2				2	1	2
CO4	2	2	2						3				2	2	2
CO5	2	2	2						3				2	2	2

1-Low, 2- Medium and 3- High Correlation

Course Code	Course Title	L	T	P	S	J	C
CSEN1071	**DATA COMMUNICATIONS**	2	0	0	0	0	2
Course Owner	Department of Computer Science and Engineering	Syllabus version				1.0	
Course Pre-requisite(s)	Nil	Contact hours				28	
Course Co-requisite(s)		Approved on: April 1, 2022					
Alternate Exposure							

A large majority of computer applications require communication of data from one device to another. As such, this course deals with data communications, including conversion of data into a signal, propagation of the signal through a medium and conversion of the signal back into data. Proper communication also requires the two communicating devices to follow a common protocol. This course covers the concepts of layered network architecture, properties of different transmission media and data communication principles. Various signal encoding techniques and their merits and demerits are taught, together with basic error and flow control techniques and multiplexing. The course acts as a foundation for later courses.

Course Objectives

1. Introduce the concepts of Data Communications and different models
2. Impart the characteristics of various transmission media.
3. Familiarize different analog and digital transmission techniques.
4. Expose the basic error control and flow control techniques.
5. Acquaint with static channel allocation using TDMA and FDMA.

UNIT - I Data communication, Data networking and the Internet LTP 600

A communication model, data communications, networks, the Internet.

Protocol Architecture: Need for protocol architecture, TCP/IP protocol architecture, OSI model, TCP/IP Vs OSI model.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain basic working of the computer network L2
- infer the necessity of layered protocol architecture L2
- compare the OSI and TCP/IP architectures L2

Pedagogy tools: Blended learning, video lectures, self-reading

UNIT - II Data transmission LTP 500

Concepts and terminology, analog and digital data transmission, transmission impairments, channel capacity. Transmission Media: Guided and unguided

Learning Outcomes:

After completion of this unit, the student will be able to

- summarize various transmission impairments L2
- describe analog transmission, digital transmission and channel capacity L2
- compare guided and unguided media L2

Pedagogy tools: Blended learning, video lectures, self-reading

UNIT - III Signal encoding techniques LTP 600

Digital data to digital signals, digital data to analog signals, analog data to digital signals, analog data to analog signals.

Learning Outcomes:

After completion of this unit, the student will be able to

- illustrate various signal encoding techniques L2
- analyze signal encoding techniques L4
- select an encoding technique for a given network scenario L3

Pedagogy tools: Blended learning, video lectures, self-reading

UNIT - IV Digital Data Communication Techniques LTP 600

Asynchronous and synchronous transmission, types of errors, error detection techniques, error correction techniques (single bit)

Data link control protocols: Flow control, error control.

Learning Outcomes:

After completion of this unit, the student will be able to

- compare synchronous and asynchronous transmission L2
- test for errors in a given data stream L4
- analyze various flow control techniques L4

Pedagogy tools: Blended learning, video lectures, self-reading

UNIT - V Multiplexing LTP 500

Frequency division multiplexing, characteristics, synchronous time division multiplexing, characteristics, statistical time division multiplexing, characteristics.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the need for multiplexing L2
- summarize the characteristics of multiplexing techniques L2
- compare the performance of multiplexing techniques under different conditions L2

Pedagogy tools: Blended learning, video lectures, self-reading

Textbook(s):

1. William Stallings, Data and Computer Communications, 8/e, Pearson Education., 2013.

Reference Book(s):

1. Fred Harshall, Data Communications, Computer Networks and Open systems,4/e, Pearson Education, 2005.
2. Behrouz A Forouzan, Data Communications and Networking, 4/e, McGraw Hill, 2012.

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

1. illustrate and summarize the OSI and TCP/IP network architectures
2. compare the properties of various transmission media
3. utilize error correction and detection techniques to detect or correct errors
4. analyze flow control schemes for data transmission
5. explain basic signal encoding and multiplexing techniques

	Programme Outcomes (POs)												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1									1			1		
CO2	1	1								1			1		
CO3	1		2							1				1	
CO4	2			3						1					2
CO5	1	2			2					1			1		2

1-Low, 2- Medium and 3- High Correlation

Course Code	Course Title	L	T	P	S	J	C
CSEN2001	**DATA STRUCTURES**	3	0	2	0	0	4
Course Owner	Department of CSE	Syllabus version				1.0	
Course Pre-requisite(s)	Programming with C or Python	Contact hours				46	
Course Co-requisite(s)		Approved on: April 1, 2022					
Alternate Exposure							

The study of data structures, a fundamental component of a computer science education, serves as the foundation upon which many other computer science applications are built. Knowledge of data structures is a must for students who wish to work in the design and implementation of any software system. The organization of data in an efficient way for application is the major focus of the course.

Course Objectives

1. Introduction to sort and search techniques.
2. Familiarize with linear data structures and operations on them.
3. Understand the concepts of stack and Queue and their applications.
4. Edify non-linear data structure graph and its applications.
5. Represent and manipulate data using non-linear data structure trees to design algorithms for various applications.

UNIT - I Searching and sorting LTP 802

Introduction to data structures, Array / List based representation and operations.
Searching: Linear search, Binary search.
Introduction to Sorting: Insertion sort, selection sort, bubble sort, merge sort, quick sort
Learning Outcomes:

After completion of this unit, the student will be able to

- Understand the various data structure representation (L1)
- Analyse the performance of the various Searching techniques (L2)
- Analyse the performance of the various Sorting techniques.(L2)

Pedagogy tools: Blended learning

UNIT - II Linked list LTP 1104

Linked lists: Creation of single linked list, double linked list, circular linked list, and operations on it.

Learning Outcomes:

After completion of this unit, the student will be able to

- create single, double and circular linked lists.(L2)
- implement operations on linked lists(L2)
- compare different types of linked list(L2)

Pedagogy tools: Blended learning

UNIT - III Stacks & Queues LTP 803

Stacks: Definitions, operations and applications, array and linked representation of stacks.
Queues: Definitions and operations,array and linked representation of queues and Types of Queues.
Learning Outcomes:

After completion of this unit, the student will be able to

- discuss how stacks and queues are implemented using arrays andlinkedlists(L2)
- explain the implementation of priority queues(L2)
- list the applications of stacks, queues and priority queues(L1)

Pedagogy tools: Blended learning

UNIT - IV Trees LTP 802

Trees: Definitions and properties, representation of binary trees, operations, binary tree traversals, binary search tree, AVL trees, and operations on AVL trees, heap sort.

Learning Outcomes:

After completion of this unit, the student will be able to

- discuss the properties of trees, binary trees , binary search trees(L2)
- explain different tree traversals and applications(L2)
- understand the AVL Tree and operations on them (L2)

Pedagogy tools: Blended learning

UNIT - V Graphs LTP 1104

Graphs: data structure for graphs, properties of graphs, types of graphs, graph representations, Graph traversals, directed acyclic graph, shortest path algorithms, spanning trees and min spanning tree.

Learning Outcomes:

- demonstrate different graph representations and operations(L2)
- illustrate the working of shortest path algorithms and min spanning tree(L2)

Pedagogy tools: Blended learning

Textbook(s):

1. Fundamentals of Data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed,Universities Press (India) Limited

Reference Book(s):

1. Data Structures (Revised First Edition) | Schaum's Outline Series by Seymour Lipschutz
2. Data Structures and Algorithms: Concepts - Techniques and Applications,by G. A. V. Pai,2017

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

1. Analyze various searching and sorting algorithms.
2. Demonstrate operations on linear data structures
3. Explain the representations, traversals, and applications of graphs.
4. Illustrate the mechanisms for creating, altering, and traversing various types of trees.
5. Choose a data structure that gives the best performance for a given application.

	Programme Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		1	2											1	
CO2	1	2	2	2									1	2	
CO3	1	2	2	2									1	2	1
CO4	1	2	2	2									1	2	1
CO5	1	2	2	2									1	2	1

1-Low, 2- Medium and 3- High Correlation

List of experiments:

1.Perform Linear Search on an array.

2. Perform Binary Search on a list stored in an array.

3. Develop a program to implement bubble sort technique.

4. Develop a program to implement selection sort technique.

5. Develop a program to implement insertion sort technique.

6. Develop a program to implement quick sort technique.

7. Develop a program to implement merge sort technique.

8. Design a program to create a singly linked list for the following operations

• Insert a Node at Beginning, at Ending and at a given Position

• Delete a Node at Beginning, at Ending and at a given Position

• Search, Count the Number of Nodes and Display

9. Design a program to create a doubly linked list for the following operations

• Insert a Node at Beginning, at Ending and at a given Position

• Delete a Node at Beginning, at Ending and at a given Position

• Search, Count the Number of Nodes and Display

10. Create a Circular singly linked list for adding and deleting a Node.

11. Create a stack and perform various operations on it.

12. Convert the infix expression into postfix form.

13. Perform String reversal using stack

14.Evaluation of postfix expression

15. Create a queue and perform various operations on it.

16. Construct a binary tree and perform various traversals.

17. Construct a binary search tree and perform a search operation.

18. Implement Depth First Search, Breadth First Search traversals on a graph.

19. Implement Dijkstra's Shortest Path Algorithm

20. Develop a program to implement heap sort technique.

Course Code	Course Title	L	T	P	S	J	C
19ECS202	**COMPUTER ORGANIZATION AND ARCHITECTURE**	3	0	0	0	0	3
Course Owner	Department of Computer Science and Engineering	Syllabus version				1.0	
Course Pre-requisite(s)	Digital Logic Circuits	Contact hours				45	
Course Co-requisite(s)		Approved on: April 1, 2022					
Alternate Exposure							

Computer Architecture and Organization provides a comprehensive knowledge on the structure and behaviour of computer hardware architecture and application of the design concepts. The basicconcepts of this course can have a view as to how a computer system works. This course enables the students to learn the basics of hardware components from basic gates to memory and I/O devices and instruction set architectures.

Course Objectives

1. Attain the knowledge of fundamental circuit components and techniques for designingthe circuits
2. Describe and understand the processor memory hierarchy
3. Understand the concepts of interrupts and I/O devices
4. Attain the general knowledge of advances in microprogramming and theirimplementation in computer design
5. Experience the design process in the context of a reasonable size hardware system

UNIT – I Register Transfer and Micro operations: LTP 8 0 0

Register transfer language, register transfer, bus and memory transfers, arithmetic micro-operations, logic micro-operations, shift micro-operations, arithmetic logic shift unit

Learning Outcomes:

After completion of this unit, the student will be able to

- Demonstrate the register transfer language L2
- Learn different types of micro operations L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - II Basic Computer Organization and Design LTP 11 0 0

Basic Computer Organization and Design Instruction codes, computer registers, computer instructions, timing and control, instruction cycle, memory-references instructions, input-output and interrupt, complete computer description. Design of the basic computer, Design of accumulator logic.

Micro programmed Control: Control memory, address sequencing, micro program example, Design of control unit.

Learning Outcomes:

After completion of this unit, the student will be able to

- learn different types of memory-reference instructions L2
- Construct the micro programmed control unit L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - III Central Processing Unit LTP 10 0 0

Central Processing Unit: Introduction, general register organization, stack organization,instruction formats, addressing modes, data transfer and manipulation, program control.

Pipeline and Parallel Processing: Parallel processing, pipelining, arithmetic pipeline,instruction pipeline.

Computer Arithmetic: Introduction, addition and subtraction, decimal arithmetic unit, Booth's multiplication algorithm.

Learning Outcomes:

After completion of this unit, the student will be able to

L2

- Illustrate different types of addressing modes
- Understand the concepts of pipelining and parallel processing L2
- Solve and practice computer arithmetic algorithms L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - IV Input-Output Organization **LTP 8 0 0**

Peripheral devices, I/O Interface, Asynchronous Data Transfer,Modes of Transfer, Priority Interrupt, DMA, I/O Processor, Serial Communication.

Learning Outcomes:

After completion of this unit, the student will be able to

L2

- Understand the peripheral devices
- Explain the modes of data transfer L2
- Understand I/O interface L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - V Memory Organization **LTP 8 00**

Memory Hierarchy, Main Memory, Auxiliary Memory, AssociativeMemories, Cache Memory, Virtual Memories, Memory Management Hardware

Learning Outcomes:

After completion of this unit, the student will be able to

L2

- Understand the memory hierarchy
- Analyze the organization of different types of memories L4
- Learn the memory management hardware L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

Textbook(s):

1. M. Morris Mano, Computer System Architecture, 3/e, Pearson education, 2008

Additional Reading

Reference Book(s):

1. Carl Hamacher, ZvonkoVranesic, SafwatZaky,Computer Organization,5/e, McGraw Hill,2001
2. John P. Hayes, Computer Architecture and Organization, 3/e, McGraw Hill, 1998.
3. William Stallings, Computer Organization and Architecture, 6/e, Pearson PHI, 2012.

Course Outcomes:

After successful completion of the course the student will be able to:

1. Classify the machine's instruction set architecture (ISA) including basic instruction fetchand execute cycles, instruction formats, control flow, and operand addressing modes(L2)
2. Build the design and functioning of a machines central processing unit (CPU) includingthe data path components (ALU, register file) and the control unit(L3)
3. 3.Understand the basic input/output functioning including program controlled I/O andinterrupt I/O(L1)
4. Analyze the organization of different types of memories (L4)
5. Analyze the performance of processors and cache(L4)

	Programme Outcomes (POs)												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	1	1	2									1	2	2
CO2	2	2	2	2		2			2				1	2	2
CO3	1	2	1	2					2				2	2	2
CO4	1	1	1	2									2	2	2
CO5	1	1	2	2									2	2	2

1-Low, 2- Medium and 3- High Correlation

Course Code	Course Title	L	T	P	S	J	C
CSEN2021	**COMPUTER NETWORKS**	3	0	2	0	0	4
Course Owner	Department of CSE	Syllabus version				1.0	
Course Pre-requisite(s)	CSEN1071 (Data Communications)	Contact hours				45L 15P	
Course Co-requisite(s)	Operating Systems	Approved on: April 1, 2022					
Alternate Exposure							

The course is designed to impart a basic understanding of the working of computer networks, with the Internet as the case in point. Starting with the application layer with which the user interacts directly, it covers the important principles and protocols in the application, transport, network and link layers. Brief introductions to socket programming and wireless networks are provided.

Course Objectives

1. Familiarize the student with the components of the Internet and the concept of layered protocol architecture.
2. Expose the student to the important principles behind the working of various layers of a network.
3. Enable the student to write simple network applications using socket programming.
4. Demonstrate the working of the most important protocols used in the Internet.
5. Acquaint the student with the basics of wireless networking.

UNIT - I Computer networks and the Internet LTP 906

Computer networks and the Internet: Internet, The Network Edge, The Network Core: Delay, Loss and Throughput in Packet-Switched Networks, Protocol Layers and Their Service Models, History of Computer Networking and the Internet

Learning Outcomes:

After completion of this unit, the student will be able to

- identify the roles of the various components of the Internet L3
- explain network parameters such as delay, loss and throughput L2
- model the network using a layered architecture L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - II Application Layer LTP 906

Principles of Network Applications, The Web and HTTP, Electronic Mail in the Internet, DNS- The Internet's Directory Service, Socket Programming: Creating Network Applications

Learning Outcomes:

After completion of this unit, the student will be able to

- summarize the principles governing the working of network applications L2
- outline the working of popular applications in the Internet L2
- develop simple network applications using socket programming L6

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - III The Transport Layer LTP 906

Introduction and Transport-Layer Services, Multiplexing and Demultiplexing, Connectionless Transport: UDP, Principles of Reliable Data Transfer, Connection-oriented Transport: TCP, Principles of Congestion Control: TCP Congestion Control

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the need for multiplexing and demultiplexing at the transport layer L2
- compare connectionless service with connection-oriented service L4
- outline the working of TCP and UDP L2
- analyze the principles of congestion control L4

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - IV The Network Layer **LTP 906**

Introduction, Virtual Circuit and Datagram Networks, Inside Router, The Internet Protocol (IP), Routing Algorithms-The Link State (LS) Routing Algorithm, The Distance Vector (DV) Routing Algorithm, Hierarchical Routing

Learning Outcomes:

After completion of this unit, the student will be able to

- distinguish between virtual circuit and datagram networks L4
- outline the working of the Internet Protocol L2
- explain and analyze the working of routing algorithms L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - V The Link Layer, Wireless and Mobile Networks **LTP 906**

Introduction to the Link Layer, Multiple Access Links and Protocols, Switched Local Area Networks. Introduction to Wireless and Mobile Networks, Wireless Links and Network Characteristics, WiFi: 802.11 Wireless LANs (Architecture and MAC Protocol), Mobile IP

Learning Outcomes:

After completion of this unit, the student will be able to

- summarize the protocols used for multiple access links L2
- compare the characteristics of wireless networks with those of wired networks L4
- outline the working of IEEE 802.11 standard and Mobile IP L2

Pedagogy tools: Blended learning, Case Study,, video lectures, self-reading

Textbook(s):

1. James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach, 6/e, Pearson, 2012.

Reference Book(s):

1. Andrew S. Tanenbaum and David J. Wetherall, Computer Networks, 5/e, Prentice Hall, 2011
2. Larry L. Peterson and Bruce S. Davie, Computer Networks: A Systems Approach, 3/e, Morgan Kaufmann, 2011.
3. Richard Stevens, UNIX Network Programming – Volume 1, 3/e, Prentice Hall of India, 1997.

