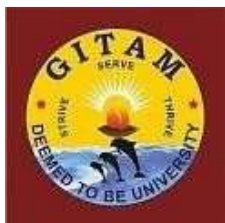


GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT (GITAM)
(Deemed to be University)
VISAKHAPATNAM * HYDERABAD * BENGALURU

Accredited by NAAC with A⁺ Grade



REGULATIONS AND SYLLABUS
OF
Bachelor of Engineering
In
Electronics and Communication Engineering

(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>



Department of Electrical, Electronics and Communication
Engineering GITAM (Deemed to be University)

B Tech (Electronics and Communication Engineering) Programme

VISION

To excel in higher education by imparting quality teaching and research and to meet the challenges in Electrical, Electronics and Communication Engineering

MISSION

1. To impart technical skills, value-based education to students, to enable them to face the demands of the industry
2. To create innovative and instructional learning methods to hone the skills for solving problems of society
3. To carry out research through constant interaction with R & D organizations and industry
4. To motivate the students to develop expertise in multidisciplinary technologies for a sustainable growth

PROGRAM EDUCATIONAL OBJECTIVES

- PEO1 To impart knowledge of mathematics and science concepts as tools to device and deliver efficient solutions to problems of Electronics & Communication Engineering
- PEO2 To inculcate analytical ability in the students to keep pace with changing technologies and to imbibe skill and research culture to meet the industrial and societal needs
- PEO3 To provide a platform for the graduate to be successful in technical and professional careers or develop as an entrepreneur
- PEO4 To instil teamwork, leadership, and communication skills in the student with professional, ethical, and human values to be responsible citizen of the society

PROGRAMME OUTCOMES

Upon successful completion of the programme, students will be able to

- PO1 **ENGINEERING KNOWLEDGE:** Apply the knowledge of Mathematics, Science, Engineering Fundamentals, and an Engineering specialization to the solution of Complex Engineering problems.
- PO2 **PROBLEM ANALYSIS:** Identify, formulate, research literature, and analyze Complex Engineering problems reaching substantiated conclusions using first principles of Mathematics, Natural Sciences, and Engineering Sciences.
- PO3 **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.
- PO4 **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.
- PO5 **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.
- PO6 **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.
- PO7 **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.
- PO8 **ETHICS:** Apply ethical principles and commit to Professional Ethics and responsibilities and norms of the engineering practice.
- PO9 **INDIVIDUAL AND TEAMWORK:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10 **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.
- PO11 **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 multi-disciplinary environments.
- PO12 **LIFELONG LEARNING:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO)

Upon successful completion of BTech ECE Programme, student will be able to

- PSO 1 design and develop electronic, communication and signal processing systems for engineering applications in the fields of consumer electronics, embedded, wireless communication, networking, and allied interdisciplinary areas.
- PSO 2 demonstrate the use of modern tools and techniques for solving contemporary real-world problems in electronics and communication systems
- PSO 3 research and devise appropriate technologies for implementation of the electronics and telecommunications systems as an entrepreneur/researcher with professional ethics & concern for societal wellbeing

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 (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%
Major Core (PC)	52	32%
Major Electives (PE)	15	9%
Open Electives (UE)	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

The list of courses to be taken by students under **Faculty Core** are listed below

Faculty Core (FC)

Cours e Code	Level	Course Name	L	T	P	S	J	C
		Management Basket	3	0	0	0	0	3
PHYS1001		Physics Basket 1	2	1	2	0	0	4
PHYSXXXX		Physics Basket 2	3	1	0	0	0	4
CHEM1001		Chemistry	2	1	2	0	0	4
MATHXXXX		Maths Basket 1	2	0	0	0	0	2
MATHXXXX		Maths Basket 2	2	0	0	0	0	2
MATHXXXX		Maths Basket 3	2	0	0	0	0	2
MATHXXXX		Maths Basket 4	2	0	0	0	0	2
MATHXXXX		Maths Basket 5	2	0	0	0	0	2
MATHXXXX		Maths Basket 6	2	0	0	0	0	2
		Design Thinking	0	0	2	0	0	1
		Artificial Intelligence Applications	0	0	2	0	0	1
		Probability and Statistics	3	0	0	0	0	3
MECH1011		Engineering Visualization and Product Realization	0	0	4	0	0	2
MECH1021		Workshop	0	0	4	0	0	2
EECE1001		Basic Electrical and Electronics Engineering	2	1	2	0	0	4
CSEN1011		Problem Solving and Programming in C	0	0	6	0	0	3
CSEN1021		Programming with Python	0	0	6	0	0	3
		Internship 1	0	0	0	0	1	1*
		Internship 2	0	0	0	0	1	3
		Comprehensive Examination	1	0	0	0	0	1*
		Capstone Project - Introduction	0	0	0	0	2	2
		Capstone Project - Final	0	0	0	0	6	6
		Universal Human Values	3	0	0	0	0	3*
		Project Exhibition 1	0	0	0	0	1	1*
		Project Exhibition 2	0	0	0	0	1	1*

Courses Offered under Mathematics Basket

S. No	Level	Course code	Course name	Offered to	L	T	P	S	J	C
1	1	MATH1001	Single variable calculus	All BTech branches						
2	1	MATH1011	Several variable Calculus							
3	1	MATH1021	Transform Techniques							
4	1	MATH1031	Differential Equations							
5	1	MATH1041	Discrete Mathematics	CSE						
6	1	MATH1051	Graph Theory	CSE						
7	1	MATH1061	Introduction to Mathematics - I	BT						
8	1	MATH1071	Introduction to Mathematics - II	BT						

Courses Offered for BioTechnology Department

S. No	Level	Course code	Course name	Offered to	L	T	P	S	J	C
1	1	BTEN1001	Introduction to Biotechnology-I	BT						
2	1	BTEN1011	Biotechnology Workshop	BT						
3	1	BTEN1021	Introduction to Biotechnology-II	BT						
4	1	BTEN1031	Process Calculations	BT						

Courses Offered under Physics Basket

S. No	Level	Course code	Course name	Offered to	L	T	P	S	J	C
1	1	PHYS1001	Physics	All B.Tech branches						
2	1	PHYS1011	Mechanics and Properties of Matter	AE, CE, ME						
3	1	PHYS1021	Principles of Quantum Mechanics	CSE						
4	1	PHYS1031	Physics of Semi Conducting devices	ECE, EEE						
5	1	PHYS1041	Mechanics and Modern Physics	BT						

The list of courses to be taken by students under **Major Core (Programe Core)** are listed below

S.No.	Program Core	L	T	P	S	J	C
PC0	Electronics Workshop	0	0	2			1
PC1	Signals and Systems	2	1	0			3
PC2	Network Theory and Analysis	2	1	0			3
PC3	Electronic Devices and Amplifier Circuits	3	0	2			4
PC4	Random Processes	2	0	0			2
PC5	Analog Communications	2	0	0			2
PC6	Digital Logic Design	3	0	2			4
PC7	Analog Circuits	3	0	2			4
PC8	Control Systems	2	1	0			3
PC9	Electromagnetic Waves	3	0	0			3
PC10	Digital Signal Processing	3	0	2			4
PC11	Digital Communications	3	0	2			4
PC12	Antenna Analysis and Design	3	0	0			3
PC13	Communication Networks	3	0	2			4
PC14	Microprocessors and Microcontrollers	3	0	2			4
PC15	VLSI Design	3	0	2			4
	Total						52

The list of courses to be taken by students under **Major Electives (Program Electives)** are listed below

S. No	Program Electives	L	T	P	S	J	C
1	Information Theory and Error Control Coding	3	0	0	0	0	3
2	Wireless Communications	3	0	0	0	0	3
3	Fiber Optic Communications	3	0	0	0	0	3
4	Satellite Communications	3	0	0	0	0	3
5	Wireless Networks	3	0	0	0	0	3
6	Global Positioning Systems	3	0	0	0	0	3
7	Software Defined Networks	3	0	0	0	0	3
8	Transmission Lines and Waveguides	3	0	0	0	0	3
9	EMI - EMC Systems	3	0	0	0	0	3
10	Radar Systems	3	0	0	0	0	3
11	Microwave Engineering	3	0	0	0	0	3
12	RF Circuit Design	3	0	0	0	0	3
13	ARM System Development	3	0	0	0	0	3
14	Internet of Things	3	0	0	0	0	3
15	IoT Architecture and Protocols	3	0	0	0	0	3
16	IoT Applications	3	0	0	0	0	3
17	Wireless Sensor Networks	3	0	0	0	0	3
18	Sensors and Signal Conditioning	3	0	0	0	0	3
19	IoT Security	3	0	0	0	0	3
20	Cloud based IoT	3	0	0	0	0	3
21	Real Time Signal Processing	2	0	2	0	0	3
22	Digital Image Processing	3	0	0	0	0	3
23	DSP Processors	3	0	0	0	0	3
24	Biomedical Signal Processing	3	0	0	0	0	3
25	Speech Processing	3	0	0	0	0	3
26	Digital Signal Compression	3	0	0	0	0	3
27	Computer Organization and Design	3	0	0	0	0	3
28	Hardware Modeling with HDLs	3	0	0	0	0	3
29	FPGA System Design	2	0	2	0	0	3
30	VLSI Design Automation	3	0	0	0	0	3
31	Analog IC Design	3	0	0	0	0	3
32	Linear Integrated Circuits	3	0	0	0	0	3
33	Modern VLSI Devices	3	0	0	0	0	3
34	C-Based VLSI Design	3	0	0	0	0	3
35	Digital System Design	3	0	0	0	0	3
36	Data Structures with Python	2	0	2	0	0	3
37	Artificial Neural Networks	3	0	0	0	0	3
38	Machine Learning	3	0	0	0	0	3
39	Deep Learning	3	0	0	0	0	3
40	Machine Learning for Electronic Design Automation	3	0	0	0	0	3
41	Machine Learning for Wireless Communications	3	0	0	0	0	3

Opt any five courses from Programme Elective basket

Open Elective (PE)#

Opt eligible PC/PE courses from other programmes as an open elective courses and earn 24credits

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, bibliography, 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 / create pivot 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 Cunninham, S. & Moor, P. (nd). New Cutting Hedge (Intermediate). Longman
2. Cambridge 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: Reading, 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 make 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. Cambridge 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. Oxford: 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. analytical, 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 emphasizes 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	Collaborative 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), presentation, 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 scaffolding through open-house discussion, Note-making (Group work), Group Discussion (free), post performance 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 disagreeing 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/celebrations/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-reflection 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. Cambridge 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 to Paragraph. 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. Cunningham, 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.

Online Resources

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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, <i>Self Awareness</i> : Self Motivation, Accurate Self Assessment (SWOT Analysis), Self Regulation: <i>Self Control, Trustworthiness & Adaptability</i>	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 Ineffective Teams, 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: <i>The Communication Process</i> , Elements of Interpersonal Communication, <i>Non-Verbal Communication</i> : Body Language, Posture, Eye Contact, Smile, Tone of Voice, <i>Barriers to Communication</i> . 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 Specific, 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], Cryptarithmic & Modular Arithmetic (Cryptarithmic, 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], Cryptarithmic & Modular Arithmetic (Cryptarithmic, 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, Cryptarithmic, 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 heavily dependent 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.

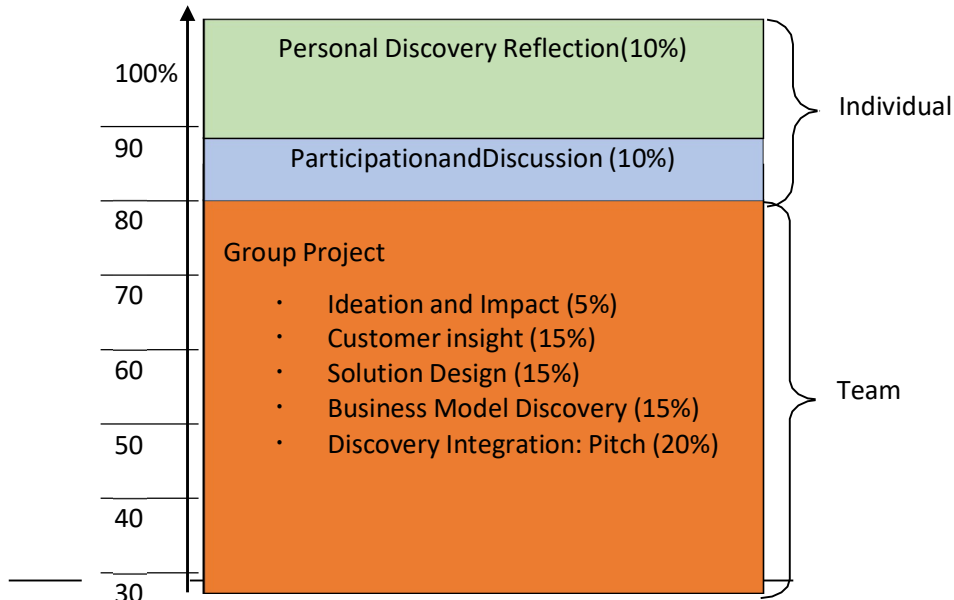
“Design” is fun, particularly when you merge customer insight with your own creativity. Enjoy! In this book, we provide structured methods to be an active listener and learner from customers as well as a product or service designer.

