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

Accredited by NAAC with A+ Grade

CURRICULUM AND SYLLABUS

OF

B.Tech Civil 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 Civil Engineering

(Effective from academic year 2021-22 admitted batch)

Program Educational Outcomes (PEO):

The program educational objectives of the Department of Civil Engineering Program are to produce engineers whose attributes several years after graduation are marked by their ability to

PEO 1	Graduates will have strong foundation and understanding of the fundamental principles of mathematics, science, and engineering enabling graduates to pursue their careers as practicing civil engineers in civil and Allied Engineering fields.
PEO 2	Graduates will have ability to pursue Post-Graduation and research in lifelong learning in the emerging and allied areas of Civil Engineering and Business
PEO 3	Graduates will be able to practice Civil Engineering in a ethical manner and implement eco- friendly sustainable technologies for the benefit of industry and society.
PEO 4	Graduates will be able undertake consultancy services in contemporary areas to offer solutions to the technical challenges of the society.

PROGRAM OUTCOMES (PO) and PROGRAM SPECIFIC OUTCOMES (PSO)

Engineering Graduates will be able to:

PO 1	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	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.
PO 4	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.

PO 5	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.
PO 6	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.
PO 7	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	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.
PO 11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSO)

After the culmination of the course students will be able to acquire:

PSO1	Graduates shall demonstrate sound knowledge in analysis, design and execution of civil engineering infrastructure projects with appropriate consideration for cost, safety and sustainability.
PSO2	Serve the society by solving various civil engineering problems focusing on sustainable development and following professional ethics.
PSO3	Graduates will be able to provide sustainable solution for real time problems through research.

Course structure of B. Tech (Civil Engineering) 2021-2022 admitted batch

University Core (UC)

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

* Pass/Fail courses
\# Opt any three courses among the five
^ Online/Swayam/NPTEL Courses

Softskills courses 5 and 6

Course code	Level	Course title	L	T	P	S	J	C
CLAD2001	2	Preparation for Campus Placement - 1 (Softskills 5A)	0	0	2	0	0	1
CLAD2011	2	Preparation For Higher Education (GRE/ GMAT) - 1 (Softskills 5B)	0	0	2	0	0	1
CLAD2021	2	Preparation for CAT/ MAT - 1 (Softskills 5C)	0	0	2	0	0	1
CLAD2031	2	Preparation For Campus Placement - 2 (Softskills 6A)	0	0	2	0	0	1
CLAD2041	2	Preparation For Higher Education (GRE/ GMAT) - 2 (Softskills 6B)	0	0	2	0	0	1
CLAD2051	2	Preparation for CAT/ MAT - 2 (Softskills 6C)	0	0	2	0	0	1

Sports courses

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

Club activity courses

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

Community service courses

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

Faculty Core (FC)

Course code	Level	Course title	L	T	P	S	J	C
MATH1001	1	Single Variable Calculus	2	0	0	0	0	2
MATH1011	1	Several Variable Calculus	2	0	0	0	0	2
	1	Problem Solving and Programming with C	0	0	6	0	0	3
PHYS1001	1	Physics	2	1	2	0	0	4
MECH1011	1	Engineering Visualization and Product Realization	0	0	4	0	0	2
	1	Basic Electrical and Electronics Engineering	2	1	2	0	0	4
MATH1021	1	Transform Techniques	2	0	0	0	0	2
	1	Differential Equations	2	0	0	0	0	2
CHEM1001	1	Chemistry	2	1	2	0	0	4
PHYS1011	1	Mechanics and Properties of Matter	2	1	2	0	0	4
CSEN1021	1	Programming with Python	0	0	6	0	0	3
	1	Workshop	0	0	4	0	0	2
	2	Maths Basket 5 - Numerical Techniques	2	0	0	0	0	2
	2	Maths Basket 6 - Linear Algebra	2	0	0	0	0	2
	2	Management Basket	3	0	0	0	0	3
	3	Project Exhibition 1	0	0	0	0	1	1*
MATH1281	3	Probability and Statistics	3	0	0	0	0	3
	3	Project Exhibition 2	0	0	0	0	1	1*
	3	Internship 1	0	0	0	0	1	1*
	3	Internship 2	0	0	0	1	0	3
	4	Applications of Artificial Intelligence	0	0	2	0	0	1
	4	Capstone Project - Introduction	0	0	0	1	0	2
	4	Comprehensive Examination	1	0	0	1	0	1*
	4	Capstone Project - Final	0	0	0	1	0	6
	4	Universal Human Values	3	0	0	0	0	3*

* Pass/Fail courses

Programme Core/ Major Core (PC/MaC)

Course code	Level	Course title	L	T	P	S	J	C
	2	PC1 - Engineering Mechanics	3	0	0	0	0	3
CIVL2011	2	PC2 - Fluid Mechanics	3	0	3	0	0	4
CIVL2021	2	PC3 - Surveying	3	0	3	0	0	4
CIVL2031	2	PC0 - Civil Engineering Workshop	0	0	2	0	0	1
CIVL2041	2	PC4 - Mechanics of Solids	3	0	3	0	0	4
CIVL2051	2	PC5 - Environmental Engineering	3	0	2	0	0	4
CIVL2061	2	PC6 - Geotechnical Engineering	3	0	3	0	0	4
CIVL2071	2	PC7 - Construction Materials and Concrete Technology	2	0	3	0	0	3
CIVL2081	3	PC8 - Structural Analysis	3	0	0	0	0	3
CIVL2091	3	PC9 - Highway Engineering	3	0	2	0	0	4
CIVL3001	3	PC10 - Design of Reinforced Concrete Structures	3	0	0	0	0	3
CIVL2101	3	PC11 - Architectural Planning and CAD Lab	0	0	2	0	0	1
CIVL2111	3	PC 12 - Survey Camp (Shall be conducted during the Summer periodafter 4th Semester and the Evaluation shall be conducted in 5th Semester)	0	0	2	0	0	1
CIVL3011	3	PC13 - Design of Steel Structures	3	0	0	0	0	3
CIVL3021	3	PC14 - Water Resources Engineering	3	0	0	0	0	3
CIVL2121	3	PC15 - Computer Applications in Civil Engineering Lab	0	0	3	0	0	1
CIVL2131	4	PC16 - Estimation and Costing	3	0	0	0	0	3

Programme Elective (PE)#

Course code	Level	Course title	L	T	P	S	J	C
CIVL3031	3	Repairs, Renovation and Rehabilitation of Structures (PE-1)	2	0	2	0	0	3
CIVL2141	3	Foundation Engineering (PE-1)	2	0	2	0	0	3
CIVL3041	3	Traffic Engineering (PE-1)	2	0	2	0	0	3
CIVL3051	3	Hydraulic Machines (PE-1)	3	0	0	0	0	3
	3	Artificial Neural Networks (PE-1)	2	0	2	0	0	3
CIVL3071	3	Advanced Structural Analysis (PE-2)	2	0	2	0	0	3
CIVL3081	3	Advanced Foundation Engineering (PE-2)	3	0	0	0	0	3
CIVL3091	3	Pavement Analysis and Design (PE-2)	3	0	0	0	0	3
CIVL3101	3	Open Channel Hydraulics (PE-2)	3	0	0	0	0	3
	3	Introduction to Machine Learning (PE-2)	2	0	2	0	0	3

CIVL3111	3	Advanced Reinforced Concrete Structures (PE-3)	3	0	0	0	0	3
CIVL3121	3	Rock Mechanics (PE-3)	3	0	0	0	0	3
CIVL3131	3	AI applications Remote Sensing andGeographic Information Systems (PE-3)	2	0	2	0	0	3
CIVL2181	3	Sanitary Engineering (PE-3)	3	0	0	0	0	3
CIVL3151	4	Advanced Design of Steel Structures (PE-4)	3	0	0	0	0	3
CIVL3161	4	Ground Improvement Techniques (PE-4)	3	0	0	0	0	3
CIVL3171	4	Transportation Infrastructure Engineering (PE-4)	3	0	0	0	0	3
CIVL3181	4	Advanced Water Resources Engineering (PE-4)	3	0	0	0	0	3
CIVL3191	4	Construction Management with AI Applications (PE-4)	3	0	0	0	0	3
CIVL3211	4	Prestressed Concrete (PE-5)	2	0	2	0	0	3
CIVL3221	4	Geosynthetics (PE-5)	3	0	0	0	0	3
CIVL3231	4	Road Safety Auditing (PE-5)	3	0	0	0	0	3
CIVL3241	4	Air Pollution & Its Control (PE-5)	3	0	0	0	0	3
CIVL3251	4	AI applications in Analysis ,Designand material Testing of Structures (PE-5)	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 course and earn 24 credits

Total credit distribution

Description	Credits	% of Program (in credits)
University Core	12	8%
Faculty Core	57	36%
Major Core	52	32%
Major Electives	15	9%
Program Minor / Open Electives	24	15%
Total	160	

CSEN1001: IT Productivity Tools

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

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

Course Objectives

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

List of Experiments

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

Text Books:

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

References/Online Resources

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

Course Outcomes

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

LANG1001: Communication Skills in English - Beginners

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

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

Course Objectives

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

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

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

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

List of Activities & Tasks for Assessment

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

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

References

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

Online References

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

Course Outcomes

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

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

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

LANG1011: Communication Skills in English

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

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

Course Objectives

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

List of Tasks and Activities

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

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

Reference Books

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

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

Course Outcomes

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

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

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

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

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

LANG1021: Advanced Communication Skills in English

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

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

Course Objectives

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

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

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

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

List of Activities & Tasks for Assessment

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

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

Reference Books

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

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

Online Resources

1. https://www.grammarly.com/blog/
2. https://www.nationalgeographic.org/education/
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4. https://www.englishclub.com/
5. https://www.oxfordlearnersdictionaries.com/
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8. https://freerice.com/categories/english-vocabulary
9. http://www.5minuteenglish.com/
10. https://breakingnewsenglish.com/
11. https://www.digitalbook.io/
12. https://librivox.org/

Course Outcomes

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

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

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

Course Description:

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

Course Objectives:

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

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

Course Outcomes

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

References:

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

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

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

Course Description:

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

Course Objectives:

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

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

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

Course Outcomes

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

References:

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

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

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

Course Description:

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

Course Objectives:

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

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

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

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

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

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

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

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

Course Outcomes:

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

References:

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

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

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

Course Description:

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

Course Objectives:

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

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

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

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

Course Outcomes:

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

References:

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

VEDC1001: Venture Development

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

Course Description

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

The course is divided into four sections:

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

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

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

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

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

Course Objectives

Students will have the opportunity to:

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

Course Materials

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

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

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

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

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

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

Group Project Overview

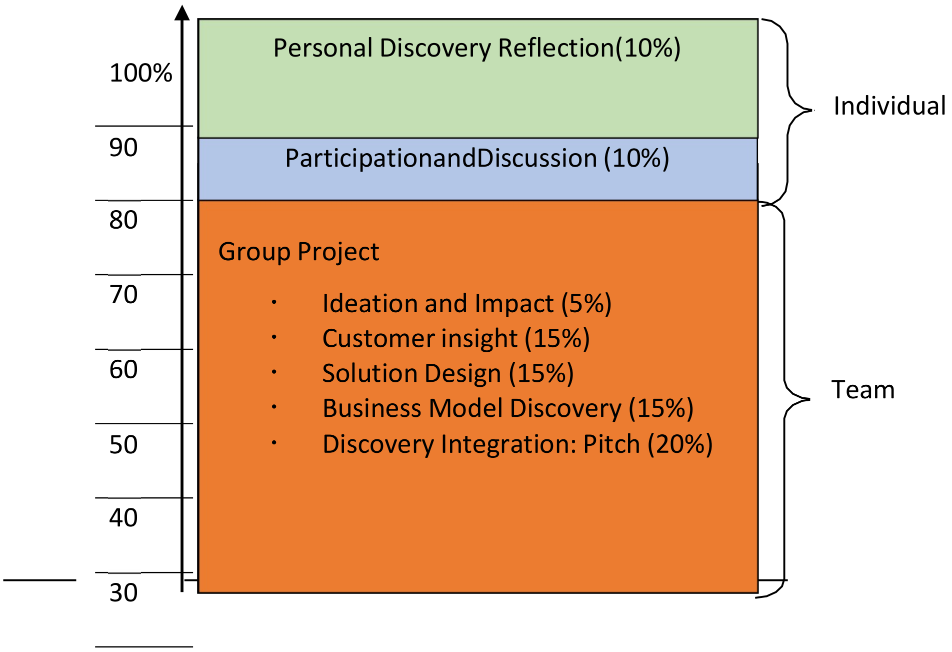
This is a semester length project and the cornerstone component of the course. The group project will give you the opportunity to apply the course concepts to a real situation. You will learn about the entrepreneurship for your own business or your work in organizations. Even if you are not going to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

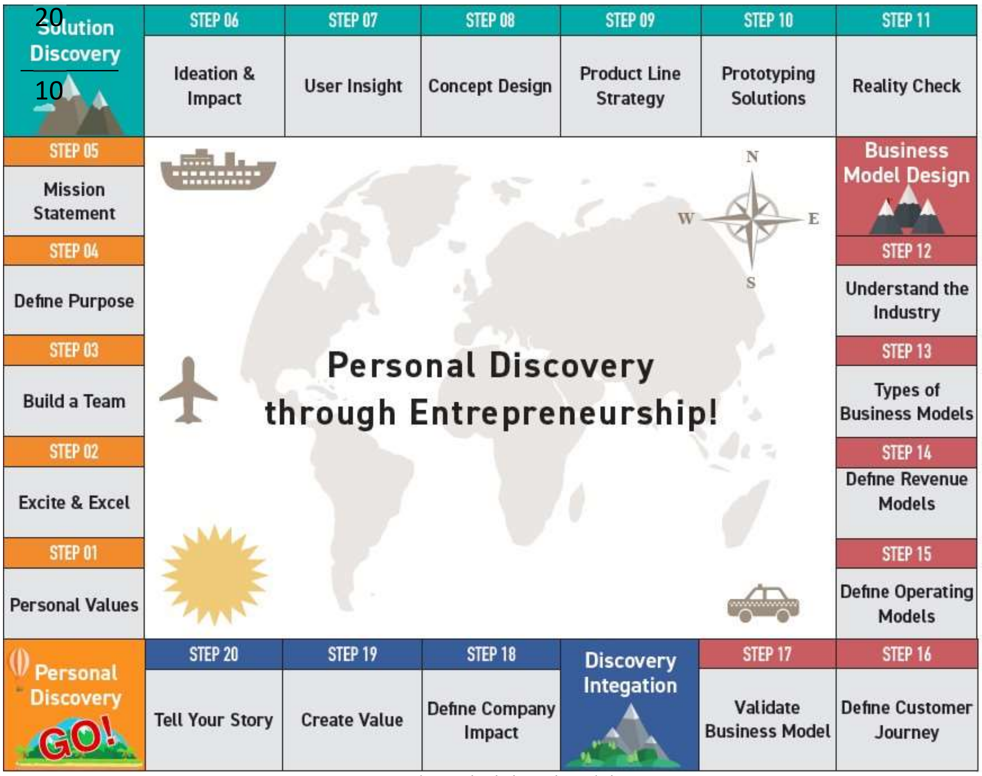
Talking to customers is one of the most important steps in investigating your business because your entrepreneurial vision must correspond to a true market opportunity. With your group, select 5-6 potential customers willing to be interviewed. They should represent a cross-section of our target market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

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

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

<u>Project Components and Grading</u>





[20 Steps and activities in this course]

<u>Deliverables</u>

There are a number or different deliverables for the course that follow the templates presented in the book, as applied to your own venture idea. Do your best to keep up with the timeline of the class; do not fall behind! Later templates build on the learnings from prior templates. Make the most of your team! Everyone needs to pitch in. In no case, should one person be taking the lead on all templates.Rather,different team members should take the lead on specific deliverables. Coordinate well. Let your teacher know if a team member is not carrying his or her load.

Specific Deliverables

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

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

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

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

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

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

Business Model Design Hand-in Package: 15%

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

Discovery Integration Hand-in Package: 20%

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

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

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

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

Individual Innovation Assignments

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

(1) Personal Discovery Reflection Journal (10%)
At the beginning of this semester, you will have a time to think about your self (who you are, what you are good at, what areas you want to contribute on) using a couple of templates. After that sessions, you will have a quiet moment to think about yourself, yourcareer, and your happiness in your life. Please write 2-page reflectional journal what you feel and learning through the personal discovery sessions.

(2) Insight Learning Reflection Journal (10%)
At the end of this semester, you are to prepare a short reflection of impressive sessions aswell as related activities outside the classroom. Specially, (1) reflect on the key points from lectures, reading, discussion, guest speakers, and interviews, (2) apply this to your own situation, and (3) outline ways that you intend to use this knowledge in the future.

Course Schedule

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

<table>
<tr><th>Week</th><th>Session</th><th>Topics and Steps</th><th>Key CONCEPTS Introduced in Class</th><th>Class Focus Activity</th></tr>
<tr><td rowspan="2">3</td><td>5</td><td rowspan="2">Ideation & Impact
(Step 06)</td><td>Ideation Methods
• An in-class ideation exercise</td><td>Team:
• Problem to Solve Templates, Step 4, Page 62, and 63</td></tr>
<tr><td>6</td><td>Increasing the Impact of an Idea. (The Eat-Your-Coffee Video – a good example of ideation)</td><td>Team:
• Idea Impact Template, Step 6, Page 69</td></tr>
<tr><td rowspan="2">4</td><td>7</td><td rowspan="2">User Insights Frameworks
(Step 07)</td><td>• Identifyand find the right target users.
• Interview style and methods
• The Customer Interview template.</td><td>Team:
• Customer Interviews Template, Step 7, Pages 75
• Edit interview template for your project.</td></tr>
<tr><td>8</td><td>Laddering methods for interviews</td><td>Team:
• Latent Needs Template, Step 7, Page 93</td></tr>
<tr><td rowspan="2">5</td><td>9</td><td rowspan="2">User Insights Customer Interviews
(Step 07)</td><td>• Finding latent needs
• Field work check-in</td><td>Team:
• Latent Needs Template, Step 7, Page 93
• Field work – customer interviewing</td></tr>
<tr><td>10</td><td>• Think about innovation across the entire use case
• Field work check-in</td><td>Team:
• Full Use Case Template, Step 7, Page 99
• Field work – customer interviewing</td></tr>
<tr><td rowspan="2">6</td><td>11</td><td rowspan="2">User Insights Interpreting Results
(Step 07)</td><td>• Interpreting customer interview results
• Field work check-in</td><td>Team:
• Field work – customer interviewing
• Also talk to retailers/dealers if appropriate</td></tr>
<tr><td>12</td><td>• Idea Reshaping based on Customer Interviews
• Field work check-in</td><td>Teams prepare results of results from customer interviews and how the original ideas have been reshaped& improved.</td></tr>
<tr><td rowspan="2">7</td><td>13</td><td rowspan="2">User Insights Interpreting Results
(Step 07)</td><td rowspan="2">• Customer Research Reports
• Implications for product and service design</td><td rowspan="2">• Teams prepare PPTs for class presentation
• Customer Insight Template Hand-in Package</td></tr>
<tr><td>14</td></tr>
</table>

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

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

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

<table>
<tr><th>Week</th><th>Session</th><th>Topics and Steps</th><th>Key CONCEPTS Introduced in Class</th><th>Team or Individual Activity</th></tr>
<tr><td rowspan="2">15</td><td>29</td><td rowspan="2">Tell Your Story</td><td rowspan="2">

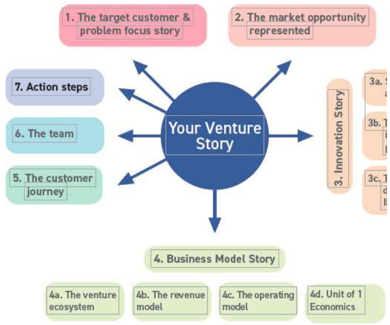
- Presentation Format and Style
- Format:
(1) Title Slide with names and contact information
(2) The Target Customer and the Problem to be Solved
(3) The Market Opportunity
(4) The Innovation Story
(5) The Business Model Story
(6) The Customer Journey
(7) The Team
(8) The Proposed Action Steps.
(9) Appendices (if needed or desired)
- If you have built a prototype during the class, please bring it and show it to us!

(The Fortify Video is a good example of how a good technical idea can translate into a business model, and next, into a well-funded venture.)

</td><td rowspan="2">

Team:

- The PPT Presentation



- Practice, practice, practice!
- Not too many words on one slide
- Use pictures
- Use template to develop your thinking, but try to create slides that are not just the templates.

</td></tr>
<tr><td>30</td></tr>
<tr><td colspan="3">Final Course Deliverables</td><td>Due on the Monday after the weekend of the final class meeting.</td><td>Team: Your Venture PPTs

Individual: Insight Learning Reflection Journal</td></tr>
</table>

Course Outcomes

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

DOSP1001: Badminton

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

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

Course Objectives:

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

Course Outcomes:

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

List of Activities:

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

Instructional Plan:

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

Reference:

1. Handbook of the Badminton World Federation (BWF)

DOSP1011: Chess

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

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

Course Objectives:

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

Course Outcomes:

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

List of Activities:

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

Instructional Plan:

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

Reference:

1. International Chess Federation (FIDE) Handbook

DOSP1031: Football

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

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

Course Objectives:

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

Course Outcomes:

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

List of Activities:

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

Instructional Plan:

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

Reference:

1. FIFA Laws of the Game

DOSP1041: Volleyball

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

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

Course Objectives:

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

Course Outcomes:

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

List of Activities:

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

Instructional Plan:

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

Reference:

1. FIVB - Official Volleyball Rules

DOSP1051: Kabaddi

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

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

Course Objectives:

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

Course Outcomes:

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

List of Activities:

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

Instructional Plan:

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

Reference:

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

DOSP1091: Basketball

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

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

Course Objectives:

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

Course Outcomes:

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

List of Activities:

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

Instructional Plan:

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

Reference:

1. FIBA Basketball Official Rules

DOSP1111: Throwball

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

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

Course Objectives:

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

Course Outcomes:

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

List of Activities:

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

Instructional Plan:

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

Reference:

1. World Throwball Federation - Rules of the Game

DOSL1001: Club Activity – Participant

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

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

Course Objectives

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

List of Student Club Activities

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

List of Activities

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

Text Books

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

References

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

Course Outcomes

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

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

DOSL1011: Club Activity – Member of the Club

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

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

Course Objectives

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

List of Student Club Activities

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

List of Activities

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

Text Books

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

References

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

Course Outcomes

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

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

DOSL1021: Club Activity – Leader of the Club

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

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

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

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

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

Text Books

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

References

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

Course Outcomes

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

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

DOSL1031: Club Activity – Competitor

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

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

Course Objectives

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

List of Student Club Activities

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

List of Activities

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

Text Books

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

References

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

Course Outcomes

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

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

POLS1001: Indian Constitution and History

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

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

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

Course Outcomes:

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

Unit I: India as a Nation **6 hrs**
Khilani, S. (2004). *Introduction, The Idea of India*, Chapter 1. New Delhi: Penguin Books, pp. 1-15.
Rowat, D. (1950). 'India: The Making of a Nation', *International Journal, 5*(2), 95-108. doi:10.2307/40194264
Brass, P. (2018). 'Continuities and Discontinuities between pre- and post-Independence India', Chapter 1. *The Politics of Idea since independence*, New Delhi: Cambridge University Press. pp. 1-30.

Module Learning Outcomes

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

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

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

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

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

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

Module Learning Outcomes

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

Unit 4: Citizenship **6 hrs**

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

Module Learning Outcomes

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

Unit 5: Separation and Distribution of Powers 6 hrs

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

Module Learning Outcomes

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

Recommended Readings:

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

PHPY1001: Gandhi for the 21st Century

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

Course Description

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

Course Objectives

The objectives of the course are;

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

Module I : MK Gandhi: Childhood and Education

M K Gandhi, Formative Years (1869-1893): Early childhood - study in England - Indian influences, early Western influences.

Module II: From Mohan to Mahatma-South African Experiences

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

Module III: Gandhi and Indian National Movement

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

Module IV: Gandhi and Sustainable Development

Gandhian Constructive Programs-Eleven Vows-Sarvodaya-Seven Social Sins-Gandhian Economics and Sustainable Development

Module V: Gandhi and Contemporary Issues

Conflict Resolution Techniques of Gandhi-Ecological Challenges and Gandhian solutions-Gandhian Ethics-An Analysis

Learning Outcomes

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

5. To examine the significance of constructive programs today

Course Outcomes

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

References

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

DOSL1041: Community Services - Volunteer

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

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

Course Objectives

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

List of Community Service Activities

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

List of Activities

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

Text Books

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

References

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

Course Outcomes

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

DOSL1051: Community Services - Mobilizer

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

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

Course Objectives

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

List of Community Service Activities

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

List of Activities

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

Text Books

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

References

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

Course Outcomes

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

ENVS1001: Environmental Studies

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

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

Course Objectives

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

Course Outcomes

After the completion of the course student will be able to

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

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

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

Activity:

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

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

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

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

Activity”

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

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

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

Activity

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

Learning Outcomes:

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

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

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

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

Activity:

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

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

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

Activity:

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

Text Book(s)

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

Additional Reading

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

Reference Book(s):

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

Journal(s):

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

Website(s):

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

From Climate Science to Action | Coursera

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

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

MFST1001: Health & Wellbeing

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

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

Course Objectives

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Course outcomes:

By the end of the course, student will

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

CLAD2001: Preparation for Campus Placement-1

(Soft Skills 5A)

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

Course Description:

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

Course Objectives:

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

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

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

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

4. Reasoning: Logical and Verbal Reasoning

Course Outcomes:

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

References:

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

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

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

Course Description:

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

Course Objectives:

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

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

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

3. Analytical Writing Assessment: Issue/ Argument

4. Integrated Reasoning

Course Outcomes:

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

References:

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

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

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

Course Description:

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

Course Objectives:

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

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

2. Data Interpretation: Data Interpretation and Data Sufficiency

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

Course Outcomes:

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

References:

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

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

CLAD2031: Preparation for Campus Placement-2

(Soft Skills 6A)

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

Course Description:

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

Course Objectives:

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

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

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

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

4. Reasoning II: Logical and Verbal Reasoning

Course Outcomes:

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

References:

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

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

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

(Soft Skills 6B)

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

Course Description:

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

Course Objectives:

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

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

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

3. Analytical Writing Assessment II: Issue/ Argument

4. Integrated Reasoning II

Course Outcomes:

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

References:

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

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

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

Course Description:

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

Course Objectives:

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

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

Course Outcomes:

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

References:

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

FINA3001: Personal Financial Planning

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

Course Overview

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

Course Objectives:

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

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

Unit 1: Basics of Financial Planning
Financial Planning Meaning, Need, Objectives, Financial Planning Process, Time Value of Money and its application using excel (NP)

Unit 2: Risk and Insurance Management
Need for insurance, Requirement of insurance interest, Role of insurance in personal finance, Steps in insurance planning, Life and Non-life insurance products, Life insurance needs analysis (NP)

Unit 3: Investment Products and Measuring Investment Returns
Investment Products: Small Saving Instruments, Fixed Income Instruments, Alternate

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

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

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

Text Books

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

Reference Books

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

PHYS1001: PHYSICS

L	T	P	C
3	0	2	4

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

Course Objectives

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

UNIT I: Basics of Electromagnetics **9 L**

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

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

Learning Outcomes:

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

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

UNIT II: Fiber Optics **7 L**

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

Learning Outcomes:

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

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

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

UNIT III: Dielectric, Magnetic and superconducting Materials **10 L**

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

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

Learning Outcomes:

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

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

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

UNIT IV: Semiconductor Physics **8 L**

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

Learning Outcomes:

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

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

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

UNIT V: Semiconductor Devices **8 L**

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

Learning Outcomes:

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

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

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

Text Book(s)

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

Reference book(s)

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

Journal(s):

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

PHYSICS LABORATORY

List of Experiments

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

Text Book:

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

PHYS1031: MECHANICS AND PROPERTIES OF MATTER

L	T	P	C
3	1	0	4

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

Course Objectives

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

UNIT-I Mechanics: 10 Hours

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

Learning Outcomes:

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

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

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

UNIT-II Elasticity 8 Hours

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

Learning Outcomes:

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

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

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

UNIT - III Thermal Properties 10 Hours

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

Learning Outcomes:

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

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

UNIT - IV Acoustics 8 Hours

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

Learning Outcomes:

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

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

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

UNIT– V: Sensors 9 Hours

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

Learning Outcomes:

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

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

Text Book(s)

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

Reference Book(s)

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

Course Outcomes:

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

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

PHYS1011: PRINCIPLES OF QUANTUM MECHANICS

L	T	P	C
3	1	0	4

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

Course Objectives

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

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

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

Learning Outcomes:

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

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

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

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

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

Learning Outcomes:

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

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

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

UNIT – III: Quantum Tunneling (8 Hours)

One dimensional infinitely rigid box-energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical tunnelling in one dimensional rectangular potential barrier, 1D linear harmonic oscillator (no derivation required, only eigen function, eigen values and zero-point energy).