Journal(s):

1. Afaqui, M. Shahwaiz, Eduard Garcia-Villegas, and Elena Lopez-Aguilera. "IEEE 802.11 ax: Challenges and requirements for future high efficiency WiFi." IEEE wireless communications 24, no. 3 (2016): 130-137.
2. Hiertz, Guido R., Dee Denteneer, Sebastian Max, Rakesh Taori, Javier Cardona, Lars Berlemann, and Bernhard Walke. "IEEE 802.11 s: the WLAN mesh standard." IEEE Wireless Communications 17, no. 1 (2010): 104-111.

Website(s):

1. https://www.coursera.org/learn/computer-networking
2. https://www.geeksforgeeks.org/basics-computer-networking/
3. https://www.netacad.com/portal/web/self-enroll/m/course-860135
4. https://www.ece.rutgers.edu/~marsic/books/CN/links/

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

1. interpret the concept of modular network design using layered protocol architecture (L5)
2. list the various components in the Internet and their functions (L1)
3. analyze various types of services provided by each layer in the network architecture (L4)
4. discuss the working of the important protocols used in the Internet (L6)
5. develop simple network applications and test them (L6)

Course Code	Course Title	L	T	P	S	J	C
CSEN1101	**Operating Systems**	3	0	2	0	0	4
Course Owner	Department of CSE	Syllabus version				1.0	
Course Pre-requisite(s)	Knowledge of any programming language and data structures	Contact hours				75	
Course Co-requisite(s)		Approved on: Mar 7, 2022					
Alternate Exposure							

Operating system is an essential part of any computer system. This course is designed to explain the basics and the applications of operating system, the working of operating system. This course also focuses on other concepts of operating system: scheduling Algorithms, process management and process synchronization. It also gives us a detailed idea about memory management and file concepts

Course Objectives

1. To introduce students with basic concepts of operating system, its functions and services.
2. To provide the basic concepts of process management and synchronization.
3. To familiarize the dead lock issues.
4. To understand the various memory management schemes.
5. To give exposure over mass storage structures and system protection.

UNIT - I **LTP 8 0 6**

Introduction: What operating systems do, computer system organization, computer-system architecture, operating system structure, resource management, Protection and security, kernel data structures

Operating system Structures: operating system services, system calls, loaders and linkers, operating system structure, building and booting an operating system.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the main responsibilities of an operating system (OS) and the history leading to their current form L2
- list the most fundamental subsystems and services of OS L1
- analyze and list out different system calls L4

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - II **LTP 8 0 6**

Process Management: Process concepts, process scheduling, Operations on processes, inter-process communication

CPU Scheduling: Multithreaded programming, Multi-core Programming, Multi-threading Models, Scheduling-criteria, scheduling algorithms, algorithm evaluation.

Learning Outcomes:

After completion of this unit, the student will be able to

- demonstrate the concepts of Process, thread and CPU scheduling L2
- list out different scheduling algorithms L1
- analyze scheduling algorithms with different examples L4

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - III **LTP 8 0 6**

Process Synchronization: Critical section problem, Peterson's solution, synchronization hardware, Mutex locks, semaphores, monitors, classic problems of synchronization.

Deadlock: System model, deadlock characterization, deadlock prevention, deadlock avoidance,

deadlock detection, recovery from deadlock.

Learning Outcomes:

After completion of this unit, the student will be able to

- classify and compare hardware and software solutions to the critical section problem, demonstrate several classical process synchronization problems L2
- analyze deadlock prevention and avoidance policies L4
- apply different methods to recover from deadlock L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - IV **LTP 8 0 6**

Memory Management: contiguous memory allocation, paging, segmentation, structure of page the table,swapping.

Virtual memory: Demand paging, Copy-on-Write, page-replacement, allocation of frames, thrashing.

Learning Outcomes:

After completion of this unit, the student will be able to

- list out detailed description of various ways of organizing memory hardware L1
- analyze various techniques of allocating memory to processes, analyze different file concepts and access methods. L4
- compare different page replacement algorithms L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - V **LTP 8 0 6**

File Concepts: File concept, access Methods, directory and disk structure, protection.

Mass-storage structure: Overview of Mass-Storage Structure, disk scheduling, Swap space management

System Protection: Goals of protection, principles of protection, Domain of protection, Access matrix.

Learning Outcomes:

After completion of this unit, the student will be able to

- analyze File Concepts and system protection techniques L4
- evaluate disk scheduling algorithms L5

Pedagogy tools: Blended learning ,Case let, video lectures, self-reading

Textbook(s):

1. Abraham Silberchatz, Peter B. Galvin, Greg Gagne, Operating System Concepts, 10/e, John Wiley, 2018.

Additional Reading

Reference Book(s):

1. Andrew S Tanenbaum, Modern Operating Systems, 2/e, Pearson/PHI, 2014.
2. Crowley, Operating System- A Design Approach, McGraw-Hill, 2012.
3. Stallings, Operating Systems - Internal and Design Principles, 5/e, 2013.
4. Pal Chaudhary, Operating system principles & Design, 1/e, PHI Learning, 2013.
5. Deitel and Deitel, Operating System, Pearson Education, 2003.
6. D.M. Dhamdhere, Operating systems- A Concept based Approach,2/e, McGraw Hill, 2010.

Journal(s):

1.

Website(s):

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

1. illustrate the basic and overall view of operating system (L2)
2. analyze the concept of a process, process life cycle, process states and state transitions (L4)
3. implement and practice CPU scheduling strategies, process synchronization techniques and memory-management schemes (L3)
4. simplify and resolve Deadlock handling situation (L4)
5. evaluate Disk storage management, protection and security mechanisms (L5)

	Programme Outcomes (POs)												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1					2									2	
CO2			2											3	
CO3	3	3	2										2	1	1
CO4		1	1											1	
CO5		1	1												1

1-Low, 2- Medium and 3- High Correlation

Software requirements: Linux's Shell
Operating System: Ubuntu, Linux Operating System

1. Familiarity and usage of Linux System calls
   a. Process management: fork(), exec(), wait(), sleep() ...,
   b. File management: open (), read (), write (), seek (), close ()...

2. Simulate the following CPU scheduling algorithms
   A) FCFS b) SJF c) Round Robin d) Priority

3. Write a program to Implement Producer Consumer Problem solution

4. Simulate Bankers Algorithm for Dead Lock Avoidance

5. Simulate the page replacement algorithms
   a) FIFO b) LRU c) LFU d) Optimal Page Replacement

6. Simulate Paging Technique of memory management.

7. Simulate all File Organization Techniques
   a) Single level directory b) Two level c) Hierarchical

8. Write a program to implement disk scheduling algorithms.
   a) FCFS b) SCAN c) C-SCAN

Course Code	Course Title	L	T	P	S	J	C
CSEN1111	Object Oriented Programming with Java	0	0	4			2
Course Owner	Department of Computer Science	Syllabus version				1.0	
Course Pre-requisite(s)	Programming with C/Python	Contact hours				58	
Course Co-requisite(s)		Approved on: April 1, 2022					
Alternate Exposure							

This course enables the students to gain knowledge on various object oriented aspects of Java. The course tours the students through classes, inheritance, interfaces, packages, exceptions, generics, graphical programming concepts. The knowledge gained in this course can be applied to develop standalone applications for Android, Real Time Programming etc.

Course Objectives

1. To familiarize object-oriented programming concepts and techniques.
2. To illustrate classes and class libraries, developing classes for simple applications.
3. To illustrate the usage of Arrays and Strings.
4. To demonstrate various types of Inheritance mechanisms.
5. To introduce packages applicability and usage of Exceptions.

UNIT – I Java Programming Fundamentals LTP 0010

Java Language, Key Attributes of Object-Oriented Programming, Java Development Kit, Simple Program, Create Blocks of Code, Keywords, Identifiers, The Java Class Libraries.

Data Types and Operators: Java's Primitive Types, Literals, Variables, Scope and Lifetime of Variables, Operators- Arithmetic, Relational, Logical, Bitwise, Assignment. Type conversion in Assignments, Using a Cast, Operator Precedence.

Program Control Structures: if, switch, for, enhanced for, while, do-while, break, continue.

Exercises:

1. Program to read a number from the user and print whether it is positive or negative.
2. Program to solve quadratic equations (use if, else if and else).
3. Take three numbers from the user and print the greatest number.
4. Program that keeps a number from the user and generates an integer between 1 and 7 and displays the name of the weekday.
5. Program that reads in two floating-point numbers and tests whether they are the same up to three decimal places.
6. Program that takes a year from user and print whether that year is a leap year or not.
7. Program to display the first 10 natural numbers.
8. Program to input 5 numbers from keyboard and find their sum and average.
9. Program in Java to display the multiplication table of a given integer.
10. Program in Java to display the pattern like right angle triangle with a number.

    Input number of rows : 5

    Expected Output :

    1

    12

    123

    1234

    12345

Learning Outcomes:

After completion of this unit, the student will be able to

- Explain attributes of object oriented programming. L2
- Write a basic program L2
- Apply various datatypes and operators specific to Java L3
- Implement control structures and extended structures specific to Java L3

Pedagogy tools: Blended learning

UNIT - II Introduction to Classes Objects and Methods LTP 0012

Class Fundamentals, Objects creation, Reference Variables and Assignment, Methods, Returning a Value, Using Parameters, Constructors, Parameterized Constructors, new Operator, this Keyword, finalize() method, Wrapper Classes, Parsing, Auto boxing and Unboxing. **I/O**: Command-Line Arguments,Scanner andBufferedReader Classes,

A Closer Look into Methods and Classes: Controlling Access to Class Members, passing objects to methods, passing arguments, Returning Objects, Method Overloading, Overloading Constructors, Understanding Static, Variable-Length Arguments.

Exercises:

1. Program to read two numbers and perform the arithmetic operations using methods.
2. Program that performs arithmetic operations with values of type char.
3. Design a class to overload a method compare() to return the greater of two as follows:
   void compare(int, int)
   void compare(char, char)
   void compare(String, String)
4. Program that creates a class Account that stores a variable balance. The class has methods to start account, to deposit money, to withdraw money and tell the current balance amount.
5. Program to implement a Book class that stores the details of a book such as its code, title and price (Use constructors to initialize the objects).
6. Differentiate between static and non-static methods in java.
7. Illustrate the usage of 'this', 'final' and 'finalize' using a java program.
8. Write a java program to implement the concept of dynamic method dispatch
9. How to pass the variable length arguments in java, illustrate with an example program.
10. Write a java program to overload the constructors.
11. Read the command line arguments and print the total number of arguments and its values.

Learning Outcomes:

After completion of this unit, the student will be able to

- Identify the advantage of using classes L3
- Implement classes that support user input L3
- Implement polymorphism through overloading L3
- Interpret knowledge on method usage variants in classes L2

Pedagogy tools: Blended learning

UNIT - III Arrays and Strings LTP 0012

Arrays: 1D Arrays, Multidimensional Arrays, Irregular Arrays, Array References, Using the Length Member.Arrays class of util package, Array Lists,Vector class

Strings: String class, constructors, length(), string literals, concatenation, toString(), Character extraction, string comparison, searching strings, modifying, data conversion, changing the case, joining, split().
StringBuffer class: constructors, length(), capacity(), ensureCapacity(), setLength(), charAt(), setCharAt(), getChars(), append(), insert(), reverse(), delete(), deleteCharAt(), replace().

Exercises

1. Program for sorting a given list of names in ascending order.
2. Program to multiply two given matrices?
3. Program to find Maximum and minimum value in an array of size "M", passed as argument.
4. Program to read and print an array of size N rows with variable column size .(Hint: Irregular array).
5. Program that copies contents of one array to another using length member.
6. Program to find element from an sorted array using binary search (java.util.package)
7. Program to delete duplicate elements from an array of size 5.
8. Program that reverses an array and stores it in the same array.
9. Program to implement all String methods on a Input String.
10. Convert a given integer array of Size "N" into string.
11. Program to read and print a given string using different methods.
12. Program to reverse the words in a string.
13. Program to read a string and replace all the vowels with a '$' symbol.

14. Program to count the number of occurrences of a search string in a given text string.

Learning Outcomes:

After completion of this unit, the student will be able to

- Demonstrate the knowledge on Arrays and irregular arrays L2
- Interpret the usage of Arrays, ArrayLists and Vectors L2
- Choose methods for performing various operations on strings L1

Pedagogy tools: Blended Learning

UNIT - IV Inheritance and Interfaces LTP 0012

Inheritance: Basics, Member Access and Inheritance, Constructors and Inheritance, Using Super, Multilevel Hierarchy, Constructor execution hierarchy, Superclass References and Subclass Objects, Method Overriding, Abstract Classes, Using final.

Interfaces: Fundamentals, Creating and Implementing an Interface, Using Interface References, Implementing Multiple Interfaces, Extending Interfaces, Nested Interface.

Exercises:

1. Define a class Point with two fields x and y each of type double. Also , define a method distance(Point p1, Point p2) to calculate the distance between points p1 and p2 and return the value in double. Use Math.sqrt( ) to calculate the square root.
2. A class Shape is defined with two overloading constructors in it. Another class Test1 is partially defined which inherits the class Shape. The class Test1 should include two overloading constructors as appropriate for some object instantiation. You should define the constructors using the super class constructors. Also, override the method calculate() in Test1 to calculate the volume of a Shape.
3. Create a class named 'Member' having the following members: Name, Age, Phone number, Address, Salary. It also has a method named 'printSalary' which prints the salary of the members. Two classes 'Employee' and 'Manager' inherits the 'Member' class. The 'Employee' and 'Manager' classes have data members 'specialization' and 'department' respectively. Now, assign name, age, phone number, address and salary to an employee and a manager by making an object of both of these classes and print the same.
4. Create a class named 'Shape' with a method to print "This is This is shape". Then create two othe classes named 'Rectangle', 'Circle' inheriting the Shape class, both having a method to print "This i rectangular shape" and "This is circular shape" respectively. Create a subclass 'Square' of 'Rectangle having a method to print "Square is a rectangle". Now call the method of 'Shape' and 'Rectangle' clas by the object of 'Square' class.
5. Create a class with a method that prints "This is parent class" and its subclass with another method that prints "This is child class". Now, create an object for each of the class and call
    - method of parent class by object of parent class
    - method of child class by object of child class
    - method of parent class by object of child class
6. Create a class telephone with ( ) , lift ( ) and disconnected ( ) methods as abstract methods create another class smart telephone and demonstrate polymorphism
7. Design a vehicle class hierarchy in Java, and develop a program to demonstrate Polymorphism.
8. Write a program to find the roots of a quadratic equation using interface and packages.
    - Declare an interface in package Quad1
    - Declare another package Quad2 and implement the interface
9. Write a Program to generate Fibonacci Series by using Constructor to initialize the Data Members.
10. Develop a program to demonstrate multiple inheritance through interface.

Learning Outcomes:

After completion of this unit, the student will be able to

- Use various types of inheritance L3
- Implement multiple inheritance through interfaces L3

Pedagogy tools: Blended Learning

UNIT - V Packages and Exception Handling **LTP 0012**

Packages: Package Fundamentals, Member Access, Importing Packages, Static import.

Exception Handling: Exception Hierarchy, Fundamentals, Consequences of an Uncaught Exception, Handling errors, Multiple Catch, Throwing and Rethrowing an Exception, Throwable, using finally, using throws, Creating Exception Subclasses.