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 be 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 of 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 your 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 too complex to present to outside people who have not taken the course. Therefore, design this pitch 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 Journals as 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, your career, 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 as well 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

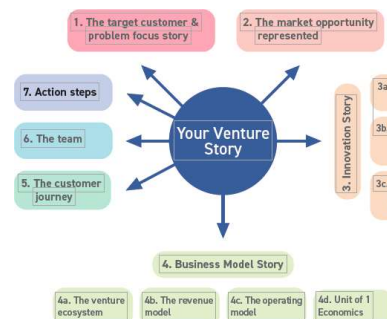
Week	Session	Topics and Steps	Key CONCEPTS Introduced in Class	Class Focus Activity
1	1	Course Overview	<ol style="list-style-type: none"> 1. Why is entrepreneurship important? 2. What is Personal Discovery through Entrepreneurship? 3. Four Stages; Personal Discovery, Solution Discovery, Business Model Discovery, Discovery Integration 4. Preparation (finding interesting areas) 	Lecture and Discussion
	2	Personal Discovery (Step 01, Step 02)	<ol style="list-style-type: none"> 1. Personal Values 2. Strength and Weakness 	Individual: <ul style="list-style-type: none"> • 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)	<ol style="list-style-type: none"> 1. Review Problem Area Template at the beginning of the book to find classmates who want to work on the same problem area. 2. Find teammates <ol style="list-style-type: none"> (1) Shared values (2) Levels of commitment (3) Skills and experiences (Same or Different?) 	Problem template: Page 9 <ul style="list-style-type: none"> • 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)	<ol style="list-style-type: none"> 1. Methods for defining and refining a venture's purpose 2. Defining a Venture's Purpose 3. Creating a Vision Statement 	Team: <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> An in-class ideation exercise 	Team: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> Idea Impact Template, Step 6, Page 69
4	7	User Insights Frameworks (Step 07)	<ul style="list-style-type: none"> Identify and find the right target users. Interview style and methods The Customer Interview template. 	Team: <ul style="list-style-type: none"> Customer Interviews Template, Step 7, Pages 75 Edit interview template for your project.
	8		Laddering methods for interviews	Team: <ul style="list-style-type: none"> Latent Needs Template, Step 7, Page 93
5	9	User Insights Customer Interviews (Step 07)	<ul style="list-style-type: none"> Finding latent needs Field work check-in 	Team: <ul style="list-style-type: none"> Latent Needs Template, Step 7, Page 93 Field work – customer interviewing
	10		<ul style="list-style-type: none"> Think about innovation across the entire use case Field work check-in 	Team: <ul style="list-style-type: none"> Full Use Case Template, Step 7, Page 99 Field work – customer interviewing
6	11	User Insights Interpreting Results (Step 07)	<ul style="list-style-type: none"> Interpreting customer interview results Field work check-in 	Team: <ul style="list-style-type: none"> Field work – customer interviewing Also talk to retailers/dealers if appropriate
	12		<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> Customer Research Reports Implications for product and service design 	<ul style="list-style-type: none"> Teams prepare PPTs for class presentation Customer Insight Template Hand-in Package
	14			

We ek	Sess ion	Topics and Steps	Key CONCEPTS Introduced in Class	Class Focus Activity
8	15	Concept Design (Step 08)	<ul style="list-style-type: none"> • Defining Customer Value • Understanding Customer Value Proposition 	Team: <ul style="list-style-type: none"> • Customer Value Proposition • Template: Step 8, Page 107 • Draft the CVP
	16		<ul style="list-style-type: none"> • Presentation and review of CVPs 	Team: <ul style="list-style-type: none"> • Complete CVP
9	17	Competitive Analysis and Positioning (Step 08)	<ul style="list-style-type: none"> • Understanding of Competitive Matrix • Competitive positioning: creating your separate space 	Team: <ul style="list-style-type: none"> • Identify major competitors, and dimensions for analysis • Template: Step 8, Page 109
	18		<ul style="list-style-type: none"> • Presentations of Competitive Analyses and Positionings 	Team: <ul style="list-style-type: none"> • Perform the competitive analysis and present results, including positioning
10	19	Product Line Strategy (Step 09)	<ul style="list-style-type: none"> • Product line framework: good, better, best on underlying platforms, plus application to Services. 	Team: <ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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
We ek	Sess ion	Topics and Steps	• Key CONCEPTS Introduced in Class	Team or Individual Activity
11	21	Reality Check (Step 11)	<ul style="list-style-type: none"> • The purpose of the Reality Check, testing the product concept, channel preferences, and much other. 	Team: <ul style="list-style-type: none"> • Reality Check Survey Template and Results: Step 11, Page 141, 143-144

	22		<ul style="list-style-type: none"> • Guidance on the number or additional customers for the reality check survey • How to analyze and interpret the results 	<ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • Team reports on Reality Check Results • Examine major components of an Industry Analysis • Review Templates 	Team: <ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • Defining the Business Model: • Lecture on basic structure and different types. • Illustrating it as the flow of product, money, and information. 	Team: <ul style="list-style-type: none"> • Business Model Illustration Template, Step 13, Page 170

Week	Session	Topics and Steps	· Key CONCEPTS Introduced in Class	Team or Individual Activity
13	25	Business Model (Steps 14, 15, 16, 17)	<ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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.
	26			
14	27	Impact Visioning (Step 18)	<ul style="list-style-type: none"> • Develop clear statements for business and societal impact. • Look at good existing examples of companies that do both. 	Team: <ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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	Tell Your Story	<ul style="list-style-type: none">• Presentation Format and Style• Format:<ul style="list-style-type: none">(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! <p>(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.)</p>	<p>Team:</p> <ul style="list-style-type: none">• The PPT Presentation  <ul style="list-style-type: none">• 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.
	30			
Final Course Deliverables			Due on the Monday after the weekend of the final class meeting.	<p>Team: Your Venture PPTs</p> <p>Individual: Insight Learning Reflection Journal</p>

Course Outcomes

- Identify one's values, passions, skills and their will to contribute to society
- Formulate an idea and validate it with customers
- Demonstrate prototyping and analyze the competition for the product
- Create business models for revenue generation and sustainability of their business
- Come up with a pitch that can be 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
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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
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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
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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
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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
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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 Kabaddi - International Kabaddi Federation

DOSP1091: Basketball

L	T	P	S	J	C
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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
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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
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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-curricular 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-curricular 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-curricular 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-curricular 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-curricular 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 Sheryl WuDunn)
2. The story of My Experiments with Truth (author: M. K. Gandhi)
3. List of student run and other Government and non-government community service 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 – Environmental Pollution
III**

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; $F = -\text{grad } V$; 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 conduction in solids; Thermal conductivity - Forbes 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 processes 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. Aruldas, 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, Uli Würfel (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-Einstein 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-Boltzmann, Fermi-Dirac and Bose-Einstein 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 (Fraunhofer 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 MnO₂ 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, Thomas 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} , $\sin bx/\cos bx$, 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 graph 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

$$\begin{array}{llll}
 \lim_{x \rightarrow a} \frac{x^n - a^n}{x - a} & \lim_{x \rightarrow 0} \frac{\sin x}{x} & \lim_{n \rightarrow 0} \frac{1 - (1+n)^{-1}}{n} & \lim_{x \rightarrow 0} \frac{e^x - 1}{x} \\
 1) & 2) & 3) & 4) \\
 \lim_{x \rightarrow 0} \frac{a^x - 1}{x} & & &
 \end{array}$$

(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

$$\int_a^b \sin^n x \, dx, \quad \int_a^b \cos^n x \, dx \quad \int_a^b \cos^n x \sin^m x \, dx$$

Of $\int_a^b \sin^n x \, dx$ and $\int_a^b \cos^n x \, dx$ (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 techniques 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 2×2 , 3×3 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 Cramer'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 $z = (a, b)$ 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 $x \cos \theta + y \sin \theta = p$, 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 Fermat's theorem and quadratic residues.
- To explain Chinese 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, 4th 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. (11)
- Estimate the true error and approximate error between the iterations of the mathematical procedure. (15)
- Formulate system of linear equations from engineering problem and solve using any of the numerical procedure(16)