Learning Outcomes:

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

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

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

UNIT - IV Quantum Properties of Electrons (9 Hours)

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

Learning Outcomes:

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

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

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

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

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

Learning Outcomes:

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

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

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

Textbook(s):

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

Reference Book(s):

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

Springer Journal(s):

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

Websites:

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

PHYS1021: PHYSICS OF SEMICONDUCTING DEVICES

L	T	P	C
3	**1**	**0**	**4**

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

Course Objectives

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

UNIT I Elements of light (8 hours)

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

Learning Outcomes:

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

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

UNIT II: Semiconductor Materials (10 hours)

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

Learning Outcomes:

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

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

UNIT III: Light-semiconductor interaction **(10 hours)**

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

Learning Outcomes:

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

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

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

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

Learning Outcomes:

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

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

UNIT V: Semiconductor devices **(8 hours)**

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

Learning Outcomes:

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

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

Text Books:

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

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

Reference Books:

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

Course Outcomes

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

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

PHYS1041: MECHANICS AND MODERN PHYSICS

L	T	P	C
3	1	0	4

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

Course Objectives

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

UNIT - I Fundamentals of Dynamics and Oscillations 10 Hours

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

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

Learning Outcomes:

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

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

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

UNIT - II Modern Physics (Quantum Physics) 8 Hours

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

Learning Outcomes:

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

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

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

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

UNIT – III: Optics   10 Hours

Interference: Introduction, interference in thin films due to reflected light: interference in parallel-sided film and wedge-shaped film, Newton’s rings. Diffraction: Introduction; Fraunhofer diffraction at single slit (qualitative only), diffraction due to N-slits (diffraction grating) (qualitative only), determination of wavelength of light with a plane transmission grating.
Polarisation: Introduction; Double refraction –double refraction in calcite crystal, negative and positive crystals, Nicol’s prism, Retarders (quarter and half¬wave plates).

Learning Outcomes:

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

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

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

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

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

Learning Outcomes:

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

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

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

UNIT - V   Sensors   9 Hours

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

Learning Outcomes:

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

- Illustrate the principle of strain and pressure sensors

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

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

Textbook(s):

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

Reference Book(s):

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

Journal(s):

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

CHEM1001: CHEMISTRY

L	T	P	C
3	0	2	4

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

Course objectives

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

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

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

Learning outcomes:

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

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

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

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

Learning outcomes:

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

- define electrode potential. (L-1)

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

Unit-3: Engineering materials and Polymer Chemistry **8L**

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

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

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

Learning outcomes:

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

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

Unit-4: Corrosion and its control **8L**

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

Learning outcomes:

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

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

Unit-5: Nanomaterials and Analytical Instrumental Techniques **8L**

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

Analytical Instrumental Techniques

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

Learning outcomes:

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

- classify nanomaterials. (L-2)

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

Course outcomes

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

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

Text Books:

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

Reference Books:

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

CHEMISTRY LABORATORY

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

Course objectives

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

List of experiments

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

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

Course Outcomes:

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

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

Text Books

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

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

MATH1001 - SINGLE VARIABLE CALCULUS

L	T	P	C
2	0	0	2

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

Course Objectives:

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

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

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

Learning Outcomes:

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

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

Unit II: Derivatives and applications (7 hours)

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

Learning Outcomes:

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

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

Unit III: Integrals and applications (7 hours)

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

Learning Outcomes:

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

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

Unit IV: Techniques of integration (6 hours)

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

Learning Outcomes:

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

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

Textbook:

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

References:

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

Course Outcomes:

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

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

MATH1011- SEVERAL VARIABLE CALCULUS

L	T	P	C
2	0	0	2

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

Course Objectives:

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

Unit I: Partial derivatives and applications (7 hours)

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

Learning Outcomes:

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

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

Unit II: Double integrals (6 hours)

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

Learning Outcomes:

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

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

Unit III: Triple integrals (5 hours)

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

Learning Outcomes:

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

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

Unit IV: Integrals and Vector fields (8 hours)

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

Learning Outcomes:

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

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

Textbook:

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

References:

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

Course Outcomes:

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

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

MATH 1021: TRANSFORM TECHNIQUES

L	T	P	C
2	0	0	2

Preamble

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

Course Objectives:

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

Unit-1: Laplace transforms (5 hrs)

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

Learning Outcomes:

After completion of this unit student able to

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

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

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

Learning Outcomes:

After completion of this unit student able to

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

Unit-3: Fourier Series (6 hrs)

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

Learning Outcomes:

After completion of this unit student able to

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

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

MATH1031: DIFFERENTIAL EQUATIONS

L	T	P	C
2	0	0	2

Preamble

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

Course Objectives:

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

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

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

Learning Outcomes:

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

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

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

Learning Outcomes:

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

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

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

Learning Outcomes:

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

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

Unit-4:Introduction to Partial Differential Equations (5 hrs)
Introduction, Formation of Partial Differential Equation(PDE), Solutions of a PDE, Equations solvable by direct integration, Linear equations of the first order.
Learning Outcomes:
- find the partial differential equation (L3).
- find the solution of a partial differential equation (L3).
- solve PDE by direct integration (L3)

Unit-5: Partial Differential Equations of Second Order (5 hrs)
Homogeneous linear equations with constant coefficients, Rules for finding the complementary function and particular integral,Working procedure to solve the equations.
Learning Outcomes:
- apply a range of techniques to find solutions of PDEs (L3)
- identify the basic properties of PDEs (L3)
- find the solutions of homogenous and non-homogenous linear partial differential equations (L3).

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

References:

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

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

MATH1041: DISCRETE MATHEMATICS

L	T	P	C
2	0	0	2

Preamble :

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

Course Objectives:

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

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

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

Learning outcomes:

After completion of this unit, student will be able to

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

Unit-2: Mathematical logic (5 hrs)

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

Learning Outcomes:

After completion of this unit, student will be able to

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

Unit-3: Sets and Relations (5 hrs)

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

Learning Outcomes:

After completion of this unit, student will be able to

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

Unit-4: Recurrence relations **(5hrs)**

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

Learning Outcomes:

After completion of this unit, student will be able to

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

Unit-5: Algebraic Structures **(6 hrs)**

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

Learning Outcomes:

After completion of this unit, student will be able to

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

Text Books:

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

Reference books:

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

Course Outcomes:

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

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

MATH1051: GRAPH THEORY

L	T	P	C
2	0	0	2

Preamble

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

Course Objectives:

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

Unit-1: Basics of graphs **(5 hrs)**

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

Learning Outcomes:

After completion of this unit, student will be able to

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

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

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

Learning Outcomes:

After completion of this unit, student will be able to

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

Unit-3: Paths and circuits **(6 hrs)**

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

Learning Outcomes:

After completion of this unit, student will be able to

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

Unit-4: Trees **(5 hrs)**

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

Learning Outcomes:

After completion of this unit, student will be able to

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

Unit 5: Applications of Trees and Fundamental circuits (5 hrs)
Preorder, in order and post order traversals, Prefix and Postfix notations of an arithmetic expression, parsing trees.

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

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

Text Book:

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

Reference Book:

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

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

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

MATH1061 - INTRODUCTION TO MATHEMATICS I

L	T	P	C
2	**0**	**0**	**2**

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

Course Objectives:

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

Unit- I : **3 hrs**

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

Learning Outcomes:

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

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

3 hrs

Unit- II : Trigonometry

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

Learning Outcomes:

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

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

8 hrs

Unit- III : Differential Calculus

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

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

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

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

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

Learning Outcomes:

After completing this unit, the student will be able to

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

8 hrs

Unit IV: Integration

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

Definite Integrals: Definition of a definite integral and its properties (without proof), formulae Of $\int_0^{\pi/2} Sin^n\theta\, d\theta$, $\int_0^{\pi/2} \cos^n\theta\, d\theta$ and $\int_0^{\pi/2} \cos^n\theta\, Sin^m\theta\, d\theta$ (without proofs).

Learning Outcomes:

After completing this unit, the student will be able to

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

10 hrs

Unit V: Introduction to differential equations and Multivariable calculus

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

Learning Outcomes:

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

Course Outcomes:

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

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

Text Books:

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

References:

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

MATH1071 - INTRODUCTION TO MATHEMATICS II

L	T	P	C
2	**0**	**0**	**2**

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

Course Objectives:

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

Unit I: Matrices **8hr**

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

Learning Outcomes:

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

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

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

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

Learning Outcomes:

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

Unit III: Partial Fractions **6 hrs**

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

Learning Outcomes:

After completing this unit, the student will be able to

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

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

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

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

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

Learning Outcomes:

After completing this unit, the student will be able to

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

Course Outcomes:

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

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

Text Books:

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

References:

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

DIFFERENCE EQUATIONS

L T P C
2 0 0 2

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

Course Objectives:

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

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

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

Learning outcomes:

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

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

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

Learning outcomes:

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

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

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

Learning outcomes:

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

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

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

Learning outcomes:

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

UNIT-V: (Applications of Z-transforms) (5 hrs)
Solving difference equations and simultaneous linear difference equations with constant coefficients by Z-transforms.
Learning outcomes:
Student will be able to know how to find the solution of a difference equation using Z-transforms.

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

Reference books:
1. Advanced Engineering mathematics by Irvin Kreyszig

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

NUMERICAL TECHNIQUES

L	T	P	C
2	0	0	2

Preamble

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

Course Objectives:

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

Unit-1: **(6 hours)**

Solution of algebraic and transcendental equations: Regula-falsi method and Newton-Raphson method. **Solution of linear system of equations-**Iterative methods: Gauss Jacobi method, Gauss Seidel method, and finding the eigenvalues of a matrix by Power method.

Learning Outcomes:

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

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

Unit-2: **(5 hours)**

Interpolation: Difference operators (shifting, delta, del) and difference tables, Newton's forward and backward interpolation formulae, Divided difference formula, and Lagrange's interpolation formula.

Learning Outcomes:

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

- find a function using various methods (L3).

Unit-3: **(5 hours)**

Numerical Differentiation: Derivatives using forward, and backward difference formulae.

Numerical Integration: Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule.

Learning Outcomes:

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

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

Unit-4: **(5 hours)**

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

Learning Outcomes:

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

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

Unit-5: **(5 hours)**

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

Learning Outcomes:

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

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

Text Book(s):

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

References:

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

Course Outcomes:

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

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

OPERATIONS RESEARCH

L	T	P	C
2	0	0	2

Preamble:

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

Course Objectives: This course is designed to:

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

Unit – I **4 hours**

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

Learning Outcomes :

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

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

Unit – II **8 hours**

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

Learning Outcomes:

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

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

Unit – III **5 hours**

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

Learning Outcomes:

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

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

Unit – IV **4 hours**

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

Learning Outcomes :

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

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

Unit – V **5 hours**

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

Learning Outcomes :

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

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

Course outcomes:

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

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

Text Books:

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

Reference Books:

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

COMPLEX VARIABLES

L T P C
2 0 0 2

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

Course Objectives

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

MODULE – I **6 hours**
Functions of a Complex variable: Limit and continuity, Differentiation, Analytic functions, Cauchy-Riemann equations, harmonic functions, finding harmonic conjugates- applications to flow problems.
After completion of this unit student able to

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

Module - II **5 hours**
Geometrical representation of f(z) – Some standard transformations – Bilinear transformation - Conformal mappings. Special conformal transformations ($w = z^2$, $w= z+1/z$, $w = e^z$, w= coshz)
.
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, 42^{nd} 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, 8^{th} Edition, Lakshmi Publications, New Delhi, 2012.

Course Outcomes

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

NUMBER THEORY

L	T	P	C
2	0	0	2

PREAMBLE

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

Course Objectives

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

Unit 1 **(5 hrs)**

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

Learning Outcomes:

After completion of this unit, student will be able to

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

Unit 2 **(5 hrs)**

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

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

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

Unit 3 **(5 hrs)**

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

Learning Outcomes:

After completion of this unit, student will be able to

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

Unit 4 **(5 hrs)**

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

Learning Outcomes:

After completion of this unit, student will be able to

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

Unit 5 **(5 hrs)**
Polynomial Arithmetic, Primitive roots, Legendre symbol, Jacobi symbol
Learning Outcomes:
After completion of this unit, student will be able to
- learn polynomial arithmetic: (L3)
- perceive the Legendre and Jacobi symbols (L5)

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

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

LINEAR ALGEBRA

L	T	P	C
2	0	0	2

Preamble

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

Course Objectives:

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

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

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

Learning Outcomes:

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

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

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

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

Learning Outcomes:

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

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

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

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

Learning Outcomes:

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

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

Unit-4: Inner Product Spaces **(5 hours)**

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

Learning Outcomes:

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

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

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

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

Learning Outcomes:

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

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

Text Books:

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

Reference Books:

1. Advanced Engineering Mathematics, 7th Edition, Peter V. O'Neil.
2. Advanced Engineering Mathematics, 2nd Edition, Michael. D. Greenberg.
3. Introduction to linear algebra, 5th Edition, Gilbert Strang.
4. Applied Mathematics (Vol. I & II) , by P. N. Wartikar& J. N. Wartikar.
5. Digital Image Processing, R C Gonzalez and R E Woods.

Course Outcomes:

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

- solve the system of linear equations (L3)
- calculate Eigen values and Eigen vectors(L4)
- Finding the basis(L4)
- learn Singular value decomposition and principal Component analysis (L5)

PROBABILITY THEORY AND RANDOM VARIABLES

L	T	P	C
2	0	0	2

Preamble

To expose the students to the basics of probability theory and random processes essential for their subsequent study of analog and digital communication.

Course Objectives:

- To know about various random life length models and their uses in finding the reliability of different electronic devices.
- To learn about basic properties and characteristics of various random processes with reference to signal and trunk processes.

Unit 1: Probability **5 hours**

Axioms of probability theory. Probability spaces. Joint and conditional probabilities. Bayes' Theorem- Independent events.

Learning Outcomes:

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

- Understand events and how to assign probabilities to outcomes (L3)
- Solve applications involving probabilities (L4)

Unit 2: Random Variable **5 hours**

Random variables and random vectors. Distributions and densities. Independent random variables. Functions of one and two random variables.

Learning Outcomes:

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

- evaluate moments and cumulative distribution functions for both discrete and continuous random variables (L3)
- characterize functions of random variables (L5)

Unit 3: Multiple Random Variables **6 hours**

Vector random variables, joint distribution and density functions, properties, conditional distribution and density, statistical independence, distribution and density of a sum of random variables, central limit theorem.

Learning Outcomes:

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

- describe conditional and independent events and conditional random variables (L3)
- describe independent events and independent random variables and their sums (L3)

Unit 4: Expected Value of a Function of Random Variables **6 hours**

Joint moments about the origin, joint central moments, jointly Gaussian random variables - two random variables case, N random variable case.

Learning Outcomes:

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

- characterize jointly multiple discrete and continuous random variables (L5)

- describe N Random variables independent events and independent random variables and their sums (L3)
- characterize jointly multiple discrete and continuous random variables (L5)

Unit 5: Random Process **6 hours**

Temporal characteristics - the random process concept, stationarity and statistical independence, correlation functions, Gaussian random processes, Poisson random process.

Learning Outcomes:

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

- explain basic concepts of a random process, calculate the mean, variance, autocorrelation, and power spectral density of a stationary random process (L3)
- apply the knowledge of random variables in real life situations (L5)

Text Book(s)

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw Hill, 2002.
2. Athanasios Papoulis, S. Unnikrishnan Pillai, Probability, Random Variables and Stochastic Processes, 4/e, Tata McGraw Hill, 2002.

References

1. Simon Haykin, Communication Systems, 4/e, Wiley Student Edition, 2006.
2. Henry Stark, John W. Woods, Probability and Random Processes with Application to Signal Processing, 3/e, Pearson Education, 2002.

Course Learning Outcomes:

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

- Analyze the outcomes of random experiments and develop the concept of random variables and obtain probabilities through them (L3)
- define single random variables in terms of their PDF and CDF, and calculate moments such as the mean and variance (L3)
- explore the random experiments specified by multiple random variables and study the Distribution of them (L4)
- apply the fundamentals of probability theory and random processes to practical engineering problems, and identify and interpret the key parameters that underlie the random nature of the problems (L5)

RANDOM PROCESSES

L	T	P	C
2	0	0	2

Preamble

This course is designed to impart knowledge on random processes needed in applications such as signal processing, digital communications, speech processing, data modelling, etc.

Course Objectives:

1. To familiarize the students in the concepts of probability and random variables.
2. To study Random Processes, its types, distribution, and density functions.
3. To study Gaussian and Poisson processes.
4. To apply random process to signal processing in communication systems.
5. To apply skills in analysing random phenomena which occur in Electrical and Electronics Engineering applications.

Unit-1: Random Processes: (6 hours)

Temporal characteristics - the random processes concept, Classification of random processes, stationarity and statistical independence. Time averages and Ergodicity.

Learning Outcomes:

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

- solve the problems on multiple random variables, joint distribution and statistical independence, (L1)
- understand the classifications of random processes and concepts such as strict stationarity, wide-sense stationarity (L2)
- apply the concept on time averages and ergodicity (L3)

Unit-2: Correlation and Covariance functions: (5 hours)

Auto correlation, Cross correlation, Properties. Covariance functions. Gaussian random processes, Poisson random processes:

Learning Outcomes:

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

- know the definition of auto correlation and its application(L1)
- to understand about the correlation functions(L2)
- demonstrate the specific applications to Poisson and Gaussian processes and representation of low pass and band pass noise models (L2)

Unit-3: Density functions : (5 hours)

Probability density and joint probability density functions, Properties.

Learning Outcomes:

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

- know about joint probability density functions and its applications (L1)
- apply concept of joint density functions in random process (L3)
- apply the probability models and function of random variables based on single & multiple random variables (L3)

Unit-4:Spectral densities functions - I : **(5 hours)**

Spectral characteristics, the power density spectrum: Properties, relationship between power density spectrum and autocorrelation function

Learning Outcomes:

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

- understand the concept of power density functions (L2)
- apply substitution to compute power density function properties (L3)
- apply the concepts of power density functions and auto correlation (L3)

Unit-5 Spectral densities functions-II : **(5 hours)**

Cross-power density spectrum, Properties, relationship between cross power spectrum and cross-correlation function.

Learning Outcomes:

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

- develop an appreciation of the role of random processes in system modelling (L1)
- apply the concepts of filtering and prediction of a random process (L3)
- apply the specialised knowledge in random processes to solve practical engineering problems. (L3)

Course Outcomes:

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

- solve the problems on multiple random variables, joint distribution and independence
- solve the problems Gaussian and Poisson processes
- understand the concept of random processes and determine covariance and spectral density of stationary random processes
- characterize the random signals in communication systems with their autocorrelation and power spectral density functions

Textbook (s)

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw Hill, 2002.

References

1. Athanasios Papoulis, S. Unnikrishnan Pillai, Probability, Random Variables and Stochastic Processes, 4/e, Tata McGraw Hill, 2002.
2. Simon Haykin, Communication Systems, 4/e, Wiley Student Edition, 2006.
3. Henry Stark, John W. Woods, Probability and Random Processes with Application to Signal Processing, 3/e, Pearson Education, 2002.

OPTIMIZATION METHODS

L	T	P	C
2	0	0	2

Preamble:

Optimization is the art of finding the best result under given conditions. In this fast-expanding world, an engineer has to use many Optimization methods, as it is the most significant in decision-making, design, manufacturing, maintenance, planning, and scheduling.

Course Objectives: This course is designed to:

- introduce various optimization methods for solving real-world problems
- find optimal solutions to transportation, assignment, and sequencing problems
- know project planning and scheduling
- study the network analysis techniques through CPM and PERT

Unit – I **6 hours**

Transportation Problem: Introduction and LP formulation of Transportation Problem, feasible solution, basic feasible solution, finding Initial basic feasible solutions by North West corner rule, Least-cost entry method, Vogel's approximation method, Transportation Algorithm (MODI Method) to find an optimal solution.

Learning Outcomes:

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

- understand the problem of transportation problem (L2)
- find initial BFS by various methods (L3)
- apply MODI method for finding optimal transportation cost (L3)

Unit – II **5 hours**

Assignment Problems: Introduction to Assignment Problem, Mathematical formulation, Hungarian Method for finding optimal solution, unbalanced assignment problem, Travelling Salesman Problem.

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

- understand the problem of assignment problem(L2)
- apply the technique of solving the assignment problem using the Hungarian Method (L3)
- find an optimal solution to unbalanced assignment problem (L3)
- find the optimal route for the salesman (L3)

Unit – III **4 hours**

Sequencing Problem: Introduction, Basic terminology, Algorithms to obtain optimal solutions for sequencing problems with n jobs and two machines and n jobs and k machines.

Learning Outcomes:

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

- find optimal job sequencing (L3)
- find the optimal sequence for processing n jobs through two machines (L3)
- convert k machine problem into two machine problem (L4)
- find the optimal sequence for processing n jobs through k machines (L3)

Unit – IV **4 hours**

Network Analysis in Project planning: Project, Project Planning, Project Scheduling, Project Controlling, Work breakdown structure, Network Techniques, terms used in network-activity, event, path, network, dummy activity, looping, Fulkerson's rule, network diagram, and activity on node diagram.

Learning Outcomes :

By the end of this unit, the student will be able to:

- understand the problem of network models (L2)
- know the terms activity, node, labeling (L3)
- know the rules to draw the network diagram (L3)
- construct network diagram (L2)

Unit – V **7 hours**

PERT and CPM: Critical path method (CPM), Measure of activity, Critical path analysis, the four floats, subcritical and supercritical activities, slack, Programme evaluation and review technique (PERT), time estimates, frequency distribution curve for PERT

Learning Outcomes:

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

- know the technique of Critical Path Method (CPM) (L3)
- know the technique of PERT (L3)
- find time estimates (L3)
- estimate the probability of completing the project (L2)

Course outcomes:

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

- apply MODI method for finding optimal transportation cost
- apply Hungarian Method for solving assignment problems and finding an optimal route to the salesman
- understand the process of finding optimal sequencing for processing jobs on machines
- understand the network terminology and construction
- apply CPM and PERT techniques for project management

Text Books:

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

Reference Books:

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

COMPUTATIONAL METHODS

L T P C
3 0 0 3

Preamble:
It is designed for the students for the basic understanding of techniques for numerical solution of algebraic equations, differentiation, integration used to solve engineering application problems.

Course Objectives:

- Develop the mathematical skills in the areas of numerical methods.
- Focus on the theory and applications of numerical methods in many engineering subjects which require solutions of linear systems, finding eigenvalues, eigenvectors, interpolation, and applications, solving ODEs, PDEs.
- Help in the foundation of computational mathematics for postgraduate courses, specialized studies, and research.
- Train in developing the codes for implementing the numerical methods using any programming languages.
- Formulate a mathematical model for a given engineering problem

UNIT I 9 hours

Mathematical Modeling of Engineering Problems:
Approximations: Accuracy and precision, round-off and truncation errors, error problem with example problems. **Roots of Equations:** Formulations of linear and non-linear algebraic equations, solution with bisection, Newton-Raphson and Secant methods. Application to practical problems. **Algebraic Equations**: Formulation of linear algebraic equations from engineering problems, solution of these problems by Gauss elimination method, pitfalls of elimination and techniques for improving the solutions, Gauss Seidel iteration for solving sparse equations by avoiding storage of zero coefficients in matrix, convergence of iteration methods. LU decomposition methods for symmetric (Chelosky) matrices.

Learning Outcomes:

After completion of this unit the student will be able to

- Find the root for linear and non-linear algebraic equations by using iterative methods. (l1)
- Estimate the true error and approximate error between the iterations of the mathematical procedure. (l5)
- Formulate system of linear equations from engineering problem and solve using any of the numerical procedure(l6)

UNIT II 9 hours

Eigenvalues and Eigenvectors Problems: Formulation of equations to column, truss, spring-mass and friction problems. Solutions for the largest and smallest eigenvalues and corresponding eigenvectors. **Interpolation Methods:** Polynomial interpolation, Lagrange interpolation polynomials with equi- spaced data. **Regression or Curve Fitting:** Linear regression by least squares method.

Learning Outcomes:

After completion of this unit the student will be able to

- Interpolate a polynomial with any given data(L4)
- Fit a curve using linear regression(L3)
- Calculate Eigenvalues and corresponding Eigenvectors for a given system of equations.(L3)

UNIT III **8 hours**

Initial Value Problems: Ordinary differential equations, Euler, Heun's and Ralston methods. Runge- Kutta method of 2nd and 4th order, application to vibration and heat transfer problems. **Boundary Value Problems:** Linear and nonlinear ordinary differential equations, boundary value problems over semi-infinite domain, solution of nonlinear equations by finite difference method.

Learning Outcomes:

After completion of this unit the student will be able to

- Solve ODE's with R-K 2^{nd} and 4^{th} order methods. (L3)
- Interpret the boundary conditions for initial value and boundary value problems. (L2)
- Appreciate the merits of various numerical methods for solving ODE's.(L5)

UNIT IV **8 hours**

Laplace Equations: Finite difference discretization of computational domain, different types of boundary conditions, solution to elliptic equations. **Parabolic Transient Diffusion Equations:** Explicit and implicit formulation, Crank Nicolson Method.

Learning Outcomes:

After completion of this unit the student will be able to

- Classify the given partial differential equation.(l2)
- Discretize the given domain by finite difference method for both elliptic and parabolic pde's. (l3)
- Apply the boundary conditions for any given problem satisfying the physics of the problem.(l2)

UNIT V **8 hours**

Numerical Integration: Trapezoidal, Simpson's 1/3 and 3/8 rule and Gauss quadrature method.

Learning Outcomes:

After completion of this unit the student will be able to

- Solve the integration problem by using numerical methods. (l3)
- Understand the application of simpson's $1/3^{rd}$ and $3/8^{th}$ methods.(l2)

List of Computational Exercises:

1. Determine the real root for a given polynomial equation by (i) Bisection, (ii) Newton-Raphson until the approximate error falls below 0.5%.
2. Solve the system of simultaneous linear equations by

(i) Naïve -Gauss elimination
(ii) Gaussian elimination with partial pivoting
(iii) Gauss -Seidal method.
(iv) LU decomposition

3. Implement power method to find Eigenvalues and Eigenvectors for Spring mass system
4. Solve the parabolic partial differential equations by using explicit, implicit and semi-implicit methods
5. Solve the elliptic partial differential equations by finite difference techniques.
6. Finding the integral for a second-order polynomial using Gauss quadrature formula.
7. Solve numerical differentiation problems using Runge-Kutta 2^{nd} and 4^{th} order methods.
8. Find the integral by numerical methods such as Trapezoidal and Simpson's rule.