Exercises:

1. Program to demonstrate the visibility of members in subclasses of same and different packages.
2. Program to create a user defined package in Java.
3. Program to find the roots of a quadratic equation using interface and packages.
    - Declare an interface in package Quad1
    - Declare another package Quad2 and implement the interface
4. Define a Interface Polygon in package pack1. create a class triangle from Polygon in package pack2, override method to calculate area of the triangle and raise an exception if it is an equilateral triangle.
   Note : Exception has to be defined in package pack3.
5. Develop a program to demonstrate exception handling by using THROW, MULTIPLE CATCH & FINALLY statements.
6. Create a class Student with attributes roll no, name, age and course. Initialize values through parameterized constructor. If age of student is not in between 15 and 21 then generate user-defined exception "AgeNotWithinRangeException". If name contains numbers or special symbols raise exception "NameNotValidException". Define the two exception classes.
7. Program to throw a user defined exception for employee details
    - If an employee name is a number, a name exception must be thrown.
    - If an employee age is greater than 50, an age exception must be thrown
8. Program to demonstrate nested exception.
9. Create an Account class with data members accno, name,bal. Include methods deposit(), withdraw(). Raise an exception when balance in account is less than 1000.
10. Create a Student class with data members Rollno, Name, marks in subjects. Include methods to compute average. Raise an exception if the student has more than 2 backlogs.

Learning Outcomes:

After completion of this unit, the student will be able to

- Develop packages L3
- Employ exceptions originated in various scenarios L3

Pedagogy tools: Blended Learning

Textbook(s):

1. Herbert Schildt, Dale Skrien, Java Fundamentals A Comprehensive Introduction, 1/e, Tata McGraw Hill, 2017.
2. Herbert Schildt, The Java complete References, 9/e, Tata McGraw Hill,2014.

Additional Reading

Reference Book(s):

1. Y.DanielLiang , An Introduction to JAVA Programming, 10/e, Tata McGraw Hill.
2. Kathy Sierra, Head First Java, 2/e, Shroff Publishers, 2012.
3. Balagurusamy , Programming with JAVA, 2/e, Tata McGraw Hill, 2014.

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

1. describe the data types, operators and control structures (L2)
2. understand the concepts of Object Oriented Programming (L2)
3. make use of Arrays and Strings related operations (L3)
4. apply features of OOPs to build real time applications (L3)
5. demonstrate the ease of handling various scenarios of program execution without abrupt interruption (L2)

	Programme Outcomes (POs)												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1		1													
CO2	1	2												1	
CO3	1	2	1	1									1	2	1
CO4	1	2	2	1									1	2	
CO5	1	2	1	1									1	2	1

1-Low, 2- Medium and 3- High Correlation

Course Code	Course Title	L	T	P	S	J	C
CSEN2031	ARTIFICIAL INTELLIGENCE	3	0	2	0	0	4
Course Owner	Department of CSE	Syllabus version				1.0	
Course Pre-requisite(s)	19EID131	Contact hours				45T 30P	
Course Co-requisite(s)	19ECS134						
Alternate Exposure	Programming Knowledge and Data structures Knowledge						

This course enables the students to think critically about what makes humans intelligent, and how computer scientists are designing computers to act more like us. Artificial Intelligence (AI) is the study of how to make computers make things that can 'think' and act the right way, given the circumstances. AI plays an important role in the design and development of systems with intelligent behaviour. The primary objective of this course is to provide an introduction to the basic principles and applications of Artificial Intelligence.

Course Objectives

1. To understand the fundamentals of Artificial Intelligence
2. To solve problems by using search algorithms
3. To gain insight into competitive environments using adversarial search algorithms
4. To learn knowledge representation and knowledge representation techniques
5. To address the uncertainty and to learn the ways of learning

UNIT - I Basics of Artificial Intelligence **LTP 9-0-4**

Introduction: What is AI? Imitation Game, Foundations of AI, History of AI, the state of Art of AI, Applications of AI.

Intelligent Agents: Agents and Environments, Examples, The Concept of Rationality, Nature of Environments, The Structure of Agents.

Learning Outcomes:

After completion of this unit, the student will be able to

- define Artificial Intelligence L1
- explain how agents work in environments L2
- explain the nature of environments L2
- classify various structures of agents L2
- compare various types of agents L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - II Search Algorithms **LTP 9-0-8**

Solving Problems by Searching: Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies: Breadth-first Search, Depth-first Search and DFS variations, Lowest-cost-first Search, Informed (Heuristic) Search Strategies: Greedy Best-first Search, A* search, Recursive Best First Search, Heuristic Functions.

Beyond Classical Search: Local Search Algorithms and Optimization Problems: Hill-climbing Search and variations to resolve problems with steepest ascent, Genetic Algorithms.

Learning Outcomes:

After completion of this unit, the student will be able to

- compare various uninformed search techniques L2
- apply various uninformed search techniques L3
- list various heuristic search techniques L1
- outline the working of heuristic functions L2
- contrast among heuristic search techniques L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - III Adversarial Search and Logical Agents **LTP 9-0-6**

Adversarial Search: 2-Player Games, Optimal Decisions in Games: AND-OR graph, Minimax algorithm, Alpha-Beta Pruning. Chance based games.

CSP, Constraint Networks, Solving CSP by Search

Logical Agents: Knowledge-based Agents, Propositional Logic, Propositional Theorem Proving: Inference.

Learning Outcomes:

After completion of this unit, the student will be able to

- Illustrate multiagent problem solving L2
- Apply alpha-beta pruning to game trees L3
- illustrate CSP formulation and solutioning L2
- define knowledge-based agents L1
- Apply inference in Propositional Logic L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - IV First-Order Logic LTP 9-0-6

Propositional Logic – Proof By Resolution**,** Forward Chaining, Backward Chaining,
First-Order Logic: Syntax and Semantics of First-Order Logic, Models for First-Order Logic, Quantifiers,
Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution in First-Order Logic.

Learning Outcomes:

After completion of this unit, the student will be able to

- Apply inference using Forward and backward chaining L3
- Illustrate expressiveness of first-order inference L2
- outline unification and lifting L2
- apply resolution in first-order logic for inferencing L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - V Uncertainty and Learning LTP 9-0-6

Uncertainty: Acting under Uncertainty, Conditional Probabilities, Full Joint Distributions, Bayes Rule and its Applications: Bayesian Networks.
Basics of Learning: Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, Unsupervised Learning.

Learning Outcomes:

After completion of this unit, the student will be able to

- identify situations that involve uncertainty L1
- analyse ways of acting during uncertainty L2
- apply Bayesian rule L3
- understand the basics of learning L2
- compare various learning techniques L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

Textbook(s):

1. Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach,3 rd Edition, Pearson.
2. David L. Poole and Alan K. Mackworth,
   Artificial Intelligence: Foundations of Computational Agents, 2nd Edition.

Additional Reading

Reference Book(s):

1. Elaine Rich, Kevin Knight and Shivashankar B. Nair, Artificial Intelligence, TMH Education Pvt. Ltd., 2008.
2. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Pearson.

Journal(s):

Website(s):

1. https://artint.info/2e/html/ArtInt2e.html

Lab Exercises suggested:

1. Revisit/Refresh the Study of Python and PROLOG (can use any other programming Language also)
2. Write a program to control the VACUUM Cleaner moves (Intelligent systems design process)
3. Write a program to solve Monkey & Banana Problem.
4. Write a program to solve Water-Jug problem (PROLOG)
5. Write a program to solve 8-tiles puzzle problem (Using heuristics).
6. Write a program to solve Shortest path problem: (i) Using BFS (ii) Using Lowest-cost-first search
7. Write a program to implement TIC – TAC - TOE game (Understanding Minimax Algorithm and Alpha – Beta pruning)
8. Write a program to implement Hangman game (Or Wordle).
9. Write a program to understand Propositional logic using KANREN, SYMPY, pyDatalog packages in Python.
10. Write a program to understand Inferential logic using KANREN, SYMPY, pyDatalog packages in Python.
11. Write a program to implement a binary classification using Decision Trees (Understanding Decision Trees)

Lab Infrastructure:

1. Python, PROLOG on Windows or Linux
2. Python packages KANREN, Sympy, pyDataLog

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

1. Relate to the concept of artificial intelligence, the role of intelligent agents, uninformed and informed search techniques (L2)
2. Analyse and solve problems using various Search mechanisms(L3)
3. interpret real-world problems in competitive environments (L2)
4. create knowledge representation at features level and apply inference for finding solutions (L4)
5. infer the ways of acting on uncertainty (L4)

	1-Low, 2- Medium and 3- High Correlation														
	Programme Outcomes (POs)												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3					1							2		
CO2			3	2					2					2	
CO3		2	2												1
CO4		3											2		
CO5			3		2							2		2	

Course Code	Course Title	L	T	P	S	J	C
CSEN2061	**Database Management Systems**	3	0	2	0	0	4
Course Owner	Department of CSE	Syllabus version				1.0	
Course Pre-requisite(s)	19EID131	Contact hours				45L+30 P	
Course Co-requisite(s)	19ECS134	Approved on: April 1, 2022					
Alternate Exposure	Knowledge of Programming, Data Structures						

This course provides fundamental and practical knowledge on database concepts by means of organizing the information, storing and retrieve the information in an efficient and a flexible way from a well-structured relational model. This course ensures that every student will gain experience in creating data models and database design

Course Objectives

• Focus the role of a database management system in an organization and construct ER Diagram
• Demonstrate basic database concepts, including the structure and operation of the relational data model and basic database queries using SQL
• Applying advanced database queries using Structured Query Language (SQL)
• Evaluating logical database design principles and database normalization
• Demonstrate the concept of a database transaction, concurrency control, and data object locking and protocols

UNIT - I	Introduction to DBMS and Database Design	LTP	9 0 6

Introduction to DBMS: File system vs DBMS, advantages of DBMS, storage data, queries, DBMS structure, Types of Databases – Hierarchical, Network, Relational, Key-Value, Object Oriented, XML DB, Overview of File Structures in database, **Data base Design:** data models, the importance of data models. **E-R model:** Entities, attributes and entity sets, relationship and relationship set, mapping cardinalities, keys, features of ER model, conceptual database design with ER model.

Learning Outcomes:

After completion of this unit, the student will be able to

• Interpret the basic terminology of DBMS like data, database, database management systems	L2
• Compare different types of DBMS	L2
• Define data models	L1
• Model a given application using ER diagram	L3

Pedagogy tools: board and Chalk, PPT, online videos

UNIT - II	Relational Model and Basic SQL	LTP	9 0 6

Relational model: Integrity constraints over relations and enforcement, querying relation data, logical database design, views, destroying/altering tables and views.
Basic SQL: Introduction to SQL, Basic SQL Queries: DML, DDL, DCL, TCL

Learning Outcomes:

After completion of this unit, the student will be able to

• Translate an ER Model to Relational Model	L2
• Match the integrity constraints from ER model to relational model	L1
• Compare the difference between views and physical tables and working with views	L2
• Create and modify database using SQL queries	L5

Pedagogy tools: board and Chalk, PPT, online videos

UNIT - III	Advances SQL and PL/SQL	LTP	9 0 6

Structured Query Language (SQL): Select Commands, Union, Intersection, Except, Nested Queries, Aggregate Operators, Null values, Relational set operators, SQL join operators
Relational Algebra(RA): Selection, Projection, Set operations, Joins
Relational Calculus (TRC, DRC): Tuple Relational Calculus, Domain Relational Calculus
PL/SQL, Assertions, Triggers

Learning Outcomes:

After completion of this unit, the student will be able to

• Illustrate different types of queries (simple queries, nested queries, and aggregated queries) in SQL	L2
• Build Triggers and active database using PL/SQL programs	L3
• Construct the given Query in Relational Algebra and Relational Calculus	L3
• Interpret query evaluation	L2

Pedagogy tools: board and Chalk, PPT, online videos

UNIT - IV	Schema Refinement and Normal Forms	LTP	9 0 6

Schema Refinement and Normal Forms: Introduction to Schema Refinement, Functional Dependencies, Reasoning about Functional Dependencies. Normal Forms, Properties of Decomposition, Normalization, different types of dependencies.

Learning Outcomes:

After completion of this unit, the student will be able to

• Illustrate need for schema refinement	L2
• Interpret functional dependencies (FDs)	L2
• Apply Decomposition methods	L3
• Create refined schemas	L5

Pedagogy tools: board and Chalk, PPT, online videos

UNIT - V	Introduction to Transaction Management, Concurrency Control and Crash Recovery	LTP	9 0 6

Introduction to Transaction Management: ACID properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock-Based Concurrency Control.
Concurrency Control: 2PL, Serializability and Recoverability, Introduction to Lock Management, Lock Conversions, Dealing with Deadlocks, Concurrency control without locking.
Crash Recovery: Aries, Recovering from a System Crash.

Learning Outcomes:

After completion of this unit, the student will be able to

• Interpret transaction management in DBMS	L2
• Explain the importance of concurrency control mechanisms	L2
• Develop knowledge about concurrency control with and without locks	L3
• Identify different types of crashes in DBMS	L3

Pedagogy tools: board and Chalk, PPT, online videos

Textbook(s):

1. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, McGraw-Hill, 3e, 2014
   Note: File Structure refer Chapter 8
2. H.F.Korth and A.silberschatz, Database System Concepts, McGraw-Hill, 6e, 2011.

Additional Reading

Reference Book(s):

1. D. Ullman, Principles of Database and Knowledge – Base Systems, Vol 1,1/e, Computer Science Press,1990.
2. RamezElmasri, Shamkant B. Navathe, Fundamentals of Database Systems, Pearson Education, 7e, 2016.

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

- Understand database design principles (L2)
- Apply data Modelling using E-R diagrams (L3)
- Create refined data models using normalization(L5)
- Build database queries using Structured Query Language (L3)
- Understand the transaction management and concurrency control (L2)

DBMS LAB

1. Developing a sample ER model for the specified database.
2. Create a database and learn to set various constraints (can use Sailors example from textbook1, University example from textbook2)
3. Familiarization of SQL DDL commands-create, alter, drop, rename and truncate
4. Use of DML commands-select, insert, update and delete
5. Use of different of operators for nested sub-queries.
6. Use of Joins
7. Use of grouping functions
8. Creating Views
9. PL/SQL programming environment
10. Declaring triggers and use of cursors.

Lab infrastructure

1. Oracle Server and Client System
2. SQL Server
3. MS Access

	1-Low, 2- Medium and 3- High Correlation														
	Programme Outcomes (POs)												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3					1							2		
CO2			3	2					2					2	
CO3		2	2												1
CO4		3											2		
CO5			3		2							2		2	

Course Code	Course Title	L	T	P	S	J	C
19ECS234	**DESIGN AND ANALYSIS OF ALGORITHMS**	3	0	2	4	0	4
Course Owner	Department of Computer Science	Syllabus version				1.0	
Course Pre-requisite(s)	Problem Solving and Programming in C/Python	Contact hours				43	
Course Co-requisite(s)		Approved on: April 1, 2022					
Alternate Exposure							

This course enables the students to gain knowledge in various techniques of designing algorithms, estimating the efficiency of the developed algorithms in terms of time and space. The knowledge gained in this course can be applied to the latest developments in technology.

Course Objectives

1. Explain the asymptotic performance of algorithms.
2. Demonstrate the complexity of an algorithm in terms of time and space.
3. Help to design and implement programs in various programming paradigms.
4. Familiarize with efficient algorithms in software design and development.

UNIT - I **LTP 900**

Introduction to Algorithms: Algorithm specification, Performance Analysis. Divide and Conquer: The general method: Binary search, finding maximum and minimum, Merge sort, Quick sort, Selection sort, Strassen's Matrix multiplication.

Learning Outcomes:

After completion of this unit, the student will be able to

- define and specify the characteristics of an algorithm L1
- analyse the performance of an algorithm L4
- list different methods in analysing time complexity L1
- interpret divide and conquer technology for designing algorithms L2
- illustrate the efficiency of algorithms designed L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - II **LTP 800**

The Greedy Method: The general method, Knapsack problem, Job sequencing with deadlines, optimal storage on tapes, minimum cost spanning trees, single source shortest paths.

Learning Outcomes:

After completion of this unit, the student will be able to

- define control abstraction of Greedy method L1
- illustrate the significance of greedy method L2
- compare divide and conquer strategy with greedy method L2
- apply the method to implement various applications L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - III **LTP 800**

Dynamic Programming: The general method, multistage graphs, all pairs shortest paths, optimal binary search trees, reliability design, the travelling sales person problem.

Learning Outcomes:

After completion of this unit, the student will be able to

- compare dynamic method with previous methods L2
- apply dynamic method for developing algorithms L3
- illustrate the merits of dynamic method L2
- analyze the performance of algorithms L4

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - IV **LTP 900**

Basic search and traversing techniques: Techniques for Binary trees, Techniques for Graphs, connected components and spanning trees, Bi-connected components, and depth first search. Back Tracking: The General Method, Eight Queens problem, Sum of subsets, Graph coloring, Hamiltonian cycle.

Learning Outcomes:

After completion of this unit, the student will be able to

- illustrate techniques of searching L2
- make use of different methods of searching and traversing L3
- recall the concept of spanning trees L1
- apply principles of backtracking in solving problems related to graphs L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - V **LTP 900**

Branch and Bound: The method, traveling sales person problem, 0/1 knapsack problem, efficiency considerations.