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 2nd and 4th 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 1/3rd and 3/8th 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 2nd and 4th 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), χ^2 - test for goodness of fit, χ^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 Friends, 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
Textbook(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 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 [$1 - X^2/2! + X^4/4! - \dots$].
- Print following patterns

```
*
*
* *
* * *
* * * *
```

```
A
B B
C C C
D D D D
E E E E E
```

```
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 nC_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 AI 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 Chatbot, Architecture of a Chatbot. NLP in the cloud, NL Interface, How to Build a Chatbot, Transformative user experience of chatbots, Designing Elements 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 and Autonomous 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, 2017
2. Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach.

Reference Book(s)

1. Aurélien Giron. Hands on Machine Learning with Scikit-Learn and TensorFlow concepts, Tools, and Techniques to Build intelligent Systems , Published by O'Reilly Media, 2017
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 with Python - Publishing (2016).
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 AI 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), χ^2 - test for goodness of fit, χ^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 Friends, 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 1 3

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; π -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, Radar range equation, Friis 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 to me. 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

ELECTRONICS WORKSHOP

L	T	P	C
0	0	2	1

This workshop will enable the student to know the basics of electronic components and devices, their identification and selection for a given circuit. This lab makes the student to operate and use electronic devices, wire and fabricate various circuits on his own. The testing of the circuits wired / fabricated can be tested with the knowledge of various sources and power supplies introduced. Mini project is carried out towards end of the lab, which will inculcate good practice of hands on experience and experiential learning.

Course Objectives:

- to introduce and make use of Active and Passive electronic components.
- to impart knowledge of regulated power supplies, function generators and CRO and their applications.
- to enable wiring / soldering practice simple electronic circuits using various components on breadboard / PCB.
- to teach students about Diode as a switch, transistor as a switch and hardware components of a simple computer.
- to introduce solar panels and their wiring.
- to introduce hardware components like SMPS, switches, ports, input and output devices of a simple computer.
- to wire and test a mini project.

List of Experiments:

1. Study of resistance color codes, identification of active and passive electronic components.
2. Study and use of bread board trainer kit.
3. Study of multimeter , oscilloscope, function generation and regulated power supply.
4. Soldering of electronic components on PCBs.
5. Study of battery types, specifications, construction and ratings.
6. Study of semiconductor device (Diodes, Transistors, Thyristors) functionality and specifications
7. Study of Optoelectronic Devices (LEDs, Photoresistors, Photodiodes, Phototransistors)
8. Study of Basic Filter types and their design issues
9. Study of Voltage Regulators and Power Supplies
10. Study of Audio Electronic Circuits (Microphones, Preamplifiers, Mixer circuits)
11. Embedded System design with Arduino and Arduino IDE

Case Studies/Mini Projects

Any three design projects related to

1. Power Supply Design
2. Amplifier Design
3. Signal Source Design
4. Filter Design
5. Electromechanical Design
6. Arduino

Text Books

1. Louis E. Frenzel, Jr., Practical Electronic Design for Experimenters, Mc Graw Hill Publishers, 2020
2. Paul Scherz, Simon Monk, Practical Electronics for Inventors, 4/e, Mc Graw Hill Publishers, 2021

Course Outcomes:

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

- decode the resistance / inductance / capacitance values & tolerances (L4).
- understand and use RPS, voltmeter, ammeter, multimeter, function generator and CRO (L4).
- study and use breadboard for various circuit wiring (L5).
- fabricate simple circuits on a PCB and test them (L6).
- understand various hardware parts of a computer (L2).
- complete a mini project using Arduino and test it (L6).
- List various electronic devices and list their specifications (L2)

SIGNALS AND SYSTEMS

L	T	P	C
2	1	0	3

Pre-requisites : Transform Techniques
Alternate Exposure : Knowledge of MATLAB

Signals contain information about the behaviour or nature of some phenomenon and are functions of one or more independent variables. A system processes the signal for producing desired behaviour. Signal processing plays an extremely important and continually growing role in areas of science and technology such as communications, aeronautics and astronautics, acoustics, seismology, biomedical engineering and speech processing. This course introduces the basic concepts and mathematical tools required for signal processing.

Course Objectives

1. To explain the mathematical representation /classification of continuous-time and discrete-time signals and systems
2. To provide an understanding of characterization of linear-time invariant systems using impulse response and convolution function
3. To familiarize the application of Fourier series, Fourier transform and their properties to continuous-time and discrete time signals and systems
4. To impart the knowledge of Laplace and Z-transform and their properties to analyse continuous-time and discrete-time signals respectively.

Course Outcomes

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

- describe the mathematical model of continuous - time/discrete - time signals and systems and perform mathematical operations on signals (L2)
- determine the output response of continuous time/ discrete time LTI system using convolution integral and convolution sum(L2).
- analyse the characteristics of linear – time invariant systems(L4).
- derive the frequency domain representation of signals and systems using transform techniques(L3).
- determine the output response of LTI systems using CTFT and DTFT(L2).

Unit I Signals and Systems

8 Hours

Signals and Systems: continuous-time and discrete-time signals, transformations of the independent variable, exponential and sinusoidal signals, the unit impulse and unit step functions, continuous-time and discrete-time systems, basic system properties

Unit II Linear Time Invariant Systems

7 Hours

Discrete-time LTI systems: the convolution sum, continuous time LTI systems: the convolution integral, properties of linear time-invariant systems

Unit III: Fourier analysis of Continuous Time Signals and Systems 9 Hours

Fourier series representation of continuous time periodic signals, convergence of the Fourier series, properties of continuous-time Fourier series (CTFS). Representation of Aperiodic signals: the continuous-time Fourier transform (CTFT), the Fourier transform for periodic signals. properties of the continuous-time Fourier transform, systems characterized by linear constant-coefficient differential equations.

Representation of aperiodic signals: the discrete-time Fourier transform, properties of the discrete-time Fourier transform, the Fourier transform for periodic signals, systems characterized by linear constant-coefficient difference equations.

The Laplace Transform: the region of convergence (roc) for Laplace transforms, the inverse Laplace transform, properties of the Laplace transform. The Z-Transform: The region of convergence for the z-transform, the inverse-z transform, properties of the z-transform.

Simulation Assignments

This course shall involve at least 5 simulation assignments based on (but not limited to)

- Basics of MATLAB
- Generation of Continuous Time signals and Discrete Time Sequences
- Implementation of Continuous-Time and Discrete-Time Systems
- Reconstruction of Continuous Time Periodic Signals from their Fourier Series Coefficients
- Filtering and Fourier Transform Analysis of Continuous Time Signals

Text Books

1. Alan V. Oppenheim, S. Willsky with S.Hamid Nawab, Signals and Systems, 2/e, Pearson Education, 1997.

Reference Books

1. Bhagawandas P. Lathi, Linear Signals and Systems, Oxford University Press, 2009
2. Simon Haykin, Barry Van Veen, Signals and Systems, 2/e, Wiley Student Edition, 2007

Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	20	10	10
Sem End Examination	Total 30 Marks					

[illegible]

NETWORK THEORY AND ANALYSIS

L	T	P	C
2	1	0	3

Pre-requisites : Transform Techniques
Alternate Exposure : Knowledge of MATLAB, SPICE Simulation Tool

This course familiarizes the student with structure, operation, modelling and design of semiconductor devices and circuits. Laboratory experiments of this course includes hardware experiments, SPICE simulations and end-to-end circuit design using EDA/PCB design software. Study of these basic circuits is helpful to train the student to design amplifier circuits, digital switches and balanced amplifiers

Course Objectives

1. To introduce the physical construction of bipolar junction transistors (BJTs) and metal oxide field effect transistors (MOSFETs)
2. To impart the knowledge on design and simulation of current mirror circuits
3. To familiarize the analysis of the input impedance, output impedance, voltage gain and bandwidth of MOSFET amplifier configurations.
4. To explain the analysis and design of differential amplifiers
5. To expose the student to semiconductor technology evolution, amplifier design principles and circuit analysis techniques

Course Outcomes

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

1. describe the device structure/physical operation, analyze BJT/MOSFET circuits using their large signal and small signal models (L1).
2. distinguish between discrete component circuit design and integrated circuit design and appreciate the relative merits and demerits of BJT and MOSFET devices (L2).
3. design current mirror circuits given the output resistance, voltage headroom and output current requirements (L5).
4. derive the low frequency and high frequency characteristics of common source, common gate, common drain amplifiers (L4).
5. analyze and design differential amplifier circuits for gain and linearity requirements (L4/L6).

Unit I: Introduction

8 Hours

Introduction: Ohms law, Kirchhoff's laws, series and parallel circuits, source transformations, delta-wye conversion, linearity and superposition theorem with simple examples, Thevenin's and Norton's theorem with simple examples, maximum power transfer theorem with simple examples. mesh, super mesh analysis, nodal, super node analysisdiscrete-time systems, basic system properties

Unit II: Time Domain Analysis of Circuits

7 Hours

Time domain analysis of circuits: transient analysis of first order and second order systems, initial and final conditions in networks. dc transients: source free and forced response of RL, RC and RLC circuits analysis using Laplace transform

9 Hours

Unit IV: Resonance

9 Hours

Unit V: Two Port Networks

7 Hours

Text Books

- ## Reference Books

- | | | | | | | |
|--------------------------|----------------|--------|--------|------------|-------|-------|
| Continuous
Evaluation | Total 70 Marks | | | | | |
| | Quiz 1 | Quiz 2 | Quiz 3 | Assignment | CAT 1 | CAT 2 |
| | 10 | 10 | 10 | 20 | 10 | 10 |
| Sem End
Examination | Total 30 Marks | | | | | |

[illegible]

ELECTRONIC DEVICES AND AMPLIFIER CIRCUITS

L	T	P	C
3	0	2	4

Pre-requisites : Transform Techniques

Alternate Exposure : Knowledge of MATLAB, SPICE Circuit Analysis Tool

This course familiarizes the student with structure, operation, modelling and design of semiconductor devices and circuits. Laboratory experiments of this course includes hardware experiments, SPICE simulations and end-to-end circuit design using EDA/PCB design software. Study of these basic circuits is helpful to train the student to design amplifier circuits, digital switches and balanced amplifiers

Course Objectives

1. To introduce the physical construction of bipolar junction transistors (BJTs) and metal oxide field effect transistors (MOSFETs)
2. To impart the knowledge on design and simulation of current mirror circuits
3. To familiarize the analysis of the input impedance, output impedance, voltage gain and bandwidth of MOSFET amplifier configurations.
4. To explain the analysis and design of differential amplifiers
5. To expose the student to semiconductor technology evolution, amplifier design principles and circuit analysis techniques

Course Outcomes

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

- describe the device structure/physical operation, analyze BJT/MOSFET circuits using their large signal and small signal models (L1).
- distinguish between discrete component circuit design and integrated circuit design and appreciate the relative merits and demerits of BJT and MOSFET devices (L2).
- design current mirror circuits given the output resistance, voltage headroom and output current requirements (L5).
- derive the low frequency and high frequency characteristics of common source, common gate, common drain amplifiers (L4).
- analyze and design differential amplifier circuits for gain and linearity requirements (L4/L6).

Unit I: Bipolar Junction Transistors

8 Hours

Bipolar Junction Transistors: device structure and physical operation, current-voltage characteristics, the BJT as an amplifier and as a switch, BJT circuits at dc, biasing in BJT amplifier circuits, small-signal operation and models.

Unit II: MOS Field-Effect Transistors

7 Hours

Device structure and physical operation, current-voltage characteristics, MOSFET circuits at dc, the MOSFET as an amplifier and as a switch, biasing in MOS amplifier circuits, small signal operation and models.

9 Hours

Unit IV: Single Stage MOSFET amplifiers

9Hours

Unit V: Differential Amplifiers

7Hours

Text Books

- ## Reference Books

- | | | | | | | |
|--------------------------|----------------|--------|--------|------------|-------|-------|
| Continuous
Evaluation | Total 70 Marks | | | | | |
| | Quiz 1 | Quiz 2 | Quiz 3 | Assignment | CAT 1 | CAT 2 |
| | 10 | 10 | 10 | 20 | 10 | 10 |
| Sem End
Examination | Total 30 Marks | | | | | |

[illegible]

RANDOM SIGNALS AND NOISE

L	T	P	C
2	0	0	2

Pre-requisites : Transform Techniques
Alternate Exposure : Knowledge of MATLAB

This course allows characterization of randomness in measured quantities and signals. This characterization allows modelling of noise sources in communication systems and further helps in designing analog and digital communication systems that transfer information in the presence of noise

Course Objectives

1. To introduce the notion of probability as a tool to characterize random events
2. To impart the knowledge of characterizing and modeling random measurements as random variables
3. Model random signals as random processes and characterize them in time domain and frequency domain.
4. To explain the classification of noise sources and modelling of noise performance of systems
5. To expose the student to mathematical tools involved in analysing

Course Outcomes

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

1. characterize random events and measurements using probability and random variables (L3)
2. model random signals as random processes and describe their characteristics using autocorrelation function and power spectral density functions respectively (L4)
3. identify different sources of noise in electronic systems (L2)
4. characterize electronic systems by their noise figure and noise temperature
5. use the notion of noise measures to carry out link budget analysis of communication links

Unit I Probability and Random Variables

8 Hours

Basics of Probability, Conditional Probability, Random Variables, Functions of a Single Random Variable, Mean, Variance, and Characteristic Function, Functions of Two Random Variables, Jointly Gaussian Random Variables, Central Limit Theorem

Unit II Random Processes

12 Hours

Random Processes: Basic Concepts, Description of Random Processes, Statistical Averages, Stationary Processes, Random Processes and Linear Systems, Random Processes in the Frequency Domain: Power Spectrum of Stochastic Processes, Transmission over LTI Systems, Gaussian and White Processes, Gaussian Processes, White Processes

Characterization of Noise

10 Hours

Noise – Sources and Classification, Thermal Noise, Shot Noise, Noise Equivalent Bandwidth of a Filter, Noise Figure and Equivalent Noise Temperature of Two-Port Networks, Narrowband Noise Representation.

Simulation Assignments

This course shall have the below simulation assignments (but not limited to)

- Generation and Histogram evaluation of uniformly distributed and Gaussian distributed random numbers and plotting their histograms
- Generation of discrete random variables with a specified probability mass function
- Analyse the effect of transformation of random variables (both analytical and simulation approaches)
- Model a given random measurement as one of the known random variables and identify the parameters
- Compute the autocorrelation function and power spectral density of random signals at the input and output of a linear system

Text Books

1. P. Ramakrishna Rao, Communication Systems, 2/e, Tata Mcgraw Hill Publications, 2018
2. Proakis, Salehi, Communication Systems Engineering, 2/e, Pearson Education, 2010

Reference Books

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw Hill, 2002.
2. Athanasios Papoulis, S. Unnikrishna Pillai, Probability, Random Variables and Stochastic Processes, 4/e, Tata McGraw Hill, 2002
3. Henry Stark, John W. Woods, Probability and Random Processes with Application to Signal Processing, 3/e, Pearson Education, 2002

Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	20	10	10