Course Outcomes:

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

- Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
- Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- Analyse and evaluate the accuracy of common numerical methods.
- Implement numerical methods using any programming language (matlab, scilab, python…)
- Write efficient, well-documented code and present numerical results in an informative way.

Text Book(s)

1. S.P. Venkateshan, P. Swaminathan, Computational Methods in Engineering, 1/e, Ane Publisher, 2014.
2. S.C. Chapra, R.P. Canale, Numerical Methods for Engineers, 6/e, Tata McGraw-Hill, 2012.

Reference

1. S.K. Gupta, Numerical Methods for Engineers, 1/e, New Age International, 2005.

PROBABILITY AND STATISTICS

L	T	P	C
3	0	0	3

Course Objectives:

- To familiarize the students with the foundations of probability and statistical methods
- To impart concepts in probability and statistical methods in engineering applications.

Unit I: Data Science and Probability **10 hrs**

Data Science: Statistics introduction, Population vs Sample, collection of data, primary and secondary data, types of variable: dependent and independent Categorical and Continuous variables, data visualization, Measures of central tendency, Measures of dispersion (variance).

Probability: Probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem (without proof).

Learning Outcomes:

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

- summarize the basic concepts of data science and its importance in engineering (L3)
- analyze the data quantitatively or categorically , measure of averages, variability (L4)
- define the terms trial, events, sample space, probability, and laws of probability (L3)
- make use of probabilities of events in finite sample spaces from experiments (L3)
- apply Baye's theorem to real time problems (L3)

Unit II: Random Variable and Probability Distributions **8 hrs**

Random variables (discrete and continuous), probability density functions, probability distribution - Binomial, Poisson and normal distribution-their properties (mathematical expectation and variance).

Learning Outcomes:

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

- explain the notion of random variable, distribution functions and expected value(L3)
- apply Binomial and Poisson distributions to compute probabilities, theoretical frequencies (L3)
- explain the properties of normal distribution and its applications (L3)

Unit III: Correlation, Regression and Estimation **8 hrs**

Correlation, correlation coefficient, rank correlation, regression, lines of regression, regression coefficients, principle of least squares and curve fitting (straight Line, parabola and exponential curves). **Estimation:** Parameter, statistic, sampling distribution, point estimation, properties of estimators, interval estimation.

Learning Outcomes:

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

- identify different trends in scatter plots, strengths of association between two numerical variables (L3)
- make use of the line of best fit as a tool for summarizing a linear relationship and predicting future observed values (L3)
- estimate the value of a population parameter, computation of point and its interval (L3)

Unit IV: Testing of Hypothesis and Large Sample Tests **8 hrs**

Formulation of null hypothesis, alternative hypothesis, the critical region, two types of errors, level of significance, and power of the test. **Large Sample Tests**: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems

Learning Outcomes:

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

- identify the difference between one- and two-tailed hypothesis tests (L3)
- analyze the testing of hypothesis for large samples (L4)

Unit V: Small Sample Tests **6 hrs**

Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), $\chi 2$ - test for goodness of fit, $\chi 2$ - test for independence of attributes.

Learning Outcomes:

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

- analyze the testing of hypothesis for small samples (L4)
- test for the Chi-square goodness of fit and independence of attributes (L4)

Text Books:

1. Miller and Freunds, Probability and Statistics for Engineers,7/e, Pearson, 2008.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

References:

1. S. Ross, A First Course in Probability, Pearson Education India, 2002.
2. W. Feller, An Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.

Course Outcomes:

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

- classify the concepts of data science and its importance (L3)
- apply discrete and continuous probability distributions (L3)
- explain the association of characteristics through correlation and regression tools (L3)
- identify the components of a classical hypothesis test (L3)
- infer the statistical inferential methods based on small and large sampling tests (L4)

MECH1011: ENGINEERING VISUALIZATION AND PRODUCT REALIZATION

L	T	P	C
0	0	4	2

The course enables the students to convey the ideas and information graphically that come across in engineering. This course includes projections of lines, planes, solids sectional views, and utility of drafting and modelling packages in orthographic and isometric drawings.

Course Objectives

- Create awareness of the engineering drawing as the language of engineers.
- Familiarize how industry communicates, practices for accuracy in presenting the technical information.
- Develop the engineering imagination essential for successful design.
- Train in 2D and 3D modeling softwares.
- Teach assembly of simple components and their animation.
- Teach basic 3D printing software for preparation of simple components

Manual Drawing: **(8 P hours)**

Introduction to Engineering graphics: Principles of Engineering Graphics and their significance-Conventions in drawing-lettering - BIS conventions. Dimensioning, sectioning and datum planes

Free hand sketching **(4 P hours)**

Free hand sketching of isometric & orthographic views and interpretation of drawings.

Computer Aided Drafting **(12 P hours)**

Introduction to CAD software: Basic drawing and editing commands: line, circle, rectangle, erase, view, undo, redo, snap, object editing, moving, copying, rotating, scaling, mirroring, layers, templates, polylines, trimming, extending, stretching, fillets, arrays, dimensions. Dimensioning principles and conventional representations.

Assemble drawings **(12 P hours)**

Constraints and assembly drawings. Engineering animation including motion curves, coordinating multiple moving parts under joint-constraints and the notion and impact of lighting and camera.

3D printing **(8 P hours)**

introduction to 3D printing software. slicing, grading and rendering of simple geometries using software

Project by group of students in the following themes **(12 P hours)**

IC engine model and 3D printed mini model
Belt drive for a bike
Four-wheel drivable ATV robot
Toy making - Carrom board, chess board & pieces model toy train, avengers
Buildings, bridges dams etc.
Wind turbine model
Design of Programmable Intelligent Controllers – PIC
Design of Printed Circuit Boards
Arduino Board Design and 3D Printing of Enclosures for Arduino Boards
Design of Radar and 3D Printing of Radar Models
Design of Mini Motherboards

Course Outcomes

After completing the course, the student will be able to

- utilize Engineering visualization as Language of Engineers. (L3)
- prepare drawings as per international standards. (L3)
- create 2D and 3D models using CAD packages. (L3)
- use 3D printing software and create model for printing of simple objects

MECH1021: WORKSHOP

L	T	P	C
0	0	4	2

This course enables the students to familiarize with the basic fabrication practices and to explore the various devices, tools and equipment used. Hands-on exercise is provided in various trade sections. Essentially student should understand the labor involved, machinery or equipment necessary, time required to fabricate and should be able to estimate the cost of the product or job work which are fundamental tasks for engineering plans.

Course Objectives

- Explain tools used in carpentry, fitting and sheet metal and practice procedure of doing experiments.
- Make the students to learn types of basic electric circuit connections and PCBs.
- Provide training to prepare FRP composites.
- Train the students on preparing 3D plastics using injection molding.
- Demonstrate on utilizing 3D printer for printing 3D objects

List of Jobs

1. Wood Working - Cross halving Joint/Dove Tail Joint/End Bridle Joint (Any two)
2. Sheet Metal working - Taper tray/conical funnel/Elbow pipe (Any Two) (including soldering).
3. Fitting- V fit/Dove Tail fit/ Semicircular fit (Any Two)
4. Electrical Wiring -Parallel and series connection
5. Electrical Wiring -Two-way switch connection
6. Electrical Wiring- Wiring of lighting systems
7. Injection molding-Make any two plastic components using injection molding machine.
8. 3D printing Demonstartion

Text Books

1. P. Kannaiah, K. L. Narayana, 'Workshop Manual', 2/e, Scitech Publications, India, 2007.
2. B. L Juneja , 'Workshop Practice ', 1/e, Cengage Learning ,Delhi, 2015

Additional Reading

1. K Mallick, 'Fiber-Reinforced Composites: Materials, Manufacturing, and Design', 3/e, CBC Press, New York, 2007.

Course Outcomes:

After completion of this lab the student will be able to

- Summarize application of different power tools (L1)
- Develop different parts with metal sheet/wood working/fits in real time applications. (L3)
- Demonstrate electrical circuits in various applications. (L2)
- Prepare models using injection molding m/c . (L3)
- Familiarize with 3D printer operations (L1)

MECH1031: DESIGN THINKING

L	T	P	J	S	C
0	0	2	0	0	1.0

Course Pre-requisite(s):Engineering Visualization and Product Realization
Design is a realization of a concept or idea into a configuration, drawing or product. Design Thinking is the cognitive and practical process by which design concepts are developed by designers. Innovation is a new idea or a new concept. Product development is the creation of a new or different product that offers new benefits to the end-user. This course introduces design thinking in product innovation.

Course Objectives
1. To familiarize the product design process
2. To introduce the basics of design thinking
3. To bring awareness on idea generation
4. To familiarize the role of design thinking in services design

Topic	Type
Each member of the group has to ask (vocally) the group members different questions about a product that they would like to design. Write down the questions and answers and submit as a word or pdf document.	Exercise
Each member of the group must ask (vocally) the group members questions about the product chosen in the previous experiment. This helps to gain indepth insights as well as new findings and information in order to grasp the problem or situation holistically or simply to find relevant questions for an interview. Write down the questions and answers and submit as a word or pdf document	Exercise
Identify relevant factors of influence that constitute the basis for a new or improved product or offer; then analyze it in a targeted manner. ➢ Make sure that you are sufficiently creative in the analysis process, because the focus is on technical “details”. ➢ Boost the efficiency of the analysis process by avoiding empty runs. ➢ Make use of a standardized procedure in order to examine the problem and solution space again with the help of data.	Exercise
➢ Do research, talk with people, and have empathy to formulate profound stories. ➢ Summarize the results from the “understand” and “observe” phases and discuss with the team. ➢ Highlight unexpected results and generate new perspectives. ➢ In general, share insights, ideas, and results (solutions) with others.	Exercise
➢ Explore untapped market opportunities. ➢ Provide differentiated and new offers based on the user needs. ➢ Adapt a strategy to new market needs by understanding the competitive edge. ➢ Establish the right vision for the design challenge or a road map for stepby-step implementation and control mechanisms.	Exercise
➢ Find out at an early stage whether the basic need is satisfied and the product attracts interest on the market. ➢ Find out through iterative testing whether the user need is met with a minimally functional product and how the product should be enhanced. ➢ Find out through user feedback how much demand there is for the product before developing further details and features. ➢ Minimize the risk of investing in a solution for which there is little demand on the market, thus saving time, money, and energy.	Exercise

➢ Perform a true A/B test or several variants of a prototype in the form of a multi-variants test or as split testing. ➢ Do a quantitative evaluation. ➢ Carry out a qualitative survey and evaluate the number and content of feedbacks. ➢ Compare individual variants of a function or a prototype (e.g. buttons, visuals, arrangement).	Exercise
➢ Collect and appraise experiences made in the project in a structured manner. ➢ Learn from experience and make use of it in the next project. ➢ Facilitate a positive attitude toward mistakes and appreciate progress. ➢ Identify and document the findings; make them applicable and usable.	Exercise
Case Studies : Example : Software Prototyping, Additive Manufacturing; Design of Arduino Boards for various applications etc	Exercise

Texbook(s)	**Topics**
1. Pahl, Beitz, Feldhusen, Grote,'Engineering Design: a systematic approach',3rd,Springer Science & Business Media,London,2007,978-1846283185	All Exercises
2. Christoph Meinel,Larry Leifer,Hasso Plattner,'Design Thinking Understand – Improve – Apply',1st,Springer,Berlin, Heidelberg,2011,978-3-642-13756-3	All Exercises

Additional Reading(s)	**Topics**
1. Marc Stickdorn, Jakob Schneider,'This is Service Design Thinking: Basics, Tools, Cases',1st,WILEY,United States,2012,978-1-118-15630-8	All Exercises

Journal(s)	**Topics**

Website(s)	**Topics**

Course Outcomes(COs)

1 Innovate new methods in product development
2 2 Apply Design Thinking in developing the new designs
3 Select ideas from ideation methods in new product development
4 Use Design Thinking in developing software products
5 Apply principles of Design Thinking in service design

CSEN1011 - PROBLEM SOLVING AND PROGRAMMING WITH C

L	T	P	C
0	0	6	3

The course is designed to enable the student to write programs for problem solving. After an introduction to program logic design using algorithms and flowcharts, converting the logic into programs is taught. The features of structured programming are explained with the C programming language as an example. This course lays the foundation both for developing program logic and for writing programs in C according to the developed logic.

Course Objectives:

1. Familiarize the student with the steps involved in writing and running a compiled program.
2. Enable the student to build program logic with algorithms and flowcharts.
3. Explain with the features and constructs of C programming such as data types, expressions, loops, functions, arrays, pointers, and files.
4. Demonstrate the handling of variables and input-output operations in C.
5. Train the student to convert program logic into C language code using a top-down approach.

Module I: Introduction to Computer Problem-Solving 12 P

Introduction, the Problem-Solving Aspect, Top-Down Design, Introduction to the idea of an algorithm, Introduction to Flowchart using Raptor tool.

Introduction to C Language – Structure of a C Program, Keywords, Identifiers, Data Types (int, float, char, unsigned int) and Variable declaration, Constants, Input / Output function. Operators, Expressions, Precedence and Associativity, Expression Evaluation, Type conversions.

Exercises: Construct a flowchart and write a program to

- Develop a calculator to convert time, distance, area, volume and temperature from one unit to another.
- Calculate simple and compound interest for various parameters specified by the user
- To enter marks of five subjects and calculate total, average and percentage.
- Calculate net salary of employee given basic,da,hra,pf and lic
- retrieve remainder after division of two numbers without using mod operator
- Convert an upper-case character to a lower-case character.
- Swap two numbers
- Enter two angles of a triangle and find the third angle.
- Check Least Significant Bit (LSB) of a number
- Input any number from user and check whether nth bit of the given number is set (1) or not (0)(hint: Use bitwise operators)

Learning Outcomes

After completion of this unit the student will be able to

- Develop algorithms and basic flowcharts for performing Input, Output and Computations (L3)
- Interpret the structure of C program and various key features of C (L2)
- Translate mathematical expressions to C notation using operators (L2).

Module II: Control Structures 15 P

- **Control Structures:** Selection Statements (making decisions) – if, if-else, nested if, else if ladder and switch statements. Repetition statements (loops)-while, for, do-while statements, Nested Loops.
- Unconditional statements-break, continue, goto.
- Pointers – Pointer variable, pointer declaration, Initialization of pointer, accessing variables through pointers, pointers to pointers, pointers to void.

Exercises: Construct a Flowchart and Write a Program to

- Check whether the triangle is equilateral, isosceles, or scalene triangle.
- Check whether entered year is a leap year or not
- Find minimum among three numbers.
- Check whether a number is divisible by 5 and 11 or not.
- Check whether a number is positive, negative or zero using switch case.
- Design a calculator that performs arithmetic operations on two numbers using switch case
- Find Roots of a Quadratic Equation
- Find factorial of a number
- Check whether number is a palindrome or not
- Check whether number is perfect or not
- Convert a decimal number to binary number
- To find the sum of the series [1-X^2/2!+X^4/4!- ....].
- Print following patterns