Algebraic Problems: The general method, Evaluation and Interpolation.

Learning Outcomes:

After completion of this unit, the student will be able to

- outline general method of branch and bound L2
- develop solution for travelling salesperson problem L3
- distinguish between performance of various methods L4
- compare different interpolation methods L4
- evaluate algebraic expressions L5

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

Textbook(s):

1. Ellis Horowitz, S. Sahni, Fundamentals of Computer Algorithms, 2/e, University Press, 1984.
2. Thomas H. Cormen, Charles E. Leiserson, Introduction to Algorithms, et.al., 3/e, MIT Press, 2012.

Reference Book(s):

1. Aho, Hopecraft, Ullman, The Design and Analysis of Computer Algorithms, 1/e, 2002.
2. Michel T. Goodrich & Roberto Tamassia, Algorithm Design: Foundations, Analysis, and Internet Examples, 1/e, John Weily and Sons, 2001.
3. Sara Baase, Allen Van Gelder, Computer Algorithms: Introduction to Design and Analysis, 3/e, Pearson Education, 1999.
4. Mark Allen Weiss, Data Structures and Algorithm Analysis in JAVA, 3/e, Pearson Education, 2011.
5. Jon Kleinberg, Eva Tardos, Algorithm Design, 1/e, Pearson, 2013.

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

1.define algorithm(L1)

2. compare various methods of designing algorithms(L2)

3. illustrate the merits and demerits of different designing techniques(L2)

4. identify best method to develop an algorithm(L3)

5. evaluate the algorithms in terms of efficiency(L5)

	Programme Outcomes (POs)												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3		1	1	1	1						1	3	3	
CO2	1	2	3	1	1			1	1		1		1	3	
CO3	1	2	3	1	1						1		2	3	
CO4	2	2	3	1	1			1	1				2	3	
CO5	3	2	3	1	1			1			1		2	3	

1-Low, 2- Medium and 3- High Correlation

Course Code	Course Title	L	T	P	S	J	C
CSEN2081	ARTIFICIAL NEURAL NETWORKS	3	0	2	0	0	4
Course Owner	Department of CSE	Syllabus version				1.0	
Course Pre-requisite(s)		Contact hours				45+30	
Course Co-requisite(s)		Approved on: April 1, 2022					
Alternate Exposure							

Artificial Neural Networks to be more precise, represent a technology that is rooted in many disciplines: neurosciences, mathematics, statistics, physics, computer science and engineering. ANN find applications in such diverse fields as modelling, time series analysis, pattern recognition, signal processing and control by virtue of an important property: the ability to learn from input data with or without a teacher.

Course objectives:

1. To understand the architecture, learning algorithm and issues of various neural networks.
2. Analyse ANN learning, Error correction learning, Memory-based learning, Competitive learning and Boltzmann learning
3. To adopt gradient - descent techniques in real time applications
4. Provide knowledge on Generalization and function approximation and various architectures of building an ANN
5. Implement and learn the applications of Self-organization Map

UNIT - I Introduction to Neural Networks **LTP 9-0-6**

Introduction, The Basic Architecture of Neural Networks, Training a Neural Network with Backpropagation, Practical Issues in Neural Network Training, Common Neural Architectures.

Learning Outcomes:

After completion of this unit, the student will be able to

- acquire a basic understanding of the neural networks L2
- have the understanding of backpropagation. L2
- explain back propagation in naturally existed organism L2
- analyse the neural network problems L4
- illustrate machine perception L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - II Shallow Neural Networks **LTP 9-0-6**

Neural Architectures for Binary Classification Models, Neural Architectures for Multiclass Models, Autoencoder: Basic Principles, Neural embedding with continuous bag of words, Simple neural architectures for graph embeddings

Learning Outcomes:

After completion of this unit, the student will be able to

- experiment with binary classification models. L3
- make use of the multiclass models. L3
- outline the knowledge of neural embeddings L2
- understand graph embeddings L2
- make use of autoencoder L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - III Deep Neural Networks: **LTP 9-0-6**

Introduction, Backpropagation, Setup and Initialization Issues, Gradient-Descent strategies, the bias-variance trade-off, Generalization Issues in Model Tuning and Evaluation, Ensemble Methods

Learning Outcomes:

After completion of this unit, the student will be able to

- understand deep neural networks L2
- visualize backpropagation L3

- experiment on model tuning and evaluation L3
- apply bias-variance trade-offs L3
- define ensemble methods L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - IV Attractor Neural Networks LTP 9-0-6

Associative Learning, Attractor Associative Memory, Linear Associative memory, Hopfield Network, application of Hopfield Network, Brain State in a Box neural Network, Simulated Annealing, Boltzmann Machine, Bidirectional Associative Memory.

Learning Outcomes:

After completion of this unit, the student will be able to

- apply linear associative memory L3
- understand simulated annealing. L2
- illustrate Boltzmann machine L2
- distinguish various associative memories L3
- explain about how to use Hopfield network L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - V Self-organization Feature Map LTP 9-0-6

Maximal Eigenvector Filtering, Extracting Principal Components, Generalized Learning Laws, Vector Quantization, Self-organization Feature Maps, Application of SOM.

Learning Outcomes:

After completion of this unit, the student will be able to

- have a basic understanding of extracting principal components. (L2) L2
- have the understanding eigen-vector filtering. (L2) L2
- infer vector quantization (L2) L2
- understanding self – organization feature maps (L2) L2
- make use of learning laws (L3) L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

Textbook(s):

1. Neural Networks and Deep Learning - Charu C. Aggarwal, Springer International Publishing AG, part of Springer Nature 2018 (Chapters 1, 2, 3)
2. Neural Networks A Classroom Approach– Satish Kumar, McGraw Hill Education (India) Pvt. Ltd, Second Edition. (Chapters 4, 5)

Additional Reading

Reference Book(s):

1. Neural Networks: A Comprehensive Foundation - Simon Haykin PHI, 2nd Edition 2005.
2. Introduction to Artificial Neural Systems-J.M. Zurada, Jaico Publications 1994.
3. Artificial Neural Networks-B. Yegnanarayana, PHI, New Delhi 1998.

Journal(s):

Website(s):

List of Lab experiments:

1. Write a program to construct a Neural network with hidden layers
2. Write a program to train the Neural Network on labeled training data
3. Write a program to train a Neural Network with Back propagation method
4. Write a program to understand Neural network architecture for Multiclass Models (such as 3 class, 4 class and so on..)
5. Write a program to implement Neural network embedding with continuous bag of words

6. Write a program to implement Gradient-Descent strategies to train Neural Networks (like Batch, Stochastic Gradient Descent, Mini-Batch Gradient Descent)
7. Write a program to design generalized Brain State in a Box of Neural Network
8. Write a program to implement Simulated Annealing for neural network
9. Write a program to implement Maximal Eigenvector Filtering
10. Write a program to implement Principal Components extraction to represent a multivariate data table as smaller set of variables
11. Write a program to implement Vector Quantization
12. Write a program to implement Self-organization Feature Maps to mimic the actions of a small class of biological neural networks

Lab Infrastructure:

1. Python or PROLOG on Windows or Linux
2. Python packages such as neural net, TensorFlow, PyTorch.

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

1. Understand the origin, ideological basics, Learning process and various Neural Architectures of ANN.
2. Understand the concepts and techniques of Shallow neural networks through the study of important neural network models.
3. Training Deep Neural Networks and Teaching Deep Learners to Generalize.
4. Apply Attractor neural networks to particular application.
5. Design a self-organizing system that are capable of extracting useful information from the environment within which they operate.

	Programme Outcomes (POs)												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2				2			1			2	2	2	3
CO2		3		2		2			1			2	2	2	3
CO3		3	3	1	1	2			1			2	2	2	3
CO4	3	3	2	3		2			1			2	2	2	3
CO5		3		3		2			1			2	2	2	3

1-Low, 2- Medium and 3- High Correlation

Course Code	Course Title	L	T	P	S	J	C
CSEN2111	**DATA VISUALIZATION AND EXPLORATION WITH R**	3	0	2	0	0	4
Course Owner	Department of Computer Science and Engineering	Syllabus version				1.0	
Course Pre-requisite(s)		Contact hours					
Course Co-requisite(s)		Approved on: April 1, 2022					
Alternate Exposure							

The course is designed to enable the student to write programs for problem solving. After an introduction to R, R Studio, Exploratory Data Analysis, Using R for Data Visualization and Graphics for Communication are designed to work together to make data science fast, fluent. This course lays for developing program logic and for writing programs in R according to the developed logic.

Course Objectives

1. To make the fundamentals of statistical analysis in R environment.
2. To be familiar with standard techniques for visualizing data.
3. To be able to transform raw data into formats suitable for analysis.
4. To be able to perform basic exploratory analysis.
5. To be able Check for missing data and other mistakes using exploratory analysis.

UNIT - I Data Visualization **LTP 906**

Data Preparation-Importing data, Cleaning Data, Introduction to Base graphics, lattice graphics, Univariate Graphs: bar graphs, pie charts, histograms, line charts, stacked bar graphs, box plots, Bivariate Graphs, Multivariate Graphs, Maps-Dot density maps, choropleth maps, Time-dependent graphs, Survival plots, Mosaic plots,3-D Scatter plot, Biplots, Heat maps, Customizing Graphs, Saving Graphs.

Learning Outcomes:

After completion of this unit, the student will be able to

- Create and edit visualizations with R. L6
- Make it easier to identify patterns, trends and outliers in large data sets L3
- Create charts to describe and compare the composition of data sets(L6
- Illustrate the distribution of data through visualization L4

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - II Introduction to R **LTP 906**

Introduction: Importance of R and R Studio (IDE).

R Language Constructs: Variables, Data types, Arithmetic and Boolean operators.

R data structures: Introduction to Data Structure in R, Vectors Lists, Data Frames, Matrices, Arrays, Strings, Factors.

Implement Graphs, Plots and Maps with R

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand the basics in R programming in terms of constructs L2
- Interpret the structure of R program and various key features of R L5
- construct R programs using various conditional statements and data structures L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - III Data Visualization with ggplot2 **LTP 906**

Introduction**,** Aesthetic Mappings**,** Facets**,** Geometric Objects**,** Statistical Transformations**,** Position Adjustments**,** Coordinate Systems**,** The Layered Grammar of Graphics.

Graphics for Communication: Introduction, label, Annotations, scales, zooming, themes.

Implement Graphics-Annotations, Scales, Zooming, Themes using ggplot2 with R

Learning Outcomes:

After completion of this unit, the student will be able to

- Gain an understanding of the grammar of graphics, the theory behind ggplot2 L2
- Learn why ggplot2 is the current best option for Data Visualization L2
- Learn how to use the different ggplot geometries L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - IV Exploratory Data Analysis LTP 906

Overview of EDA**,** Types of EDA, Procedure for conducting EDA, Exploring a new data set, summarizing numerical data, anomalies in numerical data, Visualizing relationship between variables, variation, missing values, co variation, patterns and models, Describing data-measures of central tendency, Measures of dispersion and skewness,A survey of probability concepts, The normal probability distribution. Implement Handling of Missing Values and Variance in EDA using R

Learning Outcomes:

After completion of this unit, the student will be able to

- Choose and apply the most suitable techniques for exploratory data analysis L1
- Map out the hidden underlying structure of the data L1
- Detect anomalies and missing data L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - V Statistical Modeling LTP 906

Data, Statistics, Analysis of covariance: variance (ANOVA),, Correlation Plots, Simple Linear Regression, , Multiple Linear Regressions, Logistic Regression, Clustering model.

R Markdown: Introduction, Code Chunks, Markdown Basics, R Notebooks, Output Formats. Implement Regression techniques and Clustering Model using R

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand how to implement various modeling procedures using R L2
- Explore linear and logistic regression, generalized linear models, general estimating equations L2
- Understand the benefits of using r markdown L2
- Aware of the main features of a markdown file L1
- Create reproducible markdown reports in r L6

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

Textbook(s):

1. Jared P. Lander, R for Everyone, 2/e, Pearson Publications, 2017.
2. Ronald K, Exploratory Data Analysis Using R,1/e, CRC Press, 2018.
3. Garrett Grolemund and Hadley Wickham, R for Data Science, O'Reilly Media, 1/e, 2017.

Additional Reading

Reference Book(s):

1. NormanMatloff,TheArtofRProgramming,CengageLearning,1/e,2011.
2. Seema Acharya, Data Analytics Using R ,1/e,Mc Grawhill.
3. Dr.Tania Moulik, Applied Data Visualization with R and ggplot2,1/e,Packt.

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

1. Understand the basics in R programming in terms of constructs (L2)..
2. Illustrate the distribution of data through visualizations(L4)..
3. Gain an understanding of the grammar of graphics, the theory behind ggplot2 (L3).
4. Choose and apply the most suitable techniques for exploratory data analysis(L6).
5. Explore linear and logistic regression, generalized linear models, general estimating equations(L4).

	Programme Outcomes (POs)												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1		1											1	1	2
CO2			1										1	1	3
CO3		1											1	1	2
CO4			1										1	1	3
CO5			1										1	1	3

1-Low, 2- Medium and 3- High Correlation

Course Code	Course Title	L	T	P	S	J	C
CSEN2141	OOSE Based APPLICATION DEVELOPMENT	3	0	2	0	0	4
Course Owner	Department of CSE	Syllabus version				1.0	
Course Pre-requisite(s)		Contact hours				75	
Course Co-requisite(s)		Approved on: April 1, 2022					
Alternate Exposure							

Object Oriented Software Engineering course builds on Object-Modelling concepts. Object Oriented analysis and design methodology is introduced and is compared with function oriented design approach. In this course students learn to model analysis and design using UML in the context of an iterative, use case-driven, architecture-centric process. A case tool for development of UML diagrams is introduced. Design Patterns are discussed for development standardization. The course takes the student through Unified Software Development Process using Object Oriented methodologies.

Course Objectives

1. Develop models using UML Notation
2. Analyse Requirements with Use cases
3. Related Analysis to Design
4. Design Solutions with patterns and architectural layers
5. Apply concepts to semester long software project

UNIT - I	Introduction to Software Engineering	LTP	906

Introduction: Review of Software life cycle stages, Software Processes. Introduction to OOAD, comparison with Functional approach to software development.

Overview of UML: Use Case Diagrams, Class Diagrams, Interaction Diagrams ,State Machine Diagrams, Activity Diagrams

Modelling Concepts: Systems, Models, and Views-Data Types, Abstract Data Types, and Instances -Classes, Abstract Classes, and Objects -Event Classes, Events, and Messages - Object-Oriented Modelling- Falsification and Prototyping

Learning Outcomes:

After completion of this unit, the student will be able to

• Understand OOAD concepts	L1
• Familiarize with usage of UML	L2
• Illustrate modelling concepts	L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - II	UML & Analysis	LTP	906

A Deeper View into UML: Static Modelling, Dynamic Modelling.

Dynamic Modelling: Use Case Diagrams, Class Diagrams, Interaction Diagrams, State Machine Diagrams, Activity Diagrams, Diagram Organization, Diagram Extensions

Analysis Concepts: Analysis Object Models and Dynamic Models - Entity, Boundary, and Control Objects - Generalization and Specialization

Analysis Activities: From Use Cases to Objects

Identifying Entity Objects, Identifying Boundary Objects, Identifying Control Objects, Mapping Use Cases to Objects with Sequence Diagrams, Modelling Interactions among Objects with CRC Cards, Identifying Associations, Identifying Aggregates, Identifying Attributes, Modelling State- Dependent Behaviour of Individual Objects, Modelling Inheritance Relationships between Objects, Reviewing the Analysis Model Analysis Summary , ARENA Case study

Learning Outcomes:

After completion of this unit, the student will be able to

• Categorize various uml diagrams	L4
• Illustrate Analysis concepts	L2
• Familiarize with Analysis activities	L2
• Apply the Analysis activities	L4

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - III	System Design	LTP	906

System Design: Decomposing the System

System Design Concepts**: Subsystems** and Classes, Services and Subsystem Interfaces, Coupling and Cohesion, Layers and Partitions, Architectural Styles *System Design Activities***:** From Objects to Subsystems**,** Analysis Model for a Route Planning System, Identifying Design Goals, Identifying Subsystems.

Static Modelling: Package Diagrams, Composite Structures, Component Diagrams, Deployment Diagrams.