Sem End Examination	Total 30 Marks					

[illegible]

ANALOG COMMUNICATIONS

L	T	P	C
2	0	0	2

Pre-requisites : Transform Techniques
Alternate Exposure : Knowledge of MATLAB

This course reviews the properties of Fourier Transform and exposes the fundamental concepts of modulation. Analog modulation schemes involving amplitude, angle are reviewed followed their implementation aspects in broadcasting systems

Course Objectives

1. To introduce the need for modulation to communicate signals
2. To familiarize the generation and detection of different analog modulation schemes
3. To impart knowledge of specifications and real-world applications of analog broadcasting systems
4. To expose the noise performance analysis and comparison of analog modulation schemes.

Course Outcomes

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

- explain the time domain and frequency domain description of different AM modulations schemes and compare them (L2).
- compare various modulation schemes like AM, DSBSC, SSB, VSB in terms of power and bandwidth efficiency (L4).
- list the specifications and design concerns of broadcasting systems employing analog modulation schemes (L3)
- compare the noise performance of different modulation schemes (L3)

Unit I: Fourier Transforms and Signal Transmission Through Systems 3 Hours

Electromagnetic Spectrum, Ranges and Application Areas , Continuous-Time Fourier Transform, Convolution and Correlation, Hilbert Transform, Signal Transmission through Systems. Need for Modulation

Unit II: Amplitude Modulation

10 Hours

Amplitude Modulation, Demodulation of AM Signals, AM Broadcast Transmitters, AM Broadcast Receivers, Double Sideband Suppressed Carrier (DSB-SC) Modulation, Single Sideband Modulation, Single Sideband Transmission and Reception, Compatible Single Sideband (CSSB) System, Communication Receivers, Vestigial Sideband Modulation, Comparison of Various Varieties of Amplitude Modulation

Unit III: Angle Modulation

10 Hours

Angle Modulated Signals, Narrowband Angle Modulation, Spectrum of an Angle-Modulated Signal, Power of an Angle-Modulated Signal and Effective Bandwidth, Generation of Wideband Angle-Modulated Signals, effects of Channel Non-Linearities on FM Signals, Detection of FM Signals, FM Broadcasting, FM Transmitters and Receivers, Radio and Television Broadcasting: AM Radio Broadcasting, FM Radio Broadcasting, Television Broadcasting

4 Hours

Simulation Assignments

- Modulation Property of Fourier Transform
- Generation of Amplitude Modulated waveforms with different modulation index
- Simulink modelling of Amplitude and Phase Modulation Generation/Detection schemes
- Time-Domain and Frequency Domain Analysis of different analog modulation schemes

1. P. Ramakrishna Rao, Communication Systems, 2/e, Tata McGraw Hill Publications, 2018
2. Proakis, Salehi, Communication Systems Engineering, 2/e, Pearson Education, 2010
3. Lathi, Modern Analog and Digital Communication Systems, 4/e, Oxford University Press, 2012.

1. Simon Haykin, Michael Moher, Introduction to Analog and Digital Communications, 2/e Wiley, 2007
2. Simon Haykin, Communication Systems 4/e, Wiley, 2001
3. Kennedy, David, Electronic Communication System 4/e, Tata McGraw Hill, 2012

[illegible]

DIGITAL LOGIC DESIGN

L	T	P	C
3	0	2	4

Digital Logic Design is an introductory course which provides the basic concepts involved in the design and analysis of digital circuits for computing systems. A digital circuit is constructed using basic building blocks: logic gates and flip-flops. This course deals with the design of various combinational and sequential circuits used to build more complex computing systems.

Course Objectives

1. To introduce number systems, conversion used for representing numbers in computational structures
2. To familiarize the implementation of simple logical operations using Combinational circuits
3. To acquaint the student with the design of combinational and sequential logic circuits with practical design examples
4. To expose different types of memories used in digital systems
5. To impart the design of synchronous and asynchronous digital systems
6. To demonstrate the use of standard chips and PLDs in building digital computational structures

Course Outcomes

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

1. convert any number into different base representations(L2).
2. simplify logic expressions using Boolean laws and realize using basic and universal logic gates(L3).
3. design combinational circuits for the given specifications(L4).
4. design synchronous sequential circuits for the given specifications (L4)
5. differentiate asynchronous and synchronous counters and implement Multiplexers and D flip flops using CMOS technologies(L3).

Unit I Binary Systems and Logic Gates

10 Hours

Binary Systems: digital systems, binary numbers, number base conversions, octal and hexadecimal numbers, complements, signed binary numbers, binary codes, binary logic. Boolean Algebra and Logic Gates: basic definitions, axiomatic definition of boolean algebra, basic theorems and properties of boolean algebra, boolean functions, canonical and standard forms, digital logic gates.

Unit II Simplification of Boolean functions

10 Hours

Simplification of Boolean functions: The map method, four-variable map, five-variable map, product of sums simplification, don't-care conditions, NAND and NOR implementation, exclusive-OR function.

Unit III: Combinational Logic Circuit Design

6 Hours

Combinational Logic: combinational circuits, analysis procedure, design procedure, binary adder-subtractor, decoders, encoders, multiplexers. Memories: random-access memory, memory decoding.

Unit IV: Sequential Logic Circuit Design**9 Hours**

Synchronous Sequential Logic: sequential circuits, latches, flip-flops, analysis of clocked sequential circuits, state reduction and assignment, design procedure. Registers and Counters: registers, shift registers, ripple counters, synchronous counters, ring counter.

Unit V: Implementation of Digital Logic Circuits**5 Hours**

Transistors as Switches, NMOS Logic Gates, CMOS Logic Gates, MOS Implementation of static latches and flipflops. Programmable Logic Devices: Programmable Logic Array, Programmable Array Logic, Complex Programmable Logic Devices, Field Programmable Gate Arrays. FPGA Design Flow

Text Books

1. Michael D. Ciletti, M. Morris Mano, Digital Design, 5/e, Pearson Education, 2014
2. Adel S. Sedra, Kenneth C. Smith, Microelectronic Circuits, 7/e, Oxford University Press, 2013

Reference Books

1. Zvi Kohavi, Switching and Finite Automata Theory, 2/e, Tata McGraw-Hill, 2008
2. John F. Wakerly, Digital Design Principles and Practices, 4/e, Pearson Education, 2008
3. Charles Roth, Jr., Larry Kinney, Fundamentals of Logic Design, 7/e, Cengage Learning, India, 2013.
4. Weste, Harris, CMOS VLSI Design, 4/e, Pearson Education, 2014

Continuous Evaluation	Theory Evaluation - Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	20	10	10
Sem End Examination	Total 30 Marks					

List of Laboratory Experiments:

1. Verification of Truth Tables of Logic gates and implementation of Basic gates using Universal Gates
2. Implementation of the given Boolean functions using logic gates in both SOP and POS form.
3. Simplification of the given Boolean function using K-map and implement using logic gates.
4. Realization and verification of Full adder and Full Subtractor using logic gates.
5. Implementation of the given function using decoder and logic gates.
6. Implementation of the given function using Multiplexer and logic gates.
7. Verification of State Tables of SR, D, JK and T-Flip-Flops.
8. Verify the operation of Shift Registers using D flip-flops.
9. Design and verify the operation of 4-bit and Mod-N Ripple Counters using JK flip-flops.
10. Verilog Modelling and Simulation of 1-bit full adder, 2 X 4 Decoder, Mod-13 Counter
11. Study of PLA, CPLD, FPGA Datasheets and appreciating their architectural highlights
12. FPGA Implementation of 1-bit full adder, 2 X 4 Decoder, 4-Bit Counter

ANALOG CIRCUITS

L	T	P	C
3	0	2	4

This course equips the student with design principles of electronic system building blocks including feedback, oscillators, output stages, frequency selective filters, wave shaping circuits. Laboratory experiments of this course shall include hardware experiments, SPICE simulations and end-to-end circuit design using EDA/PCB design software. Skills learnt in this course shall help the student in improving existing circuits using negative feedback, building power Amplifiers, signal processing circuits etc.

Course Objectives

1. To acquaint the students with the advantages and techniques of different negative feedback circuit configurations.
2. To introduce the basic principles of oscillator circuits and design/simulate discrete component and op-amp oscillator circuits.
3. To impart knowledge on analysis of the linearity, power efficiency and power dissipation of different output stages/power amplifiers
4. To explain the basics and design of analog frequency selective filters using Butterworth and Chebyshev approximations
5. To demonstrate the design of non-linear wave shaping circuits

Course Outcomes

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

1. analyse the characteristics of different negative feedback amplifier configurations (L4).
2. choose and design negative feedback circuits to improve the characteristics of given open loop amplifier (L3).
3. describe the basic principle of sinusoidal oscillators and identify the usage of different oscillator circuits (L1).
4. design analog filters for the given design specification (L5).
5. design different wave shaping circuits for signal processing applications

Unit I: Feedback

8 Hours

Feedback Amplifiers: The general feedback structure, properties of negative feedback, basic feedback topologies, the series-shunt feedback amplifier, the series-series feedback amplifier, shunt-shunt and shunt-series feedback amplifiers, determining loop gain.

Unit II: Oscillators

6 Hours

Oscillators: Basic principles of sinusoidal oscillators, op amp RC oscillator circuits, LC and crystal oscillators.

Unit III: Output Stages and Power Amplifiers

7 Hours

Output Stages and Power amplifiers: Classification of output stages, class A output stage, class B output stage, class AB output stage, power BJTs, class C output stage, MOS power transistor.

Unit IV: Analog Filter Design**9 Hours**

Filter Transmission, Types, and Specification, The Filter Transfer Function, Butterworth and Chebyshev Filters, First-Order and Second-Order Filter Functions, The Second-Order LCR Resonator. Active Filter Design

Unit V Multivibrator Circuits**7 Hours**

Bistable Multivibrators, Generation of Square and Triangular Waveforms Using Astable Multivibrators, Monostable Multivibrator, Integrated-Circuit Timers, Nonlinear Waveform-Shaping Circuits

Text Book(s):

1. Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Microelectronic Circuits, 6/e, Oxford University Press, 2013.
2. D Choudhury Roy, Shail B. Jain, Linear Integrated Circuits, New Age International, 2003.
3. Ramakanth Gayakward, Op-Amps and Linear Integrated Circuits, 4/e, Pearson Education, 2007.

References:

1. Behzad Razavi, Fundamentals of Microelectronics, 2/e, Wiley Student Edition, 2013.
2. R.F Coughlin, F.F Driscoll, Op-Amps and Linear Integrated Circuits, 6/e, Pearson Education, 2008.
3. S. Salivahanan, V.S. Kanchan Bhaskaran, Linear Integrated Circuits, Tata Mc- Graw Hill, 2008.
4. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 3/e, Tata Mc-Graw Hill, 2002.

Continuous Evaluation	Theory Evaluation - Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	20	10	10
Sem End Examination	Total 30 Marks					

List of Laboratory Experiments:

1. Feedback Amplifier - calculation of gain, input resistance, output resistance with and without feedback, frequency response characteristic.
2. Design and Implementation of Two stage RC Coupled amplifier.
3. Oscillators (Colpitts, RC phase-shift, Wein-bridge)
4. Class A power amplifier.
5. Class B Push - pull power amplifier.
6. Tuned voltage amplifier.
7. Analysis and simulation of RC differentiator/integrator
8. Bistable/Monstable/Astable multivibrators with 555 timer
9. Operational Amplifier Circuits (Adders, Integrators, Differentiators, Filters).
10. Op-amp based AM/FM Modulator/Demodulator Circuits.
11. Data Converters
12. Active Filter Design

CONTROL SYSTEMS

L	T	P	C
2	1	0	3

In everyday life many applications of control like control of temperature in air conditioners, water level maintenance, steering of car course etc., a never-ending list are encountered. These controls may be manual or automatic. Human body is an excellent example of automatic control system. Control system engineering deals with set of devices that control the behaviour of other devices or systems to achieve desired results. This course introduces the student to the principles and applications of control systems in everyday life.

Course Objectives

1. To expose various concepts of block diagram reduction techniques
2. To create mathematical modelling of the system.
3. To demonstrate stability of the system in time domain.
4. To impart knowledge on stability of the system in frequency domain.
5. To get acquainted with state variable analysis.

Course Outcomes

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

1. solve numerical on block diagrams reduction techniques (L3)
2. represent the mathematical model of a given system (L2).
3. determine the response of different order systems for various step inputs (L4).
4. analyse the stability of the system (L4).
5. comprehend solution of state equation (L3).

Unit I: Introduction

8 Hours

Introduction: Concepts of control systems, different examples of control systems, open loop and closed loop control systems and their differences, block diagram representation of systems considering electrical systems as examples, block diagram algebra, representation by signal flow graph, reduction using Mason's gain formula, feedback characteristics, effects of feedback

Unit II: Mathematical Modelling and Control System Components

7 Hours

Mathematical Modelling and Control System Components: Introduction to mathematical modelling of physical systems, impulse response and transfer functions, equations of electrical networks, modelling of translational and rotational mechanical systems, time response of first and second order systems with standard input signals, time domain specifications, steady state error and error constants.

Unit III: Stability

9 Hours

Concept of stability, Routh Hurwitz criterion, construction of root locus, correlation between time and frequency responses, determination of frequency domain specifications, effects of P, PI, PD and PID Controllers.

9 Hours

Unit V: State Variable Analysis

7 Hours

Text Books

- ## Reference Books

- | | | | | | | |
|--------------------------|----------------|--------|--------|------------|-------|-------|
| Continuous
Evaluation | Total 70 Marks | | | | | |
| | Quiz 1 | Quiz 2 | Quiz 3 | Assignment | CAT 1 | CAT 2 |
| | 10 | 10 | 10 | 20 | 10 | 10 |
| Sem End
Examination | Total 30 Marks | | | | | |

[illegible]

ELECTROMAGNETIC WAVES

L	T	P	C
3	0	0	3

The concept of electromagnetism is evolved from static electric and magnetic fields when time is added as fourth dimension. Electromagnetism is the principle with which all electrical machines function. Electromagnetism is used as a mode of propagation of energy at very frequencies. This is a foundation course for understanding the concept of wave transmission in free space or in any media carrying data / message / voice / audio from transmitter to receiver.

Course Objectives

1. To demonstrate the concepts of static electric and magnetic fields and their importance in electromagnetics
2. To impart the knowledge of basic characteristics of an electromagnetic field.
3. To explain the principle of transmission of energy using electromagnetic wave
4. To familiarize the electromagnetic fields and mechanism of transmission of energy in free space / dielectric medium

Course Outcomes

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

1. apply vector calculus to understand the behaviour of static electric fields in standard configurations. (L3)
2. apply vector calculus to understand the behaviour of static magnetic fields in standard configurations. (L3)
3. describe and analyze electromagnetic wave propagation in free-space, conductor and dielectric media. (L2)
justify the concept of electromagnetic waves in terms of transporting energy or information (L6)
4. describe the reflection of plane wave at normal and oblique incidence in free space and dispersive media (L4).

Unit I: Electrostatics

8 Hours

Electrostatics: Coulomb's law, electric field intensity, field due to a line charge, electric flux density, Gauss's law, electric potential, potential gradient, energy stored, Laplace's and Poisson's equations

Unit II: Magnetostatics

7 Hours

Magnetostatics: steady current, Biot-Savart's law, static magnetic field due to line current, magnetic flux density, Ampere's circuital law, Lorentz force equation, magnetic vector potential, energy stored.

Unit III: Time-varying fields and Maxwell's equations

9 Hours

Time-varying fields and Maxwell's equations: time varying fields, Faraday's law of electromagnetic induction, displacement current, Maxwell's equations in point form and integral form, boundary conditions of electromagnetic fields, polarization, magnetization.

9 Hours

Unit V: Plane Waves at Boundaries and in Dispersive Media

7 Hours

Text Books

- ## Reference Books

- | | | | | | | |
|-----------------------|----------------|--------|--------|------------|-------|-------|
| Continuous Evaluation | Total 70 Marks | | | | | |
| | Quiz 1 | Quiz 2 | Quiz 3 | Assignment | CAT 1 | CAT 2 |
| | 10 | 10 | 10 | 20 | 10 | 10 |
| Sem End Examination | Total 30 Marks | | | | | |

[illegible]

DIGITAL SIGNAL PROCESSING

L	T	P	C
3	0	2	4

Unprecedented developments in the interpersonal communications and on demand entertainment is enabled with the Digital Signal Processing (DSP) engineering. DSP is the heart of digital revolution that brought music players, mobile phones, etc. into every walk of common man life. It unified the electronics, communications, and computer science. All electronic systems today use powerful DSP concepts as their foundations. A thorough understanding of digital signal processing fundamentals and techniques is imparted in this course.