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

  A
  B B
  C CC
  D D D D
  E E E EE

  1
  2 3
  4 5 6
  7 8 9 10
  ```
- Calculate the greatest common divisor of two numbers
- Generate first n numbers in the Fibonacci series
- Generate n prime numbers
- Swap two numbers using pointers.
- Performs all the five arithmetic operations using Pointers.

Learning Outcomes:

After completion of this unit the student will be able to

- Construct C programs using various conditional statements (L3).

- Develop C programs using loops and nested loops (L6).
- Demonstrate the usage of pointers (L3).

Module III: Functions 15 P

Functions-Designing Structured Programs, user defined function- function definition, function prototype, function call, Types of functions. Parameter Passing by value, parameter passing by address, Recursive functions. Dynamic Memory allocation Functions, pointers to functions. Storage classes-auto, register, static, extern.

Exercises: Write a program using functions to

- Print even and odd numbers in a given range
- Find power of a number
- Return maximum of given two numbers
- To print all strong numbers between given interval using functions.
- Check whether a number is prime, Armstrong or perfect number using functions.
- Demonstrate call by value and call by reference mechanisms.
- Find power of any number using recursion.
- Generate Fibonacci series using recursion
- Find product of two numbers using recursion
- Find the sum of digits of a number. Number must be passed to a function using pointers.
- Find GCD (HCF) of two numbers using recursion.
- Find LCM of two numbers using recursion.

Learning Outcomes:

After completion of this unit the student will be able to

- understand the concept of subprograms and recursion (L2).
- apply the in-built functions to develop custom functions for solving problems (L3).
- make use of parameter passing mechanisms (L3).
- infer the effect of storage classes on variables (L2).

Module IV: Arrays and Strings 15 P

Arrays – Declaration and Definition of Array, accessing elements in array, Storing values in array, linear search, binary search, bubble sort, Two – dimensional arrays, multidimensional arrays. Arrays and Pointers, Pointer Arithmetic and arrays, array of pointers, Passing array to function. Strings – Declaration and Definition of String, String Initialization, unformatted I/O functions, arrays of strings, string manipulation functions, string and pointers.

Exercises: Write a program to

- Find minimum and maximum element in an array
- Implement linear search.
- Sort an array in descending order.
- Given a two-dimensional array of integers and a row index, return the largest element in that row.
- Find transpose of a matrix.
- Perform multiplication of two matrices
- Count total number of vowels and consonants in a string.
- Reverse the given string without using String handling functions.
- Sort strings in dictionary order

- To perform addition of two matrices.
- Read an array of elements of size 'n' and find the largest and smallest number using functions
- find total number of alphabets, digits or special character in a string using function

Learning Outcomes:

After completion of this unit the student will be able to

- develop programs for storing and managing collections of items using arrays (L3).
- make use of the in-built functions to manipulate strings (L3).
- solve problems related to arrays and strings (L3).

Module V: Structures and Files 15 P

Structures–Declaration, initialization, accessing structures, operations on structures, structures containing arrays, structures containing pointers, nested structures, self-referential structures, arrays of structures, structures and functions, structures and pointers, unions.

Files – Concept of a file, Opening and Closing files, file input / output functions (standard library input / output functions for text files)

Exercises: Write a program to

- Store information of a student using structure
- Add two complex numbers by passing structures to a function
- Store information of 10 students using structures
- Store Employee information using nested structure
- Read file contents and display on console.
- Read numbers from a file and write even and odd numbers to separate file.
- Count characters, words and lines in a text file.

Learning Outcomes:

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

- develop programs using structures and unions for storing dissimilar data items (L6).
- compare the utilization of memory by structures and unions (L5).
- make use of files and file operations to store and retrieve data (L3).

Text Books(s)

1. B. A. Forouzan and R. F. Gilberg, Computer Science: A Structured Programming Approach Using C, 3/e, Cengage Learning

Reference Book(s)

1. Jeri R Hanly, Elliot B Koffman, Problem Solving and Program Design in C, 7/e, Pearson Education, 2012.
2. B.W. Kernighan and Dennis M. Ritchie, The C Programming Language, 2/E, Pearson education, 2015.
3. B. Gottfried, Programming with C, 3/e, Schaum's outlines, McGraw Hill (India), 2017.
4. P. Dey and M Ghosh, Programming in C, 2/e, Oxford University Press, 2011.

Course Outcomes:

After completion of this course the student will be able to

- Build logic for solving a problem and translate it into a program. (L3).
- Define variables and construct expressions using C language (L1).
- Utilize arrays, structures and unions for storing and manipulating data (L3).
- Develop efficient, modular programs using functions (L3).
- Write programs to store and retrieve data using files (L3).

Additional Exercises:

- Given numbers x, y, and target, return whichever of x and y is closer to the target. If they have the same distance, return the smaller of the two
- There are three friends Ram, Raheem and Robert. Ram's age is 20, Raheem is aged three times more than his friend Ram. After 8 years, he would be two and a half times of Ram's age. After further 8 years, how many times would he be of Rams age? Robert's age is 25 now. Now program your computer to determine the final ages of all the three people after 16 years and also show who is elder.
- Given an actual time and an alarm clock time, both in "military" format (such as 0730 for 7:30am), print how many more minutes before the alarm rings. But if the time is after the alarm, print "Alarm already went off".
- Let there be a scenario where you and your friend are going to a restaurant. You have lunch there every fourth day, and he has his lunch there every sixth day. How many days before you meet again for lunch at the same restaurant?
- Two friends Suresh and Ramesh have **m** red candies and **n** green candies respectively. They want to arrange the candies in such a way that each row contains equal number of candies and also each row should have only red candies or green candies. Help them to arrange the candies in such a way that there are maximum number of candies in each row.
- On a chessboard, positions are marked with a letter between a and h for the column and a number between 1 and 8 for the row. Given two position strings, return true if they have the same colour.
- Given two strings s0 and s1, return whether they are anagrams of each other.
- Write a program to encrypt and decrypt a password which is alphanumeric
- Given a string, return the string with the first and second half swapped. If the string has odd length, leave the middle character in place.
- Given an array of integers, return the second-largest element.
- Given lists of integers people, jobs, profits. Each person i in people have people[i] amount of strength, and performing job j requires jobs[j] amount of strength and nets profits[j] amount of profit. Given that each person can perform at most one job, although a job can be assigned to more than one person, return the maximum amount of profit that can be attained.
- Mr. Roxy has arranged a party at his house on the New Year's Eve. He has invited all his friends - both men and women (men in more number). Your task is to generate the number of ways in which the invitees stand in a line so that no two women stand next to each other. Note that the number of men is more than the number of women and Roxy doesn't invite more than 20 guests. If there are more than 20 guests or an arrangement as per the given constraints is not possible, print 'invalid'.
- Two friends have entered their date of birth and they want to know who is elder among them. Make a structure named Date to store the elements day, month and year to store the dates.

Case Study:

- Create a structure containing book information like accession number, name of author, book title and flag to know whether book is issued or not. Create a menu in which the following functions can be done: Display book information,   Add a new book, Display all the books in the library of a particular author, Display the number of books of a particular title, Display the total number of books in the library, Issue a book (If we issue a book, then its number gets decreased by 1 and if we add a book, its number gets increased by 1)
- Ranjan is maintaining a store. Whenever a customer purchases from the store, a bill is generated. Record the customer name, amount due, the amount paid, mobile number with purchased items in file. At the end of day print the total income generated by store.
- Contact Management System- Create structure to store Contact information like name,gender,mail,phone number and address. Users can add new contact and can also edit and delete existing contact. (Hint: Use Files to store data)

CSEN1021 - PROGRAMMING WITH PYTHON

L	T	P	C
0	0	6	3

Course Objectives:

- To elucidate problem solving through python programming language
- To introduce function-oriented programming paradigm through python
- To train in development of solutions using modular concepts
- To teach practical Python solution patterns

Module I: Introduction to Python 12 H

Python – Numbers, Strings, Variables, operators, expressions, statements, String operations, Math function calls, Input/output statements, Conditional If, while and for loops.

Exercises:

- Accept input from user and store it in variable and print the value.
- Use of print statements and use of (.format)for printing different data types.
- Take 2 numbers as user input and add, multiply, divide, subtract, remainder and print the output (Same operations on floating point input as well)
- Conversion of one unit to another (such as hours to minutes, miles to km and etc)
- Usage of mathematical functions in python like math.ceil, floor, fabs, fmod, trunc, pow, sqrt etc.
- Building a mathematical calculator that can perform operations according to user input. Use decision making statement.
- Accepting 5 different subject marks from user and displaying the grade of the student.
- Printing all even numbers, odd numbers, count of even numbers, count of odd numbers within a given range.
    - Compute the factorial of a given number. b) Compute GCD of two given numbers. c) Generate Fibonacci series up to N numbers.
- Check whether the given input is a) palindrome b) strong c) perfect
- Compute compound interest using loop for a certain principal and interest amount

Learning Outcomes:

After completion of this unit the student will be able to

- solve simple problems using control structures, input and output statements. (L3)
- develop user defined functions (recursive and non-recursive). (L3)

Module II: Functions **15H**

User defined Functions, parameters to functions, recursive functions. Lists, Tuples, Dictionaries, Strings.

Exercises:

- Create a function which accepts two inputs from the user and compute $^{n}C_{r}$
- Recursive function to compute GCD of 2 numbers
- Recursive function to find product of two numbers
- Recursive function to generate Fibonacci series
- Program to print a specified list after removing the 0th, 4th and 5th elements.
  Sample List : ['Red', 'Green', 'White', 'Black', 'Pink', 'Yellow']
  Expected Output : ['Green', 'White', 'Black']
- Program to get the difference between the two lists.
- Program to find the second smallest number and second largest number in a list.
- Given a list of numbers of list, write a Python program to create a list of tuples having first element as the number and second element as the square of the number.
- Given list of tuples, remove all the tuples with length K.
  Input : test_list = [(4, 5), (4,), (8, 6, 7), (1,), (3, 4, 6, 7)], K = 2
  Output : [(4,), (8, 6, 7), (1,), (3, 4, 6, 7)]
  Explanation : (4, 5) of len = 2 is removed.
- Program to generate and print a dictionary that contains a number (between 1 and n) in the form (x, x*x).
  Sample Input: (n=5) :
  Expected Output : {1: 1, 2: 4, 3: 9, 4: 16, 5: 25}
- Program to remove a key from a dictionary
- Program to get the maximum and minimum value in a dictionary.
- Program to perform operations on string using unicodes ,splitting of string,accessing elements of string using locations
- Program for Counting occurrence of a certain element in a string, getting indexes that have matching elements.For ex -.In Rabbit count how many times b has occurred . Example-I have to go to a doctor and get myself checked. Count the number of occurrences of ‘to’.
- Program for replacing one substring by another For example - Rabbit - Replace ‘bb’ by ‘cc’
- Program to Acronym generator for any user input (ex-input is Random memory access then output should be RMA).Example - Random number (RN)
- Python function that accepts a string and calculates the number of uppercase letters and lowercase letters.
- Program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings
- Sample List : ['abc', 'xyz', 'aba', '1221'] Expected Result : 2

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

- understand the concept of subprograms and recursion (L2).
- apply the in-built functions to develop custom functions for solving problems (L3).
- make use of parameter passing mechanisms (L3).
- develop user defined functions (recursive and non-recursive). (L3)
- summarize the features of lists, tuples, dictionaries, strings and files. (L2)

Module III: Files and Packages **15 H**

Files—Python Read Files, Python Write/create Files, Python Delete Files.
Pandas -- Read/write from csv, excel, json files, add/ drop columns/rows, aggregations, applying functions.
Exercises

- read an entire text file.
- read the first n lines of a file.
- append text to a file and display the text.
- Read numbers from a file and write even and odd numbers to separate files.
- Count characters, words and lines in a text file.
- To write a list to a file.
- Given a CSV file or excel file to read it into a dataframe and display it.
- Given a dataframe, select rows based on a condition.
- Given is a dataframe showing the name, occupation, salary of people. Find the average salary per occupation.
- To convert Python objects into JSON strings. Print all the values.
- Write a Pandas program to read specific columns from a given excel file.

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

- read data from files of different formats and perform operations like slicing, insert, delete, update(L3).
- Ability to define and use of Packages(L2).

Module IV: Operations in database with suitable libraries **15 H**

SQLite3: CRUD operations (Create, Read, Update, and Delete) to manage data stored in a database. Matplotlib -- Visualizing data with different plots, use of subplots. User defined packages, define test cases.

Exercises

Special commands to sqlite3 (dot-commands)
Rules for "dot-commands"
Changing Output Formats
Querying the database schema
Redirecting I/O
Writing results to a file
Reading SQL from a file
File I/O Functions
The edit() SQL function
Importing CSV files
Export to CSV

Export to Excel
Reference - https://www.sqlite.org/cli.html
Matplotlib can be practiced by considering a dataset and visualizing it.
It is left to the instructor to choose appropriate dataset.

Learning Outcomes:
After completion of this unit the student will be able to
- visualize the data (L4).
- Understanding the various operations performed with SQLite3. (L2)
- make use of SQLite3 operations to store and retrieve data (L3).

Module V: Regular Expressions **15 H**
Regular expression: meta character, regEx functions, special sequences, Web scrapping, Extracting data.
Exercises
Write a Python program to check that a string contains only a certain set of characters (in this case a-z, A-Z and 0-9).
Write a Python program that matches a string that has an a followed by zero or more b's
Write a Python program that matches a string that has an a followed by one or more b's
Write a Python program that matches a string that has an a followed by zero or one 'b'
Write a Python program that matches a string that has an a followed by three 'b'
Write a Python program to find sequences of lowercase letters joined with an underscore
Write a Python program to test if a given page is found or not on the server.
Write a Python program to download and display the content of robot.txt for en.wikipedia.org.
Write a Python program to get the number of datasets currently listed on data.gov
Write a Python program to extract and display all the header tags from en.wikipedia.org/wiki/Main_Page
Learning Outcomes:
After completion of this unit, the student will be able to:
- make use of Web scrapping operations (L3).
- Use regular expressions to extract data from strings.(L3)

Text Books(s)
1. Programming with python, T R Padmanabhan, Springer
2. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University Press

Reference Book(s)
1. Programming with python, T R Padmanabhan, Springer
2. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University Press
3. Python for Data Analysis, Wes McKinney, O.Reeilly

Course Outcomes:
- After completion of this course the student will be able to
- Define variables and construct expressions (L1).
- Utilize arrays, storing and manipulating data (L3).
- Develop efficient, modular programs using functions (L3).
- Write programs to store and retrieve data using files (L3).

APPLICATIONS OF ARTIFICIAL INTELLIGENCE

L T P C
0 0 2 1

The surge in the production of data has led to the development of various technologies. The term "Artificial Intelligence (AI)" has become ubiquitous in everyday applications from virtual assistants to self-driving cars. Several applications such as Healthcare, Finance, Bioinformatics etc. are benefitting from the advances in the domain. The global market for artificial intelligence is going to face a phenomenal growth over the coming years with organizations across the world capitalizing on the disruptive technologies that AI is offering. This course introduces the recent applications of AI namely, Virtual Assistants, Computer Vision, along with trending topics such as Deep Learning and Reinforcement Learning. The idea of the course is to introduce the basic concepts of AI as well as latest trends in the domain. This course is envisaged to provide a basic understanding on latest developments of AI to all disciplines engineering undergraduates.

Course Objectives:

- Provide introduction to basic concepts of artificial intelligence.
- Explore applications of AI
- Explore the scope, advantages of intelligent systems
- Experiment with different machine learning concept
- Exposure to AI-intensive computing and information system framework

Week-1: 2 L

Introduction to Artificial intelligence: Basics of AL Agents and Environment, The Nature of Environment.

List of Experiment(s):

1. Implementation of toy Problems (8-Puzzle,Wumpus World, Vacuum-clean Example, etc)

Week-2: 2 P

Applications of AI: Game Playing, [Deep Blue in Chess, IBM Watson in Jeopardy, Google's Deep Mind in AlphaGo]

List of Experiment(s):

1. Implementation of (Sudoku, Crossword Puzzle, or WumpusWorld, etc)

Learning Outcomes:

The student will be able to:

- Understand the basics in AI.
- Recognize various domains in AI.

Week-3: 2 P

Conceptual introduction to Machine Learning: Supervised, Unsupervised, and Semi-Supervised Learning.

List of Experiment(s):

1. Supervise - Perform Data Labelling for various images using object recognition

Week-4: 2 P

Reinforcement Learning, Introduction to Neural Networks, Deep Learning.

List of Experiment(s):

1. Explore the effect of different hyperparameters while implementing a Simple Fully Connected Neural Network. (https://playground.tensorflow.org)

Learning Outcomes:
The student will be able to:

- Define machine learning and forms of learning
- Identify types of Neural Networks

Week-5: 2 P

Image Processing & Computer Vision: Introduction to Image processing, Image Noise, Removal of Noise from Images, Color Enhancement, Edge Detection.

List of Experiment(s):

1. Lobe.ai - Build custom models using the visual tool for Object recognition and sentiment analysis that can convert facial expressions into emoticons

Week-6: 2 P

Segmentation. Feature Detection & Recognition. Classification of images. Face recognition, Deep Learning algorithms for Object detection & Recognition.

List of Experiment(s):

1. Teachable Machine Brain.JS In Browser Object Recognition through
2. Haar Cascade Object detection for Eye and Face in Python using Open CV

Learning Outcomes:
The student will be able to:

- Identify the concepts of image processing
- Implement the methods in computer vision

Week-7: 2 P

Conceptual introduction to Natural Language Processing: Speech Recognition & Synthesis: Speech Fundamentals, Speech Analysis, Speech Modelling.

List of Experiment(s):

1. Sentiment Analysis and Polarity detection

Week-8: 2 P

Speech Recognition, Speech Synthesis, Text-to-Speech, Sentiment Analysis, Segmentation and recognition.

List of Experiment(s):

1. Text to Speech recognition and Synthesis through APIs

Learning Outcomes:
The student will be able to:

- Understand the basics of Speech Processing
- Describe natural language processing and concepts for converting speech to different forms

Week-9: 2 P

Introduction to o Chatbot, Architecture of a Chatbot. NLP in the cloud, NL Interface, How to Build a Chatbot, Transformative user experience of chatbots, DesigningElements of a chatbot, Best practices for chatbot development. NLP components. NLP wrapper to chatbots. Audiobots and Musicbots.

List of Experiment(s):

1. Building a Chatbot using IBM Watson visual studio
2. Building a Chatbot using Pandora bots
3. Build a virtual assistant for Wikipedia using Wolfram Alpha and Python

Learning Outcomes:
The student will be able to:

- Understand basic architecture of chatbots.
- Implement chatbots for various applications.

Week-10: 2 P

Smart Applications: Smart Manufacturing, Smart Agriculture, Smart Healthcare, Smart Education, Smart Grids, Smart Transportation andAutonomous Vehicles, Smart Homes, Smart Cities

List of Experiment(s):

1. Build a smart application specific to the domain of the student.

Learning Outcomes:

The student will be able to:

- Understand the application of intelligence in various domains
- Correlate Artificial Intelligence to advanced applications

Text Books(s)

1. Tom Markiewicz& Josh Zheng, Getting started with Artificial intelligence, Published by O'Reilly Media,20l7
2. Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach.

Reference Book(s)

1. Aurtlien Giron. Hands on Machine Learning with Scikit-Learn and TensorFlow concepts,Tools, and Techniques to Build intelligent Systems , Published by O'Reilly Mcdia,20l 7
2. Build an AI Assistant with wolfram alpha and Wikipedia in python.https://medium .com/@salisuwy/build-an-ai-assistant-with-wolfram-alpha-and-wikipedia-in-python-d9bc8ac838fe.
3. Joseph Howse, Prateek Joshi, Michael Beyeler - Opencv Computer Vision Projects withPython-Publishing (201 6).
4. Curated datasets on kaggle https://www.kaggle.com/datasets.

Course Outcomes:

- Able to grasp the concepts of artificial intelligence, machine learning, natural language processing, image processing
- Recognize various domains in which Al can be applied
- Implement the methods in processing an image:
- Implement simple of chatbots
- identify smart applications:

PROBABILITY AND STATISTICS

L	T	P	C
3	0	0	3

Course Objectives:

- To familiarize the students with the foundations of probability and statistical methods
- To impart concepts in probability and statistical methods in engineering applications.

Unit I: Data Science and Probability **10 hrs**

Data Science: Statistics introduction, Population vs Sample, collection of data, primary and secondary data, types of variable: dependent and independent Categorical and Continuous variables, data visualization, Measures of central tendency, Measures of dispersion (variance).

Probability: Probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem (without proof).

Learning Outcomes:

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

- summarize the basic concepts of data science and its importance in engineering (L3)
- analyze the data quantitatively or categorically , measure of averages, variability (L4)
- define the terms trial, events, sample space, probability, and laws of probability (L3)
- make use of probabilities of events in finite sample spaces from experiments (L3)
- apply Baye's theorem to real time problems (L3)

Unit II: Random Variable and Probability Distributions **8 hrs**

Random variables (discrete and continuous), probability density functions, probability distribution - Binomial, Poisson and normal distribution-their properties (mathematical expectation and variance).

Learning Outcomes:

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

- explain the notion of random variable, distribution functions and expected value(L3)
- apply Binomial and Poisson distributions to compute probabilities, theoretical frequencies (L3)
- explain the properties of normal distribution and its applications (L3)

Unit III: Correlation, Regression and Estimation **8 hrs**

Correlation, correlation coefficient, rank correlation, regression, lines of regression, regression coefficients, principle of least squares and curve fitting (straight Line, parabola and exponential curves). **Estimation:** Parameter, statistic, sampling distribution, point estimation, properties of estimators, interval estimation.

Learning Outcomes:

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

- identify different trends in scatter plots, strengths of association between two numerical variables (L3)
- make use of the line of best fit as a tool for summarizing a linear relationship and predicting future observed values (L3)
- estimate the value of a population parameter, computation of point and its interval (L3)

Unit IV: Testing of Hypothesis and Large Sample Tests **8 hrs**

Formulation of null hypothesis, alternative hypothesis, the critical region, two types of errors, level of significance, and power of the test. **Large Sample Tests**: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems

Learning Outcomes:

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

- identify the difference between one- and two-tailed hypothesis tests (L3)
- analyze the testing of hypothesis for large samples (L4)

Unit V: Small Sample Tests **6 hrs**

Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), $\chi 2$ - test for goodness of fit, $\chi 2$ - test for independence of attributes.

Learning Outcomes:

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

- analyze the testing of hypothesis for small samples (L4)
- test for the Chi-square goodness of fit and independence of attributes (L4)

Text Books:

1. Miller and Freunds, Probability and Statistics for Engineers,7/e, Pearson, 2008.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

References:

1. S. Ross, A First Course in Probability, Pearson Education India, 2002.
2. W. Feller, An Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.

Course Outcomes:

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

- classify the concepts of data science and its importance (L3)
- apply discrete and continuous probability distributions (L3)
- explain the association of characteristics through correlation and regression tools (L3)
- identify the components of a classical hypothesis test (L3)
- infer the statistical inferential methods based on small and large sampling tests (L4)

EECE1001: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

L	T	P	C
2	1	2	4

This course introduces the fundamental principles and building blocks of electrical and electronics engineering. The first three units cover the electric circuit laws, theorems, and principles of electrical machines. The last two units cover semiconductor devices and their applications.

Course Objectives:

- To impart the analysis and design aspects of DC networks in electrical and electronic circuits
- To explain the basic concepts of AC networks used in electrical and electronic circuits.
- To demonstrate the importance and operating principles of electrical machines (transformers, motors and generators)
- To impart the knowledge about the characteristics, working principles and applications of semiconductor diodes, Metal Oxide Semiconductor Field Effect Transistors (MOSFETs).
- To expose basic concepts and applications of Operational Amplifier and configurations.

Unit I: **7L**

DC Circuits: Basic circuit elements and sources, Ohms law, Kirchhoff's laws, series and parallel connection of circuit elements, Node voltage analysis, Mesh current analysis, Superposition, Thevenin's and maximum power transfer theorem.

Learning Outcomes

After completion of this unit the student will be able to

- state Ohms law and Kirchhoff's Laws (L1).
- calculate equivalent resistance of series and parallel connections in a circuit (L1).
- able to calculate voltage and current using voltage and current division methods (L2).
- determine the current, voltage and power in the given electrical circuit (L4).
- apply various theorems to analyze an electric circuit (L3).

Unit II: **8L**

AC Circuits: Alternating voltages and currents, AC values, single phase RL, RC, RLC series circuits, power in AC circuits, Power Factor, three phase systems-Star and Delta Connection-Three phase power measurement.

Learning Outcomes:

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

- describe AC voltages and currents (L1).
- analyse Series RL, RC and RLC circuits (L4).
- Learn calculations of power factor and power measurement (L2)
- Understand star and delta connections in three phase systems (L3).

Unit III: **9L**

Electrical Machines: Construction, working principle and application of DC machines, Transformers, single phase and three phase Induction motors, special machines-Stepper motor, Servo motor and BLDC motor.

Learning Outcomes:

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

- Understand working principle of dc machines (L1).
- demonstrate principle operation of transformer (L3).
- discuss about open and short- circuit tests of transformer (L2).
- explain the working principle of three phase induction motor (L5).
- gain knowledge on applications as special machines, stepper motor (L1).
- Identify and choose servo motor and BLDC motor applications (L2).

Unit IV: **8L**

Semiconductor Devices: p-n Junction diode - Basic operating principle, current-voltage characteristics, rectifier circuits (half-wave, full-wave, rectifier with filter capacitor), Zener diode as Voltage Regulator; Metal oxide semiconductor field effect transistor (MOSFET): Operation of NMOS and PMOS FETs, MOSFET as an amplifier and switch.

Learning Outcomes:

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

- describe the device structure and physical operation of a diode (L1).
- discuss V-I characteristics of diodes (L2).
- explain the use of diode as switch and in electronic circuits (L2).
- describe the construction and operation of n-channel and p-channel MOSFETs (L1).
- explain the use of MOSFET as an amplifier and bidirectional switch(L2).

Unit V: **8L**

Operational Amplifiers: The Ideal Op-amp, The Inverting Configuration, The closed loop gain, Effect of Finite open-loop gain, The Noninverting Configuration, The closed loop gain, Characteristics of Non-Inverting Configuration, Difference amplifiers, A Single Op-amp difference amplifier. Adders, subtractors, integrators, differentiators, filter circuits using Opamps,

Learning Outcomes:

After completion of this unit the student will be able to

- list the characteristics of an ideal Op Amp (L1).
- design the Inverting and Noninverting configurations of Op-Amp(L2).
- construct a single Op-amp difference amplifier (L3).
- List several applications of opamps

Basic Electrical and Electronics Engineering Laboratory

List of Experiments:

1. Verification of Kirchhoff's Laws.
2. Verification of DC Superposition Theorem.
3. Verification of Thevenin's Theorem.
4. Verification of Maximum power transfer Theorem.
5. Load test on DC generator.
6. Load test on single phase transformer.
7. Measurement of voltage, current and power factor of single phase RL, RC series circuits.
8. Measurement of voltage, current and power factor of single phase RLC series circuit.
9. Measurement of power in a three phase circuit.
10. Current Voltage Characteristics of a p-n Junction Diode/LED.
11. Diode Rectifier Circuits.

12. Voltage Regulation with Zener Diodes.
13. Design of a MOSTFET amplifier and MOSFET inverter/NOR gate
14. Inverting and Non-inverting Amplifier Design with Op-amps.
15. Simulation experiments using PSPICE
(a) Diode and Transistor Circuit Analysis.
(b) MOSFET Amplifier design.
(c) Inverting and Noninverting Amplifier Design with Op-amps.

Text Book(s):

1. D. P. Kothari, I. J. Nagrath, Basic Electrical and Electronics Engineering, 1/e, McGraw Hill Education (India) Private Limited, 2017.
2. B. L. Theraja, Fundamentals of Electrical Engineering and Electronics, 1/e, S. Chand Publishing, New Delhi, 2006.
3. Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits 6/e, Oxford University Press, 2014.

References:

1. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, Pearson Education, 2011.
2. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008.
3. R. K. Rajput, Basic Electrical and Electronics Engineering, University Science Press, New Delhi, 2012.

Course Outcomes:

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

- predict and analyse the behaviour of an electrical circuit (L3).
- analyse the performance quantities such as losses, efficiency and identify applications of DC machines (L4).
- explain the use of transformers in transmission and distribution of electric power and other applications (L2).
- demonstrate the operation and applications of various electronic devices (L2).
- construct Inverting and Noninverting configurations of Op-amp (L3).

INTERNSHIP I

L T P C J
0 0 0 1 1

Prerequisite: Completion of minimum of four semesters

Course Objectives:
The course is designed to expose the students to expected industry skills and industry environment and to take up onsite assignment as trainees or interns.

Expected Course Outcome:

At the end of this internship the student should be able to:
1. Have an exposure to industrial practices and to work in teams
2. identify skill set required to participate activity in real-time projects relevant to the industry
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. formulate technical background required to participate in Internship 2

Contents: 1 **Week**

One week of work at industry site. Supervised by an expert at the industry.

Mode of Evaluation: Internship Report, Presentation and Project Review

INTERNSHIP II

L T P C J
0 0 0 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; ye-Delta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2-port network parameters: driving point and transfer functions; State equations for networks and Network Synthesis (RL,RC,LC and RLC Synthesis): Positive real functions, hurwitz polynomial, foster and cauer forms. Continuous-time signals: LTI System & Properties,Fourier series and Fourier transform representations, sampling and aliasing concepts and applications; Discrete-time signals: discrete time Fourier transform (DTFT), DFT, FFT, Z-transform. Interconnection of systems; Filter design concepts, phase and group delay concepts

Module:2 Electronic Devices and Circuits
Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJT, LED, photo diode and solar cell; MOS Transistor Theory: nMOS, pMOS Enhancement Transistor, ideal I-V characteristics, MOS capacitor, C-V characteristics, DC transfer Characteristics of CMOS inverter.

Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Special diodes, Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, tuned amplifiers, power and operational; Simple opamp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and op-amp configurations; Function generators, 555 timers, open and closed loop applications of Comparators, Voltage Regulators, regulator protection methods, noise analysis of electronic circuits, PLLs and Data converters

Module 3: Digital Circuits

Number systems; Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip-flops, counters, shift- registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microcontroller (8051): architecture, programming, memory and I/O interfacing.

Module:4 Electromagnetics

Electrostatics; Maxwell‟s equations: differential and integral forms and their interpretation boundary conditions, wave equation, Poynting vector; Plane waves and properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth; Transmission lines: equations, characteristic impedance, impedance matching, S-parameters, Smith chart; Waveguides: modes, boundary conditions, cut-off frequencies, Rader range equvation, Friss formula; Antennas: antenna types, radiation pattern, gain and directivity, return loss, antenna arrays; Wave Propagation, Antenna design considerations - Microstrip and Horn antennas. Basics of radar; Properties and characteristics of light sources (Laser and LED) and detectors; Light propagation in optical fibers.

Module 5: Control Systems

Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; Closed loop control system design by Nichols plot , PID controller design, Lag, lead and lag-lead compensation, States space models, states space equations and solutions, states space methods for controller designs and non-linear control systems and its applications.

Module 6: Communications

Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem. Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; inter-symbol interference and its mitigation; Wireless Communication: Structure of a Wireless Communication Link, Modulation Techniques: QPSK, MSK, GMSK. Basics of TDMA, FDMA and CDMA.

Mode of Evaluation: 12 Quizzes with Multiple Choice Questions. Best 10 quizzes are considered for computing 100M. Student shall score atleast 80% in atleast 8 quizzes to be considered for grading

CAPSTONE PROJECT – INTRODUCTION

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

Course Objectives:

To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Course Outcome:

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

1. Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
2. Perform literature search and / or patent search in the area of interest.
3. Conduct experiments / Design and Analysis / solution iterations and document the results.
4. Perform error analysis / benchmarking / costing
5. Synthesis the results and arrive at scientific conclusions / products / solution
6. Document the results in the form of technical report / presentation

Course Logistics

Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.

1. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.
2. Can be individual work or a group project, with a maximum of 3 students.
3. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.
4. Carried out inside or outside the university, in any relevant industry or research institution.
5. Publications in the peer reviewed journals / International Conferences will be an added advantage

Mode of Evaluation: Periodic reviews, Presentation, Final oral viva, Poster submission

HSMCH102 - UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY

L T P C
2 1 0 3

Human Values Courses: During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

OBJECTIVE: The objective of the course is four fold:

1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

COURSE TOPICS: The course has 28 lectures and 14 practice sessions in 5 modules:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I.
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'.
2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility.
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).
4. Understanding the characteristics and activities of 'I' and harmony in 'I'.
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.

6. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available tome. Identifying from one's own life.

Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature.
3. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.
4. Holistic perception of harmony at all levels of existence.
5. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order

4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order:
   a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
   b. At the level of society: as mutually enriching institutions and organizations
7. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

READINGS: Text Book

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference Books

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Lectures hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor’s role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self- observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations.

Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials)would also provide support to a student in performing actions commensurate to his/her beliefs. It is
intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty.

Teacher preparation with a minimum exposure to at least one 8- day FDP on Universal Human Values is deemed essential.

ASSESSMENT:
This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:
Assessment by faculty mentor: 10 marks
Self-assessment: 10 marks
Assessment by peers: 10 marks
Socially relevant project/Group Activities/Assignments: 20 marks Semester End Examination: 50 marks
The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

OUTCOME OF THE COURSE: By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to- day settings in real life, at least a beginning would be made in this direction.

This is only an introductory foundational input. It would be desirable to follow it up by

a) faculty-student or mentor-mentee programs throughout their time with the institution
b) Higher level courses on human values in every aspect of living. E.g. as a professional

PROJECT EXHIBITION I

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

Course Objectives:
To provide platform for the student to exhibit their project work to

a) Excite interested students in continuing/initiating in the work of interest
b) Attract startups/industry to commercialize the project work
c) acquire comments on improving the quality of the work from other students/academicians/industry

Mode of Evaluation: Poster submission, Viva-Voce Examination

PROJECT EXHIBITION II

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

Course Objectives:
To provide platform for the student to exhibit their project work to

a) Excite interested students in continuing/initiating in the work of interest
b) Attract startups/industry to commercialize the project work
c) acquire comments on improving the quality of the work from other students/academicians/industry

Mode of Evaluation: Poster submission, Viva-Voce Examination

Programme Core (PC)

	Course Code	Course Title	L	T	P	J	S	C
		PC1:ENGINEERING MECHANICS	3	0	0	0	0	3
	Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
	Course Pre-requisite(s)	None	**Contact hours**				30	
	Course Co-requisite(s)	None	**Date Approved**					
	Alternate Exposure							

Course Description

This course is an introduction to learning and applying the principles required to solve engineering mechanics problems. Concepts will be applied in this course from previous courses of basic mathematics and physics This course addresses the modeling and analysis of static equilibrium problems with an emphasis on real world engineering applications and problem solving..This course forms the backbone of mechanical engineering design and acts as a prerequisite to mechanics of solids, design of machines and kinematics and dynamics of machinery.

Course Objectives

1. Explain the effect of force and moment and equilibrium in engineering applications.
2. Compute geometric properties such as centroid and moment of inertia of various plane sections.
3. Explain kinematics of particles and rigid bodies.
4. Analyze the rigid bodies under dynamic conditions.
5. Exposethe concepts of work-energy, conservation of energy and momentum to rigid bodies.

Course Outcomes:

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

1. obtain a basic understanding of the laws of solid mechanics. [**L-1**]
2. comprehend the significance of the concepts of solid mechanics in engineering systems. [**L-2**]
3. calculate the physical properties of rigid bodies required for the analysis of engineering

systems. [**L-3**]
4. apply the principles of statics and dynamics to solve engineering problems. [**L-3**]
5. analyze various static and dynamic engineering systems and understand the underlying mechanics and drawbacks/problems. [**L-4**]

UNIT I **10L**

Introduction to Engineering Mechanics: Units, Significance of Engineering Mechanics, Composition and resolution of forces, parallelogram law, principle of transmissibility, types of force systems - concurrent and non-concurrent, coplanar forces, resultant of coplanar force systems, couple, moment of a force, Varignon's theorem, concept of free body diagrams, concept of equilibrium of coplanar force systems.

Learning Outcomes:

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

recognize the significance of Engineering Mechanics in design. [**L-1**]
calculate the moments and resultant forces. [**L-3**]
draw free body diagrams. [**L-3**]
utilize the concept of equilibrium. [**L-3**]

UNIT II **8 L**

Friction: Laws of friction, types of friction, equilibrium of force systems involving frictional forces, wedge friction. Free body diagrams involving frictional forces.

Analysis of Structures: Introduction to plane trusses, analysis of plane trusses by method of joints and method of sections.

Learning Outcomes:

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

- comprehend the concept of friction. [**L-2**]
- identify different types of trusses. [**L-2**]
- analyze the plane trusses by method of joints and the method of sections. [**L-4**]

UNIT III **8 L**

Properties of Surfaces: Centroid and center of gravity, derivation of centroids from first moment of area, centroids of composite areas.

Moment of Inertia: Area moment of inertia of plane and composite shapes, parallel axis theorem, perpendicular axis theorem, polar moment of inertia, radius of gyration.

Learning Outcomes:

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

- identify the centre of gravity of plane figures. [**L-2**]
- calculate the centre of gravity of composite plane shapes. [**L-3**]
- understand the concepts of moment of inertia and radius of gyration. [**L-2**]
- determine moment of inertia for composite plane shapes. [**L-3**]

UNIT IV **8 L**

Kinematics: Equations of motion for rigid bodies under constant and variable acceleration, rectilinear and curvilinear motion, projectile motion, use of rectangular coordinates, tangential and normal coordinates, radius of curvature, rotation of a rigid body about a fixed axis.

Learning Outcomes:

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

- develop equations of motion for particles and rigid bodies in motion. [**L-3**]
- find velocity and acceleration in rectilinear and curvilinear motions. [**L-4**]
- trace the path of projectile. [**L-3**]

UNIT V **8 L**

Kinetics: Principles of dynamics - Newton's Laws of motion, D'Alembert's principle in rectilinear translation, principle of work and energy.

Ideal Systems: Principle of conservation of energy, concept of power, conservation of linear momentum, principle of momentum and impulse, impact - types of impact.

Learning Outcomes:

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

- apply Newton's 2^{nd} law and D'Alembert's principle in rectilinear translation. [**L-3**]
- utilize the principle of work and energy in dynamic systems. [**L-3**]
- make use of principle of momentum and impulse on dynamic bodies. [**L-4**]

Text Book(s):

1. N.H. Dubey, Engineering Mechanics: Statics and Dynamics, Tata McGraw Hill, 2017.

2. S. Timoshenko, D.H. Young, J.V. Rao, Sukumar Pati, Engineering Mechanics (in SI units), 5/e, McGraw Hill, 2017.

References:

1. Basudeb Bhattacharya, Engineering Mechanics, 2/e, Oxford University Press (India), 2016.
2. Irving Shames, G.K.M. Rao, Engineering Mechanics: Statics and Dynam-ics, 4/e, Pearson, 2009.
3. K.L. Kumar, Veenu Kumar, Engineering Mechanics, 4/e, Tata McGraw Hill, 2011.
4. S.S. Bhavikatti, Engineering Mechanics, 4/e, New Age International, 2018.

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

Course Code	Course Title	L	T	P	J	S	C
	PC2:FLUID MECHANICS	3	0	3	0	0	4.5
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	None	**Contact hours**				60	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

Course Description

This basic course helps the learner to understand the behaviour of fluids, properties of fluids, measurement of pressure, velocity and discharge of flowing liquids. This course introduces the knowledge of principles of fluid statics, kinematics and fluid dynamics and to solve various problems related to hydrostatic forces on plane surfaces, hydrodynamic force on pipe bend. The learner will familiarize with the concepts to compute losses and discharge in pipe flow. This course introduces the fundamental knowledge of hydraulic machines like pumps and turbines.

Course Objectives:

1. to explain properties of fluids and pressure measurement using manometers.
2. to describe the hydrostatic forces on different plane surfaces.
3. to teach classification of fluid flow, continuity equation, velocity potential, stream function, flow net analysis.
4. to analyze fluid dynamics using Bernoulli's equation for measurement of flow using different flow measuring devices
5. to impart concepts of flow through pipes for computation of losses and discharge in pipe flow.
6. to teach the fundamentals of hydraulic machines like pumps and turbines.

Course Outcomes:

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

1. Understand the principles of various properties of fluids (L-2), Compute pressure using manometers, forces on submerged bodies using hydrostatic law (L-3).
2. Determine the possibility of flow and its characteristics using continuity equation; velocity potential and stream function (L-3).
3. Compute discharge using Venturimeter, Orificemeter, orifice, mouthpiece, notches and weirs (L-3)
4. Apply Darcy-Weisbach equation to determine losses in pipes, power transmission through pipes (L-3).
5. Understand the working operation of Pumps and Turbines (L-2).

Unit-I: **8 L**

Introduction:

Dimensions and Units– Physical properties of fluids: Mass Density,Specific Weight, Specific gravity, Specific Volume, Dynamic and Kinematic Viscosity, Surface Tension, Capillarity, Vapour Pressure, Bulk Modulus – Ideal and Real Fluids.

Pressure at a point, Pascal's law – Atmospheric, Gauge and Vacuum pressure – Measurement of pressure – Pressure gauges, Simple and Differential Manometers.

Learning outcomes:
After completion of Unit-I, students will be able to
- explain the properties of fluids (L-1).
- find the surface tension force and shear stress of liquids (L-2)
- illustrate the measurement of pressure using manometers (L-2).
- calculate the differential pressure using manometers (L-3).

Unit-II: 9 L
Fluid Statics: Hydrostatic forces on submerged plane surfaces, center of pressure, analysis of lock gates, buoyancy, metacentric height.

Fluid Kinematics: Description of fluid flow, Stream line, path line, streak lines and stream tubes. Classification of fluid flow: Steady and Unsteady, Uniform and Non-uniform, Laminar and Turbulent, Rotational and Irrotational flows – Equation of continuity – Definition and properties of stream function and velocity potential function, Rotation components, Flow-net.

Learning outcomes:
After completion of Unit-II, students will be able to
- classify the flow characteristics (L-2).
- explain the principles of hydrostatics, kinematics (L-2).
- solve the problems related to fluid statics and kinematics (L-3).
- distinguish the types of flows (L-4).

Unit-III: 9 L
Fluid Dynamics: Types of forces – Bernoulli's equations for flow along a stream line and for 2-D flow, Momentum equation and its application – Forces on pipe bend.
Measurement of Flow using Venturimeter and Orificemeter, Orifice and Mouthpiece; Flow over Rectangular, Triangular Notches, Broad crested weirs.

Learning outcomes:
After completion of Unit-III, students will be able to
- explain the principles of fluid dynamics (L-2).
- compute the forces on a pipe bend (L-3).
- calculate the rate of flow using various flow measuring devices (L-3).

Unit-IV: 8 L
Closed Conduit Flow: Reynolds experiment – Laws of Fluid friction – Darcy-Weisbach's equation, variation of friction factor with Reynolds number – Moody Chart, total energy line and hydraulic gradient line, minor losses – pipes in series – pipes in parallel - Siphon pipe – Power transmission through pipes, water hammer.

Learning outcomes:
After completion of Unit-IV, students will be able to
- explain HGL, TEL, Laws of Fluid Friction, Water Hammer (L-1).
- describe Reynolds experiment (L-2).

- compute losses and discharge in pipe flow (L-3).
- apply Darcy-Weisbach equation (L-3).

Unit-V: 8 L

Pumps: (Theory only) Centrifugal Pumps – Single and Multistage Pumps – Working Principles – Priming – Head, Power and Efficiency – Cavitation in Pumps - Specific Speed – Performance characteristics curves of Centrifugal Pump.

Turbines: (Theory only) Classification of Turbines – Impulse Turbines - Reaction Turbines – Various components and their functions – Draft Tubes – Radial, axial and mixed flow turbines – Impulse Turbines – Unit quantities, Specific Speed and Performance characteristics of Turbines.

Learning outcomes:

After completion of Unit-V, students will be able to

- explain the working operation of Centrifugal Pump (L-2).
- describe the performance characteristics of Centrifugal Pump (L-2).
- classify the Turbines (L-2).
- explain the working operation of Turbines (L-2).
- describe the performance characteristics of Turbines (L-2)

Fluid Mechanics & Hydraulic Machines Laboratory

Objectives

1. To explain the flow measurement in pipes and open channels.
2. To demonstrate the friction loss in pipe flow.
3. To demonstrate the Bernoulli's equation.
4. To apply the impulse-momentum equation to study impact of jets.
5. To compute the efficiencies and study the performance characteristics of turbines, pumps.

List of Experiments

1. To determine the coefficient of discharge of Venturimeter and Orificemeter.
2. To determine the coefficient of discharge of mouthpiece and small orifice by constant head and falling head methods.
3. To determine the coefficient of discharge of V-notch (triangular notch) & rectangular notch.
4. To compute the friction factor using Darcy-Weisbach Equation for pipes of different diameters.
5. To verify the Bernoulli's equation.
6. To find the coefficient of impact of a jet impinged on to a fixed flat circular vane & hemispherical vane.

7. To study the performance characteristics of Pelton wheel turbine.

8. To study the performance characteristics of the Francis Turbine.

9. To study the working principles of a centrifugal pump.

10. To study the working principles of a reciprocating pump.

Learning Outcomes

The student will be able to:

- Calculate the coefficient of discharges of flow measuring devices (L-3).
- Calculate the friction factor (L-3).
- Compute the total head in a pipe flow by using Bernoulli's equation (L-3).
- Calculate the coefficient of impact of a jet (L-3).
- Calculate the efficiencies and draw the performance characteristic curves of turbines & pumps (L-3).
- Compute the flow through measuring devices (L-3).

Text Books

1. P.N. Modi and S.M. Seth, Hydraulics and Fluid Mechanics and Hydraulic Machines, Standard Book House, 2019.
2. A.K. Jain, Fluid Mechanics, Khanna publishers, 2010.

Laboratory Manuals

1. Laboratory Manuals available in FM Laboratory.
2. Sarbjit Singh, Experiments in Fluid Mechanics, Prentice Hall of India Pvt. Ltd, Learning Private Limited, Delhi, 2012.
3. V.P. Gupta J. Chadra and K.S. Gupta, Laboratory Manual of Fluid Mechanics and Machines, CBS Publishers and Distributors, New Delhi, 2006.

Reference Books

1. L. Victor, Streeter and E. Benjamin Wylie, Fluid Mechanics, Tata McGraw Hill, 2015.
2. M. Franck White, Fluid Mechanics, Tata McGraw Hill, 2017.
3. K. Subramanya, Theory and Applications of Fluid Mechanics, Tata McGraw Hill, 2001.
4. K.R. Arora, Laboratory Experiments in Fluid Mechanics, 2003.
5. Fluid Mechanics virtual labs. http://eerc03-iiith.vlabs.ac.in/
6. https://vspgitcivil.gitam.edu/Infrastructure

Fluid Mechanics NPTEL Course:

https://nptel.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/fluid_mechanics/index.htm
https://nptel.ac.in/courses/105105110/

<table>
<tr><td rowspan="7"></td><td>Course Code</td><td>Course Title</td><td>L</td><td>T</td><td>P</td><td>J</td><td>S</td><td>C</td></tr>
<tr><td></td><td>PC3: SURVEYING</td><td>3</td><td>0</td><td>3</td><td>0</td><td>0</td><td>4.5</td></tr>
<tr><td>Course Owner</td><td>Department of Civil Engineering</td><td colspan="4">Syllabus version</td><td colspan="2">1.0</td></tr>
<tr><td>Course Pre-requisite(s)</td><td>None</td><td colspan="4">Contact hours</td><td colspan="2">60</td></tr>
<tr><td>Course Co-requisite(s)</td><td>None</td><td colspan="4">Date Approved</td><td colspan="2"></td></tr>
<tr><td>Alternate Exposure</td><td colspan="7"></td></tr>
</table>

Course Description

Surveying is the art of taking measurements which will determine the relative positions of various points on the surface of the earth. It may be represented on a plan to a convenient and suitable scale. The various natural and artificial features may be shown in their correct horizontal and vertical positions. The data collected from a survey is used in the preparation of plans, maps, profiles, charts and diagrams. In addition, process of surveying may be used for the delineation of property boundaries, computation of areas and volumes also to set out the proposed work on the ground.

Course Objectives:

1. impart knowledge on basics of surveying
2. provide exposure to different techniques of surveying and associated equipment
3. explain about tachometry, geodetic surveying, satellite surveying
4. familiarize working principles of survey instruments and types of errors encountered in field and calculations
5. demonstrate modern advanced surveying techniques involved such as remote sensing, total station, GPS, Photogrammetry etc

Course Outcomes:

The student will be able to

1) Summarize about basics involved in different types of surveying like tape, compass, levelling, theodolite and tacheometer[L2]
2) demonstrate skills in measuring of distances, angles, levelling and curve setting[L2]
3) develop skill to carry out tachometry, geodetic surveying wherever situation demands.[L3]
4) select appropriate method of surveying based on the needs [L3]
5) inspect the accuracy of the recorded reading in surveying output [L4]

Unit I **8L**

Introduction, Chain and Compass Surveying: Surveying objectives, plane surveying principles and classification, linear measurements, instruments for surveying, preparation of map and plan, measurement of distance, chain surveying principles, offsets, chain surveying instruments, measurement of directions and angles, problems on obstacles of chain surveying, types of compass, meridians and bearings, local attraction, magnetic declination, traversing with a chain and compass, plotting of traverse, adjustment of closing error, problems on chain surveying.

Learning Outcomes:

After the completion of Unit, students will be able to

- **define** the objectives and classification of surveying [L1]
- **list** various surveying equipment[L1]
- **explain** principles involved in chain surveying[L2]
- **develop**knowledge on concepts of compass surveying, types and measurements[L3]
- **solve** problems related to chain and compass surveying[L3]

Unit II **8L**

Plane table Surveying, Levelling and Contouring: Principle and instruments used in plane table surveying, working operations, methods of plane table surveying, instruments for leveling, principle and classification of leveling, bench marks, readings and booking of levels, height (level) computations, field work, longitudinal and cross-sectional levelling, problems on levelling, plotting the profile, contours, characteristics of contours, contours of natural features, methods of contouring, interpolation, contour gradient, contour maps, problems on contouring.

Learning Outcomes:

After the completion of Unit, students will be able to

- **explain** the principles, working operations and methods related to plane table surveying[L2]
- **develop** knowledge on concepts and terms related to levelling [L3]
- **solve**problems related to levelling (level calculations)[L3]
- **list**different types of levelling[L1]
- **demonstrate**knowledge on contouring, process and related problems[L2]

Unit III 9L

Theodolite Survey and Traversing, Tacheometric Surveying: Theodolite component parts, classification, theodolite observations, principle of theodolite survey and traversing, field work, traverse computations, practical problems, principle of tacheometry, methods of tacheometry, tacheometric tables, reduction diagram, tacheometry as applied to subtense measurement, field work for tacheometric surveying, errors.

Learning Outcomes:

After the completion of Unit, students will be able to

- **find** the different components of theodolite along with their functions[L1]
- **apply** knowledge of theodolite in taking observations[L3]
- **explain**principles of theodolite survey and traversing[L2]
- **develop** understanding on principles and methods of tacheometry[L3]
- **demonstrate** knowledge of tacheometric principles in field work and measurements[L2]

Unit IV **9L**

Curve Setting: Types of curves, elements of a curve, setting out a simple curve, setting out a compound curve, checks on field work, reverse curve, transition curves, super elevation, deflection angles, transition curves, characteristics of transition curves, types of vertical curves, setting out vertical curves, Construction Surveys: setting out of buildings, computation of areas, earthwork measurements: LS&CS, computation of volumes.

Learning Outcomes:
After the completion of Unit, students will be able to

- **list** different types of curves along with their elements[L1]
- **demonstrate** the process of setting out curves in the field [L2]
- **identify**difference betweensimple, compound and transition curves[L3]
- **infer** knowledge on types of vertical curves and the methods of setting of vertical curves [L2]
- **solve**forquantities of earth work (both areas and volumes) in construction[L3]

Unit V **8L**

Trigonometrical Surveying, Triangulation and Total Station: Base of the object accessible, base of an inclined object accessible, reduced level of the elevated points with inaccessible bases, instrument axes at different levels, principle of triangulation, purpose and classification of triangulation surveys, layout of triangulation, field work, triangulation stations, triangulation computations, EDM instruments, total station, global positioning system

Learning Outcomes:
After the completion of Unit, students will be able to

- **identify** different cases in trigonometrical surveying[L3]
- **develop**understanding of principle of triangulation and relative terminology[L3]
- **solve** problems in triangulation[L3]
- **demonstrate** skills of distances, angles using total station[L2]
- **develop**knowledge of global positioning system[L3]

Text Book(s)

1. B.C. Punmia, A.K.Jain, Arun Jain, Surveying I and II, 17/e, Laxmi Publications, 2016.
2. R. Subramanian, Surveying and Levellin, 2/e, Oxford University Press, 2014.
3. D.G Charles, R.W. Paul, Elementary Surveying, 15/e, Prentice Hall, 2018

References:

1. S.K. Roy, Fundamentals of Surveying, 2/e, Prentice Hall of India, 2011.
2. T.P. Kanetkar, (2012), Surveying and Levelling, Part I and II, New Central Book Agency, 2012.

SURVEYING LABORATORY

Course Objectives:

1) impart the basics of linear and angular measurements in field using surveying equipment
2) demonstrate accurate measurements, field booking, plotting and adjustment of errors
3) familiarize students in levelling techniques and contour map development
4) explain the concepts of theodolite surveying and traversing
5) impart knowledge in principles of tacheometry

List of Experiments:

1) Survey of an area by chain survey (closed traverse) and plotting
2) Compass traversing
3) Radiation method, intersection methods by plane table survey
4) Traversing by plane table survey
5) Fly leveling (differential leveling)
6) Longitudinal and cross sectioning
7) Grid contouring and indirect contouring
8) Theodolite survey
9) Trigonometric leveling to determine heights/elevations
10) Tacheometry
11) Setting of curves
12) Demonstration of auto level and total station

Course Outcomes:

the student will be able to

1) carry out the experiments on linear and angular measurements.
2) adjust the errors and tabulate the measurements in the field book
3) acquire knowledge on concepts of levelling and contouring
4) apply the concepts of theodolite surveying and traversing.
5) Implement principles of tacheometry in the field

<table>
<tr><td rowspan="6"></td><td>Course Code</td><td>Course Title</td><td>L</td><td>T</td><td>P</td><td>J</td><td>S</td><td>C</td></tr>
<tr><td></td><td>PC0:CIVIL ENGINEERING WORKSHOP</td><td>0</td><td>0</td><td>3</td><td>0</td><td>0</td><td>1.5</td></tr>
<tr><td>Course Owner</td><td>Department of Civil Engineering</td><td colspan="4">Syllabus version</td><td colspan="2">1.0</td></tr>
<tr><td>Course Pre-requisite(s)</td><td>None</td><td colspan="4">Contact hours</td><td colspan="2">30</td></tr>
<tr><td>Course Co-requisite(s)</td><td>None</td><td colspan="4">Date Approved</td><td colspan="2"></td></tr>
<tr><td>Alternate Exposure</td><td colspan="7"></td></tr>
</table>

Course Description

The course aims at enhancing the application skills of the civil engineering students. It is very important for a budding civil engineer to understand the basic civil engineering works by means of practicing various trades of construction. In order to efficiently carry out the tasks in the workshop, the basic theory related to the trades like masonry, plumbing etc. is taught first and then the practical exposure is provided.

Course Objectives:

1. **Explain** to students about the basic construction practices, building services and specifications in the Civil Engineering profession.
2. **Demonstrate** assembling of pipeline and various sanitary fittings.
3. **Acquaint** the difference between English Bond and Flemish Bond.
4. **Study** the application of white wash, distemper, colour wash and painting of surfaces.
5. **Familiarize** the construction of models of different structures.
6. **Create** knowledge on process of estimation of prices of various building materials by market survey.

Course Outcomes: At the end of the course student will be able to:

1. **explain** civil engineering construction practices and specifications of different civil engineering materials **(L-2)**.
2. **demonstrate** the assembling ofpipeline, brick wall and various sanitary fittings **(L-2).**
3. **make use of** application ofwhite wash, distemper, and paints on surfaces **(L-3)**.
4. **construct** the models of buildings, bridges and trusses etc**. (L-3).**
5. **outline** the salient features of laying of tiles for floors and recharge pit construction**.(L-2)**

6. **summarize** the specifications and compare rates of various construction materials.**(L-2)**

INTRODUCTION TO CIVIL ENGINEERING 14 L

To introduce construction practices such as brick masonry, plastering, painting and laying of tiles and building services such as plumbing. To acquaint the students with the specifications and market rates of different civil engineering materials by undertaking market survey.

WORKSHOP:

List of Experiments: 28 L

1. Assemble a pipeline as per the piping layout using pipes and accessories.
2. Exercise involving sanitary fittings such as water closets, wash basins.
3. Assemble a brick wall using English bond and Flemish bond without using mortar.
4. Marking a line diagram of a building by using chain and accessories.
5. Plastering of a given brick surface.
6. Applying white wash, distemper and colour wash of given surface.
7. Painting of old and new metal surfaces.
8. Laying of tiles for floors.
9. Model making of different structures like building, bridges and different types of trusses.
10. Exercise involving construction of a recharge pit.
11. Market survey: For trade/commercial names, specifications, units of purchase and prevalent market rates for the following:
    a. Various types of Stones (Blocks and slabs)
    b. Various types of bricks, hollow blocks, etc.
    c. Tiles- Flooring tiles and clay roofing etc.
    d. Sanitary ware pipes, water closets etc
    e. Various types of cements