System Design Activities: Addressing Design Goals: Mapping Subsystems to Processors and Components, Identifying and Storing Persistent Data, Providing Access Control, Designing the Global Control Flow, Identifying Services, Identifying Boundary Conditions, Reviewing System Design

Learning Outcomes:

After completion of this unit, the student will be able to

• Understands the basics of System design	L1
• Familiarize with Design goals	L2
• Apply UML to system design	L4

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - IV	Object Design	LTP	906

Object Design: Reusing Pattern Solutions

Reuse Concepts, Reuse Activities: Selecting Design Patterns and Components Encapsulating Data Stores with the Bridge Pattern, Encapsulating Legacy Components with the Adapter Pattern, Encapsulating Context with the Strategy Pattern, Encapsulating Platforms with the Abstract Factory Pattern, Encapsulating Control Flow with the Command Pattern, Encapsulating Hierarchies with the Composite Design Pattern, Heuristics for Selecting Design Patterns, Identifying and Adjusting Application Frameworks

Object Design: Specifying Interfaces,

Interface Specification Concepts**:** Class Implementor, Class Extender, and Class User, Types, Signatures, and Visibility, Contracts: Invariants, Preconditions, and Post conditions, Object Constraint Language, OCL Collections: Sets, Bags, and Sequences, OCL Quantifiers: for All and exists, ARENA Case study

Learning Outcomes:

After completion of this unit, the student will be able to

• Understands the basics of Object design	L1
• Familiarize with Object design with patterns	L2
• Apply the Object design	L4

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - V	Coding & Testing	LTP	906

Mapping Models to Code

Mapping Concepts Model Transformation, Refactoring, Forward Engineering, Reverse Engineering, Transformation Principles, Mapping Activities: Optimizing the Object Design Model, Mapping Associations to Collections, Mapping Contracts to Exceptions, Mapping Object Models to a Persistent Storage Schema.

Testing:

An Overview of Testing, Testing Concepts: Faults, Erroneous States, and Failures, Test Cases, Test Stubs and Drivers, Corrections Testing Activities: Component Inspection, Usability Testing, Unit Testing, Integration Testing, System Testing Managing Testing: Planning Testing, Documenting Testing , Assigning Responsibilities ,Regression Testing, Automating Testing

Learning Outcomes:	
After completion of this unit, the student will be able to	
• Understands mapping models to code	L1
• Apply Forward and Reverse engineering	L4
• Adapt various testing strategies	L6
• Familiarize with Automated Testing	L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

Textbook(s):

1. Bernd Bruegge and Allen H. Dutoit, Object-Oriented Software Engineering Using UML, Patterns, and Java, Prentice-Hall.
2. Michael R. Blaha and James R Rumbaugh, Object-Oriented Modeling and Design with UML, Prentice Hall
3. Craig Larman, Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and the Unified Process, Prentice-Hall.

Reference Book(s):

1. Stephen R. Schach, Object-Oriented Software Engineering, McGraw-Hill
2. Stephen R. Schach, Introduction to Object-Oriented Analysis and Design, McGraw-Hill
3. G. Booch, J. Rumbaugh and I. Jacobson, The Unified Modeling Language User Guide, Second Edition, Addison Wesley, 2005
4. UML2 and the Unified Process, Jim Arlow and Ila Neustadt, Addison Wesley,2005

Website(s):

1. https://pl.cs.jhu.edu/oose/resources/tools.shtml
2. https://pl.cs.jhu.edu/oose/resources/tools.shtml
3. https://www.upgrad.com/blog/software-development-project-ideas-topics-for-beginners/
4. http://www.cs.gordon.edu/courses/cs211/ATMExample/index.html

Lab Activities Suggested:

Draw standard UML diagrams using a UML modelling tool and map design to code and implement. Test the developed code and validate whether the SRS is satisfied to a semester-long software engineering project by following the sequence of steps given below

1. Identifying Requirements from Problem Statements
2. Modelling UML Use Case Diagrams and Capturing Use Case Scenarios
3. Identifying Domain Classes from the Problem Statements
4. State chart and Activity Modelling
5. Modelling UML Class Diagrams and Sequence Diagrams
6. Mapping diagram to code (Forward Engineering)
7. Designing Test Suites

*Project can be carried out in teams

Course Outcomes:

After successful completion of the course the student will be able to:

1.Describe the OOAD paradigm (Unified Processes)
2. Employ the UML diagramming standards.
3. Demonstrate use of a software tool to support the planning, analysis and design phases
4. Use a case tool for all UML diagrams.
5. Develop prototypes of the system design, code, and Testing

	1-Low, 2- Medium and 3- High Correlation														
	Programme Outcomes (POs)												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3					1							2		
CO2			3	2					2					2	
CO3		2	2												1
CO4		3											2		
CO5			3		2							2		2	

Course Code	Course Title	L	T	P	S	J	C
19EAI332	**Automata Theory and Compiler Design**	3	1	0	0	0	4
Course Owner	Department of Computer Science and Engineering	Syllabus version				1.0	
Course Pre-requisite(s)		Contact hours				45	
Course Co-requisite(s)		Approved on: April 1, 2022					
Alternate Exposure							

Finite Automata comprises theoretical computer science to study abstract machines for solving computation problems. Compilers play a significant role in fulfilling users' computing requirements, specified in programs in a high-level language, which translate into machine-understandable form. The process involved in such a transformation of a program is quite complex. This course intends to help the students learn the fundamentals of the theory of computation that can recognize formal languages typically illustrated by the Chomsky hierarchy and how this knowledge enables one to design a compiler. Automata Theory provides the basis for developing a compiler.

Course Objectives

- Impart the mathematical concepts of theoretical computer science from the perspective of formal languages in solving computational machines.
- Familiarize various formal languages, grammar, and their relationships.
- Demonstrate various finite state machines and recognize formal languages.
- Explore the basic techniques that underlie the principles, algorithms, and data structures inCompiler Construction.
- Gain experience in using automated tools that helps in transforming various phases of the compiler.

UNIT - I Finite Automata and Regular Languages LTP 9 0 0

Central concepts of strings, languages and automata theory, Regular expressions and languages, Deterministic Finite Automata (DFA) and equivalence with Regular expression, Non- Deterministic Finite Automata, and equivalence with DFA, Minimization of Finite Automata by partitioning, Chomsky hierarchy of grammars

Learning Outcomes:

After completion of this unit, the student will be able to

- Illustrate the central concepts of automata theory L2
- Construct Deterministic Finite Automata equivalent to Non-Deterministic Finite Automata L3
- Construct a Non-Deterministic Finite Automaton equivalent to a regular expression L3
- Build the equivalent minimized Deterministic Finite Automata L3
- Illustrate the central concepts of automata theory L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT – II Grammars LTP 9 0 0

Regular grammars equivalent with Finite Automata, Context-free grammars, and languages; Parse trees; Applications; Ambiguity in grammars and Languages, Simplification of Context-Free Grammars, Closure Properties of Context-Free Languages, Membership Algorithm (CYK).Push down automata, Equivalence of push down automata and context free grammar

Learning Outcomes:

After completion of this unit, the student will be able to

- Classify the Chomsky hierarchy of grammars for formal languages L2
- Construct an unambiguous grammar from ambiguous grammar L3
- Decide whether a string belongs to a given context free language or not using membership algorithm L5

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - III Introduction to Compiler Design LTP 9 0 0

The Structure of Compiler, The Science of Building a Compiler in Bootstrapping and Cross compiler, The role of the Lexical analyser, Input Buffering, Specification of Tokens, Recognition of Tokens, The Lexical Analyzer Generator (LEX/FLEX).

Learning Outcomes:

After completion of this unit, the student will be able to

- Summarizing various phases involved in the design of compiler construction L2
- Comparing methods involved in constructing the compiler L2
- Highlighting how regular expressions help to design the Lexical Analysis phase L1
- Exploring how LEX Tool simplifies the design of the Lexical Analysis phase L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - IV Parsing Techniques LTP 9 0 0

Top-Down parsing: Recursive Descent Parsing, Non-recursive Predictive Parsing, Bottom-Up parsing - Shift Reduce Parsing, Simple LR Parser, More Powerful LR Parsers (CLR&LALR), Parser Generator (YACC).

Learning Outcomes:

After completion of this unit, the student will be able to

- Design the possible ways of constructing parsers L3
- Identifying the issues involved in creating an efficient Top-Down (LL) parser L1
- Implementing LR Parsers L3
- Illustrating the design of parser through YACC tool L4

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT – V Other Phases of Compiler Design LTP 9 0 0

Intermediate Code Generation: Three Address codes**.**

Code Optimization: The Principal Sources of Optimization, Basic blocks, and Flow Graphs, Optimization of Basic Blocks. **Code Generation:** Issues in designing a code Generator, The Target Language, A Simple CodeGenerator, Peephole Optimization.

Learning Outcomes:

After completion of this unit, the student will be able to

- Illustrating various techniques to store three address statements L3
- Identifying issues involved in the machine-independent code optimization L1
- Illustrating with a suitable example on local and loop optimization L4
- Estimating the processes involved in obtaining the final code L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

Textbook(s):

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages and Computation, 3/e, Pearson, 2008.
2. Alfred.V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey. D. Ullman, Compilers Principles,Techniques and Tools, 2/e, Pearson Education, 2008.

Reference Book(s):

1. Alfred.V. Aho, J.D.Ullman, Principles of compiler design, Narosa Publications, 2002
2. Peter Linz, An Introduction to Formal Language and Automata, NarosaPub. House, Reprint 2000.
3. Michael Sipser, Introduction to Theory of Computation, 3/e, Wadsworth Publishing Co Inc, 2012.

Course Outcomes:

After successful completion of the course the student will be able to:

1. Illustrate the concepts in the design of Finite State Machines to recognize Regular Languages(L2)
2. Analyze the relation between grammar and language, and design Context-Free Grammars for formal languages (L4)
3. Define and analyse various phases involved in developing a compiler(L1)
4. Compare between bottom-up and top-down parsing techniques(L2)
5. Identify different machine-independent optimization generating target code techniques (L4)

	Programme Outcomes (POs)												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1												1	2	1
CO2	1	1											1	2	2
CO3	1	2											2	2	2
CO4	2	2	2	2					1				2	1	2
CO5	2	2	1						2				2	1	2

1-Low, 2- Medium and 3- High Correlation

Course Code	Course Title	L	T	P	S	J	C
CSEN2171	**Deep Learning**	2	1	0	0	0	3
Course Owner	Department of CSE	Syllabus version				1.0	
Course Pre-requisite(s)	CSEN2001; CSEN3001	Contact hours				45	
Course Co-requisite(s)		Approved on: April 1, 2022					
Alternate Exposure							

This course is designed to introduce modern techniques of neural networks and deep learning, which have revolutionized machine learning and artificial intelligence practice to graduate students. D*eep Learning focuses to learn feature hierarchies with features at higher levels in the hierarchy formed by the composition of lower-level features. This course aims to cover the basics of Deep Learning and some of the underlying theory with a particular focus on supervised Deep Learning along with a good coverage of unsupervised methods.*

Course Objectives

1. To summarize neural networks and regularization techniques.
2. To familiarize Convolution Neural Networks and its architecture.
3. To learn Recurrent Neural network architecture and its effectiveness
4. To illustrate deep unsupervised learning techniques
5. To inspect neural network architecture in real time applications

UNIT - I	**LTP**	**6 3 0**

Deep Feed Forward Networks, Gradient descent, Back propagation, Regularization techniques: Parameter Norm Penalties, Norm penalties as constrained optimization. (6.1, 6.2, 6.5, 7.1, 7.2)

Learning Outcomes:

After completion of this unit, the student will be able to:

• Outline the concepts of Neural networks and its applications	L2
• Understand Gradient descent and Back propogation algorithms	L2
• Evaluate Neural Networks Regularization techniques	L5

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - II	**LTP**	**6 3 0**

Convolution Network: Architectures, Convolution operations, Pooling layer, Variants of the basic Convolution Function, Efficient Convolution algorithms, Random and unsupervised features, Neuro Scientific Basis for Convolutional Networks (9.1, 9.3, 9.5, 9.8, 9.9, 9.10)

Learning Outcomes:

After completion of this unit, the student will be able to

• Interpret the mechanism of Convolution neural network.	L2
• Analyse the working principles of pooling layer	L4
• Assess Various efficient convolutional algorithms	L4

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - III	**LTP**	**6 3 0**

Sequence Modelling: RNN, Encoder and decoder archerites, DRN, Recursive Neural Networks, LSTM and other Gated RNN, GRU (10.2, 10.4, 10.5, 10.6, 10.10, 10.11)

Learning Outcomes:

After completion of this unit, the student will be able to

• Understand the Encoder and Decoder architectures of RNN	L2
• Differentiate RNN and Recursive NN	L2
• Inference the LSTM and GRU algorithms	L4

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - IV	**LTP**	**6 3 0**

Auto encoders: Under complete auto encoders, regularized encoders, stochastic encoders and decoders

Deep generative models: Boltzmann Machines, restricted Boltzmann machines, Deep Belief networks, Deep Boltzmann machines for real world data (14.1, 14.2,14.3, 20.1 to 20.5)

Learning Outcomes:

After completion of this unit, the student will be able to

• Relate auto Encoders learning	L2
• Illustrate Boltzmann machines	L2
• Summarize belief networks	L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - V	**LTP**	**630**

Applications of Deep Learning: Large scale Deep learning, Computer vision, speech recognition, NLP, other applications (12.1 to 12.5)

Learning Outcomes:

After completion of this unit, the student will be able to

• Develop a neural network model for Object detection	L5
• Analyse the Generative adversarial networks for Image applications	L4
• Compare Image segmentation and generation techniques.	L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

Textbook(s):

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016
2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press,2015.

Reference Book(s):

1. Amlan Chakrabarti Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra, Deep Learning, First Edition, Pearson
2. Sandro Skansi, Introduction to Deep Learning, Springer

Website(s):

https://www.coursera.org/deeplearning-ai

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

1. Understand the role of neural networks and its various applications.
2. Construct the architecture of CNN and its usage.
3. Outline the RNN architecture and its effectiveness.
4. Investigate auto encoders techniques in deep learning.
5. Analyse the applications of Deep Learning and Image Processing.

	Programme Outcomes (POs)												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	1							1	2	1	1	1		1
CO2	1	2	3		2					1		1	1	1	1
CO3	1	2	3		2					1		1	1	1	1
CO4	1	2	2		2					1		1	1	1	
CO5	2	2	3	2	2	2	1	1		2	1	1	1	1	

1-Low, 2- Medium and 3- High Correlation

Course Code	Course Title	L	T	P	S	J	C
CSEN2201	**BIG DATA ANALYTICS**	3	0	0	0	0	3
Course Owner	Department of Computer Science and Engineering	Syllabus version				1.0	
Course Pre-requisite(s)		Contact hours				45	
Course Co-requisite(s)		Approved on: Mar 7, 2022					
Alternate Exposure							

The course is designed which largely involves collecting data from different sources, manage it in a way that it becomes available to be consumed by analysts and finally deliver data products useful to the organization business. The process of converting large amounts of unstructured raw data, retrieved from different sources to a data product useful for organizations forms the core of Big Data Analytics.

Course Objectives

1. Optimize business decisions and create competitive advantage with Big Data analytics.
2. Introducing Java concepts required for developing map reduce programs.
3. Derive business benefit from unstructured data.
4. Imparting the architectural concepts of Hadoop and introducing map reduce paradigm.
5. To introduce programming tools Hbase & HIVE in Hadoop echo system.

UNIT - I LTP 900

What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.

Learning Outcomes:

After completion of this unit, the student will be able to

- demonstrate the big data concepts for real world data analysis. L1
- building a complete business data analytic solution and apply structure of Hadoop data with Hive L6

Pedagogy tools: Blended learning, video lectures, self-reading

UNIT - II LTP 900

Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schemeless databases, materialized views, distribution models, sharding, master-slave replication, peer to peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations.

Learning Outcomes:

After completion of this unit, the student will be able to

- develop Map Reduce concepts through Java L2
- demonstrate the big data concepts for real world data analysis L1
- analyze the configuring of Hadoop clusters effectively. L3

Pedagogy tools: Blended learning, video lectures, self-reading

UNIT - III LTP 900

Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures.

Learning Outcomes:

After completion of this unit, the student will be able to

- Analyse the configuring of Hadoop clusters effectively L3
- Develop Map Reduce concepts through Java L2

Pedagogy tools: Blended learning, video lectures, self-reading

UNIT - IV LTP 900

MapReduce workflows, Unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats.

Learning Outcomes:

After completion of this unit, the student will be able to

- develop Map Reduce concepts through Java L2
- analyse the configuring of Hadoop clusters effectively L3
- illustrate Hadoop API for Map reduce framework L4

Pedagogy tools: Blended learning, video lectures, self-reading

UNIT - V LTP 900

HBase, data model and implementations, HBase clients, HBase examples, praxis.Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration, Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries.