Course Objectives

1. To introduce the frequency analysis of discrete time LTI systems
2. To identify different hardware structures for IIR systems
3. To explain the numerical computation of DFT / FFT along with their properties and applications
4. To expose the design of IIR filters
5. To expose the design of FIR filters

Course Outcomes

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

1. list the advantages of digital signal processing over analog signal processing (L1)
2. describe discrete time signals and generate them using MATLAB
3. describe the frequency domain analysis of discrete time signals and systems and carry out the analysis using MATLAB
4. realize a digital filter in different forms and compare their complexity
5. compute the DFT/IDFT of a sequence and understand the complexity issues
6. design a digital FIR/IIR filter for given design specification and implement design using MATLAB

Unit I: Discrete Time Systems

8 Hours

Transform Analysis of Discrete Time LTI Systems: Frequency response of LTI systems. System Functions for Systems Characterized by Linear Constant Coefficient Difference Equations: Stability, causality, impulse response for rational system functions. Structures for IIR Discrete Time Systems: Direct, parallel and cascade form.

Unit II: Discrete Fourier Transform

7 Hours

The Discrete Fourier Transform (DFT): Representation of periodic sequences. The discrete Fourier series, Fourier representation of finite duration sequences, the discrete Fourier Transform (DFT), computation of DFT, properties of the DFT, circular convolution and linear convolution using DFT, overlap-add method, overlap-save method.

Unit III: Fast Fourier Transform

5 Hours

Fast Fourier Transform (FFT): Radix-2 decimation-in-time and decimation-in-frequency FFT algorithms, inverse FFT.

Unit IV: Design of IIR Filters**9 Hours**

Design of IIR Filters: Design of analog prototypes from digital filter specifications using Butterworth and Chebyshev approximations, design of IIR filters from analog filters, Butterworth filters and Chebyshev filters design using impulse invariance, bilinear transformation

Unit V: Design of FIR Filters**8 Hours**

Design of FIR Filters: Linear discrete time systems with generalized linear phase, design of linear phase FIR filters using window functions (rectangular, Hamming, Hanning, Blackman and Kaiser) frequency sampling technique.

Text Book(s):

1. A.V. Oppenheim, R. W. Schaffer, Digital Signal Processing Prentice Hall of India, 2004.

References:

1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4/e, Pearson Education, 2007.
2. Sanjay K. Mitra, Digital Signal Processing- A Computer Based Approach, 4/e, Tata Mc Graw Hill Publications, 2011
3. Iffachor E.C, Jervis B.W, Digital Signal Processing – A Practical Approach, 2/e, Pearson Education, 2002

List of Laboratory Experiments:**Part 1: Digital Signal Processing System Design/Simulation with MATLAB (Using MATLAB/Octave/Python)**

1. Generation of discrete time signals in time domain.
2. Implementation of discrete time systems in time domain.
3. Frequency analysis of discrete time signals using DTFT.
4. Frequency analysis of discrete time systems using DTFT
5. Discrete Fourier transform (DFT) and properties
6. FIR filter design.
7. IIR filter design.

Part 2: Real-Time Digital Signal Processing Implementation (Using TMS320C6478 LCDK Kit)

1. Study of TMS320C6478 DSK and code composer studio.
2. Sinusoidal waveform generation.
3. FIR filter implementation on LCDK Kit.
4. IIR filter implementation on LCDK Kit.
5. Mini project on DSP (Example: DTMF generation and detection using correlation processing/FFT).

Continuous Evaluation	Theory Evaluation - Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	20	10	10
Sem End Examination	Total 30 Marks					

DIGITAL COMMUNICATIONS

L	T	P	C
3	0	2	4

Noise-free and reliable long-distance communication has become a reality due to the advances in digital communications. This course introduces the process of analog-to-digital conversion and elaborates on techniques communicating digital data in both power limited and bandlimited channels. Noise performance of various digital modulation schemes is also introduced to create insight on choice of proper digital modulation technique for a particular application

Course Objectives

1. To expose the student to advantages of digital communication over analog communications
2. To represent information in analog signal using digital samples using sampling, quantization and encoding
3. To elaborate the Understanding Inter Symbol Interference and methods to mitigate its effect
4. To expose the student to digital passband modulation techniques and illustrate power vs bandwidth tradeoffs
5. To compare the noise performance of different digital modulation schemes

Course Outcomes

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

1. describe the sampling of analog signals and their reconstruction in time and frequency domain
2. explain the time division multiplexing of analog telephone signals using pulse code modulation
3. describe the different carrier modulation schemes and compare their BER performance and bandwidth requirements
4. derive the Nyquist criterion for distortion less baseband transmission.
5. distinguish between band-limited and power-limited systems and their constraints.
6. describe the generation and detection of DS and FH spread spectrum, OFDM systems

Unit I: Analog to Digital Conversion

8 Hours

Advantages of Digital Communication over Analog Communication Systems. Analog to Digital Conversion: sampling process, pulse modulation schemes- pulse amplitude, pulse width, pulse position modulation. pulse code modulation (PCM), differential pulse code modulation, delta modulation, time division multiplexing.

Unit II: Baseband Transmission Of Digital Data

7 Hours

Baseband Transmission of Digital Data: The Intersymbol Interference Problem, The Nyquist Channel, Raised-Cosine Pulse Spectrum, Baseband Transmission of M-ary Data, The Eye Pattern.

Unit III: Digital Band-Pass Modulation Techniques

9 Hours

Binary Amplitude-Shift Keying, Phase-Shift Keying, Frequency-Shift Keying, Summary of Three Binary Signalling Schemes, Noncoherent Digital Modulation Schemes, M-ary Digital

Modulation Schemes, Mapping of Digitally Modulated Waveforms onto Constellations of Signal Points

Unit IV: Noise in Digital Communications

5 Hours

Bit Error Rate, Detection of a Single Pulse in Noise, Optimum Detection of Binary PAM in Noise, Optimum Detection of BPSK, Detection of QPSK and QAM in Noise, Optimum Detection of Binary FSK, Differential Detection in Noise, Summary of Digital Performance

Unit V: Spread Spectrum and OFDM Communication Techniques **8 Hours**

Spread Spectrum Modulation: Pseudo-noise sequences, notion of spread spectrum, direct sequence spread spectrum with coherent binary phase shift keying, Frequency hop spread spectrum. Introduction to Orthogonal Frequency-Division Multiplexing, Modulation and Demodulation in an OFDM System, Applications of OFDM

Text Books

1. Simon Haykin, Michael Moher, Introduction to Analog and Digital Communications, 2/e Wiley, 2007.
2. Proakis, Salehi, Fundamentals of Communication Systems, 2/e, Pearson Education, 2017

Reference Books

1. Simon Haykin, Communication Systems 4/e, Wiley, 2001
2. Proakis, Salehi, Communication Systems Engineering, 2/e, Pearson Education, 2010
3. P. Ramakrishna Rao, Communication Systems, 2/e, Tata Mcgraw Hill Publications, 2018

List of Laboratory Experiments:

1. MATLAB Simulation of Sampling and reconstruction of analog signals.
2. MATLAB Implementation of Uniform Quantizer and quantization noise analysis
3. MATLAB Simulation of DPCM scheme
4. PCM transmission
5. Simulation of Baseband Transmission and Equalization using MATLAB Simulink
6. MATLAB Simulink modelling of ASK Generation and Detection
7. MATLAB Simulink modelling of PSK Generation and Detection
8. MATLAB Simulink modelling of FSK Generation and Detection
9. Simulation and Noise Performance Analysis of Digital modulation schemes using MATLAB/Simulink/ LABVIEW/MULTISIM.
10. Real-Time Implementation of Digital Modulation Schemes on SDR Kits
11. MATLAB Implementation of Spread Spectrum and Orthogonal Frequency Division Multiplexing Systems

Continuous Evaluation	Theory Evaluation - Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	20	10	10
Sem End Examination	Total 30 Marks					

ANTENNA ANALYSIS AND DESIGN

L	T	P	C
3	0	0	3

Pre-requisites : Transform Techniques, Electromagnetic Waves

Alternate Exposure : Knowledge of MATLAB

In today's world, all modes of communications are tending towards wireless. Any wireless device is to be equipped with antenna, which converts the energy suitably for radiation into free space or vice versa. Concepts of radiation and various types of antennas based on various classifications are introduced in this course. Synthesis of antennas, that is, building an antenna array for generating a desired radiation pattern is also presented.

Course Objectives

1. To introduce the basic characteristics and fundamental parameters of antennas
2. To familiarize the concepts of wire antennas
3. To acquaint the student with knowledge of high frequency antennas
4. To impart knowledge about types of antenna arrays and their analysis and synthesis
5. To introduce antennas for mobile communications

Course Outcomes

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

- explain the radiation mechanism of an antenna and its fundamental parameters and observe practically the radiation pattern of antennae(L2).
- distinguish the wired antennas based on their field components(L2).
- examine the radiation pattern of aperture antennas theoretically and practically(L3).
- explain how to improve the strength and directivity of antenna using antenna arrays (L2).
- identify the requirement of microstrip and smart antenna in applications(L2).
- design micro strip antenna using simulation software (L6).

Unit I: Antenna Characteristics

8 Hours

Characteristics of Antennas: Introduction, types of antennas, radiation mechanism, current distribution on a thin wire antenna, fundamental parameters of antenna, Friis transmission equation and radar range equation, introduction to auxiliary vector potentials.

Unit II Wire Antennas

7 Hours

Wire Antennas: Infinitesimal dipole, small dipole antenna, half wavelength dipole, region of separation, ground effects, image theory.

Unit III: Aperture Antennas

5 Hours

Aperture Antennas: Introduction, introduction to rectangular wave guides, E-plane sectoral horn, H-plane sectoral horn, pyramidal horn antenna, parabolic reflector antenna.

Unit IV: Antenna Arrays and Synthesis

9 Hours

Antenna Arrays: Introduction, two element array, N element linear array, uniform amplitude and spacing, directivity, super directivity. Antenna Synthesis: Introduction, continuous sources, Schelkunoff polynomial method.

8 Hours

Text Books

- ## Reference Books

- | | | | | | | |
|--------------------------|----------------|--------|--------|------------|-------|-------|
| Continuous
Evaluation | Total 70 Marks | | | | | |
| | Quiz 1 | Quiz 2 | Quiz 3 | Assignment | CAT 1 | CAT 2 |
| | 10 | 10 | 10 | 20 | 10 | 10 |
| Sem End
Examination | Total 30 Marks | | | | | |

[illegible]

COMMUNICATION NETWORKS

L	T	P	C
3	0	2	4

This course introduces the student to the fundamental principles and tools used in building data communication networks. This course shall augment other courses that require networking services including Internet of things, Wireless Networks and Wireless Sensor networks

Course Objectives

1. To introduce the basics of computer network technology, typical network scenarios, layering models and service descriptions
2. To familiarize the principles and usage of networking applications including web, HTTP, DNS and socket programming
3. To acquaint the principles and design issues of transport layer services and the protocols supporting these services for different network applications
4. To acquaint the data plane and control plane aspects of network layer
5. To demonstrate the data link layer aspects and physical layer technologies enabling the internet

Course Outcomes

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

1. describe the notion of services, protocols, layering and fundamentals metrics of data networks(L1)
2. appreciate the need and operation of different application layer protocols and their services(L1).
3. explain the different transport layer services, protocols and their operation(L4).
4. demonstrate the architecture of internet and identify the use of different routing algorithms (L4).
5. compare the capabilities and use of different MAC layer protocols, devices employed in different physical layer technologies(L4).

Unit I: Computer Networks and the Internet

8 Hours

Services description and definition of protocol, Network Edge and Network Core. Delay, Loss and Throughput in Packet-Switched Networks, Protocols layers and their service models.

Unit II: Application Layer

7 Hours

Application Layer: Principles of Network Applications, The Web and the HTTP, Electronic Mail, Domain Naming Systems, Socket Programming.

Unit III: Transport Layer

5 Hours

Transport Layer: Introduction to transport layer services, multiplexing and demultiplexing, connectionless transport: UDP, principles of reliable data transfer, connection-oriented transport: TCP.

Unit IV: Network Layer

9 Hours

Network Layer (Data Plane): Overview of network layer, Internals of a Router, Internet Protocol: IPv4, Addressing, IPv6. Network Layer (Control Plane): Routing algorithms, Intra-AS routing (OSPF), Routing among ISPs (BGP), Internet control message protocol (ICMP).

8 Hours

Text Books

- ## Reference Books

- ### List of Laboratory Experiments:

- | | | | | | | |
|--------------------------|-------------------------------------------|--------|--------|------------|-------|-------|
| Continuous
Evaluation | Theory Evaluation - Total 70 Marks | | | | | |
| | Quiz 1 | Quiz 2 | Quiz 3 | Assignment | CAT 1 | CAT 2 |
| | 10 | 10 | 10 | 20 | 10 | 10 |
| Sem End
Examination | Total 30 Marks | | | | | |

Continuous Evaluation	Laboratory Evaluation - Total 100 Marks									
	Lab1	Lab2	Lab3	Lab4	Lab5	Lab6	Lab7	Lab8	Lab9	Lab10
	10	10	10	10	10	10	10	10	10	10
Sem End Examination	Total 20 Marks									

[illegible]

MICROPROCESSORS AND MICROCONTROLLERS

L	T	P	C
3	0	2	4

Electronic gadgets became part and parcel of a common man these days. Microcontroller is an essential heart of any electronic gadget. It is the device which is responsible for the operation the gadget whatever may be the application of use. Microprocessor is that component which drives the microcontroller. Essential features of the microprocessor as well as the microcontroller are introduced in this course. Interfacing this controller with many a number of peripherals is also treated elaborately

Course Objectives

1. To familiarize the concepts and architecture of 16 bit microprocessor 8086
2. To explain assembly language programming of 8086 microprocessor
3. To demonstrate the architecture, instruction set and programming of 8051 microcontroller
4. To impart the knowledge of C programming to interface various peripherals like data converters, timers, serial port etc
5. To demonstrate microcontroller based embedded system

Course Outcomes

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

1. summarize the concepts of architecture, instruction set and addressing modes of 8086 microprocessor (L2).
2. develop programs of 8086 microprocessor to perform various tasks and verify the programs with 8086 kits (L3).
3. differentiate between microprocessor and microcontroller and understand the basics of 8051 microcontroller and perform experiments with microcontroller 8051 using Keil-C51 (L4).
4. interpret the interfacing of microcontroller with different peripheral devices such as timers, serial port, ADC and DAC etc. and verifying it practically using trainer kits (L3).
5. identify the architectural highlights of ARM processors (L4).

Unit I: 8086 Architecture

8 Hours

The Processor 8086: Register organization of 8086, architecture of 8086, signal description of 8086, physical memory organization, I/O addressing capability.

Unit II: Instruction Set and Interrupts

7 Hours

Instruction Set and Interrupts: Addressing modes of 8086, instruction set of 8086, assembly language programs (example programs), interrupts and interrupt service routines, interrupt cycle of 8086, non-maskable interrupt, maskable interrupt (INTR).

Unit III: 8051 Microcontroller

5 Hours

Introduction to Microcontroller 8051: Intel family of 8 bit microcontrollers, architecture, signal description, register set of 8051, important operational features of 8051, program status word (PSW).

Unit IV: Programming 8051 Timers and Serial Ports**9 Hours**

Programming 8051 Timers and Serial Port: Basic registers of timer, modes of operation, programming timers in C (examples), Basics of serial communication, baud rate in 8051, SBUF, SCON, serial port programming in C (examples).

Unit V: Interfacing 8051 with ADC/DAC**8 Hours**

Interfacing of Peripherals to 8051: ADC 0808/0809 chip with 8 analog channels, programming ADC 0808/0809 in C, DAC interfacing DAC 0808, programming DAC in C. Introduction to ARM Processor: The ARM family history, ARM family variations.

Text Books

1. AK Ray, KM Bhurchandi, Advanced Microprocessors and Peripherals, 2/e, Tata McGraw Hill Publications, 2009.
2. Muhammad Ali Mazidi, Janice Gillispie, Mazidi, Rolin D. Mc Kinlay, The 8051 Microcontroller and Embedded Systems using Assembly and C, Second Edition, Pearson Education, 2002
3. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Janice Mazidi, ARM Assembly Language Programming & Architecture, Pearson Education, 2002

Reference Books

1. Barry B. Brey, The Intel Microprocessors: Architecture, Programming and Interfacing, 8/e, Pearson Education, 2008.
2. Kenneth J. Ayala, 8086 Micro Processor: Programming and Interfacing the PC, 1/e, Delmar Cengage Learning, 2007.
3. Douglas V Hall, Microprocessors and Interfacing: Programming and Hardware, 2/e, Tata Mc Graw Hill, 2006.