    f. Various types of timber available in market, timber allied products such as plywood, hard board, block board, Sun mica and various preservatives of timber available in market.
    g. Materials required for white washing, colour washing.
    h. Various types of distempers - both oil bound and water bound.
    i. Sound insulating materials available in the local market.

j. Fire proofing material available in local market.

k. Various types of glass available in local market.

Text Book(s)

1. Rangawala, Engineering Materials (Materials Science), Charotar Publishing house, 2017.
2. B.C. Punmia, AshokKumarJain, Arun KumarJain, **Building Construction**, 11/e, Laxmi Publications (P)Ltd, Hyderabad, 2017.

References:

1. Mimi Das Saikia, Bhargab Mohan Das, Madan Mohan Das, Elements of Civil Engineering, 1/e, PHI Learning Private Limited, 2011.
2. P.C. Varghese, A Text Book Building Materials, 2/e, Prentice Hall India Learning Private Limited, 2015
3. Ketki Rangwala Dalal, Essentials of Civil Engineering, 1/e, Charotar Publishing House, 2012.

Course Code	Course Title	L	T	P	J	S	C
	PC4: MECHANICS OF SOLIDS	3	0	3	0	0	4.5
Course Owner	Department of Civil Engineering	Syllabus version				1.0	
Course Pre-requisite(s)	Engineering Mechanics	Contact hours				60	
Course Co-requisite(s)	None	Date Approved					
Alternate Exposure							

Course Description

The response or deformation of elastic bodies subjected to different types of loading will be discussed. Various stresses developed such as bending, shear and torsion in structural elements will be estimated. The course is a prerequisite forStructural Analysis and design courses such as Design of RCC and Design of Steel structures.

COURSE OBJECTIVES

1. To introduce the concepts of stress, strain, Hooke's law and their application.
2. Todemonstratethe concept of Shear Force (SF) and Bending Moment (BM).
3. To explainthe concept of transformation ofstresses andprincipal stresses.
4. To facilitatethe estimate of bending and shear stresses.
5. To demonstratethe variation of shear stress in circular members under torsion.

COURSE OUTCOMES:

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

1. find the stresses, strains and deformationsin axially loaded members(L1).
2. determine forces in statically determinatebeams(L2).
3. identify the plane of principal stresses (L3).
4. interpret the flexural behavior and shear flow ofthe beams(L2).
5. find the stresses in circular shafts subjected totorsion(L1).

Unit I **8L**

Simple Stresses and Elastic Constants

Introduction, stress strain curve, factor of safety, lateral strain, bars of varying and tapering cross section, compound bars subjected to loads, temperature stresses in bars, Modulus of rigidity, complementary shear, Bulk Modulus, Relation between E and N.

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

- Illustrate the fundamental concepts of stress and strain(L2).
- determine the stresses in bars of varying and taperedsections(L2).
- determine the temperature stresses invbars(L2).
- relate Modulus of Rigidity and BulkModulus(L2).
-

Unit II **10L**

Shear Forces and Bending Moments:

Beams, Types of loads and supports, Shear Force and Bending Moments,SF and BM diagrams for cantilever, simply supported and overhanging beams subjected to point loads and udl, Relationship between rate of loading, shear force and bending moment.

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

- classify different types of beams (L2).
- construct shear force and bending moment diagrams for cantilever, simply supported and overhang beams(L3).
- utilize the relationship between rate of loading, shear force and bending moment(L3).

Unit III **8L**

Complexstresses

Stresses on inclined plane on block subjected to normal stress and shear stress along two planes at right angles, principal plane and principal stresses, Mohr's circle for finding principal stresses, Directions of principal planes, Volumetric strain.

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

- determine the stresses on an inclined plane at a point in a two-dimensional state ofstress (L2).
- explain principal plane and principalstress(L2).
- construct Mohr's circle of stresses(L3).
- identify the plane of maximum shearstress(L3).

Unit IV **8L**

Stresses in beams

Introduction, assumptions in the theory of bending, section Modulus, Shear Stresses in beams, Shear stress variation in rectangular sections.

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

- explain the basic assumptions in the theory of purebending(L2).
- determine Section Modulus(L2).
- determine bending stresses in beams (L2).
- determine shear stresses inbeams(L2).

Unit V **8L**

Torsional Stresses in Shafts& Springs:

Introduction, Analysis of Torsional Stresses, Power transmitted, Combined bending and Torsion, Principal Stresses.

Helical Springs: Closed coiled helical springs.

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

- find torsional stress in circularshafts(L1).
- Determine the power transmitted inshafts(L2).
- find stresses in shafts due to combined bending andtorsion(L1).
- determine deflection of closed coiled helical springs (L2).

Text Book(s):

1. V.N Vazirani and M.M Ratwani, Analysis of Structures Vol-I, Khanna Publishers,2003.
2. R.Subrahmanian, Strength of Materials, 3/e, Oxford University Press, 2016.

References:

1. Ferdinand.P.Beer&Russell.E.Johnston, Mechanics of Materials, Mc Graw Hill Education, 7/e, 2017.
2. S.S. Rattan, Strength of Materials, 2/e, Tata McGraw Hill Education, 2011.
3. Gere &Timoshenko, Mechanics of Materials, 4/e, CBS Publishers& Distributors, 2004.
4. Stephen Timoshenko, Strength of Materials Part I & II, 3/e, CBSPublishers & Distributors, 2002.

MECHANICS OF SOLIDS LABORATORY

LIST OF EXPERIMENTS

1. Stress-strain characteristics of steel and cast iron by conducting tension test on rods.
2. Stress-strain characteristics of steel and cast iron by conducting compression test on rods.
3. Stress-Strain characteristics of steel and cast iron by conducting tension test on flats.
4. Shear strength of timber and steel by conducting
   a) direct shear test for timber b) double shear test for steel
5. Hardness of steel, aluminium, copper and brass by conducting Brinnell's, Rockwell's and Vicker's tests.
6. Impact strength of steel and aluminium by conducting Izod's and Charpy's tests.
7. Modulus of rigidity of steel wires and rods by conducting torsion test.
8. Compression strength of timber and brick by conducting compression test.
9. Failure planes of ductile and brittle materials under tension, bending and torsion.
10. Bending stress in cantilever beam by conducting bending test.
11. Shear stress in simply supported beam by conducting bending test.
12. Stiffness of helical spring under compression.

References

1. **IS-1608:(2005)**- Metallic Materials - Tensile Testing at Ambient Temperature (Third Revision)

2. **IS432-Part I (1982)-**Specification for Mild Steel and Medium Tensile Steel Bars and Hard-Drawn Steelwire For Concrete Reinforcement Part I Mild Steel and MediumTensile Steel Bars (Third Revision)

3. **IS 1500: (2005)**Method for Brinell Hardness Test For Metallic Materials(ThirdRevision)

4. **IS 1586 (Part 2) : 2012**Metallic Materials — Rockwell Hardness Test Part 2Verification and Calibration of Testing Machines (Scales A, B, C, D, E, F, G, H, K, N, T) (Fourth Revision)

5. **IS-1598 (2003)**Metallic Materials- Method for Izod Impact Test of Metals (First Revision)

6. **IS 1757:1988 (2003)**Method for Charpy Impact Test (V-Notch) on Metallic Material (Second Revision)

7. **IS 5242:1979 (2006)**Method of Test for Determining Shear Strength of Metals (First Revision)

8. sm-nitk.vlabs.ac.in.

9. https://home.iitm.ac.in/kramesh/Strength%20of%20Materials%20Laboratory%20Manual.pdf

LEARNING OUTCOMES

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

- Interpret the stress strain characteristics of tension and compression members (L2).
- demonstrate the properties such as hardness and impact strength(L2).
- find the shear resistance by conducting shear test (L1).
- illustrate the planes of failure for brittle and ductile materials (L3).
- determine the compressive strength of timber and brick. (L2).

Course Code	Course Title	L	T	P	J	S	C
	PC5: ENVIRONMENTAL ENGINEERING	3	0	3	0	0	4.5
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	None	**Contact hours**				60	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

Course Description

Water and waste water treatment removes contaminants and undesirable components, or reduces their concentration so that the water becomes fit for its desired end-use. To understand the mechanism of treatment process, this course involves the principles of science and engineering. This basic fundamental course introduces the student to estimate water demand and to calculate waste water generation. Study of physical, chemical and biological characteristics of water and waste water helps the student to assess the quality of water and degree of treatment to be given for their safe disposal.

Course Objectives:

1. to study the importance of Protected water supply and quality of water as per standards
2. to impart the working principal of Sedimentation , filtration and disinfection methods
3. to familiarize with various water distribution systems and its installations
4. to expose sewage characteristic, treatment methods and design of unit operations
5. to study the functionality of basic sanitary fitting in house plumbing.

Course Outcome:

Student will be able to

1. analyse the quality for water based on Indian standards-L3
2. make use of design considerations to design water treatment units –L3
3. analyze and interpret the pipe networking systems –L4
4. calculate various design parameters of waste water treatment plant–L3
5. explain the functions of various sanitary fittings –L4

UNIT– I **8 L**

Protected water supply – Population forecasts, design period – water demand – factors affecting – fluctuations – fire demand – water quality and testing – drinking water standards - Waterborne diseases - Comparison from quality and quantity and other considerations – intakes – infiltration galleries.

Learning Outcomes:

a. explain the importance of protected water supply –L2.
b. apply appropriate formula to estimate population forecast – L3
c. analyze and compare water quality parameters with bureau of indian standards -L4.

d. summarize various intake structures involved in pumping of surface water-L2

UNIT -II **10 L**

Sedimentation – principles of coagulation-flocculation, clarifier coagulants - Filtration – theory – working of slow and rapid gravity filters disinfection – theory of chlorination, chlorinedemand, other disinfection practices- Miscellaneous treatment methods.

Learning Outcomes:

a. explain the principles involved in sedimentation, coagulation and filtration-L2
b. construct the flow chart of conventional water treatment process –L3
c. make use of design considerations to design various unit operations in water treatment process–L3
d. summarize other miscellaneous methods of water treatment –L2

UNIT -III **8 L**

Distribution systems – Gravity system – Pumping system – Dual system – Layout distribution system – Dead End – Grid Iron – Radial systems – Analysis of Pipe networks - Hardy Cross and equivalent pipe.

Learning Outcomes:

a. explain different distributive systems –L2
b. select appropriate layout distribution system –L3
c. analyze pipe networking systems -L4

UNIT -IV **10 L**

Characteristics of sewage – cycles of decay – decomposition of sewage, examination of sewage – B.O.D. – C.O.D. equations. Introduction to primary and secondary treatment of waste water, sedimentation tanks biological treatment – trickling filters. Sludge digestion – design of Digestion tank – Sludge disposal by drying – septic tanks and Imhoff Tanks working principles and design – soak pits,. Feacal waste and septage management**,** Introduction to government policies and programs- environmental aspects.

Learning Outcomes:

a. explain the characteristics of sewage –L2.
b. illustrate the procedures for testing the quality of sewage-L2
c. analyse the equations of b.o.d &c.o.d –L3
d. make use of design considerations to design all unit operations involved in waste water treatment –L3

UNIT -V **6 L**

Sluice Valves – Pressure Relief Valves – Check walls – Meters – Sewer appurtenance - inverted siphon – catch basins — sanitary fittings-traps – one pipe and two pipe systems of plumbing. sewage pipe network

Learning Outcomes:

a. explain all types of sewer appurtenances –L2
b. analyse the working principles of all sewer appurtenances-L3

c. summarize various sanitary fittings –L2
d. differentiate between one pipe and two pipe systems of plumbing-L4

Textbooks:

1. Water supply and sanitary engineering by G.S. Birdi, Dhanpat Rai & Sons publishers,2014
2. Water Supply Engineering, Vol-I & Waste water engineering, Vol-II, P.N.MODI, STANDARD Book House, 2016

Reference books:

1. B.C. Punmia, Ashok Jain & Arun Jain, Laxmi Publications Pvt. Ltd, New Delhi,
2. Elements of environmental engineering by K.N. Duggal, S. Chand Publishers.
3. https://nptel.ac.in/courses/105104102/
4. https://nptel.ac.in/courses/105105048/

Environmental Engineering Laboratory

The water required for public water supply should be potable or wholesome water. The water required for domestic consumption should possess a high degree of purity and it should be free from suspended impurities, bacteria, etc. The objective of this laboratory course is to give practical knowledge in fixing water and wastewater quality in order to identify the pollution status and arriving at the appropriate treatment techniques and control measures required to keep up their quality standards.

Course Objective

- To demonstrate Physical & chemical parameters of water and wastewater
- To study the growth of microorganism
- To expose the standards of water and waste water with BIS & WHO

Course Outcomes:

- Determine physical, chemical and biological characteristics of water and wastewater –(L5)
- Assess the quality of water and wastewater –(L5)
- Decide the degree of treatment required for water and wastewater-(L5)

List of Experiments

Cycle –I :

1. Analysis of pH ; Conductivity; Turbidity
2. Analysis of Acidity; Alkalinity
3. Analysis of Total Hardness; Calcium Hardness
4. Analysis of Available chlorine; Residual chlorine
5. Conducting Jar test for determining optimum dosage of coagulant
6. MPN –Calculation, Demo only

Cycle –II :

7. Determination of Total Solids, Total Dissolved Solids & Settelable Solids
8. Determination of Phosphates & sulphates.
9. Determination of Dissolved Oxygen
10. Determination of Biochemical Oxygen Demand (Demo only).
11. Determination of Chemical Oxygen Demand (Demo only).

Reference Books/Manual:

1. Standard methods for the examination of water and wastewater. (2012). 21st Edition, Washington: APHA.
2. Indian standard Drinking water –specifications,2nd Revision ,IS 10500:2012
3. Guidelines for water quality management –CPCB ,2008
4. Guidelines for drinking- water quality,4TH EDITION,2017
5. B. Kotaiah and Dr. N. Kumara Swamy, Environmental Engineering Laboratory Manual, Charotar Publishing House Pvt. Ltd., 1st Ed., 2007.

	Course Code	Course Title	L	T	P	J	S	C
		PC6: GEOTECHNICAL ENGINEERING	3	0	3	0	0	4.5
	Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
	Course Pre-requisite(s)	None	**Contact hours**				60	
	Course Co-requisite(s)	None	**Date Approved**					
	Alternate Exposure							

Course Description

GTE is an essential interdisciplinary course in civil engineering. Soil has been used as a foundation supporting medium as well as an excellent material for construction of embankments, earth dams, canal levees etc. Improvement of engineering performance of soil is important for compacted engineered fills. Identification, classification and characterization is very important aspect when soil is used as a construction material. Soil behaviour under loads, compressibility, Settlement prediction and shear strength aspects play a vital role in the design of sub-structure and long term stability of structures. It could be an essential prerequisite for foundation engineering course.

Course Objectives:

1. To expose the aspects of origin, formation of Soils to classify the soil as a construction material.
2. To study the flow through soils and understanding the importance of effective stress in the soil behaviour and stability.
3. To enable the estimation of Critical Hydraulic Gradient on permeable foundations
4. To acquaint the calculation of the settlements in clayey soils.
5. To demonstrate the shear strength parameters at different drainage conditions in an attempt to simulate short term and long term stability.

Course Outcomes:

The student will be able to

- explain Soil behaviour, Gravimetric, Volumetric, Functional interconnecting relationships & phase model concepts. Identify, Classify and characterise the soil as a construction material. –L2
- illustrate the problems in flow through the soils and acquire knowledge in the importance of Effective Stress Concepts.-L2
- analyze Stress distribution in Soils, based on elastic theories, analytical and graphical methods.-L3
- solve Compaction & Consolidation problems and compute the probable long term settlement of structures.-L3
- determine shear strength parameters by analytical and graphical methods-L2

Unit I **9 L**

Soil Properties: Origin and formation of soils, General types of soils, residual and transported soils,three phase representationof soil mass, physical properties of soil – void ratio, porosity, degree of saturation, water content, module weights, specific gravity – their functional relationships, relative density.

Consistency Limits: Determination and various indices – plasticity index,consistency index, liquidity index – uses and applications of consistency limits in soil engineering, activity ratio.

Classification: I.S and MIT grainsize classification, Indian standard classification for fine grained and coarse grained soils for general engineering purposes.

Learning Outcome:

After completion of Unit I, students will be able to

- explain the origin of the soil formation and geological weathering cycle. - L2
- apply principles of phase model concept, volumetric, gravimetric relations for soil properties and perform basic weight-volume calculations. – L3
- relate interconnecting functional relationships from fundamental phase model concepts for solving numerical problems -L2
- explain the consistency of soil – Atterberg's limits, uses and field behavior of Soils. -L2
- make use of IS code -1498. I S method for soil classification Procedures for General Engineering Purposes both for fine grained Soils and course Grained Soils. –L3

Unit II **8L**

Soil Hydraulics: Types of soil water, Darcy's law and its limitations,determination of coefficient of permeability, laboratory methods-constant head and variable head permeameter tests,factors influencing coefficient of permeability, permeability of stratified soils, stress principle for saturated soils-total, neutral and effective stresses, no flow, downward flow and upward flow conditions,quick sand conditions, critical hydraulic gradient, piping failures in dams founded on permeable formations

Learning Outcomes:

After completion of Unit II, students will be able to

- explain the Sources of Soil water and theconcepts and fundamental laws governing flow through porous medium in soils.-L2
- summarize the approximate range of coefficient of permeability (K) values and rate the soils based on hydraulic conductivity values. -L2
- formulate expressions for the estimation of coefficient of permeability for Variable/ Constant headpermeameters, average K-values for Stratified Soils for solving numerical problems. – L3
- conclude significance of effective stress in controlling mechanical behavior of soils and relationship between total stress and effective stress in saturated porous medium. –L3
- formulate expressions for no flow, upward flow and downward flow of seepage flow through soils and estimation of critical hydraulic gradient. –L3

Unit III **8L**

Stress Distribution: Boussinesq's theory for the determination of verticalstresses due to point loads, assumptions and validity, extension to circular loaded areas, equivalent point load method,2 : 1 approximate method, Westergaard's theory& equation, Newmark's influence chart - construction and use, contact pressure distribution beneath rigid footings.

Learning Outcomes:

After completion of Unit III, students will be able to

- explain the concepts of elastic stress distribution theories, various assumptions made in order to derive expressions. (J.V.Boussinesq's and Wetergaard's theories only)–L2
- estimate the vertical compressive stresses and shear stresses induced in soils due to loading on to the soil, how stresses are transferred through soils. –L3
- determine both geostatic and induced stresses due to point loads, line and extended to area loads. –L3
- estimate the stresses due to loading analytical methods also by simple graphical methods–L3
- determine the Stresses induced due to loading on horizontal, vertical planes and plotting isobar diagrams for computation of significantdepth below foundation. –L3

Unit IV **9L**

Consolidation: Oedometer Tests, e-p and e-log p curves – compressionindex, coefficient of compressibility and coefficient of volume change, Terzaghi's assumptions for one dimensional consolidation, equation and application, coefficient of consolidation, degree of consolidation vs time, initial compression, primary compression and secondary compression, normally consolidated, over consolidated and under consolidated clayey deposits,

Compaction: Mechanism of compaction, factors affecting compaction,effect of compaction on engineering properties of soils, field compaction equipment and quality control.

Learning Outcomes:

After completion of Unit IV, students will be able to

- compare the differentiate betweenthe processes of Soil Compaction & Consolidation. –L2
- predict the long term consolidation Settlements experienced by structures. –L3
- estimate the consolidation time period and Rate of Settlements-L2
- construct compaction control curve to determine a) MDD b) OMC c) ZAV Curve-L3
- adapt Quality Control of EarthStructures and for Road Works with Specifications-L3

Unit V **8 L**

Shear Strength of Soils: Stress at a point, Mohr circle of stress, Mohr-coulomb's failure theory, shear tests – direct shear box, unconfined compression, tri-axial compression, and field vane shear tests, shear parameters, types of shear tests in the laboratory based on drainage conditions, shear strength of sands, critical void ratio, thixotrophy and dilatancy of sands.

Learning Outcomes:

After completion of Unit V, students will be able to:

- explain the Shear Parameters of Soil, different drainage conditions to simulate field conditions and factors influencing shear parameters of soil. -L2
- solve numerical problems with different types of Shear Tests used are Direct Shear, Tri-axial and Unconfined compression for different soil types. –L4
- estimation of Shear Parameters of Soil by analytical methods, -L3
- construct Mohr's circles, and other graphical methods for Shear Parameters of Soil –L3
- analyze the shear strength problems with pore water pressure measurements so as to determine Total Stress and Effective Stress Parameters. –L4

Text Book(s):

1. Dr. K. R Arora,'Soil Mechanics and Foundation Engineering', 5th, Standard Publisher Distribbutor, NewDelhi, 2020.
2. Gopala Ranjan and A.S.R, Rao, Basic and Applied Soil Mechanics, 2/e, New Age International Publishers, Third edition 2016.

References:

1. C. Venkataramaiah, Geotechnical Engineering, New Age International, 2006..
2. M. Braja Das, Principles of Geotechnical Engineering,Cengage Learning, 2013.

NPTEL Links:

Unit-1: https://nptel.ac.in/courses/105103097/1
Unit-2:https://nptel.ac.in/courses/105103097/25
Unit-3:https://nptel.ac.in/courses/105103097/20
Unit-4:https://nptel.ac.in/courses/105103097/37
Unit-5:https://nptel.ac.in/courses/105103097/43

GEOTECHNICAL ENGINEERING LABORATORY

Course Objectives:

- To demonstrateIndex and Engineering Properties of Soils
- To study the Permeability properties of soil
- To impart the knowledge on Compaction Characteristics.
- To enable the estimation of Shear Parameters of various soils
- To demonstrate the Long term Settlement characteristics of Soils

LIST OF EXPERIMENTS:

1. Determination of water content by Oven drying and Calcium carbide method (rapid).

2. Determination of specific gravity of soil grains by pycnometer and density bottle

3. Determination of grain size analysis by sieve analysis

4. Determination of Atterberg's limits (LL / PL /SL).

5. Determination of field density by core cutter method / sand replacement method.

6. Determination of permeability of soil by falling head /variable head permeameter method.

7. Determination of optimum moisture content and max density by IS light compaction test.

8. Determination of relative density of soils.

9. Determination of shear strength by direct shear test.

10. Determination of shear strength by unconfined compression test for cohesive soils.

11. Determination of shear strength by tri-axial compression test.

12. Differential Free swell Index Test

Demonstration:

1. Determination of co-efficient of consolidation and compressibility of soils by consolidation test.
2. Determination of swell pressure of soil by swell pressure test.

List of IS Codes:

S.NO	NAME OF THE EXPERIMENT	IS CODE
1	Specific Gravity By Pycnometer Method	IS: 2720 Part 3 – 1980
	Specific Gravity By Density Bottle Method	
2	Field Density Test - Core Cutter Method	IS:2720 Part 29 -1975
	Insitu Density – Sand Replacement Method	IS :2720 Part 28- 1974
3	Determination Of Density Index (Relative Density) Of Cohesion less Soil	IS:2720 Part 14 – 1983
4	Liquid Limit Test	IS:2720 Part 5 – 1985
	Plastic Limit Test	IS:2720 Part 5 – 1985
	Shrinkage Limit Test	IS :2720 Part 6 – 1972
5	Field Identification And Classification of Soils	IS: 1498 -1970 Any Standard Text Book
6	Grain Size Distribution By Sieve Analysis	IS : 2720 Part 4-1985

7	Permeability Test- Variable Head Method	IS:2720 Part 17 -1986
8	IS Light Weight Compaction Test	IS:2720 Part 7 – 1980
9	Consolidation Test	IS:2720 Part 15 – 1986
10	Swell Pressure Test	IS: 2720 Part 41 – 1977
11	Direct Shear Test	IS :2720 Part 13 – 1986
12	Unconfined Compressive Strength Test	IS:2720 Part 10 - 1991
13	Triaxial Shear Test	IS:2720 Part 11 – 1971

Learning outcomes: The student will be able to

- demonstrate the water content by Oven drying and Calcium carbide method.-L2
- demonstrate the specific gravity of soil grains by pycnometer and density bottle-L2
- construct the grain size distribution curve of a soil-L4
- determine the Atterberg's limits or consistency limits-L3
- demonstrate the field density by core cutter and sand replacement method-L2
- estimate the permeability of soil by falling head permeameter method-L3
- determine compaction characteristics of a soil by IS Light Weight Compaction test-L3
- demonstrate the relative density of soils-L2
- estimate the shear strength Parameters of a soil by Ddirect Shear test- L3
- estimate the shear strength Parameters by unconfined compression test for cohesive soils L3
- estimate the shear strength Parameters of a soil by tri-axial compression test L3
- demonstrate the Free swell Index test of soils.- L2

Course Outcomes: Student shall be able to

- determine index properties of soils like moisture content, consistency limits, Specific gravity of soil grains, and density of soil stratum and voids ratio, Gradation of soil and coefficient of permeability of soils. –L2
- estimate the Shear Strength parameters of soils using Direct shear/ Tri-axial/UCS-L3
- determine the settlement characteristics using Consolidation test.-L2

Text Books:

1. S.Mittal&J.P.Shukla, Soil testing for Engineers, Khanna Publications-2012.
2. K.V.S.AppaRao,V.C.S Rao, Soil Testing-Laboratory Testing and Question Bank,

University of science Press-2016.

Virtual Labs:

- 1.http://smfeiiith.vlabs.ac.in/exp1/Introduction.html?domain=Civil%20Engineering&lab=Soil%20Mechanics%20Lab
- 2.http://smfeiiith.vlabs.ac.in/exp3/Introduction.html?domain=Civil%20Engineering&lab=Soil%20Mechanics%20Lab
- 3.http://smfeiiith.vlabs.ac.in/exp4/Introduction.html?domain=Civil%20Engineering&lab=Soil%20Mechanics%20Lab
- 4.http://smfeiiith.vlabs.ac.in/exp2/Introduction.html?domain=Civil%20Engineering&lab=Soil%20Mechanics%20Lab
- 5.http://smfeiiith.vlabs.ac.in/exp6/Introduction.html?domain=Civil%20Engineering&lab=Soil%20Mechanics%20Lab
- 6.http://smfeiiith.vlabs.ac.in/exp7/Introduction.html?domain=Civil%20Engineering&lab=Soil%20Mechanics%20Lab
- 7.http://smfeiiith.vlabs.ac.in/exp9/Introduction.html?domain=Civil%20Engineering&lab=Soil%20Mechanics%20Lab
- 8.http://smfeiiith.vlabs.ac.in/exp10/Introduction.html?domain=Civil%20Engineering&lab=Soil%20Mechanics%20Lab

Course Code	Course Title	L	T	P	J	S	C
	PC7: CONSTRUCTION MATERIALS & CONCRETE TECHNOLOGY	2	0	3	0	0	3.5
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	None	**Contact hours**				60	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

COURSE DESCRIPTION

This course deals with different kinds of construction materials used in Civil Engineering. It also discusses about the properties of concrete which is a widely used as a Construction material. This course is a pre requisite for design courses such as Design of Reinforced Concrete Structures and Advanced Design of Reinforced Concrete Structures. This course gives confidence for the learners in judicious selection of materials used in the construction industry.

COURSE OBJECTIVEs

1. To familiarize with the basic construction materials.
2. To help in deciding the suitability of the materials in construction.
3. To demonstrate the gradation of aggregates as construction materials.
4. To enable the conduct of workability tests of concrete.
5. To train on mix design for concrete.

COURSE OUTCOMES

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

1. list the construction materials in Civil Engineering (L1).
2. summarize types of foundations and walls(L2).
3. list different types of cement(L1).
4. Explain the behaviourof fresh concrete (L2).
5. designconcrete mixes as per codal provisions (L3)

Unit I - Construction Materials: 5L

Stones and Bricks -Properties of building stones, classification of stones, stone quarrying, various types of bricks and blocks used for construction, tests on bricks and blocks

Wood: Classification of various types of woods used in buildings, Timber – Market forms – Industrial timber– **Plywood** – Veneer –panels of laminates.

Learning Outcomes

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

- illustrate the properties of stones and bricks suitable for construction (L2).
- demonstrate tests on bricks(L2).
- explain the suitability of wood (L2).

Unit II- Construction Practices: 5L

Structural system-load bearing structure- framed structure- load transfer mechanism

Foundations – Deep and Shallow foundations

Masonry -Types of masonry, English and Flemish bonds, Rubble and Ashlar Masonry.

Wall: Load bearing wall, partition wall, shear wall

Finishings- Damp Proofing and water proofing materials and uses, Plastering Pointing, white washing and distempering.

Learning Outcomes

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

- illustrate the difference between load bearing walls and partition walls. (L2).
- summarize the uses of damp proofing and water proofing materials (L2).
- define plastering and pointing (L1).

Unit III 6L

Cement: Portland cement – chemical composition – Hydration, Setting of cement – Structure of hydrate cement – Test on physical properties – Types and different grades of cement.

Aggregates: Classification of aggregate Particle shape & texture –, strength & other mechanical properties of aggregate – Specific gravity, Bulk density, porosity, adsorption& moisture content of aggregate – Bulking of sand – Soundness of aggregate –Sieve analysis – Fineness modulus Grading curves – Grading of fine & coarse Aggregates

Learning Outcomes

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

- illustrate the structure of hydrated cement(L2).
- classify the cements(L2).
- classify the aggregates (L2).

Unit IV **6L**

Fresh Concrete: Process of manufacture of concrete, quality of mixing water, properties of fresh concrete, workability, factors affecting workability, measurement of workability.

Admixtures: Benefits of admixtures, types of admixtures, accelerating admixtures, retarding admixtures, water-reducing admixtures, super plasticizer.

Learning Outcomes

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

- illustrate the process of manufacture of concrete (L2).
- Demonstrate the workability of concrete (L2).
- outline about admixtures, types and benefits (L2).

Unit V **6L**

Strength of Concrete: Water/cement ratio, effect of age and specimen size on strength of concrete,

Mix proportions:-Factors in the choice of mix proportions – Proportioning of concrete mixes by– IS 10262- 2009 and IS 456.

Learning outcomes

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

- explain the effect of water-cement ratio on strength of concrete (L2).
- Identify factors in the choice of mix proportioning (L3).
- Design concrete mix as per codal provisions (L3).

Text Book(s)

1. S.C. Rangwala, Engineering Materials, 4/e, Charotar Publishing House, 2017.
2. M.S. Shetty, Concrete Technology,8/e, S.Chand and Company Ltd, 2018.

References

1.P.C. Varghese, A Text Book Building Materials, 2/e, Prentice-Hall, Publication, 2015.

2. A.M. Neville and J.J. Brooks, Concrete Technology,2/e, Pearson Education, Noida, Uttar Pradesh, 2019.
3. P.K.Mehta, Concrete: Microstructure, Properties and Materials, 4/e, McGraw-Hill Education, 2014.
4. A.R.Santha Kumar, Concrete Technology, 2/e, Oxford University Press India, 2018.
5. http://textofvideo.nptel.ac.in/105102012/lec41.pdf
6. https://nptel.ac.in/courses/105102088/

CONSTRUCTION MATERIALS &CONCRETE TECHNOLOGY LABORATORY

MATERIAL TESTS

1. Compression test on Stones, Solid and Hollow Blocks.
2. Determination of fineness of two types of cements by sieving and Blain's apparatus.
3. Determination of consistency of cement and setting time of two types ofcement. IS 4031(Part 5)
4. Determination of specific gravity of two types of cement(IS:4031-PART 11)
5. Determination of compressive strength of two types of cements.IS 4031(Part 6) & IS 4031(Part 7)
6. Grading of fine and coarse aggregate by conducting sieve analysis.
7. Determination of specific gravity and bulking characteristics of fine aggregate.
8. Determination of workability of design mix concrete of specific grade by slump cone test.IS: 1199
9. Designing a concrete mix of a particular grade for a target slump using superplasticizers.
10. Determination of workability of design mix concrete of specific grade by compaction factor apparatus.IS: 1199