Learning Outcomes:

After completion of this unit, the student will be able to

- Analyse the configuring of Hadoop clusters effectively. L3
- Illustrate Hadoop API for Map reduce framework. L4
- Develop basic programs of map reduce framework particularly driver code, mapper code, reducer code. L5
- Building a complete business data analytic solution and apply structure of Hadoop data with Hive. L6
- Analyse the configuring of Hadoop clusters effectively. L3

Pedagogy tools: Blended learning, video lectures, self-reading

Textbook(s):

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. P. J. Sadalage, M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2014.
3. Tom White, "Hadoop: The Definitive Guide", 3/e,4/e O'Reilly, 2015.

Reference Book(s):

1. Douglas Eadline,"Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem", 1stEdition, Pearson Education, 2016. ISBN-13: 978-9332570351

Website(s):

https://www.coursera.org/programs/gitam-coursera-program-for-faculty-p4k5n?authProvider=gitam&collectionId=&productId=EKaYq511EeuKthKm1CVWdQ&productType=course&showMiniModal=true

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

1. demonstrate the big data concepts for real world data analysis.
2. develop Map Reduce concepts through Java.
3. illustrate Hadoop API for Map reduce framework.
4. develop basic programs of map reduce framework particularly driver code, mapper code, reducer code.
5. Building a complete business data analytic solution and apply structure of Hadoop data with Hive.

	Programme Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
CO2	0	1	2	0	3	0	0	1	1	0	1	0	2	3	0
CO3	1	0	0	0	2	0	0	0	0	0	0	0	0	3	0
CO4	0	0	3	0	3	0	0	0	1	1	2	0	0	0	2
CO5	0	2	1	0	2	0	0	0	1	0	1	0	0	0	1

1-Low, 2- Medium and 3- High Correlation

Course Code	Course Title	L	T	P	J	S	C
CSEN2001	**Cloud-based IoT**	3	0	0	0	0	3
Course Owner	Department of CSE	Syllabus version				1.0	
Course Prerequisite(s)	CSEN2191 IoT Architectures and Protocols	Contact hours				45 (T)	
Course Co-requisite(s)		Approved on: April 1, 2022					
Alternate Exposure							

IoT requires several enabling technologies due to the volume of data and diverse application requirements. Distributed computing in the form of cloud, fog or edge computing is one such enabler of IoT. This course provides the basic principles of cloud computing, cloud computing architecture, cloud native application development and deployment, with a focus on IoT applications. It also discusses the importance of fog and edge computing in IoT networks. Example fog and edge middleware and its working are covered, together with the use cases of health monitoring, smart surveillance and smart transportation.

Course Objectives

1. To introduce the basic principles of cloud computing, cloud native application development and deployment, containerization, micro-services and application scaling.
2. To equip the students to understand major industry players in the public cloud domain for application development and deployment.
3. To establish the importance of the fog, edge and cloud hierarchy.
4. To familiarize the student with fog and edge middleware.
5. To enable the student to develop IoT applications using fog, edge or cloud computing where appropriate.

UNIT - I Introduction to Cloud Computing LTP 900

Introduction to Cloud Computing: Definition, Characteristics, Components, Introduction to Microsoft Azure, Cloud provider, SAAS, PAAS, IAAS and other Organizational scenarios of clouds.

Learning Outcomes:

After completion of this unit, the student will be able to

- List cloud deployment models. L1
- Infer the need for cloud computing .L2

Pedagogy tools: Blended learning,video lectures, self-reading, case study

UNIT - II Cloud Computing for IoT LTP 900

Role of Cloud Computing in IoT – AWS Components – S3 – Lambda – AWS IoT Core -Connecting a web application to AWS IoT using MQTT- AWS IoT Examples.

Learning Outcomes:

After completion of this unit, the student will be able to

- Outline the role of cloud computing in IoT. L1
- Summarize the working of AWS and AWS IoT. L2
- Develop a web application with AWS IoT.. L4

Pedagogy tools: Blended learning, Flipped classroom, video lectures, self-reading

UNIT - III IoT and New Computing Paradigms LTP 900

Introduction, Relevant Technologies, Fog and Edge Computing Completing the Cloud, Advantages of FEC: SCALE, How FEC

Achieves These Advantages: SCANC, Hierarchy of Fog and Edge Computing, Business Models, Opportunities and Challenges

Learning Outcomes:

After completion of this unit, the student will be able to

- Summarize the benefits of fog and edge computing for IoT. L2
- Outline the business models using fog and edge computing for IoT. L1
- Explain the hierarchy of fog , edge and cloud for IoT. L4

Pedagogy tools: Blended learning, video lectures, self-reading

UNIT - IV Middleware for Fog and Edge Computing LTP 900

Introduction, Need for Fog and Edge Computing Middleware, Design Goals, State-of-the-Art Middleware Infrastructures

Learning Outcomes:

After completion of this unit, the student will be able to

- Justify the need for middleware in the fog and edge layers.. L4

- Deduce the design issues in developing middleware for the fog and edge layers. L4
- Explain the working of popular fog and edge middleware. L4

Pedagogy tools: Blended learning, video lectures, self-reading

UNIT - V Fog/Edge-based IoT Applications LTP 900

Exploiting Fog Computing in Health Monitoring: Introduction, An Architecture of a Health Monitoring IoT-Based System with Fog Computing, Fog Computing Services in Smart E-Health Gateways, System Implementation

Smart Surveillance Video Stream Processing at the Edge for Real-Time Human Objects Tracking: Introduction, Human Object Detection, Object Tracking, Lightweight Human Detection,

Fog Computing Model for Evolving Smart Transportation Applications: Introduction, Data-Driven Intelligent Transportation Systems, Mission-Critical Computing Requirements of Smart Transportation Applications, Fog Computing for Smart Transportation Applications.

Learning Outcomes:

After completion of this unit, the student will be able to

- Outline the working of popular IoT applications such as health monitoring, smart surveillance and shart transportation. L1
- Summarize the principles of object detection and tracking.. L2
- Design a suitable framework using fog, edge and cloud computing for a given IoT application. L4

Pedagogy tools: Blended learning, case study, video lectures, self-reading

Textbook(s):

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman, CRC Press.
2. Fog and Edge Computing: Principles and Paradigms, Rajkumar Buyya (Editor), Satish Narayana Srirama (Editor), Wiley Series on Parallel and Distributed Computing. ISBN: 978-1-119-52498-4
3. Adrian McEwen, Designing the Internet of Things, Wiley, 2013.
4. https://docs.aws.amazon.com/greengrass/index.html

Reference Book(s):

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things – A Hands on Approach", Universities Press, 2015.
2. Kevin, Townsend, Carles, Cufí, Akiba and Robert Davidson, "Getting Started with Bluetooth Low Energy" O'Reilly

Journal(s):

1. Sabireen H., Neelanarayanan V., "A Review on Fog Computing: Architecture, Fog with IoT, Algorithms and Research Challenges", ICT Express, Volume 7, Issue 2, 2021, Pages 162-176, ISSN 2405-9595,
2. Partha Pratim Ray, "A survey of IoT cloud platforms", Future Computing and Informatics Journal, Volume 1, Issues 1–2, 2016, Pages 35-46, ISSN 2314-7288,
3. Alessio Botta, Walter de Donato, Valerio Persico, and Antonio Pescapé. 2016. Integration of Cloud computing and Internet of Things. Future Gener. Comput. Syst. 56, C (March 2016), 684–700. DOI:https://doi.org/10.1016/j.future.2015.09.021
4. P. Pierleoni, R. Concetti, A. Belli and L. Palma, "Amazon, Google and Microsoft Solutions for IoT: Architectures and a Performance Comparison," in IEEE Access, vol. 8, pp. 5455-5470, 2020, doi: 10.1109/ACCESS.2019.2961511.

Website(s):

https://aws.amazon.com/iot/

https://github.com/Cloudslab/iFogSim

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

1. Distinguish between fog, edge and cloud computing. (L4)
2. Explain the basics of cloud computing. (L4)
3. Develop IoT applications using AWS IoT. (L4)
4. Compare fog and edge computing middleware . (L2)
5. Develop IoT applications using fog, edge and cloud computing as necessary. (L4)

	Programme Outcomes (POs)												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	2											1		
CO2	1	3	2	3	2								1	1	2
CO3	1	3	2	3	2								1	1	2
CO4	1	2	2	3	2								1	2	3
CO5	1	2	s	3	2								1		

1-Low, 2- Medium and 3- High Correlation

Course Code	Course Title	L	T	P	S	J	C
CSEN1121	**Cryptography and Network Security**	3	0	0	0	0	3
Course Owner	Department of Computer Science and Engineering	Syllabus version				1.0	
Course Pre-requisite(s)	CSEN2021; CSEN1071	Contact hours				60	
Course Co-requisite(s)	CSEN2021	Approved on: Mar 7, 2022					
Alternate Exposure	Number Theory and its Applications						

The aim of this course is to introduce information security concepts to the students. This course develops a basic understanding of goals, threats, attacks and mechanisms, algorithms, and their design choices. The course also familiarizes students with a few mathematical concepts used in cryptology. The course emphasizes giving a basic understanding of attacks in cryptosystems and how to shield information from attacks. It also deals with message authentication, Digital signatures and Network security.

Course Objectives

1. Understand basics of security concepts and comprehend Classical Encryption Techniques (L3)
2. Impart various symmetric cryptographic techniques (L2)
3. Learn number theory related to RSA and Diffie-Hellman algorithms (L3)
4. Study different hash functions and message authentication techniques (L3)
5. Impart knowledge on application and transport layers security concepts (L2)

UNIT - I Introduction and Classical Encryption Techniques LTP 900

Introduction: Computer Security Concepts, The OSI Security Architecture, Cryptography, cryptanalysis, attacks, services, security mechanisms.

Classical Encryption Techniques: Substitution Techniques, Caesar Cipher, Monoalphabetic Ciphers, Playfair Cipher, Hill Cipher Polyalphabetic Ciphers. Transposition Techniques.

Learning Outcomes:

After completion of this unit, the student shall be able to

- Illustrate different security attacks L2
- Apply classical substitution methods L3
- Explain Transposition techniques L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - II Symmetric Key Cryptography: LTP 900

Symmetric Key Cryptography: Block Ciphers and the Data Encryption Standard (DES) algorithm. Differential and linear cryptanalysis, triple DES. Block cipher design principles, Block cipher modes of operation, Advanced Encryption Standard (AES), Stream Ciphers: RC4.

Learning Outcomes:

After completion of this unit, the student shall be able to

- Distinguish block and stream ciphers L2
- Explain the working of block cipher DES and AES algorithm L2
- Work with stream cipher RC4 L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - III Number theory LTP 900

Number theory: Divisibility and The Division Algorithm, The Euclidean Algorithm, Modular Arithmetic, Prime Numbers, Fermat's and Euler's Theorems, Testing for Primality, The Chinese Remainder Theorem. Public Key Cryptography: Principles of a public-key cryptosystem, RSA algorithm, security of RSA. Diffie Hellman key exchange.

Learning Outcomes:

After completion of this unit, the student shall be able to

- Illustrate the concepts of divisibility, modularity, and primality L2
- Program RSA algorithm using the suitable programming language L4
- Explain Diffie Hellman key exchange method L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - IV Cryptographic Hash Functions: **LTP 900**

Cryptographic Hash Functions: Applications of hash Functions, Secure Hash Algorithm (SHA) SHA-512, SHA 3. MAC and Digital Signatures: Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, HMAC, DAA, and CMAC. Digital signatures, Digital Signature Standard (DSS). Authenticated Encryption: CCM, GCM.

Learning Outcomes:

After completion of this unit, the student shall be able to

- Explain and implement simple hash functions L2
- Discuss message authentication techniques L2
- Explain Digital Signature Standard (DSS) L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - V Key management and distribution, Internet Security: **LTP 800**

Key management and distribution: Distribution of Public Keys, X.509 Certificates

Internet Security: Introduction to SSL and TLS.

Email Security: Pretty Good Privacy (PGP), S/MIME.

IP Security: IP security overview, IP security Policy, Encapsulating Security Payload.

Learning Outcomes:

After completion of this unit, the student shall be able to

- Explain transport-level security techniques L2
- Discuss application-level security techniques L2
- List network-level security techniques L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

Textbook(s):

1. William Stallings. Cryptography and Network Security – Principles and Practice, 7/e. Pearson Education, 2017.

Additional Reading: https://www.techtarget.com/searchsecurity/definition/cryptography

Reference Book(s):

1. Behrouz A Fourozen and DebdeepMukhopadhyaya, Cryptography and Network Security, 3/e, McGraw Hill, 2015.
2. Atul Kahate, Cryptography and Network Security, 4/e, McGraw Hill, 2019.
3. Buchmann, Introduction to Cryptography, Springer, 2004
4. Bruce Schneier, Applied Cryptography: Protocols, Algorithms, and Source Code in C (cloth), 2/e, Publisher: John Wiley & Sons, Inc., 1996.
5. Chwan-Hwa(John) Wu, Introduction to Computer Networks and Cybersecurity, CRC Press, 2013

Journal(s):

1. Parrilla, L.; Castillo, E.; Morales, D.P.; García, A. Hardware Activation by Means of PUFs and Elliptic Curve Cryptography in Field-Programmable Devices. *Electronics* **2016**, *5*, 5. https://doi.org/10.3390/electronics5010005

Website(s):

1. Rcryptect: Real-time detection of cryptographic function in the user-space filesystem - ScienceDirect
2. Lightweight cryptography in IoT networks: A survey - ScienceDirect

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

1. Illustrate the working of classical encryption techniques (L3).
2. Describe the working of symmetric encryption techniques (L2)
3. Experiment with the working of public-key cryptography algorithms such as RSA, Diffie-Hellman (L3)
4. Apply Hash functions and message authentication techniques (L3)
5. Summarize Application and transport layers security mechanisms. (L2)

	Programme Outcomes (POs)												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2												2		
CO2		2		1								1		2	
CO3		3			2										3
CO4		2	3									1			2
CO5		1	1												1

1-Low, 2- Medium and 3- High Correlation

Course Code	Course Title	L	T	P	S	J	C
CSEN2181	**DIGITAL FORENSICS**	3	0	2	0	0	4
Course Owner	Department of Computer Science Engineering	Syllabus version				1.0	
Course Pre-requisite(s)		Contact hours				45L 30P	
Course Co-requisite(s)		Approved on: April 1, 2022					
Alternate Exposure							

The course is designed to enable the student to understand underlying principles and many of the techniques associated with the digital forensic practices and cybercrime, investigate attacks, handling evidence. Student can have a sneak review of Computer Forensics, Network Forensics, and Mobile Forensics

Course objectives:

1. Familiarize the student about digital and computer forensics.
2. Enable the student to learn analysis of crime scene.
3. Manage and present evidence
4. Demonstrate investigation process.

UNIT - I **LTP 906**

Forensic Science, Digital Forensics, Digital Evidence, The Digital Forensics Process, The Identification Phase, The Collection Phase, The Examination Phase, The Analysis Phase, The Presentation Phase

Learning Outcomes:

After completion of this unit, the student will be able to

- understand basics of digital forensics L1
- differentiate the types of forensic technologies L4

Pedagogy tools: Blended learning

UNIT - II **LTP 906**

Digital Forensic Readiness, Law Enforcement versus Enterprise Digital Forensic Readiness, A Rationale for Digital Forensic Readiness, Frameworks, Standards, and Methodologies, Becoming “Digital Forensic” Ready, Enterprise Digital Forensic Readiness,

Learning Outcomes:

After completion of this unit, the student will be able to

- differentiate between law enforcement and enterprise forensics L4
- understand the Frameworks, Standards, and Methodologies of digital forensics L1

Pedagogy tools: Blended learning

UNIT - III **LTP 906**

Evidence Collection: Data Acquisition, Forensic Copy, Examination: Disk Structures, File Systems Analysis: Analysis Tools, Timeline Analysis, File Hashing, Filtering, Data Carving, Memory Analysis : Collection Phase, Examination Phase

Learning Outcomes:

After completion of this unit, the student will be able to

- illustrate duplication and preservation of digital evidence L3
- perform analysis on captured data L2

Pedagogy tools: Blended learning

UNIT - IV **LTP 604**

Embedded Systems and Consumer Electronics, Mobile Phones, Telecommunication Networks, Mobile Devices and Embedded Systems as Evidence, Malware and Security Considerations, Ontologies for Mobile and Embedded Forensics Collection Phase, Examination Phase

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand various embedded systems and consumer electronics L1
- Collect data and perform analysis on captured data L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - V LTP 906

Computer Networking, Layers of Network Abstraction, The Internet, Tracing Information on the Internet, Collection Phase – Local Acquisition, Collection Phase – Network Acquisition, The Examination and Analysis Phases

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand about various networks L1
- Perform forensic analysis to find evidences on internet L3

Pedagogy tools: Blended learning

Textbook(s):

1. Andre Arnes, Digital Forensics, Wiley, 1st, 2017

Additional Reading

Reference Book(s):

1. John R.Vacca, John Sammons ,Computer Forensics computer crime scene investigation, second edition,2014.
2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications

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

1. understand the basics of digital forensics.
2. implement the capture, duplication, and preservation of digital evidence.
3. analyse the digital evidence to find the digital artifacts.
4. understand basics of performing analysis to find the evidence
5. Understand the ways to capture network evidences

	Programme Outcomes (POs)												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	2		3			2	1	1	1			3	2	2
CO2	2	2	3	3			2	1	1	1			3	2	2
CO3	1	2		3			2	1	1	1			3	2	2
CO4	2	2		3	3		2	1	1	1			3	2	2
CO5	1	2		3			2	1	1	1			3	2	2

1-Low, 2- Medium and 3- High Correlation

Course Code	Course Title	L	T	P	S	J	C
CSEN2121	ETHICAL HACKING	3	0	2	0	0	4
Course Owner	Department of Computer Science Engineering	Syllabus version				1.0	
Course Pre-requisite(s)		Contact hours				45L 30L	
Course Co-requisite(s)		Approved on: April 1, 2022					
Alternate Exposure							

Introduces the ethical hacking methodologies. Covers applying cyber security concepts to discover and report vulnerabilities in a network. Explores legal and ethical issues associated with ethical hacking. Government agencies and business organizations today are in constant need of ethical hackers to combat the growing threat to IT security. A lot of government agencies, professionals and corporations now understand that if you want to protect a system, you cannot do it by just locking your doors

Course objectives:

1. Learn aspects of security, importance of data gathering, foot printing and system hacking.
2. Learn tools and techniques to carry out a penetration testing.
3. How intruders escalate privileges?
4. Explain Intrusion Detection, Policy Creation, Social Engineering, DDoS Attacks, Buffer Overflows and Virus Creation.
5. Compare different types of hacking tools.