List of Experiments

Experiments with Microprocessor 8086 using Assembler:

1. Arithmetic operations on 8 bit and 16 bit operands.
2. Transfer block of data from one memory location to another memory location.
3. Programs using monitor routines.
4. Compute maximum, minimum and sorting (ascending and descending).
5. Generate Fibonacci series, average of N numbers and factorial of N.

Experiments with Microcontroller 8051 using Keil-C51:

1. Arithmetic operations on 8051.
2. Transfer given string serially with suitable baud rate.
3. Generation of waveforms using timers of 8051.
4. Interface DAC with 8051 to generate waveforms.
5. Interface ADC with 8051 to read analog data and display read data.

Simulation Experiments with ARM Development System

1. Demonstration of ARM Development System and Tools
2. Basic Experiments involving memory and I/O interfacing

Continuous Evaluation	Theory Evaluation - Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	20	10	10
Sem End Examination	Total 30 Marks					

VLSI DESIGN

L	T	P	C
3	0	2	4

VLSI Design allows large number of electronic devices to be integrated in a single small chip resulting in high speed of operation and low power dissipation. This has dramatically improved the evolution of telecommunication systems and electronic appliances. This course introduces the student to the two popular VLSI design methodologies including FPGA design and full custom IC design. FPGAs are used in the design of low-volume digital integrated circuits with reconfigurability and less design time. Full custom methodology allows high-volume design of integrated circuits with low area, high speed and ultra-low-power dissipation. Further, students will be exposed to industry-standard FPGA boards and IC design tools.

Course Objectives

1. To introduce the design flow of integrated circuits using hardware description languages and programmable logic devices.
2. To explain the architecture and usage of different types of programmable logic devices including PLAs, PLDs, CPLDs and FPGAs
3. To describe semiconductor technology evolution, the different steps of IC fabrication process and appreciate the role of mask layout in the design process.
4. To provide an understanding of the constraints imposed by fabrication engineer and learn to prepare mask layouts as per design rules
5. To comprehend the design of combinational and sequential circuits from MOS schematic to layout.

Course Outcomes

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

1. model combinational/sequential logic circuits and their testbenches at different levels of abstraction in Verilog (L3).
2. describe and compare the architectures of different programmable logic devices (L2).
3. explain the evolution of IC technology and its fabrication process (L1).
4. derive the stick diagram and mask layout for a given MOS circuit (L5).
5. build combination and sequential building blocks at the subsystem level using different MOS circuit styles (L5).

Unit I: Modeling Digital Circuits with HDLs

10 Hours

VLSI Design Methodologies: Computer Aided Design: Hardware description languages, Verilog description of combinational circuits, Verilog modules, Verilog assignments, procedural assignments, modeling flip-flops using always block, delays in Verilog, compilation, simulation, and synthesis of Verilog code, Verilog data types and operators, simple synthesis examples, Verilog models for multiplexers, modeling registers, counters and finite state machines using Verilog always statements, behavioral and structural Verilog, testing a Verilog model

Unit II: Programmable Logic Devices

6 Hours

Programmable Logic Devices: Simple programmable logic devices (SPLDs), Complex programmable logic devices (CPLDs), Field programmable gate arrays (FPGAs), implementing functions in FPGAs.

Unit III: Full Custom IC Design

7 Hours

IC Design Technology: Integrated Circuit (IC) era, Metal Oxide Semiconductor (MOS) and related VLSI technology, basic MOS transistors, enhancement mode transistor action, NMOS fabrication, CMOS fabrication, comparison of NMOS, CMOS, BICMOS, GaAs technologies. Basic Electrical Properties of MOS Circuits: Drain current vs drain-source voltage relationships, MOS transistor threshold voltage, pass transistor, NMOS inverter, CMOS inverter

Unit IV: MOS Circuit Design Process

9 Hours

MOS Circuit Design Process: MOS Layers, stick diagrams, design rules and layout, 2 μ m micron based design rules, layout diagrams, symbolic diagrams. CMOS Circuit and Layout Design using Static Complementary CMOS Logic Style. Delay and Power Analysis of CMOS Logic Circuits

Unit V: Subsystem Design and Layout

8 Hours

Subsystem Design and Layout: Some architectural issues, switch logic, gate (restoring) logic, examples of structured design, parity generator, multiplexers, general logic function block. Design of Latches and Flipflops using Static Complementary CMOS

Text Books

1. Charles H. Roth, Lizy Kurian John, Byeong Kil Lee, Digital Systems Design using Verilog, 1/e, Cengage Learning, 2016
2. Douglas A. Pucknell, Kamran Eshraghian, Essentials of VLSI Circuits and Systems, 1/e, Prentice Hall, 2012.
3. Weste, Harris, CMOS VLSI Design, 4/e, Pearson Education, 2014

Reference Books

1. Kang, Leblibici, CMOS Digital Integrated Circuits, 3/e, Tata McGraw Hill, 2001.
2. Jan M. Rabaey, Digital Integrated Circuits, 2/e, Pearson Education, 2002.
3. Jackson, Hodges, Analysis and Design of Digital Integrated Circuits, 3/e, Tata McGraw Hill, 2010

List of Experiments

Part 1: FPGA Implementation of Digital Circuits

1. Verilog modelling, simulation and FPGA implementation of combinational logic circuits: basic gates, multiplexer, comparator, adder/subtractor.
2. Verilog modelling, simulation and FPGA implementation of combinational building blocks: Multipliers, decoders, address decoders, parity generator, ALU.
3. Verilog modelling, simulation and FPGA implementation of sequential logic circuits: D-Latch, D-Flip flop, registers.
4. Verilog modelling, simulation and FPGA implementation of sequential building blocks: Ripple counters, synchronous counters, shift registers (serial-to-parallel, parallel-to-serial)
5. Verilog modelling, simulation, and FPGA implementation of finite state machines: Mealy state machine, Moore state machine,
6. Digital system design examples: GCD processor example, arithmetic multiplier.

Part 2: Full Custom Design of Digital Circuits

Full custom IC design flow: Schematic, symbol, simulation, layout, Design Rule Checking (DRC), layout vs. schematic (LVS), RC Extraction (RCX) and post layout simulation of

1. CMOS inverter,
2. NAND gate
3. Complex Gates
4. One-bit full adder
5. D-flip flop.
6. Delay and Power Analysis of CMOS Digital Circuits

Continuous Evaluation	Theory Evaluation - Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	20	10	10
Sem End Examination	Total 30 Marks					

Continuous Evaluation	Laboratory Evaluation - Total 100 Marks									
	Lab1	Lab2	Lab3	Lab4	Lab5	Lab6	Lab7	Lab8	Lab9	Lab10
	10	10	10	10	10	10	10	10	10	10
Sem End Examination	Total 20 Marks									

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PROGRAM ELECTIVES

ARM SYSTEM DEVELOPMENT

L	T	P	C
3	0	0	3

The emphasis of this course is to familiarize with the advanced 32-bit ARM microcontroller architecture, programming and develop applications. This course provides the knowledge of LPC2148 microcontroller architecture and pipelining concept used in it. Programming of LPC 2148 with polling and interrupt methods are emphasized. The students are exposed to the interfacing external peripheral devices.

Course Objectives:

1. To provide a clear understanding on the RISC and CISC and ARM philosophy.
2. To program ARM 32 microcontroller in assembly language.
3. To familiarize the pipelining concept used in advanced microcontrollers.
4. To describe the concepts of peripheral interfacing with ARM microcontroller.
5. To introduce programming with embedded C.

Course Outcomes:

- understand the ARM philosophy and ARM data flow model (L1).
- analyze and understand ARM instruction set and THUMB instruction set (L4).
- understand the exception, interrupts and interrupt handling schemes (L2).
- describe the architectural features of LPC2148 microcontrollers (L2).
- explain the hardware and interfacing peripheral devices to LPC2148 (L2).

Unit I:

8 Hours

Introduction to ARM 7 Architecture: The RISC design philosophy, ARM design philosophy, embedded system hardware- AMBA bus protocol, embedded system software-applications. ARM core data flow model, Registers, CPSR-Processor modes.

Unit II:

8 Hours

ARM Instructions Set: Fundamentals of ARM instructions, Barrel shifter, Classification and explanation of instructions with examples-Data processing, Branch, Load-store, SWI and Program Status Register instruction, Introduction to THUMB, Differences between ARM and THUMB, Register usage in Thumb.

Unit III:

9 Hours

Exception Handling: ARM processor exceptions and modes, vector table, exception priorities, link register offsets. Interrupts- assigning interrupts, interrupt latency, IRQ and FIQ exceptions with example- code for enabling and disabling IRQ and FIQ exceptions, Comparison between exception and interrupts. Interrupt handling schemes- nested interrupt handler, non-nested interrupt handler. Basic interrupt stack design

Unit IV:

9 Hours

Introduction to ARM7 Microcontroller: LPC2148 ARM 7 microcontroller, Features of LPC2148, Architecture of LPC2148, addressing mode, Memory organization, ARM register model, programmer model, oscillator, PLL, CPSR, SPSR, 3stage pipelining.

Unit V:

8 Hours

Interfacing with ARM: LED,GPIO programming with embedded C, LCD interfacing, programming of LCD, ADC, Interfacing of LM35 temperature sensor, DAC, Timers,UART programming, transfer of a character and receive of a character program.

Text Books:

1. Andrew N. SLOSS, ARM System Developer's guide, ELSEVIER Publications, 2016.
2. Steve Furber, ARM System-on-chip Architecture, Pearson Education, 2012.

References:

1. In Sider's Guide to Philips Arm7 Based Microcontroller, Shitex.co.uk.
2. ARM Assembly Language – William Hohl, CRC Press.

INTERNET OF THINGS

L	T	P	C
3	0	0	3

The Internet of Things (IoT) is a network of a wide variety of devices like vehicles, humans, soil etc. These devices gather data using sensors, which can be used for monitoring or control. This course is an introduction to the embedded devices, communication protocols used in IoT.

Course Objectives

1. Introduce the fundamental concepts of IoT and physical computing
2. Illustrate diverse methods of deploying smart objects and connect them to network.
3. Expose the student to a variety of embedded boards and IoT Platforms
4. Familiarize the student with application program interfaces for IoT.
5. Enable students to create simple IoT applications.

Course Outcomes

- Interpret the impact and challenges posed by IoT networks leading to new architectural models.
- Compare and contrast the deployment of smart objects and the technologies to connect them to network.
- Understand design methodology and hardware platforms involved in IoT.
- students will be able implement IoT applications using Raspberry Pi.
- Design cloud applications and analyse the design considerations and methodologies.

Unit I Introduction to Internet of Things 8 Hours

The Internet of Things: An Overview, The Flavor of the Internet of Things, The "Internet" of "Things", The Technology of the Internet of Things, Enchanted Objects, Advantages and Disadvantages of IoT Applications, Characteristics of IoT, IoT Applications, Components of IoT System, IoT Architecture and Levels, Technologies used in IoT, Building Blocks of IoT, Functional blocks of IoT.

Unit II Transducers, Sensors and Actuators 9 Hours

Introduction to Transducers, Introduction to Sensors: Classification and Types of Sensors, Criteria to choose a Sensor, Classification of Actuators, Interfacing concepts to Embedded Systems, Wireless Sensor Networks and its Technologies: Architecture of WSN, Network topologies, Issues/Challenges and Security in WSN, Wireless Sensing Technologies (RF Modem, Bluetooth, Wi-Fi, Zigbee, RFID and LoRa), Case Studies of Bluetooth/Zigbee/RFID/LoRa applications.

Unit III: IoT Physical Devices and Endpoints- Arduino UNO 8 Hours

Introduction to Arduino, Arduino UNO Board, Installing the Software, Fundamentals of Arduino Programming, Example modules on Arduino.

Unit IV IoT Physical Devices and Endpoints- Raspberry Pi 10 Hours

IoT Physical Devices and Endpoints - RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi with Python : Temperature Sensor, Connecting Raspberry Pi via SSH, Remote access to RaspberryPi.

10 Hours

Text Books

1. Srinivasa K G, “Internet of Things”, CENGAGE Learning India, 2018
2. Introduction to IoT by Sudip Misra, Anandarup Mukherjee, CAMBRIDGE, 2021 Edition
3. Internet of Things and its Applications: Made simple (English Edition)
4. Programming the Raspberry pi : Getting Started with Python by Simon Monk, McGrawHill-2013
5. Internet of Things with Raspberry Pi and Arduino by Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh and Mahendra Swain, CRC Press Taylor & Francis Group.

1. Adrian McEwen, Hakim Cassimally , Designing the Internet of Things, Wiley Publications, 2012
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. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1stEdition, VPT, 2014. (ISBN: 978-8173719547)
4. Adrian McEwen, Hakim Cassimally, —Designing the Internet of Things, John Wiley and Sons 2014.

Continuous Evaluation	Total 70 Marks							
	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Assignment	CAT 1	CAT 2
	4M	4M	4M	4M	4M	10M	Mid Term-20M/30M	NPTEL/Coursera-10M/20M
Sem End Examination	Total 30 Marks							

[illegible]

IOT ARCHITECTURE AND PROTOCOLS

L	T	P	C
3	0	0	3

The purpose of this course is to impart knowledge on IoT Architecture and various protocols, study their implementations

Course Objectives

1. To Understand the Architectural Overview of IoT
2. To Understand the various IoT Protocols (Datalink, Network, Transport, Session, Service)

Course Outcomes

- Understand the concepts of IoT Architecture Reference model and IoT reference architecture.
- Understand the concept of Cloud IoT Architecture.
- Analyze various IoT Data Link & Network layer Protocols.
- Analyze various IoT Transport & Session layer Protocols.
- Analyze various IoT Service layer Protocols.

Unit I Designing the Architecture of an IP-based Internet of Things 9 Hours

IoT Architecture-State of the Art – Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Physical/link Layer, Network Layer, Transport Layer, Application Layer.

Unit II Interoperability 8 Hours

Cloud IoT platform architecture, REST Architectures, The Richardson maturity model

Unit III: IoT Data Link Layer & Network Layer Protocols 10 Hours

PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), WirelessHART, ZWave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH, ND, DHCP, ICMP, RPL, CORPL, CARP

Unit IV Transport & Session Layer Protocols 10 Hours

Transport Layer: TCP, MPTCP, UDP, DCCP, SCTP, TLS, DTLS, Session Layer: HTTP, CoAP, XMPP, AMQP, MQTT, REST, Websocket

Unit V Service Layer Protocols & Security 8 Hours

Service Layer: one M2M, ETSI M2M, OMA, BBF, Security in IoT Protocols: MAC, 802.15.4, 6LoWPAN, RPL, Application Layer

Text Books

1. Internet of Things: Architectures, Protocols and Standards, Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri.

2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
3. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI 3. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
4. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014. (ISBN: 978-8173719547)

Reference Books

1. Misra, S., Mukherjee, A., & Roy, A. (2021). Introduction to IoT. Cambridge: Cambridge University Press. doi:10.1017/9781108913560
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. Hersent, Olivier, David Boswarthick, and Omar Elloumi. The internet of things: Key applications and protocols. John Wiley & Sons, 2011.

Continuous Evaluation	Total 70 Marks							
	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Assignment	CAT 1	CAT 2
	4M	4M	4M	4M	4M	10M	Mid Term-20M/30M	NPTEL/Coursera-10M/20M
Sem End Examination	Total 30 Marks							

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1		3	1		1						2	2	1	2	
2		2			2						2	2	1		
3	2	1										1	1		
4	2	1										1	1		
5	2	1										1	1		

IOT APPLICATIONS

L	T	P	C
3	0	0	3

This course will introduces application areas of IoT technologies by conducting Industrial case studies and IoT Standards,IoT legal perspectives at design phase

Course Objectives

1. Introducing the application areas of IoT technologies by conducting Industrial case studies
2. Processing the knowledge on IoT Standards and IoT legal perspectives at design phase

Course Outcomes

- Explore Smart Water & Environment applications and IoT Use Cases and IoT Use Cases
- Investigate Smart Metering & Smart Cities applications and IoT Use Cases
- Investigate Smart Health ,Home Automation , Smart Retail & Logistics applications and IoT Use Cases
- Comprehend the Smart Industrial control & Agricultural applications and IoT Use Cases
- Understand the standardization of IoT and IoT Legal perspectives

Unit I Smart Water and Environment 6 Hours

Smart Environment: Forest Fire Detection, Air Pollution, Snow Level Monitoring, Landslide and Avalanche Prevention, Earthquake Early Detection. Smart Water: Potable water monitoring, Chemical leakage detection in rivers, Swimming pool remote measurement, Pollution levels in the sea, Water Leakages, River Floods

Unit II Smart Metering and Smart Cities 6 Hours

Smart Cities: Parking, Structural Health, Noise Urban maps, Smart Phone Detection, Electromagnetic Field Levels, Traffic Congestion, Smart Lighting, Waste Management, Smart Roads. Smart Metering : Smart Grid, Tank level, Photovoltaic Installations, Silos Stock Calculation

Unit III: Smart Health ,Home Automation, Retail and Logistics 10 Hours

Home Automation: Energy and Water Use, Intrusion Detection Systems. Health: Fall Detection, Medical Fridges, Sportsmen Care, Patients Surveillance, Ultraviolet RadiationSmart Retail: Supply Chain Control, NFC Payment, Intelligent Shopping Applications, Smart Product Management. Logistics: Quality of Shipment Conditions, Item Location, Storage Incompatibility Detection, Fleet Tracking