11. Determination of workability design mix concrete of specific gradeby Vee Bee Consistometer. IS: 1199
12. Determination of unit weight, water absorption and compressive strength of design mix concrete of specific grade. IS 516.
13. Determination of split tensile strength (IS 516) and modulus of rupture of plain concrete beam (IS 5816).

Text Book(s) :

1.B.S Raghuwanshi, A course in WorkshopTechnology,DhanpatRai&Co,2015.
2. Anurag A. Kandya, Elements of Civil Engineering, Charotar Publishing house,2011.

References:

1. Satheesh Gopi, Basic Civil Engineering, Pearson Publishers,2009.
2. Rangwala, Essentials of Civil Engineering, Charotar Publishing House,2012.
3. **IS1121(part-I):1974(2008)**Methods of Test for Determination of Strength Properties of Natural Building Stones Part I Compressive Strength (First Revision)
4. **IS 1077:1992 (2007)** -Common Burnt Clay Building Bricks – Specification(Fifth Revision)
5. **IS :4031 (Part 4)- 1988 (1995)**Methods of Physicaltestsfor Hydraulic Cement Part 4 Determination Of Consistency Of Standard Cement Paste (First Revision)
6. **IS 4031(Part-I):1996 (2005**)Method of Physical Tests for Hydraulic Cement-Part 1 - Determination of Fineness by Dry Sieving (Second Revision)
7. **IS : 4031 (Part 5) – 1988 (2005**) Methods of Physical Tests for Hydraulic Cement - Part 5 Determination of Initial and Final Setting Times (First Revision)
8. **IS : 4031 (Part 6) – 1988(2005)**Methods of Physical Tests for Hydraulic Cement - Part 6 Determination of Compressive Strength of Hydraulic Cement other than Masonry Cement.
9. **IS 1383:1970 (2002)**Specification for Coarse and Fine Aggregates from Natural Sources for Concrete (Second Revision)
10. **IS: 2386 (Part III) – 1963 (2002)**Methods Of Test For Aggregates For Concrete Part Ill Specific Gravity, Density, Voids, Absorption and Bulking
11. IS 10262: 2009 –Concrete Mix Proportioning Guidelines
12. **IS : 1199 -1959 (2004)**Methods of Sampling and Analysis of Concrete (Eleventh Reprint November 1991)
13. **IS : 516 – 1959 (2004)**Methods of Tests for Strength of Concrete (Eighteenth Reprint June 2006)
14. **IS 5816: 1999 (2004**) Splitting Tensile Strength of Concrete - Method of Test (First Revision)

Learning Outcomes:

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

- summarize various physical properties of cement (L3).
- choose aggregates by performing specific gravity and fineness modulus test (L3).
- estimate the materials required for a particular grade of concrete (L3).
- make use of various testing methods for deciding the workability of concrete(L3).
- Evaluate the compressive strength, split tensile and modulus of rupture of concrete(L3).

<table>
<tr><td rowspan="6"></td><td>Course Code</td><td>Course Title</td><td>L</td><td>T</td><td>P</td><td>J</td><td>S</td><td>C</td></tr>
<tr><td></td><td>PC8: STRUCTURAL ANALYSIS</td><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Course Owner</td><td>Department of Civil Engineering</td><td colspan="4">Syllabus version</td><td colspan="2">1.0</td></tr>
<tr><td>Course Pre-requisite(s)</td><td>Mechanics of Solids</td><td colspan="4">Contact hours</td><td colspan="2">30</td></tr>
<tr><td>Course Co-requisite(s)</td><td>None</td><td colspan="4">Date Approved</td><td colspan="2"></td></tr>
<tr><td>Alternate Exposure</td><td colspan="7"></td></tr>
</table>

COURSE DESCRIPTION

The student will be able to analyze statically determinate members such as columns, cylinders and indeterminate structural members such as fixed beams and continuous beams. Various methods for computing deflections in beams and trusses are covered in this course. Design of Reinforced Concrete Structures and Design of Steel Structures require this course as a prerequisite.

COURSE OBJECTIVES

1. To demonstrate calculation of displacements in statically determinate beams andtrusses.
2. To familiarize with the analysis of indeterminate beams.
3. To familiarize with the analysis of continuous beams using various methods.
4. To explain the behavior of long columns.
5. To facilitate the analysis of cylinders.

COURSE OUTCOMES:

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

1. calculate the deflections in statically determinate beams andtrusses (L2).
2. construct SFD and BMD for fixed and two span continuousbeams using Slope Deflection Method (L3).
3. construct SFD and BMD for fixed and two span continuous beams usingMoment Distribution method and Kanismethod (L3).
4. solve bucklingload oncolumns (L3).
5. evaluate the stresses incylinders(L5).

Unit I **8L**

Deflection of Statically Determinate Structures- Introduction, Relation between curvature, slope and deflection, Deflection curves, Maculay’s Method, Moment area method, Slopes and deflection for cantilevers and simply supported beams

Deflection of Trusses: Deflection of trusses by Unit load method(having 5 members or less)

Learning Outcomes

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

- relate between curvature, slope and deflection(L1).
- determine the slopes and deflections of statically determinate beams using Maculay'smethod(L3).
- determine the slopes and deflections of staticallydeterminate beamsusing Moment areamethod(L3).
- determine the deflection of trusses using Unit loadmethod(L3).

Unit II **8L**

Analysis of Indeterminate Beams

Fixed beams: Shearforce and bending moment diagrams for Fixed beams subjected to UDL and point loads

Two span continuous beams: Shear force and bending moment diagrams for two span continuous beams using Slope deflection method

Learning Outcomes

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

- analyze fixed beams(L4).
- construct shear force and bending moment diagrams for fixedbeams (L3).
- construct shear force and bending moment diagram for two span continuousbeams using Slope deflectionmethod(L3).

Unit III **10L**

Analysis of two span continuous beams

Moment distribution method: Shear force(S.F) and bending moment (B.M) diagrams for two span continuous beams using Moment Distribution Method

Kani's method: Shear force and bending moment diagrams for two span continuous beams using Kani's Method

Learning Outcomes

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

- analyze two span continuous beams (L4).

- construct shear force and bending moment diagram for two span continuous beams using Moment DistributionMethod (L3).
- construct shear force and bending moment diagram for two span continuous beams using Kani'sMethod (L3).

Unit IV **8L**

Columns and Struts: Introduction, Column with one end free and other fixed, Column with both ends hinged, column with both ends fixed, column with one end fixed and the other hinged, Limitation of Euler's formula, column carrying eccentric load, Rankine-Gordon formula, Perry's formula.

Combined bending and direct stresses–Introduction, Limit of eccentricity for no tension in the section.

Learning Outcomes

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

- make use of Euler's theory for analysis of long columns(L3).
- make use of Rankine Gordon's formulas for columns (L3).
- solve eccentrically loadedcolumns (L3).

Unit V **8L**

Thin Cylinders - Introduction, Stresses and strains in thin cylinders, volumetric change in cylinder.

Thick cylinders: Thick cylinders subjected to internal pressure and external pressure, compound cylinders.

Learning outcomes

After completion of this unit, the student will be able to

- classify thin and thick cylinders (L2).
- analyze stresses in cylinders(L4).
- determine the stresses in compound cylinders (L5).

Text Book(s)

1. V.N Vazirani and M.M Ratwani, Analysis of Structures Vol-II, Khanna Publishers,2012.
2. T.S. Thandavamoorthy, Structural Analysis, 2/e, Oxford University press, 2011.

References

1.C.K.Wang, Statically Indeterminate Structures,TataMcGrawHill,2010.
2. G. Pandit, S. Gupta, Rajesh Gupta,'Theory of Structures (Vol.II)',3, McGraw Hill Education, India, 2017.
3. https://nptel.ac.in/downloads/105101085/.

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**S**	**C**
	PC9: HIGHWAY ENGINEERING	3	0	3	0	0	4.5
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	None	**Contact hours**				60	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

COURSE DESCRITION

Highway engineering is a very diverse and multidisciplinary field, which deals with the planning, design,operation and maintenance of transportation systems.The course aims to make thestudents learn the principles of highways, their components anddesign of flexible and rigid pavements. Further, students will getacquainted with treatment for failures and remedial measures during maintenance of pavements.

Course Objectives:
The purpose of this course is to
1. Impart knowledge on the history and current trends in highway development
2. explain concepts of geometric design related to roads along with their applications
3. familiarize about different materials used for the highway construction along with their properties
4. instruct the types of pavements along with their design procedures, construction and maintenance
5. train traffic related information on highways

Unit I **8L**

Highway Development and History of Roads: History of development of roads, highway development in India, classification of roads, planning surveys, highway alignment, engineering surveys for highway alignment.
Learning Outcomes:
After the completion of Unit, students will be able to
- **gain** knowledge about the history of roads [L2]
- **summarize** the road development in India[L2]
- **classify** different types of roads[L2]
- **explain** the basic requirements of highway alignment[L2]
- **list** various surveys required for road development[L1]

Unit II **9L**

Highway Geometric Design: Highway cross-sectional elements, stopping sight distance, overtaking sight distance, intermediate sight distance, camber, super elevation, extra widening, setback distance at horizontal curves, design of horizontal curves, transition curves, vertical curves.
Learning Outcomes:
After the completion of Unit, students will be able to
- **list** outvarious highway cross-sectional elements[L1]
- **analyze** different sight distances concepts[L3]
- **determine**super elevation, extra widening and set backs at horizontal curves[L5]

- **design** vertical curves for different conditions[L3]
- **explain**theimportance of design of transition curves[L2]

Unit III **9L**

Pavement Materials and Design: Highway materials: aggregate properties and tests: crushing, abrasion and impact test, bitumen properties and tests, - penetration, ductility, viscosity, binder content and softening point design of pavements: design of flexible pavement by C B R method as per IRC 37-2012 and theory of empirical mechanistic method, stresses in rigid pavement by Westergaards and IRC methods, design of overlay by Benkelman beam method.

After the completion of Unit, students will be able to

- **identify** different materials used inhighway construction[L3]
- **explain** the different properties of aggregate and bitumen[L3]
- **design** of flexible pavement as per IRC Codes[L4]
- **categorize**various stresses in rigid pavement[L4]
- **estimate** theoverlay thickness using Benkelman Beam Method[L5]

Unit IV **8L**

Highway Construction and Maintenance: highway construction: earthen roads, WBM roads, bituminous roads and cement concrete roads, highway maintenance: failure of flexible and rigid pavements and their maintenance, highway drainage: surface and sub surface drainage system.

After the completion of Unit, students will be able to

- **compare** highway construction techniques by various materials[L2]
- **interpret**existing conditions of road[L3]
- **identify** the failures in flexible and rigid pavements[L3]
- **explain**differentmaintenance activities on flexible and rigid pavements[L2]
- **demonstrate** importance of highway drainage[L2]

Unit V **8L**

Traffic Engineering: Traffic characteristics: road user characteristics and vehicle characteristics, traffic studies: traffic volume study, speed studies and origin and destination studies, traffic control devices: signs, signals and markings and traffic islands, intersection: introduction to un-channelized and channelized intersections and rotary intersections.

After the completion of Unit, students will be able to

- **identify**different types of traffic characteristics[L3]
- **illustrate**types of traffic studies along with their procedures[L2]
- **explain** types of traffic control devices[L2]
- **distinguish** between channelized and un-channelized intersections[L4]
- **explain**the concepts of rotary intersections[L2]

Course Outcomes:

The student will be able to

1) explain highway development and classify roads and highway alignment.[L2]
2) categorize highway geometrics for different conditions[L4]
3) evaluate a flexible and rigid pavement[L5]
4) apply the principles of highway construction, maintenance and drainage systems[L3]
5) acquire knowledge on traffic characteristics, traffic studies, traffic control devices and

intersections[L3]

Text Book(s):

1. Khanna, S.K.,Justo, C.E.G., Veeraragavan. A. Highway Engineering, Nemchandand Bros,Roorkee, 2015
2. Fred L. Mannering , Scott S. Washburn Principles of Highway Engineering and Traffic Analysis, 7th Edition, John Wiley & Sons, 2020

References:

1. Roger P. Roess, Elena S. Prassas, William R. McShane,'Traffic Engineering', Pearson, 2019
2. C. Jotin Khisty and B. KentLal, Transportation Engineering', Pearson India, 2016.
3. D.V. Bhavanna Rao G. Venkatappa Rao, K. Ramachandra Rao, Kausik Pahari,'Highway Material Testing and Quality Control', Wiley, 2019.

HIGHWAY ENGINEERING LABORATORY

Course Objectives:

The purpose of this course is to

1. Develop knowledge on different pavement materials currently in use
2. Identify properties of pavements materials and their corresponding quality control tests
3. Gain knowledge on traffic flow characteristics be performing different studies
4. Familiarize with the concept of intersection design (signalized and un-signalized)

List of Experiments

1. Determination of specific gravity and water absorption of aggregates.
2. Gradation test on aggregates.
3. Shape test of aggregates.
4. Determination of impact and compressive strength value of aggregates.
5. Determination of abrasion value of aggregates.
6. Determination of penetration, viscosity and stripping value test on bitumen.
7. Determination of ductility test of bitumen.
8. Determination softening point, flash and fire point test of bitumen.
9. Determination of optimum binder content(Marshall mix design).
10. Traffic volume studies.
11. Spot speed studies.
12. Parking studies.

Note: All laboratory tests are as per IS, ASTM, AASHTO, TRL, IRC, BS procedures specifications and guidelines.

Course Outcomes:

At the end of the course, the student will be able to

1. characterise the pavement materials
2. perform quality control tests on pavements and pavement materials
3. tabulate traffic studies for estimating traffic flow characteristics
4. design at-grade intersections

References:

- Khanna, S.K.,Justo, C.E.G., Veeraragavan. A, Highway Material Testing, 4/e, Nem Chand and Bros, Roorkee, 2013
- W. R. Mc Shane, and R.P. Roess, Traffic Engineering, Prentice Hall, 2010

<table>
<tr><td rowspan="6"></td><td>Course Code</td><td>Course Title</td><td>L</td><td>T</td><td>P</td><td>J</td><td>S</td><td>C</td></tr>
<tr><td></td><td>PC10: DESIGN OF REINFORCED CONCRETESTRUCTURES</td><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Course Owner</td><td>Department of Civil Engineering</td><td colspan="4">Syllabus version</td><td colspan="2">1.0</td></tr>
<tr><td>Course Pre-requisite(s)</td><td>Structural Analysis, Construction Materials and Concrete Technology</td><td colspan="4">Contact hours</td><td colspan="2">30</td></tr>
<tr><td>Course Co-requisite(s)</td><td>None</td><td colspan="4">Date Approved</td><td colspan="2"></td></tr>
<tr><td>Alternate Exposure</td><td colspan="7"></td></tr>
</table>

Course Description

The student will be able to analyze and design various reinforced concrete members subjected to different types of loads using Indian Standard codal provisions. The course is a prerequisite for Advanced Design Reinforced Concrete Structures and Prestressed Concrete.

Course Objectives

1. To impart the concept of working stress method.
2. To train on limit state method of design for flexure.
3. To train on limit state method of design for shear, torsion.
4. To enable the design of one-way and two-way slabs.
5. To instill the design of columns.

Course Outcomes

After completion of this course, the student will be able to

1. design of RCC beams using working stressmethod (L3).
2. design of RCC beams using Limit State Method (L3).
3. design of RCC beams for shear & Torsion (L3).
4. designof one-way and two-way slabs (L3).
5. design of short columns & isolated footings (L3).

Unit I **8L**

Loading standards as per IS 875, grades of steel and concrete, Introductionto working stress, ultimate load and limit state methods.Working stress method:Assumptions, flexure of RCC beams ofrectangular section, under reinforced, balanced and over-reinforced sections, analysis and design of singly reinforced beams of rectangular sections using working stress method.

Learning Outcomes

After completion of this unit, the student will be able to

- list different Loading standards as per IS code (L1).
- outline the assumptions used in working stress method and limit state method (L2).
- classifythe RCC beams sections (L2).
- design of singly reinforced beams using working stress method (L3).

Unit II **8L**

Limit State Method: RCC beams of rectangular sections under flexure,under reinforced, balanced and over-reinforced sections, analysis anddesign of singly and doubly reinforced beams of rectangular sections;

Design of T beams: effective flange width, analysis and design of T-beams.

Learning Outcomes

After completion of this unit, the student will be able to

- apply the principles of Limit State in design of rectangular Reinforced Beams (L3).
- design of singly reinforced RCC beams (L3).
- design of doubly reinforced RCC beams (L3).
- analyze a given T-beam section (L2).

Unit III **8L**

Shear and Torsion: Limit state of collapse in shear, types of shearfailures, truss analogy, shear, span/depth ratio, calculation of shear stress,types of shear reinforcement, design for shear in beams, analysis fortorsional moment in a member, torsion shear stress in rectangular sections,reinforcement for torsion in RCC beams.

Learning Outcomes

After completion of this unit, the student will be able to

- list different types of shear failure based on span/depth ratio (L1).
- identify the effect of Torsion in RCC beams (L3).
- design of RCC beams for shear (L3).
- design of RCC Beams for torsion (L3).

Unit IV **8L**

Design of one-way and two-way slabs (using IS 456),method of analysis,classification of slabs, design of one way simply supported slab, behaviour of twoway slab, types of two way slabs, analysis of two way slabs, designof two way slabs with different edge conditions.

Learning Outcomes
After completion of this unit, the student will be able to

- distinguish between the structural action of One Way and Two Way Slabs (L2).
- design of One way slabs (L3).
- design of Two way slabs for different edge conditions (L3).

Unit V **10L**

Columns: Short columns, minimum eccentricity, column under axialcompression, analysis and design of short columns subjected to uniaxialmoment, analysis and design of short columns subjected to bi-axialmoments.

Footings: Design of isolated footings for a column subjected to axial loading.

Learning Outcomes

After completion of this unit, the student will be able to

- distinguish between the structural action of Short and long columns (L2).
- design of short columns subjected to axial loading (L3).
- design ofshort columns subjected to uni& bi-axial moment (L3).
- design ofisolated footings (L3).

Text Book(s)

1. Pillai and Menon, Reinforced Concrete Design, 4/e, Tata McGraw Hill, 2021.

References

1. A.K. Jain, Reinforced Concrete – Limit State Design, 7/e, Standard book house, 2012
2. P.C. Varghese, Limit State Design of Reinforced Concrete, 2/e, Prentice Hallof India, 2013.
3. N. Subramanian, Design of Reinforced Concrete Structures, Oxford University, 2014.
4. https://nptel.ac.in/courses/105105105/1
5. https://nptel.ac.in/downloads/105105104/

	Course Code	**Course Title**	**L**	**T**	**P**	**J**	**S**	**C**
		PC11: ARCHITECTURAL PLANNING & CAD LAB	0	0	3	0	0	1.5
	Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
	Course Pre-requisite(s)	*Engineering Graphics*	**Contact hours**				30	
	Course Co-requisite(s)	None	**Date Approved**					
	Alternate Exposure							

Course Description

Drawing is the civil engineer’s language. The student will be able to drawa layout of site, plan, elevation and section with interior details. This course provides an overview of planning aspects of various buildings as per bye laws. This course is a prerequisite for Estimation and Costing.

Course objectives:

1. To explain the basic architectural principles.
2. To introduce the fundamentals of computer aided drawing.
3. To familiarize with building bye-laws
4. To train to draw the plan, section, elevation and site plan.
5. To teach BIM and modeling the structural components using Revit.

Course Outcomes:

After completion of this course, the student will be able to

1. apply knowledge of building bye laws (L3).
2. demonstrate and draw conventional signs, foundation details, cross section of a door and staircase (L2).
3. construct plan, section and elevation of a residential building (L2).
4. examine the efficiency of CAD design and reading of CAD drawings (L4).
5. model structural components using BIM (L3)

PLANNING ASPECTS & REGULATIONS

Unit-I: Introduction to drawing **3L**

Introduction to concept of drawings, Interpretation of typical drawings, Scales – Elements of a building drawing – Plan, Section and Elevation from the given line drawing/Site plan/floor plan of residential and public buildings, Introduction to computer aided drawing, Drawing commands

Learning outcomes:

After completion of this unit, the student will be able to

- recall elements of a building drawing (L1).
- make use of computer applications in developing drawings(L3).
- outline various drawing commands (L2).

Unit-II: Sign conventions and symbols: **2L**

Layers and Annotations in AUTOCAD, Conventional Signs- Conventional signs – Materials, Architecture, Structure, Electrical and Plumbing, Rebar drawings, Brick Bonds – Header, Stretcher, English and Flemish, one and half, two and two and half brick walls. Doors and Windows

Learning outcomes:

After completion of this unit, the student will be able to

- select conventional signs for different materials (L1).
- choose symbols used in plumbing and electrical(L1).
- choose symbols used in brick masonry(L1).

Unit-III: Building Planning & Building Byelaws: **3L**

Classification of buildings - principles of planning - dimensions of buildings.
Building bye-laws for floor area ratio, floor space index, Height of Building, open spaces – orientation of buildings - lighting and ventilation-space standards for residential, commercial & institutional categories, climatology and climatic considerations.

Learning outcomes:

After completion of this unit, the student will be able to

- list various types of buildings (L1).
- apply building byelaws (L3).
- apply principles of planning (L3).

Unit-IV: Preparation of Building Plan: **3L**

Planning and preparing sketches and working drawings of Residential buildings.

Learning outcomes:

After completion of this unit, the student will be able to

- develop floor plans, elevations and section (L3).
- plan sketches of residential buildings (L3)
- build working drawings of buildings (L3).

Unit-V: Introduction to BIM: **3L**

Principles of isometrics and perspective view of building.Fundamentals of Building Information Modelling (BIM) using Revit. Introduction Revit software tools; Drawing of structural components, walls, floors, ceiling, roof, stairs; modify tools; structural modelling, column and beam system, foundations.

Learning outcomes:

After completion of this unit, the student will be able to

- explain about basics of Building Information Modelling(L2).
- list out various tools of Revit Software (L1).
- model a structural components of a Residential building (L3).

Drafting of following Using CAD software

1. Introduction of CAD and Practicing Commands
2. Drawing of conventional signs using CAD.
3. Foundation details of a building.
4. English bond and Flemish bond.
5. Drawing of stair case.
6. Drawing of cross section of door
7. Drawing of plan, section, elevation and site plan of residential single room building.
8. Drawing of plan, section, elevation and site plan of residential two bed room house.
9. Drawing of plan, section, elevation and site plan of of duplex type house.
10. Preparation of plan, section, elevation and site plan of residential buildings given specifications.
11. Reading of one Architectural Drawing set of Single/Multi-storeyed Building.

12. Modelling of structural components, walls, floors, ceiling, roof, and stairs in a residential building using Revit.

Text Book(s)

1. Subhash C Sharma and Gurucharan Singh, Civil Engineering Drawing, Standard Publishers, 2005.
2. N. Kumara Swamy, A. Kameswara Rao, Building Planning and Drawing , 8/e, 2015.

References

3. M.G. Shah, C.M. Kale and S.Y. Patki, Building Drawing with an Integrated Approach to Build Environment, Tata McGraw- Hill Publication, 2002.
4. Ajeet Singh, Working with AUTOCAD 2000 with updates on AUTOCAD 2001, Tata-Mc Graw-Hill Company Limited, 2002.
5. B.P. Verma, Civil Engineering Drawing and House Planning, Khanna Publishers, 2014.
6. V.M. Marimuthu, R. Murugesan, S. Padmini, S. Pratheeba, Civil Engineering Drawing-I, Publishers, 2008.
7. Venugopal, Engineering Drawing and Graphics + AUTOCAD, New Age International Pvt. Ltd.,2007.

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**S**	**C**
	PC12: SURVEY CAMP	0	0	0	0	0	2
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	None	**Contact hours**				30	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

Course Objectives:

The objectives of survey camp are

- Students will be able to identify best suited instruments for carrying survey camp.
- Students will be able to collect data in the field in systematic ways.
- Students will be able to prepare and present the field data in diagrammatic and tabular form in order to be understood by others.
- Students will be able to apply theoretical surveying concepts under actual field conditions.
- Students will be encouraged to build up interpersonal skills.

Course Outcomes:

At the end of camp, the student will be able

- The students are expected to carry out basic survey works in the field with apt technical knowledge and confidence.
- Student should be able to relate classroom learning to real world situations.
- To tackle the mistakes and incomplete data from the field observations.

The survey camp will be organized by the Department of Civil Engineering, GITAM Institute of Technology, GITAM (Deemed to be University) for students as the compulsory part of the academic curriculum during fifth semester. The duration of the camp is for 2 weeks. Students will be divided into group of 5 students monitored by the faculty coordinators.

In this camp student will learn all the technical skills required for surveying by performing seven major activities which includes Reconnaissance survey (safety, schedule, site visit, etc.) and Topographical survey with hands on compass traversing, profile levelling, fly levelling, contouring, curve setting and heights & distances on the selected study area.

The study is focussed on various locations in the GITAM campus with different topographies. GITAM tunnel, Hostel area, Main entrance and exit areas, all major buildings and bhavans are identified as main places to conduct survey camp. Students in the camp will make use of all traditional surveying methods along with sophisticated instruments like total station and auto levels for accuracy and precision.

	Course Code	Course Title	L	T	P	J	S	C
		PC13: DESIGN OF STEEL STRUCTURES	3	0	0	0	0	3
	Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
	Course Pre-requisite(s)	Mechanics of Solids and Structural Analysis	**Contact hours**				30	
	Course Co-requisite(s)	None	**Date Approved**					
	Alternate Exposure							

Course Description

The design of structural members using steel as a construction material will be studied in this course.The student will be able to design various types of structural members such as tension members, compression members, flexural members and their connections using Indian Standard codalprovisions. The course is a prerequisite for Design of Advanced Steel Structures.

Course Objectives

1. To explain the design of bolted connections.
2. To explain the design of welded connections.
3. To demonstrate the behavior and design of tension members
4. To enable the design of compression members.
5. To impart the design of flexural members.

Course Outcomes

After completion of this course, the student will be able to

1. design of bolted connections (L3).
2. design of welded connections (L3).
3. design of tension members (L3).
4. design of compression members using rolled steel and built up sections (L3).
5. design of flexural members using rolled steel sections (L3).

Unit I **8L**

General: Fundamental concepts of design of structures, Types of structural steel – Mechanical properties of structural steel, Indian standard rolled steel sections, Design process, Steel

Structural systems, Loads & load combinations, Concept of Working stress and limit state method of design.

Bolted Connections: Types of fasteners, Bolts & Bolted Connection, Failure of a joint, strength and efficiency of a joint, Design of lap joint, butt joint and eccentric connections.

Learning Outcomes

After completion of this unit, students will be able to

- list the different rolled steel and built up sections(L1)
- estimate the strength and efficiency of a joint (L2)
- design of bolted joints subjected to combined loadings(L3)

Unit II **8L**

Welded Connections: Types of welds, stresses in welds, design of welded joints subjected to axial load, eccentric welded connections.

Learning Outcomes

After completion of this unit, students will be able to

- list different types of welded joints (L2)
- designwelded joints for axial loads (L3)
- designwelded joints for eccentric loads (L3)

Unit III **8L**

Tension Members: Types of tension members and sections, behaviour of tension members, Modes of failures, net effective sectional area for plates and angle sections, design of tension members using plates, single angles and double angles, lug angles.

Learning Outcomes

After completion of this unit, students will be able to

- demonstrate the net effective section area (L3)
- design of tension members (L3)
- design of lug angles (L3)

Unit IV **10L**

Compression Members: Types of compression members and sections, Behaviour and failures of Compression members, Effective length, radius of gyration and slenderness of compression members, design compressive stresses in compression, design of struts, design of axially loaded compression members, built up compression members (I section and two channels) laced and battened columns, design of eccentrically loaded columns.

Learning Outcomes

After completion of this unit, students will be able to

- design of axially loaded column (L3)
- design of built up Columns (L3)
- design of eccentrically loaded column (L3)

Unit V **8L**

Beams: Introduction, Types of steel beam sections, Classifications of sections, lateral stability of beams, factors affecting lateral stability, behavior of simple beams in bending, design strength of laterally supported & unsupported beams, design of laterally supported and unsupported beams.

Learning Outcomes

After completion of this unit, students will be able to

- classifythe types of rolled steel sections (L2)
- design of laterally supported beams (L3)
- design of laterally unsupported beams (L3)

Text Book(s)

1. S.K. Duggal, Limit state Design of Steel Structures, 3/e, Tata McGraw Hill, 2019.

2. N. Subramanyam, Design of Steel Structures, 3/e, Oxford University Press, 2018.

References

1. V.L. Shah and Veena Gore, Limit State Design of steel structures IS:800- 2007, Structures Publications,3/e, 2012.

2. M.L. Gambhir, Fundamentals of Structural Steel Design, McGraw Hill Education, 2013.

3. Ramachandra and V. Gehlot, Design of Steel Structures, 2/e, Scientific Publishers, 2015.

4. Shiyekar M R, Limit State Design in Structural Steel, 3/e, Prentice Hall of India Pvt Ltd, 2017.

5. https://nptel.ac.in/courses/105106112/3

Course Code	Course Title	L	T	P	J	S	C
	PC14: WATER RESOURCES ENGINEERING	3	0	0	0	0	3
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	None	**Contact hours**				30	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

Course Description

This course helps the learner to acquire the comprehensive knowledge of physical process of surface and ground water hydrology and able to apply the principles to estimate the runoff resulting from rainfall. The learner will be able to determine the safe yield from a well. This course introduces the concept of flow mass curve to determine the required capacity of reservoir. This course illustrates the systems and methods of irrigation. The learner will gain the knowledge of silt theories to design an unlined canal.

Course Objectives

1. to teach the physical process of surface and ground water hydrology
2. to illustrate the principles of rainfall-runoff relationship.
3. to provide an over view to solve the problems related to hydrograph analysis, well hydraulics, reservoir capacity.
4. to impart the skill to design the canal capacity for crop water requirement and design of unlined canal.

Course Outcomes:

At the end of course the students will be able to

1. estimate the storm water runoff resulting from rainfall (L-3)
2. determine the safe yield from a well (L-3)
3. determine the reservoir capacity and useful life of reservoir (L-3)
4. compute the discharge requirement for cropping patterns (L-3)
5. design the unlined canal using silt theories (L-3)

Unit I

9 L

Hydrology: Hydrologic cycle, precipitation, types of rainfall and its measurement, computation of mean depth of rainfall over an area, double mass curve; evaporation and evapo-transpiration, infiltration, infiltration indices W-index, ø - index.

Learning outcomes:

After completion of Unit-I, students will be able to

- understand the basics of engineering hydrology (L-1)
- learn the characteristics of rainfall and infiltration (L-2)
- solve problems related to mean depth of rainfall and ø – index ((L-3)
- distinguish between infiltration and runoff (L-4)

Unit II

9 L