UNIT - I **LTP 906**

Casing the Establishment: What is foot printing, Internet Foot printing, Enumeration, Scanning, basic banner grabbing, Enumerating Common Network services. Case study: Network Monitoring using Wireshark

Learning Outcomes:

After completion of this unit, the student will be able to

- Student will learn about collecting information about the target L1
- Student will learn about scanning process L4

Pedagogy tools: Blended learning

UNIT - II **LTP 906**

Securing permission: Securing file and folder permission, Using the encrypting file system, Securing registry permissions. Securing service: Managing service permission, Default services in windows 2000 and windows XP. Unix: Basic Unix commands, The Quest for Root, Remote Access vs Local access, Remote access, Local access., After hacking root.

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand about basic Linux commands L4
- Learn about securing files and folders L1

Pedagogy tools: Blended learning

UNIT - III **LTP 906**

Dial-up, PBX, Voicemail and VPN hacking, preparing to dial up, War-Dialling, Brute-Force Scripting PBX hacking, Voice mail hacking, VPN hacking, Network Devices: Discovery Autonomous System Lookup, Service Detection, Network Vulnerability.

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand about network services and attacks L3
- Illustrate about Network Vulnerability L2

Pedagogy tools: Blended learning

UNIT - IV **LTP 906**

Wireless Hacking: Wireless Foot printing, Wireless Scanning and Enumeration, Gaining Access, Tools that exploiting WEP Weakness, Denial of Services Attacks, Firewalls: Firewalls landscape, Firewall Identification-Scanning Through firewalls, packet Filtering, Application Proxy Vulnerabilities, Denial of Service Attacks, Motivation of DoS Attackers, Types of DoS attacks, Generic DoS Attacks, Wireless

Encryption, wireless hacking methodology, wireless hacking tools, and wi-fi security tools.

Learning Outcomes:

After completion of this unit, the student will be able to

- Learn about Firewall and gain knowledge of wireless hacking L1
- Know about various Hacking methods. L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - V **LTP 906**

Remote Control Insecurities, Discovering Remote Control Software, Connection, Weakness. VNC, Advanced Techniques Session Hijacking, Back Doors, Trojans, Cryptography, Subverting the systems Environment, Social Engineering, Web Hacking, poisoning attack, Web server hacking web application hacking, Hacking the internet Use, Malicious Mobile code, SSL fraud, E-mail Hacking,

Learning Outcomes:

After completion of this unit, the student will be able to

- Gain the knowledge of cryptographic approaches L1
- Understand about web hijacking, web servers' attacks L3

Pedagogy tools: Blended learning

Textbook(s):

1. Stuart McClure, Joel Scambray and Goerge Kurtz, Hacking Exposed 7: Network Security Secrets AND Solutions, Tata Mc Graw Hill Publishers
2. Bensmith, and Brian Komer, Microsoft Windows Security Resource Kit, Prentice Hall of India, 2010

Reference Book(s):

1. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, "Gray Hat Hacking the Ethical Hackers Handbook", 3rd Edition, McGraw-Hill Osborne Media paperback

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

1. Students will learn the underlying principles and techniques associated with the cybersecurity practice known as penetration testing or ethical hacking.
2. Student will become familiar with the entire penetration testing process including planning, reconnaissance, scanning, exploitation, post-exploitation and result reporting.
3. For every offensive penetration technique, the students will learn the corresponding remedial technique.
4. the students will develop a practical understanding of the current cybersecurity issues and the ways
5. how the errors made by users, administrators, or programmers can lead to exploitable insecurities.

	Programme Outcomes (POs)												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	2		3			2	1	1	1			3	2	2
CO2	2	2	3	3			2	1	1	1			3	2	2
CO3	1	2		3			2	1	1	1			3	2	2
CO4	2	2		3	3		2	1	1	1			3	2	2
CO5	1	2		3			2	1	1	1			3	2	2

1-Low, 2- Medium and 3- High Correlation

Course Code	Course Title	L	T	P	J	S	C
CSEN2191	**IoT Architectures and Protocols**	3	0	2	0	0	4
Course Owner	Department of CSE	Syllabus version				1.0	
Course Prerequisite(s)	CSEN2021 Computer Networks	Contact hours				45 (T) + 15(P)	
Course Co-requisite(s)		Approved on: April 1, 2022					
Alternate Exposure							

This course aims to provide a basic understanding of the current architectures and protocols that make up the Internet of Things. It first starts with a discussion of two standardized IoT reference models - oneM2M and IoTWF, followed by the introduction of a simplified architectural model. The "things" in IoT are then defined, leading to the introduction of the various access technologies for IoT. Popular network and application layer protocols for IoT are discussed, followed by a brief introduction to IoT data analytics.

Course Objectives

1. To introduce the popular IoT reference models.
2. To acquaint the challenges in and solutions for IoT network access.
3. To let the student examine the feasibility of IP for IoT, leading to a study of optimization of IP for IoT.
4. To enable the student to study the application layer protocols for IoT with application development in view.
5. To familiarize the student with the basics of data analytics for IoT.

UNIT - I Introduction to IoT, IoT Network Architecture Architectures **LTP 802**

What is IoT?: Genesis of IoT, IoT and digitization, IoT impact, IoT challenges.

IoT Network Architecture and Design: Drivers behind new network architectures, Comparing IoT architectures, A simplified IoT architecture.

Learning Outcomes:

After completion of this unit, the student will be able to

- Analyze the key challenges in IoT. L4
- Infer the need for new network architectures for IoT. L2
- Outline the oneM2M and IoTWF architectures. L1

Pedagogy tools: Blended learning, video lectures, self-reading, case study

UNIT - II Smart Objects and Connecting Smart Objects **LTP 904**

Smart Objects: The things in IoT: Sensors, actuators and smart objects, Sensor networks.

Connecting Smart Objects: Communications Criteria, **IEEE 802.15.4** - Standardization and Alliances, Physical Layer, MAC Layer, Topology, Security. IEEE 802.15.4g and 802.15.4e - Topology, IEEE 1901.2a - Topology, IEEE 802.11ah - Topology. LoRAWAN - Topology. NB-IoT and other LTE variations.

Learning Outcomes:

After completion of this unit, the student will be able to

- Outline the criteria for communications in IoT. L1
- Summarize the working of IEEE 802.15.4. L2
- List popular IoT access technologies and their uses. L1

Pedagogy tools: Blended learning, Flipped classroom, video lectures, self-reading

UNIT - III IP as the IoT Network Layer **LTP 904**

The business case for IP: The key advantages of IP, Adoption or Adaptation of IP.

The need for optimization: Constrained nodes, Constrained Networks, IP versions.

Optimizing IP for IoT: From 6LoWPAN to 6Lo, Header compression, Fragmentation, Mesh addressing, Mesh-under vs Mesh-over routing.

6TiSCH

RPL: Objective Function, Rank, RPL Headers, Metrics,

Learning Outcomes:

After completion of this unit, the student will be able to

- Summarize the background of routing in networks. (L2) L2
- Justify the need for optimizing IP for IoT. (L4) L4
- Explain the working of 6LoWPAN, 6TiSCH and RPL. L1

Pedagogy tools: Blended learning, video lectures, self-reading

UNIT - IV Application Protocols for IoT **LTP 905**

The Transport Layer

IoT Application Transport Methods: Application layer protocol not present, SCADA, Adapting SCADA for IP, Tunneling legacy SCADA over IP networks. Generic Web-based protocols. IoT Application Layer Protocols, CoAP, MQTT.

Learning Outcomes:

After completion of this unit, the student will be able to

- Question the feasibility of using existing application layer protocols for IoT. L4
- Deduce the design issues in developing application protocols for IoT. L4
- Explain the working of SCADA over IP, CoAP and MQTT. L1

Pedagogy tools: Blended learning, video lectures, self-reading

UNIT - V Data and Analytics for IoT **LTP 10 0 0**

An introduction to data analytics for IoT: Structured vs Unstructured Data, Data in motion vs data at rest, IoT data analytics overview, IoT data analytics challenges.

Machine Learning: Machine Learning overview, Supervised Learning, Unsupervised learning, Neural Networks, Machine Learning and getting intelligence from Big Data. Predictive analytics.

Big data analytics tools and technology: Massively parallel processing databases, NoSQL databases, HADOOP.

Edge streaming analytics: Comparing Big Data and Edge Analytics, Edge Analytics Core Functions, Distributed Analytics Systems

Learning Outcomes:

After completion of this unit, the student will be able to

- Outline IoT data analytics challenges. L1
- Summarize the principles of supervised learning, unsupervised learning and neural networks. L2
- Distinguish between edge and Big data analytics. L4
- Choose the correct data analytics framework for a given IoT application. L3

Pedagogy tools: Blended learning, case study, video lectures, self-reading

Textbook(s):

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017

Reference Book(s):

1. Hersent, Olivier, David Boswarthick, and Omar Elloumi. The internet of things: Key applications and protocols. John Wiley & Sons, 2011.
2. Buyya, Rajkumar, and Amir Vahid Dastjerdi, eds. Internet of Things: Principles and paradigms. Elsevier, 2016.

Journal(s):

1. X. Vilajosana, T. Watteyne, T. Chang, M. Vučinić, S. Duquennoy and P. Thubert, "IETF 6TiSCH: A Tutorial," in IEEE Communications Surveys & Tutorials, vol. 22, no. 1, pp. 595-615, Firstquarter 2020, doi: 10.1109/COMST.2019.2939407.
2. RPL: IPv6 routing protocol for low-power and lossy networks. (Accessed on 20/11/2019). [Online] Available: https://tools.ietf.org/html/rfc6550.

Website(s):

https://www.ietf.org/proceedings/94/slides/slides-94-rtgarea-2.pdf
https://www.thethingsnetwork.org/docs/lorawan/architecture/
https://datatracker.ietf.org/doc/html/rfc7252
https://mqtt.org/
https://www.onem2m.org/

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

1. Distinguish between different IoT network architectures. (L4)
2. Compare various access technologies for IoT. (L2)
3. Analyze the difference between protocol design at the network, transport and application layers for IoT and that for the Internet. (L4)
4. Explain the working of popular IoT protocols at the network and application layers. (L4)
5. Summarize the working of IoT data analytics. (L2)

	Programme Outcomes (POs)												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	1	1	2								2		
CO2	2	3	1	1	2								2		
CO3	2	3	1	3	2								1	1	2
CO4	2	2	1	3	2								1	2	3
CO5	2	2	1	3	2								2		

1-Low, 2- Medium and 3- High Correlation

List of experiments:

The following simulation experiments are to be carried out using ns-3, TOSSIM, COOJA or MATLAB.

1) Create a simple network with ten nodes in a linear topology. Plot the average energy spent and packet delivery ratio (PDR, end-to-end) when the simulation is run for 500 seconds for two different transmission radii. Use standard protocols at the different layers.
2) Create a small network with a tree topology (the sink at the root) and static nodes. Run the simulation for 500 seconds and examine the node energy spent and packet delivery ratio spent for transmitting data:
    a) To the sink from the leaf nodes.
    b) To the leaf nodes from the sink.
3) Create a small network with mobile sensor nodes. Any standard mobility pattern can be used. Trigger transmissions with random sources and destinations and plot the average energy spent and PDR. Use standard MAC and routing protocols.
4) Repeat the experiment in (2) using IEEE 802.15.4 at the MAC level.
5) Repeat the experiment in (2) with using 6LoWPAN for routing.
6) Repeat the experiment in (2) using IEEE 802.11 at the MAC and physical level and 6LowPAN and RPL for routing.
7) Repeat the experiment in (2) using the IETF 6TiSCH protocol stack.
8) Create a small network with two end nodes that communicate data via an edge node to a server. The link from the end nodes to the edge node is a wireless link while the link from the edge node to the server is a wired link. Capture the packets at the edge node and the server and report the PDR at these two nodes.

Course Code	Course Title	L	T	P	S	J	C
CSEN3001	**MACHINE LEARNING AND IT'S APPLICATIONS**	3	0	2	0	0	4
Course Owner	Department of CSE	Syllabus version				1.0	
Course Pre-requisite(s)		Contact hours				45+30	
Course Co-requisite(s)		Approved on: April 1, 2022					
Alternate Exposure							

Machine Learning is a flourishing subject in Computer Science which devises models that can automatically learn from data and detect patterns from data. The applications of machine learning are diverse ranging from self-driven cars to disaster management systems. With easy availability of data from different devices and measurements, machine learning techniques become imperative in analysing trends hidden in the data. This course focuses on the major tasks of machine learning that can robustly address data that is non-linear, noisy as well as high-dimensional in nature

Course Objectives

1. To understand various key paradigms for machine learning approaches
2. Familiarize with mathematical relationships across various machine learning algorithms
3. To understand various key approaches in supervised learning.
4. To understand the concept of the neural network

UNIT - I Machine Learning Fundamentals **LTP 9-0-6**

Machine Learning Fundamentals: Use of Machine Learning, Types of machine learning systems, machine learning challenges, testing and validating, working with real data, obtaining the data, visualizing the data, data preparation, training and fine tuning the model.

Learning Outcomes:

After completion of this unit, the student will be able to

- Identify different machine learning approaches and applications L1
- Demonstrate basic machine learning approach using real world data L2
- Use machine learning approach to train and fine tune a learner L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - II Linear Algebra **LTP 9-0-6**

Linear Algebra: Scalars, Vectors, Matrices and Tensors Multiplying Matrices and Vectors, Identity and Inverse Matrices, Linear Dependence and Span, Norms, The Trace Operator, The Determinant

Learning Outcomes:

After completion of this unit, the student will be able to

- Understanding the linear algebra for machine learning L1
- Applying the various matrices operations L3
- Understanding and applying the representation of real-world data for machine learning algorithms L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - III Classification & Linear Regression **LTP 9-0-6**

Prediction using Linear Regression, Gradient Descent, Linear Regression with one Variable, Linear Regression with Multiple Variables, Polynomial Regression, Feature Scaling/Selection. learning curves, regularized linear models.

Learning Outcomes:

After completion of this unit, the student will be able to

- Demonstrate various prediction approaches L2
- Describe prediction techniques for real – time data L2
- Apply linear regression to make good predictions L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - IV Logistic Regression LTP 9-0-6

Classification, training a binary classifier, performance measures, multiclass classification, error analysis, multi label classification, multi output classification.