Unit IV Smart Industrial control and Agricultural 10 Hours

Industrial Control: M2M Applications, Indoor Air Quality, Temperature Monitoring, Ozone Presence, Indoor Location, Vehicle Auto-diagnosis, Perimeter Access Control, Liquid Presence, Radiation Levels, Explosive and Hazardous Gases. Agricultural: Green Houses, Golf Courses, Meteorological Station Network, Compost, Hydroponics, Offspring Care, Animal Tracking, Toxic Gas Levels

Unit V IoT Legal Perspectives and Standardization**8 Hours**

Self-Regulation, International Legal Framework, Security and Privacy: Privacy Enhancing Technologies, Legal Challenges for a Privacy Framework, , Responsibility for Violations of Privacy, Tackling Environmental Concerns
Standardization:ISO, IEC, ETSI, IEEE, IETF, ITU-T, OASIS, OGC and one M2M

Text Books

1. Ovidiu Vermesan, Peter Friess, Internet of Things From research and innovation to market deployment, 2014, River Publishers Series in Communication, USA.
2. Introduction to IoT by Sudip Misra, Anandarup Mukherjee, CAMBRIDGE, 2021 Edition
3. Internet of Things and its Applications: Made simple (English Edition)

Reference Books

1. Ovidiu Vermesan, Peter Friess, Internet of Things Converging Technologies for Smart Environments and Integrated Eco Systems, 2013, River Publishers Series in Communication, USA.
2. Libelium Inc, Internet of Things: Case Studies, <http://www.libelium.com/resources/case-studies>, White papers, Spain.

Continuous Evaluation	Total 70 Marks							
	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Assignment	CAT 1	CAT 2
	4M	4M	4M	4M	4M	10M	Mid Term-20M/30M	NPTEL/Coursera-10M/20M
Sem End Examination	Total 30 Marks							

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1		3				3	3		3						
2		3				3			3						
3		3				3			3						
4		3				3			3						
5		3				3	2		3						

WIRELESS SENSOR NETWORKS

L	T	P	C
3	0	0	3

This course aims to provide fundamentals of wireless sensor networks and its application to critical real time.

Course Objectives

1. To learn basic principles behind a Wireless Sensor Network.
2. To study network protocols, services and applications.
3. To study the importance localization, secure aggregation, security.
4. To study simulation of wireless networks.
5. To understand the routing protocols.

Course Outcomes

- Compare and contrast Ad hoc and wireless sensor networks, describe existing applications of wireless sensor networks.
- Explain node architecture and software aspect of WSN.
- Illustrate various network level protocols for MAC and routing.
- Analyze control, clustering, localization, positioning.
- Distinguish between the various hardware, software platforms that exist for sensor networks.

Unit I Basics of WSN Vs Ad HoC 10 Hours

Basics of Ad Hoc Networks and their applications, enabling technologies, classification of Ad-hoc networks, Overview of different challenges in implementing Ad Hoc Networks, Overview of different solutions proposed for overcoming the challenges in these networks, self organizing behavior, Properties, Differences between the self-organizing systems and the conventional ones, Mechanisms for ensuring self-organization in MANETs, Co-operation in MANET's, Dealing with misbehaviors in MANETs, Incentive mechanisms for countering misbehaviors, Basic concepts of wireless sensor networks, Features of MWSNs, Different types of MWSNs, Human-Centric Sensing. Case study: The great duck island experiment.

Unit II Introduction to Sensor Node 9 Hours

Architecture and components of a sensor node, Characteristics and requirements of sensor node, Design challenges, Different sensing scenarios using WSN, Challenges in implementing WSNs, Sensor-web introduction, Types of sensor node behavior, Security of WSN, Operating systems and execution environments, Some examples of sensor nodes, Optimization goals and figures of merit, Gateway concepts, Case study: Design of SWAN sensor node.

Unit III: MAC Protocols 9 Hours

Need for MAC protocols for MANETs, Classification of MAC protocols, Hidden and exposed terminal problems, MAC protocols MACA, MACAW, DBTMA, MARCH, MAC protocols for sensor networks, Routing challenges in MANET's Proactive, reactive, and hybrid routing protocols, Examples routing protocols, Factors in performance evaluation, Issues with the adoption of ad hoc routing protocols for WSN, Data-centric routing, Position-based routing, Data aggregation Clustering-based routing algorithm.

8 Hours

Unit V Sensor platform & Tools

9 Hours

Text Books

- ## Reference Books

- | | | | | | | | | |
|--------------------------|----------------|--------|--------|--------|--------|------------|-------|-------|
| Continuous
Evaluation | Total 70 Marks | | | | | | | |
| | Quiz 1 | Quiz 2 | Quiz 3 | Quiz 4 | Quiz 5 | Assignment | CAT 1 | CAT 2 |
| | | | | | | | | |
| Sem End
Examination | | | | | | | | |

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SENSORS AND SIGNAL CONDITIONING

L	T	P	C
3	0	0	3

This course gives an understanding of how the physical parameters are transduced into proportional electrical signals. The knowledge acquired in this course is helpful in advanced courses like Bio medical Instrumentation , Analytical Instrumentation, Opto Electronic Instrumentation. The course helps the students to develop an understanding of how the sensors are to be selected, calibrated and incorporated into an automated process system.

Course Objectives

1. To provide basic knowledge sensors and transducer technology and measurement systems.
2. Expose student to various sensors and transducers for measuring different quantities.
3. To provide better familiarity with the Theoretical and Practical concepts of Transducers
4. To provide familiarity with different sensors and their applications in real life.

Course Outcomes

- Identify suitable sensors and transducers for real time applications.
- Translate theoretical concepts into working models.
- "Design the experimental applications to engineering modules and practices.
- Design engineering solutions to the Industry/Society needs and develop products.

Unit I Introduction to Measurement System 8 Hours

Introduction to measurement systems, Static characteristics of MS: Accuracy, precision, Linearity, Hysteresis, Threshold, Repeatability, Reliability, Maintainability, Span, Calibration. Sources of errors, Dynamic characteristics of M.S. - Zero order, first order instruments and their responses for impulse, step, ramp & sinusoidal Inputs and frequency response. Basics of signal conditioning: signal amplification, filtering, Instrumentation amplifier.

Unit II Resistive Sensors 8 Hours

Introduction to Sensors, Introduction to Transducers, Classification of Transducers, Resistive sensors: Potentiometers , Strain gauges and types, Bridge configuration, compensation. Resistive Temperature Detectors (RTD), Thermistors, Light-Dependent Resistors (LDR), Signal conditioning for resistive sensors: measurement of resistance , voltage dividers, Wheatstone bridge. Balance and deflection measurements

Unit III: Reactive Sensors 8 Hours

Reactance variation and Electromagnetic Sensors : Variable & Differential, Inductive sensors – Reluctance variation, Eddy current, Linear Variable Differential Transformers (LVDT), Rotary Variable Differential Transformer (RVDT). Variable Capacitive Transducers: Capacitance Principles, Capacitive Displacement Transducers, Capacitive Hygrometer and Capacitive Proximity Sensors, Signal conditioning for reactance variation sensors : problems and alternatives, ac bridges, carrier amplifiers.

Unit IV Self Generating Sensors 8 Hours

Self-generating sensors: Thermoelectric Sensors, Piezoelectric Sensors, Pyroelectric sensors,

Photovoltaic sensors , Electrochemical sensors, Signal conditioning for self-generating sensors: chopper and low-drift amplifiers, offset and drifts amplifiers , electrometer amplifiers.

Unit V Digital Sensors, Semiconductor Device Sensors 9 Hours

Digital sensors: Position Encoders, Variable Frequency Sensors – Quartz Digital Thermometer, Vibrating Wire Strain Gauges, Vibrating Cylinder Sensors. Sensors based on MOSFET Transistors, Charge coupled Sensors. MEMS Overview: Unique Characteristics of MEMS, Typical Application Areas of MEMS, MEMS Accelerometer, Optical MEMS, MEMS as a switch, MEMS Micro actuators. Principles of micro sensors: MEMS for Pressure, Force and Temperature Measurement.

Text Books

1. Doebelin E.O, "Measurement Systems – Applications and Design" , McGraw Hill International, 4th Edition, 1990.
2. Patranabis D, "Principles of Industrial Instrumentation", TMH, 2nd Edition, 1997.
3. "Murthy D V S, ""Transducers and Instrumentation"" , PHI, 1995"
4. Ramon Pallas-Areny, John G. Webster, "Sensors and Signal Conditioning", , John Wiley & Sons, 2nd Edition.
5. Graham M. Brooker, "Introduction to Sensors for Ranging and Imaging" Scitech Publishing 2009

Reference Books

1. A K Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Sons
2. Ian Sinclair, "Sensors and Transducers", Elsevier, 3rd Edition, 2011
3. John P. Bentley, "Principles of Measurement Systems", Pearson Education, 3rd Edition, 2000.
4. Julian Garder, Vijay K. Varadan, "Microsensors, MEMS and Smart Devices" John Wiley & Sons Ltd. (2006).
5. Jon Wilson , “Sensor Technology Handbook”, Newnes 2005.

Continuous Evaluation	Total 70 Marks							
	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Assignment	CAT 1	CAT 2
	4M	4M	4M	4M	4M	10M	Mid Term-20M/30M	NPTEL/Coursera-10M/20M
Sem End Examination	4M							

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	2											2		1	
2	3	2		2		2						2		1	
3	3	3		2		2			2	1	1	2	3	3	2
4	3	3	3	2		2			2	1	1	2	3	3	2
5	3	3	3	2		2			2	1	1	2	3	3	1

IOT SECURITY

L	T	P	C
3	0	0	3

The Internet of Things (IoT) is a network of a wide variety of devices like vehicles, humans, soil etc. These devices gather data using sensors, which can be used for monitoring or control. This course is an introduction to the embedded devices, communication protocols used in IoT.

Course Objectives

1. To learn the concepts about Internet of things
2. "The purpose of this course is to expose students to new developments in the areas of cybersecurity for the Internet of Things (IoT)"
3. To learn the security principles and methodologies for Internet of Things

Course Outcomes

- Ability to understand the Security requirements in IoT.
- Understand the cryptographic fundamentals for IoT
- "Ability to understand the authentication credentials and access control"
- Understand the various types Trust models and Cloud Security.

Unit I INTRODUCTION: SECURING THE INTERNET OF THINGS 8 Hours

Security Requirements in IoT Architecture - Security in Enabling Technologies -Security Concerns in IoT Applications. Security Architecture in the Internet of Things -Security Requirements in IoT - Insufficient Authentication/Authorization - Insecure Access Control - Threats to Access Control, Privacy, and Availability - Attacks Specific to IoT. Vulnerabilities – Secrecy and Secret-Key Capacity -Authentication/Authorization for Smart Devices - Transport Encryption – Attack & Fault tree

Unit II IDENTITY & ACCESS MANAGEMENT SOLUTIONS FOR IOT 8 Hours

"Identity lifecycle – authentication credentials – IoT IAM infrastructure – Authorization with Publish / Subscribe schemes – access control "

Unit III: PRIVACY PRESERVATION AND TRUST MODELS FOR IOT 8 Hours

"Concerns in data dissemination – Lightweight and robust schemes for Privacy protection – Trust and Trust models for IoT – self-organizing Things - Preventing unauthorized access."

Unit IV CRYPTOGRAPHIC FUNDAMENTALS FOR IOT 8 Hours

Cryptographic primitives and its role in IoT – Encryption and Decryption – Hashes –Digital Signatures – Random number generation – Cipher suites – key management fundamentals – cryptographic controls built into IoT messaging and communication protocols – IoT Node Authentication

Unit V CLOUD SECURITY FOR IOT 8 Hours

Cloud services and IoT – offerings related to IoT from cloud service providers – Cloud IoT security controls – An enterprise IoT cloud security architecture – New directions in cloud enabled IoT computing

Text Books

1. "Practical Internet of Things Security (Kindle Edition) by Brian Russell, Drew Van Duren "
2. Securing the Internet of Things Elsevier
3. Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations
4. "Johnson Jr, C. Richard, William A. Sethares, and Andrew G. Klein, "Software receiver design: build your own digital communication system in five easy steps," Cambridge University Press, 2011."
5. "A. Narayanan et al., "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction," Princeton
6. University Press, 2016"

Reference Books

1. Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies," O'Reilly, 2014
2. "T. Alpcan and T. Basar, "Network Security: A Decision and Game-theoretic Approach," Cambridge University Press, 2011."

Continuous Evaluation	Total 70 Marks							
	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Assignment	CAT 1	CAT 2
	4M	4M	4M	4M	4M	10M	Mid Term-20M/30M	NPTEL/Coursera-10M/20M
Sem End Examination	Total 30 Marks							

[illegible]

CLOUD BASED IOT

L	T	P	C
3	0	0	3

This module provides an overview of the Internet of Things (IoT) and Cloud Computing concepts, infrastructures and capabilities. This will help students gain the necessary knowledge to construct IoT systems and use cloud services for processing and storage of the data produced by the IoT devices. Emphasis will be placed on the architecture and design of IoT systems, the different technologies (wireless/mobile/sensor) governing system implementation and the migration of the data to the Cloud for processing. Students will gain practical experience in the development of Cloud-based IoT systems and exposure to appropriate hardware and software platforms that underpin such development.

Course Objectives

1. Evaluate industry-leading systems and technologies for public and private cloud infrastructure
2. Learn how to use cloud services for IoT applications.
3. Implement cloud features to secure and harden the cloud infrastructure

Course Outcomes

- To understand the differences between traditional deployment and cloud computing.
- Students able to learn about cloud services and cloud platforms.
- Able to understand the different IoT cloud services.
- To learn how to build a transactional web application for the cloud or migrate one to it.
- Design the IoT cloud application in different cloud platforms.

Unit I Introduction to cloud computing 8 Hours

Characteristics of Cloud computing – Cloud Models – Cloud Services – IaaS, PaaS, SaaS, DaaS– Cloud based services and applications

Unit II Cloud Services and Platforms 8 Hours

Compute Services, Storage Services, Database services, Application Services, Content Delivery Services, Analytics Services, Deployment and Management Services, identity and Access management services : Amazon Web Services, Google Cloud Platform, Windows Azure

Unit III: Cloud Application Architectures 9 Hours

Development environments for service development: Amazon, Azure, Google Appcloud platform in industry

Unit IV Privacy and Security 10 Hours

Web Application Design- Machine Image Design-privacy design –Database management, Security Concerns, Risk Issues, and Legal Aspects of Cloud Computing- Cloud Data Security.

Unit V IoT Cloud- Case Study 10 Hours

Case Study: Arduino IoT Cloud with NodeMCU, IBM Watson IoT Platform, Google Cloud IoT Core, Microsoft Azure IoT, Amazon Web Service (AWS) IoT Core.

Text Books

1. Arshdeep Bahga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", A HANDSON APPROACH Text Book series, 2013.
2. "RajkumarBuyya, Christian Vecchiola, S.ThamaraiSelvi,""Mastering Cloud Computing: Foundations and Applications Programming""", Elsevier publication, 2013"

Reference Books

1. Reese, G. (2009). Cloud Application Architectures: Building Applications and Infrastructure in the Cloud. Sebastopol, CA: O'Reilly Media, Inc. (2009).
2. Thomas Erl, ZaighamMahmood, and Ricardo Puttini,Cloud Computing Concepts, Technology & Architecture, PRENTICE HALL,2013
3. John R. Vacca, "Cloud Computing Security: Foundations and Challenges", CRC Press, 2016.

Continuous Evaluation	Total 70 Marks							
	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5	Assignment	CAT 1	CAT 2
	4M	4M	4M	4M	4M	10M	Mid Term-20M/30M	NPTEL/Coursera-10M/20M
Sem End Examination	Total 30 Marks							

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	1								1			1			
2	1											1			
3				1	2				1			1			
4			3												
5	3	3	3	3	3	2			3	3	2	2	2	2	2

REAL TIME SIGNAL PROCESSING

L	T	P	C
2	0	2	3

The course provides knowledge of DSP theory, algorithms and techniques that are applicable to the design of contemporary real-time embedded systems. Topics in both classical and statistical DSP methods are covered including optimal filtering, spectral estimation and adaptive filtering with applications in analysis

Course Objectives

1. express concepts of real time concepts, architecture and addressing modes of TMS320C6x processor.
2. express instructions and interrupts of TMS320C6x Processor
3. emphasize on data formats and constraints of DSP processors.
4. present how to realize FIR and IIR filters.
5. emphasize on adaptive filtering algorithms and optimization schemes.

Course Outcomes

- understand the real world applications, architecture and addressing modes of DSP processors.
- understand instructions and interrupts of TMS320C6x processor.
- analyze data formats and constraints related to DSP Processors
- realize FIR and IIR filters
- analyse adaptive filtering algorithms and optimization schemes for improving performance.

Unit I Introduction to Real Time Signal Processing 9 Hours

Introduction: Introduction to real time concepts, Signal Processing and DSP systems, Comparison between general purpose and DSP processors. Architecture: TMS320C6x Architecture, Functional Units, Fetch and Execute, Packets, Pipelining, Registers. Addressing modes: Linear and Circular Addressing Modes

Unit II C6x Processor 9 Hours

Instruction Set of the C6x Processor: TMS320C6x Instruction Set-Assembly Code Format, Types of Instructions, Assembler Directives, Timers, Interrupts- Interrupt Control Registers, Interrupt Acknowledgment, Multichannel Buffered Serial Ports, Direct Memory Access.

Unit III: Data representation of DSP Processors 9 Hours

Data representation of DSP Processors: Data Types, Floating-Point Format, Q-format Number Representation, Finite Word Length Effects on Fixed-Point DSPs, Overflow and Scaling, Real time implementation considerations, Memory Considerations, Code Improvement, Constraints: Memory Constraints, Cross-Path Constraints, Load/Store Constraints, Pipelining Effects with More Than One EP within an FP.

9 Hours

Infinite Impulse Response Filters: IIR Filter Structures, Direct Form I Structure, Direct Form II Structure, Direct Form II Transpose, Cascade Structure, Parallel Form Structure."

9 Hours

Adaptive Filters: Introduction, Adaptive Structures, Adaptive Linear Combiner, Performance Function Searching for the Minimum
Code Optimization: Introduction to optimization, Optimization Steps, Procedure for Code Optimization, Software Pipelining for Code Optimization, and Execution Cycles for Different Optimization Schemes.

1. To study about DSP Processors and architecture of TMS320C6713 DSP processor
2. Introduction to MATLAB and Code Composer Studio.
3. Write a MATLAB Program for the generation of basic signals such as unit impulse, unit step, ramp, exponential, sinusoidal and cosine.
4. To study matrix multiplication using code composer studio.
5. Evaluate 4 point DFT of and IDFT of $x(n) = 1, 0 \leq n \leq 3; 0$ elsewhere.
6. Implement FFT algorithm.
7. Verify Blackman and Hamming windowing techniques.
8. Implement IIR Butterworth analog Low Pass for a 4 KHz cut off frequency.
9. Verify Circular Convolution using code composer studio.
10. Verify linear convolution of two sequence using code composer studio.
11. To implement Tone Generation.
12. To implement floating point arithmetic.
13. Write a MATLAB program to design a FIR Low pass, High pass, Band pass, Band stop filter using Rectangular window.
14. Write a MATLAB program to design Chebyshev Type-I (Low pass filter, High pass, Band pass & Band stop filter).
15. Real-time audio or image processing applications

1. Boca Raton, Real-Time Digital Signal Processing from MATLAB to C with the TMS320C6x DSPs CRC Press, (2011)
2. Rulph Chassaing and Donald Reay, "Digital Signal Processing and Applications with the C6713 and C6416 DSK", Second edition, A John Wiley and Sons, Inc., Publication. ISBN 9780471704065

Reference Books

1. Kuo, woon seng-s gen, "Digital Signal Processors: Architectures, Implementations, and Applications", Pearson education.
2. B. Venkataramani, M. Bhaskar, "Digital signal processors architecture, programming and applications", TMH Edition

Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	20	10	20
Sem End Examination	Total 30 Marks					

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3												2		
2	3												2		
3		3	3						2						2
4		2	3						2						
5		3	3						2			1			3

DIGITAL IMAGE PROCESSING

L	T	P	C
3	0	0	3

This course provides an introduction to basic concepts, methodologies and algorithms of digital image processing focusing on the following three major problems concerned with digital images: (1) image enhancement and restoration for easier interpretation of images, (2) image compression techniques and (3) image analysis and object recognition. Some advanced image processing techniques (e.g., wavelet and multiresolution processing) will also be studied in this course. The primary goal of this course is to lay a solid foundation for students to study advanced image analysis topics such as computer vision systems, biomedical image analysis, and multimedia processing & retrieval.

Course Objectives

1. Introduce the scope of field of image processing and basic concepts in digital image processing
2. Demonstrate different of image enhancement techniques.
3. Describe different segmentation & compression techniques.
4. Analyze different morphological techniques.
5. Construct a model for object recognition.

Course Outcomes

- Describe the theory and algorithms that are widely used in digital image processing
- Apply a proper image enhancement technique for given a set of noisy images.
- Compare different image segmentation and compression techniques.
- Formulate solutions using morphological concepts.
- Develop any application using different image processing techniques.

Unit I Digital Image Fundamentals and Transforms 10 Hours

Elements of Visual perception, Image sensing and Acquisition , Imaging in different bands, Digital Image Representation: Black and White, Gray scale and colour Images, Relationship between pixels, Image transformations: 2D-DFT, DCT, DST, Hadamard, Walsh, Hotelling transformation, 2D-Wavelet transformation, Wavelet packets. Examples and case studies

Unit II Image Enhancement 8 Hours

Gray Level Transformations, Histogram modification and equalization, Enhancement Using Arithmetic and Logic operations, Combining Spatial Enhancement Methods , Smoothing and Sharpening Spatial Filters, Smoothing and Frequency Domain Filters, Homomorphic Filtering. Examples and case studies

Unit III: Image Restoration and Segmentation 10 Hours

Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering , Inverse filtering, Wiener filtering, Segmentation: Morphological operations in Binary and Gray Images, Point, Line and Edge segmentation. Edge linking and Boundary detection. Segmentation using thresholding, Region based segmentation, Region merging, Region splitting, Splitting and merging, Watershed segmentation, Region growing. Examples and case studies

Unit IV Image Compression**9 Hours**

Error free compression: Variable length coding, LZW, Bit-plane coding, Lossless predictive coding, Lossy compression: Lossy predictive coding, transform coding, wavelet coding. Image compression standards, CCITT, JPEG, JPEG 2000, Video compression standards. Examples and case studies

Unit V Image Representation and Recognition**8 Hours**

Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture – Patterns and Pattern classes – Recognition based on matching. Examples and case studies

Text Books

1. R. C. Gonzalez, R. E. Woods, Digital Image Processing, Pearson Education. III Ed., 2016
2. Jain A.K., Fundamentals of Digital Image Processing, Prentice-Hall, 2002.

Reference Books

1. Al Bovik (ed.), “Handbook of Image and Video Processing”, Academic Press, 2000.
2. M. Petrou, P. Bosdogianni, “Image Processing, The Fundamentals“, Wiley, 1999.
3. Bernd Jähne, Digital Image Processing, Springer-Verlag Berlin Heidelberg 2005.
4. J. C. Russ. The Image Processing Handbook. CRC, Boca Raton, FL, 4th edn., 2002.

Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	20	10	20
Sem End Examination	Total 30 Marks					

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1		3											2	3	2
2		3				2	3			2	3	2		3	
3	3	3		2		3	3			2		2		3	
4	3				2		3			2		2		2	2
5	3	3		3		2				2		2		3	2

DSP PROCESSORS

L	T	P	C
3	0	0	3

Digital Signal Processors are specialized computer chips designed to perform speedy and complex operations on digitized waveforms. This course provides an exposure to the various fixed point & a floating point DSP architectures and also applications of using these processors to real-world situations.

Course Objectives

1. Impart the knowledge of basic DSP concepts and number systems to be used, different types of A/D, D/A conversion errors.
2. Learn the architectural differences between DSP and General purpose processor.
3. Learn about interfacing of serial & parallel communication devices to the processor.
4. Implement the DSP & FFT algorithms.

Course Outcomes

- Understand the basics of Digital Signal Processing and transforms.
- Able to distinguish between the architectural features of General purpose processors and DSP processors.
- Understand the architectures of TMS320C54xx devices.
- Discuss about various memory and parallel I/O interfaces.
- Analyze the concepts of interpolation and decimation filters

Unit I INTRODUCTION TO DIGITAL SIGNAL PROCESSING 9 Hours

Introduction: Digital signal-processing system, discrete Fourier Transform (DFT) and fast Fourier transform (FFT), differences between DSP and other micro processor architectures; Number formats: Fixed point, floating point and block floating point formats, IEEE-754 floating point, dynamic range and precision, relation between data word size and instruction word size; Sources of error in DSP implementations: A/D conversion errors, DSP computational errors, D/A conversion errors, Q-notation.

Unit II ARCHITECTURE OF PROGRAMMABLE DSPs 9 Hours

Multiplier and multiplier accumulator, modified bus structures and memory access in PDSPs, multiple access memory, multiport memory, SIMD, VLIW architectures, pipelining, special addressing modes in PDSPs, on-chip peripherals.

Unit III: OVERVIEW OF TMS320C54XX PROCESSOR 9 Hours

Architecture of TMS320C54XX DSPs, addressing modes, memory space of TMS320C54XX processors. Program control, instruction set and programming, on-chip peripherals, interrupts of TMS320C54XX processors, pipeline operation.

Unit IV INTERFACING MEMORY AND I/O PERIPHERALS TO PDSPs 9 Hours

Memory space organization, external bus interfacing signals, memory interface, parallel I/O interface, programmed I/O, interrupts and I/O, direct memory access (DMA)

Unit V IMPLEMENTATIONS OF BASIC DSP ALGORITHMS 9 Hours

The Q-notation, convolution, correlation, FIR filters, IIR filters, interpolation filters,

decimation filters, an FFT algorithm for DFT filters computation of the signal spectrum.
Examples and case studies

Text Books

1. Avtar Singh and S. Srinivasan, Digital Signal Processing, Thomson Publications, 1st Edition, 2004.
2. Lapsley et al, DSP Processor Fundamentals, Architectures & Features, S. Chand & Co, 1 st Edition, 2000.
3. B. Ventakaramani, M. Bhaskar, Digital Signal Processors Architecture Programming and Applications, Tata McGraw-Hill, 1st Edition, 2006.

Reference Books

1. Sen M. Kuo & Woon-Serg Gan, Digital Signal Processors Architectures, Implementation and Application, Pearson Practice Hall, 1st Edition, 2013.
2. Ifeachor E. C., Jervis B. W, Digital Signal Processing: A practical approach, Pearson Education, PHI/, 2nd Edition, 2002.
3. Peter Pirsch, Architectures for Digital Signal Processing, John Wiley, 1st Edition, 2007.

Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	20	10	20
Sem End Examination	Total 30 Marks					

[illegible]

BIOMEDICAL SIGNAL PROCESSING

L	T	P	C
3	0	0	3

Biomedical signal processing course introduces acquisition of biological signals and analysis using signal processing techniques. The course describe the observations of physiological activities of organism and extracting significant information. This course describes the methods to analyse biological signals for filtering, removal of artifacts and classification of bio-signals

Course Objectives

1. Understand the Sources, Types & Characteristics of Different Noises and Artifacts Present in Biomedical Signals.
2. Design Time Domain and Frequency Domain Filters for Noise and Artifact Removal from Biomedical signals.
3. Understand and Apply Various Methods for Analyzing Biomedical Signal Characteristics.
4. Explore Alternative Techniques of Analyzing Biomedical Signals in Time and Frequency Domain.

Course Outcomes

- Describe various bio medical signals and their characteristics
- Apply signal averaging for different applications
- Analyze biomedical signals using Transforms
- Analyze biomedical signals using time series analysis
- Classify Biomedical signals

Unit I BIOSIGNALS AND THEIR CHARACTERISTICS 9 Hours

Source of Bioelectric potential, Resting and action potential, Propagation of action potentials in nerves, Characteristics of biomedical signals, The nature of biomedical signals signal analysis, Biomedical signal acquisition and processing, Difficulties in biomedical signal acquisition and analysis, computer aided diagnosis. Examples and case studies

Unit II SIGNAL AVERAGING 9 Hours

Basics of signal averaging, signal averaging as a digital filter, limitations of signal averaging. Removal of artifacts by averaging. Filtering for removal of artifacts: Introduction, Random noise, structured noise and physiological interference, stationary versus non stationary process. Finite time averaging :Introduction, finite time estimation of mean value, estimation of variance, correlation, synchronous averaging. Examples and case studies

Unit III: FREQUENCY DOMAIN ANALYSIS AND ADAPTIVE FILTERING 9 Hours

Frequency domain analysis Introduction, Spectral analysis, linear filtering, Removal of high frequency noise (power line interference). Adaptive filtering– LMS adaptive filter, adaptive noise canceling in ECG, improved adaptive filtering in FECG. Examples and case studies

SPEECH PROCESSING

L	T	P	C
3	0	0	3

This course introduces the student to audio engineering, its applications and perspectives in real time environment. The morphological techniques in speech processing, homomorphic speech processing, pitch estimation, Hidden Markov models of speech processing are discussed. It familiarizes the student about different filters used in speech processing for noise less transmission and uniform transmission of speech signals from source to destination.

Course Objectives

1. To explore the applications of signal processing in audio engineering.
2. To provide an understanding of hearing perception and homomorphic speech processing.
3. To familiarize speech recognition systems and voice verification
4. To introduce uniform lossless speech transmission, linear predictive coding of speech, delta modulation of speech and voice recognition systems

Course Outcomes

- Model speech production system and describe the fundamentals of speech
- Extract and compare different speech parameters.
- Choose an appropriate speech model for a given application.
- Analyse speech recognition, synthesis and speaker identification systems

Unit I Introduction to Speech Processing

9 Hours

Speech signal, signal processing, digital speech processing. Digital models for speech signals: Process of speech production, acoustic theory of speech production, uniform lossless tube models, digital models for speech signals, hearing and auditory perception

Unit II Time-Domain Methods for Speech Processing

9 Hours

Time-dependent processing of speech, short-time energy and average magnitude, short-time average zero-crossing rate, speech vs. silence discrimination, pitch period estimation using the autocorrelation function. Digital representation of the speech waveform: Instantaneous quantization, adaptive quantization, general theory of differential quantization, delta modulation.

Unit III: Fourier Analysis of Speech

9 Hours

"Short-Time Fourier Analysis: Fourier transform interpretation, linear filtering interpretation, filter-bank summation method of short-time synthesis, spectrographic displays, analysis-synthesis systems.

Homomorphic Speech Processing: Homomorphic systems for convolution, complex spectrum of speech, pitch detection, formant estimation, homomorphic vocoder."

Unit IV Linear Predictive Coding of Speech

9 Hours

Basic principles of linear predictive analysis, computation of the gain for the model, solution of the LPC equations, relations between the various speech parameters, synthesis of speech from linear predictive parameters, application of LPC parameters.

9 Hours

Text Books

- ## Reference Books

1. Ian McLaughlin, Applied Speech and Audio Processing with MATLAB examples, Cambridge University Press, 2010.
2. Lawrence Rabiner and Biing-Hwang Juang, Fundamentals of Speech Recognition, Pearson Education, 2003.
3. Daniel Jurafsky and James H Martin, Speech and Language Processing—An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Pearson Prentice Hall 2009.

Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	20	10	20
Sem End Examination	Total 30 Marks					

[illegible]

DIGITAL SIGNAL COMPRESSION

L	T	P	C
3	0	0	3

Compression of digital signals is an important aspect in computer and communications technology. This course makes the students familiar with different types of compression techniques as well as the mathematical foundation for textual, audio, image and video compression and solve the problems associated with different source coding techniques.

Course Objectives

1. To understand the concepts of data compression, and algorithms for lossy and lossless data compression.
2. To impart the knowledge of scalar and vector quantization.
3. To understand the principles of Differential Encoding techniques.
4. To develop the skill to analyze transform coding, signal modeling and its extension to compression with applications to speech, image and video processing.

Course Outcomes

- Understand mathematical foundations of data compression and factual knowledge about existing compression standards.
- Analyze coding and compression techniques.
- Differentiate modeling and coding aspect of compression.
- design uniform, non-uniform and adaptive quantizers for a given input data with low quantization error
- Understand the compression formats of image, audio and video.

Unit I Mathematical Preliminaries for Lossless Compression 9 Hours

"Mathematical Preliminaries for Lossless Compression: Overview, a brief introduction to information theory, derivation of average information, models, coding.

Huffman Coding: Overview, the Huffman coding algorithm.

Arithmetic Coding: overview, introduction, coding a sequence, generating a binary code, comparison of Huffman and arithmetic coding, adaptive arithmetic coding."

Unit II Mathematical Preliminaries for Lossy Coding 9 Hours

Mathematical Preliminaries for Lossy Coding: Overview, introduction, distortion criteria, information theory revisited, models. Scalar Quantization: Overview, introduction, the quantization problem, uniform quantizer, adaptive quantization, nonuniform quantization.

Unit III Vector Quantization and Differential Encoding 9 Hours

"Vector Quantization: Overview, introduction, advantages of vector quantization over scalar quantization, the Linde-Buzo-Gray algorithm Differential Encoding: Overview, introduction, the basic algorithm, prediction in DPCM, adaptive DPCM, delta modulation, speech coding."

Unit IV Transform and Subband Coding 9 Hours

"Transform Coding: The Transform, Transforms of interest, quantization and coding of transform coefficients, application to image compression—JPEG, application to audio compression—the MDCT.

[illegible]