Logistic Regression: Classification using Logistic Regression, Logistic Regression vs. Linear Regression, Logistic Regression with one Variable and with Multiple Variables

Learning Outcomes:

After completion of this unit, the student will be able to

- Demonstrate various classification approaches L2
- Describe classification techniques for real time data L2
- Apply classification using the logistic regression L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - V Neural Networks LTP 9-0-6

Neural Networks: Introduction, Model Representation, Gradient Descent vs. Perceptron Training, Stochastic Gradient Descent, Multilayer Perceptrons, Multiclass Representation, Back Propagation Algorithm

Learning Outcomes:

After completion of this unit, the student will be able to

- Show the working of neural networks L3
- Demonstrating different layered networks L2
- Apply classification using backpropagation L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

Textbook(s):

1. AurelionGeron, Hands-on Machine Learning with Scikit-Learn, Keras, and Tensor Flow: Concepts, Tools and Techniques to build Intelligent Systems, 2/e, O'Reilly Media, 2019.(Chapters 1,3,4,5)
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville,Deep learning, MIT press, 2016 (Chapter 2)

Additional Reading

Reference Book(s):

1. Tom M. Mitchell, "Machine Learning" First Edition by Tata McGraw- Hill Education.
2. Ethem Alpaydin,"Introduction to Machine Learning " 2nd Edition, The MIT Press, 2009
3. Christopher M. Bishop, "Pattern Recognition and Machine Learning" By Springer, 2007.
4. Mevi P. Murphy, "Machine Learning: A Probabilistic Perspective" by The MIT Press, 2012.

Journal(s):

Website(s):

Lab Exercises:

Introduction to Python libraries- Numpy, Pandas, Matplotlib, Scikit-learn.

1. Using matplotlib perform data visualization on the given dataset
2. Implement a program on eigen decomposition and SVD
3. Implement the matrices operations using both Numpy and pandas
4. Implement Linear Regression using ordinary least square(OLS) and Gradient Descent methods
5. Implement classification Logistic Regression
6. Evaluate performance measures on regression models (Linear and Logistic).
7. Implement the single layer perceptron and Multilayer Perceptron for classification
8. Implement the back propagation
9. Implement the above learning algorithms using Scikit-Learn packages
10. Tackle the curse of dimensionality by implementing PCA algorithm on a high dimensional dataset.

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

1. To formulate the different machine learning problems (L1)
2. To formulate the basics of linear algebra concepts required for machine algorithms (L2)
3. Apply various learning approaches on real time problems using Classification(L3)
4. Apply various learning approaches on real time problems using Regression(L3)
5. Construct the neural networks for classification problems(L4)

	Programme Outcomes (POs)												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2		1	2		1	1			2	2	1	3
CO2		3	2	2	2	2		1	1			2	1	1	3
CO3		3	1	3	3	2		1	1			2	2	2	3
CO4	2	3	2		3	2		1	1			2	2	1	3
CO5		3	2	2	3	2		1	1			2	2	2	3

1-Low, 2- Medium and 3- High Correlation

Course Code	Course Title	L	T	P	S	J	C
CSEN1131	SOFTWARE ENGINEERING	3	0	2	0	0	4
Course Owner	Department of CSE	Syllabus version				1.0	
Course Pre-requisite(s)		Contact hours				75	
Course Co-requisite(s)		Approved on: April 1, 2022					
Alternate Exposure	Programming Knowledge						

The purpose of this course is to impart knowledge on the basic principles of software engineering and enabling the learner to understand software lifecycle stages. Systematic development of software products or solutions is emphasized throughout the course to enable the student ensure quality of development activities.

Course Objectives

1. Provide Introduction to Software Engineering and process of Software production
2. Enable understanding of widely varying nature of software solutions and domain and technology aspects of software
3. Deconstruct different stages of Software products' life cycle and software Evolution, life cycle processes
4. Facilitate Analysis of requirements for software solution development
5. Summarize architecture, design, and implementation considerations of software solution
6. Exposure to quality aspects across the stages, planning aspects

UNIT - I Introduction to Software Engineering LTP 9-0-6

The story of Software development and issues faced, Need for Systematic process for addressing issues, Products, custom solutions, services, domains, Technologies, Software life cycle, software development life cycle, software release process, source control, versioning, maintenance of software. DevOps.
Software Development Processes: Waterfall, Iterative, Spiral.

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand Software Life cycle L1
- Understand about maintenance of software. L1
- Familiarize with the release process and versioning of software L2
- Familiarize the various process models for software development L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - II Software development phases and processes LTP 9-0-6

Software development and processes – RAD, RUP, Agile: Scrum, Prototyping
Development phases of Software in relation to Processes
What to develop? – Requirements gathering and Analysis, Types- functional, non-functional, system, User Interface, quality requirements and putting together– UML use cases, scenarios.

Learning Outcomes:

After completion of this unit, the student will be able to

- Determine Suitability of processes L3
- Understand the Rational unified process. L2
- Understand how to develop agile software L3
- Experiment with requirement gathering activity L3
- Develop usecases L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - III Requirements, design and solution LTP 9-0-6

Considerations for architecture, design, Data, modules, interfaces – application architectures.

System design: modular design – cohesion and coupling, Structural Design -Top down, Bottom up approaches, OOD; data models, User Interface guidelines; UML Activity, Sequence, Component, Collaboration, Deployment diagrams

Learning Outcomes:

After completion of this unit, the student will be able to

- Develop simple system design diagrams L3
- Familiarize with the concepts of Unified Modelling Language and its various diagrams L2
- Develop a architecture for simple software problems L3
- Understand Design approaches L1

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - IV Implementation and Ensuring Quality of software and Metrics LTP 9-0-6

How to implement – practices to follow for development – language, platform choices, coding practices, cost of bugs through life cycle

Quality from requirements to release and across versions: Faults and Fixes, Reliability models: Logarithmic Poisson Model

Testing mechanisms across life cycle: Functional, system integration, user testing, testing on different platforms. Testing Tools

Quality across versions and metrics for quality; Quality Models: ISO, CMM, Boehm, McCall; Metrics: Process and Product metrics - LOC, Function Points, Token Count

Learning Outcomes:

After completion of this unit, the student will be able to

- Assess the importance of quality through SDLC L3
- Understand the significance of Capability maturity Model L3
- Familiarize with the various testing techniques L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - V Planning for software development LTP 9-0-6

Estimation of time, resources, the cost for software development: COCOMO, Function Point, Putnam Resource Allocation Models

Planning activities and re-planning, Risk Analysis

Release mechanisms, Configuration Management, Licensing methods and Maintenance

Software Life Cycle Management - planning, tracking, communication, negotiation, delivery, quality aspects.

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand the significance of the COCOMO model L3
- Familiarize with the techniques to mitigate risks. L3
- Understand the complete life cycle of software L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

Textbook(s):

1. Ian Sommerville, “Software Engineering”, 10th Edition, Pearson Education, 2015 (overall)
2. Klaus Pohl, Chris Rupp, “Requirements Engineering Fundamentals” 2nd Edition, Rocky Nook, 2015.
3. Rajib Mall, Fundamentals of Software Engineering, 4/e, PHI, 2009. (for metrics))
4. K. K. Aggarwal & Yogesh Singh, “Software Engineering”, 3rd Edition, New Age International, 2008. (for metrics)
5. Steve Mcconnell, “Code complete”, 2nd Edition, Microsoft Press, 2004, Print 2015 (for design)
6. Frederic P. Brooks, “The Mythical Man-Month: Essays on Software Engineering”, Addison-Wesley, 1995, print 2010 (for project management)

Additional Reading

Reference Book(s):

1. Michael R Blaha, James R Rumbaugh, "Object-Oriented Modeling and Design with UML", 2nd Edition, Pearson Education, 2005
2. Axel van Lamsweerde, "Requirements Engineering" Wiley Publications, 2009

Journal(s):

Website(s):

1. http://vlabs.iitkgp.ernet.in/se/
2. http://softwarecost.org/tools/COCOMO/

Lab Activities Suggested:

1. Implement weather modeling* using the quadratic solution in stages: hard-coding variables keyboard input, read from a file, for a single set of input, multiple sets of inputs.
    a. save all versions, debug, fix problems, create a Github account
2. Develop weather modeling using the quadratic model in teams of 5 using Waterfall, Iterative, Agile modes
3.
    a. Teams of 5 to work on gathering requirements for different simple projects related to University and student activities
    b. Represent requirements in terms of lists, use cases, scenarios (UML)
    c. try simple architecture and design of modules. Represent in activity, sequence, collaboration diagrams(UML)
4.
    a. Testing quadratic modeling of weather modeling example
    b. Testing using open source testing tools: Selenium, Jmeter
5.
    a. Understand cost drivers using the COCOMO site for team projects
    b. Create a project plan in Jira

Lab Infrastructure:

1. Eclipse, Visual Studio, SQL Server, MS Access, Oracle
2. StarUML /RationalPro, jira

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

1. Demonstrate understanding of the process of Software Development: L1
2. Determine Suitability of processes for varying software applications development: L5
3. Differentiate Development phases through the life cycle of software: L4
4. Reflect on design choices and development standards: L2
5. Check and verify software quality from requirements to release of software and across versions: L4

	Programme Outcomes (POs)												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3					1							2		
CO2			3	2					2					2	
CO3		2	2												1
CO4		3											2		
CO5			3		2							2		2	

Course Code	Course Title	L	T	P	J	S	C
CSEN2131	**WIRELESS SENSOR NETWORKS**	3	0	2	0	0	4
Course Owner	Department of CSE	Syllabus version				1.0	
Course Pre-requisite(s)	CSEN1071 Data Communications CSEN2021 Computer Networks	Contact hours				44 (T) + 14(P)	
Course Co-requisite(s)		Approved on: April 1, 2022					
Alternate Exposure							

This course starts with a brief introduction of Wireless Sensor Networks (WSNs). It then introduces the concepts of localization and time synchronization and methods to perform them in WSNs. After examining the issues in medium access control, routing, transport and application layers in WSNs, the most important protocols for WSNs in each of these layers are discussed. Finally, WSN middleware and operating systems are introduced with examples.

Course Objectives

1. To introduce to the students the concepts of localization and time synchronization in WSNs and ways to perform them.
2. To enable the student to study the design issues in MAC for WSNs and popular MAC protocols for WSNs.
3. To acquaint the student with the challenges in routing in WSNs and popular routing protocols for WSNs.
4. To let the student examine the feasibility of TCP and UDP for WSNs and study WSN transport and application layer protocols.
5. To familiarize the student with the design issues for middleware and operating systems for WSNs and example middleware and operating systems for WSNs.

UNIT - I Introduction to Sensor Networks, Localization and Time Synchronization **LTP 900**

Introduction and Overview of Wireless Sensor Networks, Applications of WSNs, **Localization**: Overview, Key issues, Localization approaches, Coarse-grained node localization using minimal information, Fine-grained node localization using detailed information, Network-wide localization, **Time Synchronization:** Overview, Key issues, Traditional approaches, Fine-grained clock synchronization, Coarse-grained data synchronization

Learning Outcomes:

After completion of this unit, the student will be able to

- Define localization and time synchronization. L1
- Analyze the key design issues in localization and time synchronization for WSNs. L4
- Explain the key traditional approaches to localization and time synchronization. L4
- Differentiate between fine and coarse-grained localization and time synchronization. L2
- Outline the various ways of achieving localization and time-synchronization in WSNs. L1

Pedagogy tools: Blended learning,video lectures, self-reading, case study

UNIT - II MAC Protocols for WSNs **LTP 700**

Medium Access Control Protocols for Wireless Sensor Networks: Introduction, Background, Fundamentals of MAC Protocols, MAC Protocols for WSNs, Sensor-MAC (Case Study), IEEE 802.15.4 LR-WPANs Standard (Case Study)

Learning Outcomes:

After completion of this unit, the student will be able to

- Outline the fundamentals of MAC protocols. L1
- Summarize the working of MAC protocols for WSNs. L2
- Interpret the working of Sensor-MAC. L2
- Summarize the working of IEEE 802.15.4. L2
- Analyze the working of Sensor-MAC and IEEE 802.15.4. L4

Pedagogy tools: Blended learning, Flipped classroom, video lectures, self-reading

UNIT - III Routing for WSNs **LTP 800**

Routing Protocols for Wireless Sensor Networks: Introduction, Background, Data Dissemination and Gathering, Routing Challenges and Design Issues in Wireless Sensor Networks, **Routing Strategies in Wireless Sensor Networks**: LEACH, Directed Diffusion and geographical routing. RPL and 6LoWPAN.

Learning Outcomes:

After completion of this unit, the student will be able to

- Summarize the background of routing in networks. (L2) L2
- Interpret the role of data dissemination and gathering in WSNs. (L2) L2
- Explain the challenges and design issues in routing for WSNs. (L4) L4

- Summarize the important routing strategies in WSNs. (L2) L2
- Compare the routing strategies for WSNs. (L2) L2

Pedagogy tools: Blended learning, video lectures, self-reading

UNIT - IV Transport Control and Application Protocols for Wireless Sensor Networks **LTP 800**

A brief review of Traditional Transport Control Protocols, Feasibility of Using TCP or UDP for WSNs, Transport Protocol Design Issues, Examples of Existing Transport Control Protocols - CODA, RMST.

Application Protocols for WSNs : CoAP and MQTT

Learning Outcomes:

After completion of this unit, the student will be able to

- Summarize the working of traditional transport layer protocols. L2
- Question the feasibility of using existing transport layer protocols in WSNs. L4
- Deduce the design issues in developing transport protocols for WSNs. L4
- Infer the working of WSN transport protocols. L2
- Distinguish between various WSN transport protocols. L4

Pedagogy tools: Blended learning, video lectures, self-reading

UNIT - V Middleware and Operating Systems for Wireless Sensor Networks **LTP 800**

Middleware: Introduction, WSN Middleware Principles, Middleware Architecture, **Existing Middleware**: DDS, SensorWare.
Operating Systems: Introduction, Operating System Design Issues, Examples of Operating Systems, TinyOS, SenOS.

Learning Outcomes:

After completion of this unit, the student will be able to

- Outline WSN middleware principles. L1
- Summarize the working of example middleware architecture for WSNs. L2
- Explain operating system design issues for WSNs. L4
- Examine the working of example WSN operating systems. L3
- Distinguish between the working of example WSN operating systems and middleware. L4

Pedagogy tools: Blended learning, case study, video lectures, self-reading

Textbook(s):

1. Wireless Sensor networks- Technology, Protocols and Applications by Kazem Sohraby, Daniel Manoli , Wiley InterScience Publications 2007
2. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017
3. Networking Wireless Sensors, Bhaskar Krishnamachari, Cambridge university press, 2005

Reference Book(s):

1. Holger Karl and Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, 2005.
2. Wireless Sensor Networks, C.S Raghavendra, Krishna M.Sivalingam, Taieb znati, Springer Science 2004.

Journal(s):

1. Wei Ye, J. Heidemann and D. Estrin, "An energy-efficient MAC protocol for wireless sensor networks," *Proceedings.Twenty-First Annual Joint Conference of the IEEE Computer and Communications Societies*, 2002, pp. 1567-1576 vol.3, doi: 10.1109/INFCOM.2002.1019408.
2. Heinzelman, W., Chandrakasan, A., and Balakrishnan, H., "Energy-Efficient Communication Protocols for Wireless Microsensor Networks", Proceedings of the 33rd Hawaaian International Conference on Systems Science (HICSS), January 2000.

Website(s):

https://www.isi.edu/scadds/projects/smac/

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

1. Define localization and time synchronization. (L1)
2. Compare various localization and time synchronization techniques for WSNs. (L2)
3. Analyze the difference between protocol design at the MAC, network, transport and application layers for WSNs and that for the Internet. (L4)
4. Explain the working of popular WSN protocols at the MAC, network, transport and application layers. (L4)
5. Summarize the working of popular WSN operating systems. (L2)

	Programme Outcomes (POs)												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	2											1		
CO2	1	3											1		
CO3	1	3		3									1	1	2
CO4	1	2		2									1	2	2
CO5	1	2		3									1		

1-Low, 2- Medium and 3- High Correlation

List of experiments:

The following simulation experiments are to be carried out using ns-3 or TOSSIM.

1) Create a simple WSN with ten nodes in a linear topology. Plot the average energy spent and packet delivery ratio (PDR, end-to-end) when the simulation is run for 500 seconds for two different transmission radii. Use standard protocols at the different layers.
2) Create a small network with a tree topology (the sink at the root) and static nodes. Run the simulation for 500 seconds and examine the node energy spent and packet delivery ratio spent for transmitting data:
    a) To the sink from the leaves.
    b) To the leaves from the sink.
3) Create a small network with mobile sensor nodes. Any standard mobility pattern can be used. Trigger transmissions with random sources and destinations and plot the average energy spent and PDR. Use standard MAC and routing protocols.
4) Repeat the experiment in (2) using Sensor-MAC at the MAC level.
5) Repeat the experiment in (2) using IEEE 802.15.4 at the MAC level.
6) Repeat the experiment in (2) with a clustered network using LEACH for routing.
7) Repeat the experiment in (2) using IEEE 802.15.4 at the MAC level and 6LowPAN and RPL for routing.
8) Create a small WSN and use CoAP and MQTT at the application layer.