Hydrograph Analysis: runoff, methods of determination of runoff, Storm hydrograph, Unit hydrograph, applications of unit hydrograph, hydrograph of different durations,S-hydrograph. **Ground Water Hydrology:** Types of aquifers, Darcy's law, well hydraulics, steady flow into wells in un-confined and confined aquifers, recuperation test method for determination of yield of an open well.

Learning outcomes:
After completion of Unit-II, students will be able to
- understand the concept of unit hydrograph and its application (L-2)
- attain the knowledge of relationship between unit hydrograph and storm hydrograph and steady flow into wells (L-2)
- solve problems related to unit hydrograph and well hydraulics (L-3)
- differentiate the flow in un-confined and confined aquifers (L-4)

Unit III

8 L

Reservoir Planning: Investigations for reservoir planning, selection of site for a reservoir, zones of storage in a reservoir, reservoir yield, mass curve and demand curve, determination of reservoir capacity, yield from a reservoir, reservoir sedimentation, control of reservoir sedimentation, useful life of a reservoir.

Learning outcomes:
After completion of Unit-III, students will be able to
- understand the required investigations for reservoir planning (L-2)
- learn the relationship between mass curve and demand curve (L-2)
- determine the reservoir capacity (L-3)
- calculate the useful life of a reservoir (L-3)

Unit IV

8 L

Irrigation: Introduction of irrigation, types of irrigation systems, methods of irrigation: surface, sub-surface and sprinkler methods, drip irrigation; soil moisture constants, depth and frequency of irrigation, water requirements of crops, duty, delta, base period and their relationship, crop seasons, factors affecting duty, consumptive use of water, irrigation efficiencies.

Learning outcomes:
After completion of Unit-IV, students will be able to
- list the types of irrigation (L-1)

- explain the methods of application of irrigation water (L-2)
- solve problems related to canal capacities for cropping patterns (L-3)
- compare the irrigation efficiencies (L-4)

Unit V

8 L

Canal Systems: Classification of irrigation canals, canal alignment, , determination of canal capacities for cropping patterns, regime silt theories, design of unlined canals, Kennedy's and Lacey's theories, unlined canal design problems, cross section of a canal, balancing depth of canal.

Learning outcomes:

After completion of Unit-V, students will be able to

- classify the types of canals (L-2)
- learn and implement the regime silt theories (L-2)
- compute the balancing depth of canal (L-3)
- design the unlined canal (L-3)

Text Books

1. B.C.Punmia and Pande B.B.Lal, Irrigation and Water Power Engineering, 16/e, Laxmi Publications Pvt. Ltd., New Delhi, 2021
2. P.N.Modi, Irrigation, Water Resources and Water Power Engineering, 11/e, Standard Book House, Delhi, 2020

Reference Books

1. S.K.Garg, Irrigation Engineering, and Hydraulic Structures, Khanna Publishers, Delhi
2. K.R. Arora, Irrigation, Water Power and Water Resources Engineering, Standard Book Publishing, Delhi
3.Jayarami Reddy P., Engineering Hydrology, Laxmi Publications Pvt. Ltd., Delhi, 2016
4. Chow V.T., D.R Maidment and L.W. Mays, Applied hydrology, Tata McGraw Hill Education Pvt Ltd, Delhi, 2017.
5. Mays L.W, Water Resources Engineering, Wiley India Pvt. Ltd, 2013

Fluid Mechanics and Water Resources Engineering NPTEL Course:

https://nptel.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/fluid_mechanics/index.htm

https://nptel.ac.in/courses/105105110/

	Course Code	Course Title	L	T	P	J	S	C
		PC15: COMPUTER APPLICATIONS IN CIVIL ENGINEERING LABORATORY	0	0	3	0	0	1.5
	Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
	Course Pre-requisite(s)	*Structural Analysis, Design of Reinforced ConcreteStructures, Design of Steel Structures, Water Resources Engineering and Project Planning and Management*	**Contact hours**				30	
	Course Co-requisite(s)	None	**Date Approved**					
	Alternate Exposure							

Course Description

The student gets familiarity in i)analysis and design of RCC and steel Structure using STAAD Pro., ii)design water distribution network using EPANET, iii)schedule and plan a project using Construction Management principles, and iv) reading of spatial data using GIS. The student will be able to perform design of real time structures.

Course Objectives:

1. To demonstrate the modeling of a building.
2. To train in generating the maps using GIS software.
3. To demonstrate the design of water distribution network.
4. To facilitate project planning and scheduling.

List of Analysis or Design to be performed using Various software STAAD.Pro

1) Introduction to STAAD Pro software and basic beam analysis.
2) Analysis of RC plain and three-dimensional frames.
3) Analysis and design of structures subjected to wind and earthquake loads. (minimum five storey),
4) Typical detailing of structural elements.
5) Analysis and design of steel truss.

GIS

1) Creation of spatial data using different methods.
2) Creation of Maps with different data formats.
3) Analysis of data using GIS.
4) Generation of reports based on specific queries.

EPANET

1) Calculation of major head loss in pipes
2) Calculation of minor head losses for bends and fittings.
3) Design of a simple pipe network
4) Analysing the movement of a tracer material
5) Conducting water quality simulation

CONSTRUCTION MANAGEMENT APPLICATIONS

1) Introduction to project managementsoftwares
2) Planning and Scheduling of residential project using PERT and CPM Techniques.
3) Resource Allocation for activities of residential project
4) Controlling the time schedule of residential project.
5) Generating reports for residential project

Note: Students should learn any three software packages,

Course Code	Course Title	L	T	P	J	S	C
	PC16: Estimation and Costing	3	0	0	0	0	3
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	None	**Contact hours**				30	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

Course Description

The primary purpose of estimating and costing is the preparation for submission of a project according to administrative approval and technical sanction. The various elements of engineering involved in it viz. planning, preparing bill of quantities and abstracts of cost, drawing and detailing (specially at the actual construction stage) and organisation of labour and material with a view to provide a durable structure most economically.

Course Objectives:

1. To explain thebasics terms and standard units used in construction of civil engineeringstructures.
2. To demonstrate the different methods of estimating the quantities of items.
3. To familiarize the schedule of rates of different item of works by using standard data book.
4. To explain the estimation of earthwork in different roads and also calculate the weight of steel required in R.C.C. element.
5. To familiarize about construction contracts and tenders.

Course Outcomes:

At the end of the Course the Students will be able to

1. find out the dimensions and descriptions of construction work in a methodical way.[L-1]

2. interpretthe purpose of estimating and quantify the materialsby standard method in construction projects.[L-2]
3. constructthe different items of materials,labour and machinery with standard unit rates for a various construction work in building.[L-3]
4. interpret the quantities of estimating the road work and bar-bending schedule.[L-2]
5. illustrate the procedure of contract by process of bidding. [L-2]

UNIT – I **8 L**

Introduction: General items of work in building, standard modules, principles of working out quantities for detailed and abstract estimates,approximate method of estimating, errors in estimation, types, related termsin estimate, contingencies, different types of approvals, rules.

Specification: purpose and basic principle of general and detailedspecification (writing the detailed specification for various constructionsshould be covered in term work).

Learning outcomes:

After completion of Unit – I, students will be able to

- Explain various items of work in construction of civil structures.[L-2]
- List different types of approvals and rules needed to construct a building. [L-1]
- Identify errors occurred in estimation. [L-3]
- Summarize general and detailedspecifications for items of work. [L-2]

UNIT – II **8 L**

Detailed Estimate of Buildings: Different items of works in building,detailed measurement form, estimate of RCC building long wall- shortwall method and centre line method.

Learning outcomes:

After completion of Unit – II, students will be able to

- Explain the terms used in detailed measurement form. [L-2]
- Interpretapproximate method of estimating. [L-2]

- Make use of estimating of RCC building with long wall-shortwall method and centre line method.[L-3]

UNIT – III **9 L**

Rate Analysis: Working out of data sheet for materials and various itemsof work in buildings, standard data book, schedule of rates, and abstract estimate of buildings.

Learning outcomes:

After completion of Unit – III, students will be able to

- Identify the various materials in standard data sheet. [L-1]
- Demonstratethe schedule of rates.[L-2]
- Explainrate analysis of various items of buildings. [L-2]

UNIT – IV **9 L**

Roads: Estimation of earth work, different formulae for calculations, concrete roads, bituminous roads.

Bar bending: Introduction to bar bending schedule, beams.

Learning outcomes:

After completion of Unit – IV, students will be able to

- Classifythe different methods to calculate the earthwork of roads. [L-1]
- Interpretbar bending schedule.[L-2]
- Explain steel requirement in RCC beams.[L-2]

UNIT – V **8 L**

Contracts: Definition, element of contract, offer acceptance and consideration, valid contract, types of contracts, conditions of contract, sub-contracts, joint ventures, muster roll form 21, piecework agreement

form, work order.

Tender: Definition quotation, earnest money- security money, tender notice, tender form, bidding types and procedure, irregularities in bidding, award, arbitration- disputes settlement.

Learning outcomes:

After completion of Unit – V, students will be able to

- Identify types of contracts in construction of civil structures. [L-2]
- Explain the conditions of contract and muster roll form.[L-2]
- Illustrate different terms used in tender document. [L-2]
- Define requirement of earnest money & security money. [L-1]
- Explain the procedure of evaluating the tender. **[L-2]**

Text Books:

1. S. C. Rangwala, Estimating, Costing and Valuation, 17/e ,Charotar Publishing House, 2017.
2. B.N. Dutta, Estimating and Costing in Civil Engineering, 27/e, UB Publishers, 2014.

Reference:

1. V N Vazirani& S P Chandola, A Text book of Civil Engineering Estimation and Costing, 3/e, Khanna Publishers, 2001.
2. D.D. Kohli and R.C. Kohli, Textbook on Estimating, Costing and Accounts (Civil), 13/e , S. Chand & Company Pvt. Ltd, 2013.
3. M. Chakraborti, Estimation Costing Specifications and Valuation in Civil Engineering, 24/e , Khanna Publishers, 2014.
4. Kumar NeerajJha, Construction Project Management: Theory and Practices, 2/e, Pearson Education, 2015.
5. NPTEL Web Course- Construction Planning and managementhttps://nptel.ac.in/courses/105103093

Program Electives (PE)

Course Code	Course Title	L	T	P	J	S	C
	PE-1: REPAIRS, RENOVATION AND REHABILITATION OF STRUCTURES	2	0	2	0	0	3
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	None	**Contact hours**				30	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

Course Description

The prerequisite for this course would be Construction Materials and Concrete Technology. The study of this course helps student in identifying the causes for failure of a structure and adopting a suitable repair or rehabilitation technique. The knowledge gained by the students on repair materials and methods learnt helps in finding solution to problems related to maintenance and repair of existing structures.

Course objectives

1. Identify and define all the terms and concepts associated with deterioration of concrete structures.
2. To examine various distress and damages to concrete structures.
3. To assess the damage to structures using various field tests.
4. To illustrate various types and properties of repair materials.
5. To list various repair techniques of damaged and corroded structures.
6. Demonstrate the principles of rehabilitation and retrofit techniques.

Course Outcomes

After completion of this course, the student will be able to

1. explain the mechanisms of degradation of concrete structures affecting durability(L2).
2. develop a knowhow of the Concrete repair industry equipped with variety of repair materials and techniques(L6).

3. select appropriate repair technique and repair material(L5).
4. decide the appropriate rehabilitation/retrofitting technique for damaged structural members(L5).

Unit I

Durability and Deterioration of Concrete: **8L**

Physical causes:

Durability of concrete, causes of distress in concrete structures, Shrinkage in concrete, honeycombing in concrete, creep of concrete, Temperature changes – Internally generated temperature differences, Externally generated temperature differences, Fire on concrete, Thermal movement in concrete,

Corrosion:

Corrosion process, Damages due to corrosion

Learning Outcomes:

After completion of this unit, the student will be able to

- list the factors affecting the durability of concrete(L1).
- identify the physical parameters affecting durability of concrete due to shrinkage, creep, temperature and fire(L3).
- assess the extent of damage due to corrosion(L5).
- examine the causes for deterioration of concrete(L4).

Unit II **8L**

Damage Assessment

Investigation of Damage- Observation, Assessment Procedure

Non-Destructive Testing Methods: Introduction, Non-Destructive Testing Methods, Surface Hardness Test, Ultrasonic Pulse velocity test,

Semi-Destructive Testing Systems: Core Sampling and Testing, Half -Cell potential survey

Learning Outcomes:

After completion of this unit, the student will be able to

- apply different assessment procedures for evaluation of distressed structures.(L3).
- Illustrate non-destructive testing in evaluation of concrete structures(L2).
- evaluate the strength/extent of damage to existing buildings through field

investigations.(L5).

Unit III **8L**

Repair Materials

Polymeric repair materials, Polymeric coatings, Polymer concrete/mortar composites, Fibre reinforced concrete, Glass fiber reinforced concrete, Polyprolene fibre, Carbon fibres, Fiber reinforced polymer composites, Concrete made with industrial wastes, Bacterial concrete.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the importance of polymer concrete as repair material(L2).
- make use of industrial wastes in making of concrete(L3).
- extend the use of bacterial concrete in repair of cracks(L2).

Unit IV **8L**

Evaluation and Repair of Cracks:

Symptoms and Diagonsis of Distress, Evaluation of cracks, Selection of Repair Procedure, Repair of cracks-Preparation of Surface, Repair Techniques, Common types of repairs:Sealing of cracks, Flexible sealing, Providing additional steel, Stitching of cracks, Repair by jacketing, Autogenous Healing.

Learning Outcomes:

After completion of this unit, the student will be able to

- identify the causes for evaluation of cracks in buildings(L3).
- select repair and protection techniques for existing concrete structures(L5).
- classify different repair methods available for buildings(L2).
- decide and suggest suitable method for repair of cracks in structures(L5).

Unit V **10L**

Rehabilitation and Strengthening Techniques

Rehabilitation Techniques:

Replacement Mortar- Epoxy bonded epoxy mortar, Replacement Concrete- Epoxy-bonded Replacement concrete, Application, Shotcrete or Gunite, Grouting- Portland Cement Grouts, Polymer Grouts, Epoxy Grouting, Resin injection, Sprayed concrete, Slab jacking technique, Cathodic Protection

Strengthening methods:

Introduction-Need for strengthening, Structural Concrete Strengthening, Column Strengthening, Strengthening with external reinforcement, External Post-tensioning, Section Enlargement, Guidelines for Seismic rehabilitation of existing buildings.

Learning Outcomes:

After completion of this unit, the student will be able to

- summarize available techniques and their application for strengthening or upgrading existing structural systems(L2).
- identify the service life of buildings (L3).
- develop various maintenance and repair strategies (L6).
- adapt different retrofitting techniques for existing structures(L6).

Text Book(s):

1. B.Vidivelli, Rehabilitation of Concrete Structures, 1/e, Standard Publishers Distributors, 2018.
2. M.L.Gambhir, Concrete Technology: Theory and Practice, 4/e, Tata McGraw Hill Education Private Limited, 2013.

References:

1. Peter.H.Emmons and Gajanan.M.Sabnis, Concrete Repair and Maintainence, 2/e, Galgotia Publications Pvt Ltd, 1992.
2. S.Mahaboob Basha, A textbook of Concrete Technology, 1/e, Anuradha Publications, 2011.
3. J.Bhattacharjee, Concrete Structures Repair Rehabilitation and Retrofitting, 1/e, CBS, 2017.
4. P.C.Varghese, Maintenance Repair and Rehabilitation and Minor works of Buildings, 1/e, Prentice Hall India Learning Private Limited, 2014.

Laboratory experiments

1) Assessment of compressive strength of concrete by Rebound Hammer test.
2) To conduct Ultrasonic Pulse Velocity test on concrete.
3) Measurement of corrosion of reinforcement by Half cell Potentiometer.
4) Measurement of cover and bar diameter by Profometer.

5) Evaluation of Permeability of concrete.
6) Drying shrinkage of concrete.
7) Creep test on concrete.
8) To conduct Rapid Chloride Permeability test on concrete.
9) To assess the residual strength of concrete subjected to high temperature.
10) Core sampling and testing of concrete.
11) Repair technique on damaged concrete-Wire brush/Sand blasting technique

Course Code	Course Title	L	T	P	J	S	C
	PE-1: FOUNDATION ENGINEERING	2	0	2	0	0	3
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	None	**Contact hours**				30	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

Course Description

Preamble: A foundation is a integral part of the structure which transfer the load of the superstructure to the soil and classified in to shallow and deep foundations. For every structure foundation is essential. There are two major requirements to be satisfied in the design of foundations,i.e Provision of an adequate factor of safety against shear failure and Adequate provision against damage to the structure by total or differential settlements. To satisfy these requirements detail investigation of the properties of soil by means of laboratory or field testing. Based on the investigation report type and depth of foundation is suggested, earth pressure calculated, Stability of slope analyzed and bearing capacity also determined

Course Objectives:

1. To acquaint the need of Soil Investigation and characterisation for structural stability.
2. To study the estimation of bearing capacity of soils for shallow foundations and design considerations.
3. To study the estimation of Load Carrying Capacity of Piles and well foundations.
4. To introduce the determination of earth pressure behind retaining walls. Understand Ground Improvement Methods. Analysis of Slope Stability aspects. (This course does not cover the structural design of foundations.)

Course Outcomes:

Student shall be able to

1. **Explain** direct and indirect soil Investigation methods to be adopted prior to construction of structures – **L2**
2. **Determine** bearing capacity of soils for shallow foundations and settlement – **L4**
3. **Estimate** Load Capacities of Pile Foundations and well foundations- **L5**
4. **Estimate** earth pressure behind Retaining Structures, Ground Improvement Techniques – **L5**
5. **Perceive** the Stability analysis of Soil Slopes and arrival of FOS for the natural and manmade slopes – **L5**

Unit I **8 hours**

Subsoil Exploration: Importance, Methods of subsoil exploration, direct, indirectmethods, soundings by standard, dynamic cone and static cone penetration tests, correlations of shear parameters from N values, types of boring, types of samples, criteria for undisturbed samples, bore-logs-preparation, report writing.

Learning Outcomes: After completion of Unit-I Students will be able to:

- **Summarize** the importance of Soil Investigation and various methods of sub-soil exploration -**L2**
- **Apply** direct and indirect methods of Soil Investigation Consistent with Site Conditions/ Strata Conditions.–**L3**
- **Identify** Suitable Samplers for UD-Soil Sample Collection during Investigations-**L3**
- **Adap**t the suitable Geo-Physical, Soil exploration to supplement direct methods soil Investigation data with Electrical Resistivity, Reflection and Refraction Surveys.–**L6**
- **Propose** the conservative, appropriate, economical foundation type, depth of foundation for the soil profile.–**L6**

Unit II **9 hours**

Shallow Foundations: Safe bearing capacity and allowable bearingpressure, Terzaghi's bearing capacity equations its modifications for square, rectangular and circular foundation, types of bearing capacity failures : general, local and punching shear conditions, factors affecting bearing capacity of soil, allowable bearing pressure based on n-values, bearing capacity from plate load tests, causes of settlement, computation of elastic or immediate settlement, allowable settlement, related applications.

Learning Outcomes: After completion of Unit-II Students will be able to:

- **Classify**thetypes of different foundation systems - L2
- **Illustrate** the necessary theoretical, practical aspects for design considerations and construction of foundation systems.-**L2**
- **Identify** with various theoretical, semi-theoretical methods of determination of bearing capacity on a construction site, for shallow foundations.–**L3**
- **Estimate** Load carrying capacity for shallow foundations with different shapes -**L5**
- **Evaluate** the feasibility of foundation solutions to different types of soil conditions considering the time effect on soil behaviour.–**L5**
- **Apply** the codal provisions in order to estimate safe bearing capacity based on permissible settlements as settlements to arrive at safe soil pressure.–**L3**
- **Determine** the immediate elastic settlements and long term consolidation settlements very often governs the design of footings-**L5**

Unit III **8 hours**

Pile Foundations: Classification, use and installation, load carrying capacity of single pile, dynamic formula, static formula, pile load, load capacity of pile groups, average efficiency of pile groups, settlement of pile groups in clays, negative skin friction on plies. **Caissons**: Introduction, various forces acting and types of caissons.

Learning Outcomes: After completion of Unit-III Students will be able to:

- **Classify** pile foundations based on functionality, material –composition, method of installation (construction) and displacement of sub-soil.-**L2**
- **Identify** the methods to estimate pile load capacity (Single Pile/ Group of Piles) – **L3**

- **Identify** measures to estimate reduction of load capacity due to Negative Skin friction.–**L3**
- **Determine** the settlements of Pile groups in Sand, Granular Soils and in Clayey Sub-Soils.–**L5**
- **Analyze** the various forces acting on well foundation–**L4**
- **Estimate**load capacity of well foundations due to end bearing at the base of well and skin friction on staining. –**L4**
- **Identify** the various types of well foundations – L3

Unit IV **9 hours**

Earth Pressure: Types of earth pressures, Rankine's active and passiveearth pressures, smooth vertical wall with horizontal backfill, extension to Coloumb's wedge theory, Rebhann's graphical method for active earth pressure.

Learning Outcomes: After completion of Unit-IV Students will be able to:

- **Illustrate**Lateral Earth Pressure concept and classical theories Rankine's, Coulombs theory of active and passive earth pressures with and without sloping backfill -**L2**
- **Analyze** lateral earth pressures under at-rest, active and passive conditions – **L4**
- **Identify** design considerations of Rigid Retaining walls, flexible retaining walls for overall stability–**L3**
- **Apply** theory to granular soils as an ideal backfill and extension to clayey soil backfills.–**L3**
- **Solve** earth pressure problems of Coulombs trial wedge theory, Rebhaan'sgraphical method. –**L6**
- **Classify** the flexible retaining walls (Bulkheads) - **L2**

Unit V **8 hours**

Stability Analysis of Slopes: Introduction, types of slope failures, finiteslopes, Swedish slip circle – ø = 0 analysis, c-ø analysis, friction circle methods of stability analysis, Taylors stability number, factors influencing slope stability

Learning Outcomes: After completion of Unit-V Students will be able to:

- **Identify** various types of failure of finite slopes and method of analysis for slope stability.–**L3**
- **Explain**the various factors influencing slope stability.-**L2**
- **Determine** the FoS against slope failures and interpret the results.–**L5**
- **Analyse** those remedial measures to be adopted for stability of existing slopes.– **L4**
- **Solve** problems related to stability of slope using analytical and graphical methods-**L6**

LIST OF EXPERIMENTS:

1. Classification of soil using Hydrometric Analysis
2. Determination of Group Index of soil

3. Determination of Optimum Moisture Content and Maximum Dry Density of soil using Modified Proctor test
4. Determination of shear strength of soil using Vane Shear test
5. Determination of California Bearing Ratio of soil
6. Determination of Swell pressure of an expansive soil
7. Demonstration on Standard Penetration Test
8. Demonstration on cone Penetration Test
9. Demonstration on plate load test
10. Demonstration on pile load test

Text Book(s):

Gopala Ranjan and A.S.R. Rao, Basic and Applied Soil Mechanics, New age Publishers, 2000.

- C. Venkataramaiah, Geotechnical Engineering, New Age Publishers, 2006.
- Dr. K. R Aurora, Soil Mechanics and Foundation Engineering, Standard Publisher Dist, 2009.

References:

1. V.N.S. Murthy, Soil Mechanics, Foundation Engineering, UBS Publishers, 2011.
2. J.E. Bowles, Foundation Analysis and Design, McGraw Hill, Publishers, 2001.
3. M.D. Braja, Principles of Geotechnical Engineering, 7/e, Cengage Learning: 2013.
4. P.C. Donald, Geotechnical Engineering, Prentice-Hall India, 2010.
5. Rodrigo Salgado, The Engineering of Foundations, McgrawHill, 2006.

NPTEL LINKS

1. **Soil Exploration http://nptel.ac.in/courses/105105039/2**
2. **Shallow foundations http://nptel.ac.in/courses/105107120/**
3. **Pile foundations http://nptel.ac.in/courses/105107120/13**
4. **Earth pressures http://nptel.ac.in/courses/105107120/8**
5. **Stability analysis of soils http://nptel.ac.in/courses/105101084/55**

Course Code	Course Title	L	T	P	J	S	C
	PE-1: TRAFFIC ENGINEERING	2	0	2	0	0	3
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	None	**Contact hours**				30	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

Course Description

Students will acquire comprehensive knowledge of traffic surveys and studies such as volume count, Speed and delay, origin and destination, Parking, pedestrian and accident surveys. They will achieve knowledge on design of at-grade and grade separated intersections. Students will become familiar with various traffic control and traffic management measures

Course Objectives:

1. Provide an insight on traffic and its components, factors affecting road traffic and the design of intersection.
2. Explain sampling of data, analysis and interpretation of data in conducting various surveys.
3. Demonstrate traffic movements, types of intersections, islands, crossings and their design.
4. Enable design of signals and explain the redesigning of existing signals.
5. Impart knowledge on traffic regulations, pollution caused by traffic and the method of controlling pollution.

Course Outcomes:
After the completion of the course students should be able to

1. demonstrate components of road traffic, their characteristics and factors affecting road traffic in intersection design **[L2]**
2. apply the knowledge of sampling data in conducting various surveys and analysis **[L3]**
3. interpret traffic movements and designing islands, intersections and road lightings **[L2]**
4. explain design new signals and redesign existing signals **[L2]**
5. summarize traffic regulations, impact of noise pollution, air pollution and the method of controlling them **[L2]**

Unit I **8 L**
Introduction: Objectives and scope of traffic engineering. Components of road traffic - vehicle, driver and road. Road user characteristics; human and vehicle characteristics, factors affecting road traffic.

Learning Outcomes:
After the completion of Unit, students will be able to

- Definecomponents of road traffic[L1]
- explain different road user characteristics[L2]
- outline various human characteristics[L2]
- list various vehicle characteristics[L1]
- develop knowledge on factors affecting road traffic**[L3]**

Unit II **8 L**

Traffic Engineering: Concepts of passenger car units for mixed traffic flow. Traffic Manoeuvres. Traffic Stream Characteristics- RelationshipbetweenSpeed,FlowandDensity, capacity, level of service concept.

Learning Outcomes:

After the completion of Unit, students will be able to

- definepassenger car unit and related concepts[L1]
- explaindifferent traffic maneuvers[L2]
- identifytraffic stream characteristics[L3]
- build relationshipbetween speed, flow and density[L3]
- illustrateknowledgeon capacity and level of service**[L2]**

Unit III **10 L**

Traffic Engineering Studies and Analysis: Sampling in traffic studies; adequacy of sample size; application of sampling methods for traffic studies, objectives, methods of traffic study, equipment, data collection, analysis and interpretation (including case studies) of (i) Spot speed (ii) Speed and delay (iii) Volume (iv) Origin - destination (v) Parking.

Learning Outcomes:

After the completion of Unit, students will be able to

- list terminology related to sampling in traffic studies[L1]
- applydifferent methods of sampling for traffic studies[L3]
- plantraffic studies using identified methods and equipment [L3]
- utilizedata from traffic studies**[L4]**
- **explain** different traffic study methods such as spot speeds, speed and delay, volume, origin-destination and parking studies**[L2]**

Unit IV **8 L**

Traffic Regulations and Control: flow; Other regulations and control. traffic and method of control. General regulations; Regulations on Vehicles, drivers and Traffic management; noise and air pollution due to road.

Learning Outcomes:

After the completion of Unit, students will be able to

- showthe necessity of regulations and control for traffic flow[L2]
- explainmethods of traffic control[L2]
- listregulations on vehicles and drivers[L1]
- developknowledge ontraffic management[L3]
- identifynoise and air pollution aspects because of traffic**[L3]**

Unit V **8 L**

Traffic Control Devices: Principlesof Signal Design, Webster'smethod of Signal Design,Redesign of Existing Signals including Case Studies; Signal SystemandCoordination.Evaluation and design of road lighting

Learning Outcomes:

After the completion of Unit, students will be able to

- develop knowledge on signal design[L3]
- summarizeWebster’s method of signal design[L2]
- demonstrate knowledge of signal design by redesigning an existing signal[L2]
- explain the concept of signal coordination[L2]
- findout the evaluation and design procedures for road lighting**[L1]**

List of Experiments:

1. Volume Studies – MidBlock and Intersections
2. Speed Studies - Spot Speed Studies by Stop Watch, and Radar Speed Meter
3. Journey Time and Delay Studies - Floating Car Method
4. Parking Surveys
5. Study of Gaps and Lags – Critical Gaps and Lags at Intersections
6. Delay Measurement at Signalised
7. Delay Measurement at Unsignalised Intersections

Text Book(s):

- Kadiyali, L.R., Traffic Engineering and Transport Planning, 9/e, Khanna Publishers, 2018
- Drew, D.R. Traffic Flow Theory and Control, McGraw Hill Book Co, 1968.
- Khanna S.K., Justo C.E.G., Veeraragavan A., Highway Engineering, 9/e, Nemchand and Bros, Roorkee, 2017

References:

- Papacostas, C.A., Fundamentals of Transportation Engineering, 3/e, Prentice-Hall of IndiaPrivate Limited, New Delhi.2001
- McShane W.R. and Roess R.P., Traffic Engineering, 5/e, Prentice Hall India, 2018
- Indian Highway Capacity Manual - Indo-HCM 2017
- NPTEL Web course on Traffic Engineering and Management: https://nptel.ac.in/courses/105101008/

Course Code	Course Title	L	T	P	J	S	C
	PE-1: HYDRAULIC MACHINES	3	0	0	0	0	3
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	Fluid Mechanics	**Contact hours**				30	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

Course Description

The prerequisite for this course would be fluid mechanics. This course introduces the knowledge of application of impulse momentum equation to compute the force exerted by fluid jet on stationary and moving vanes, torque exerted on a wheel with radial curved vanes. This course gives the comprehensive knowledge of hydraulic machines to illustrate the working principles of pumps and hydraulic turbines. The learner will gain the knowledge of unit quantities, specific speed and performance characteristics of pumps and turbines.

Course Objectives:

1. to explain the application of impulse momentum equation to compute the force exerted by fluid jet on stationary and moving vanes
2. to explain the velocity triangles resulting from impact of jet of an unsymmetrical curved moving vane.
3. to impart the concepts to compute the work-done of pumps and turbines.
4. to explain the performance characteristics of turbines and pumps.
5. to summarize the functionality of various hydraulic machines.

Course Outcomes:

At the end of the course, student would be able to

1. Draw the velocity triangles resulting from the jet impinged onto a moving unsymmetrical curved vane (L-3).
2. Describe the functioning of impulse and reaction turbines, rotodynamic and positive displacement pumps (L-2).
3. Draw the performance characteristic curves of turbines (L-3).
4. Compute efficiencies of hydraulic pumps (L-3).
5. Describe the significance and working of various hydraulic machines (L-2).

Unit-I: **9 L**

Impact of free jets on vanes: Impulse Momentum Equation – Force exerted by fluid jet on stationary and moving vanes, torque exerted on a wheel with radial curved vanes, velocity triangles.

Learning outcomes:

After completion of Unit-I, students will be able to

- explain Impulse – Momentum Principle (L-2).
- compute impact of free jet on vanes (L-3).
- draw velocity triangles (L-3).
- compute the work-done of wheel with radial curved vanes (L-3).

Unit-II: **9 L**

Hydraulic Turbines: Elements of hydropower plants, classification of turbines – Impulse Turbines (Pelton wheel), Reaction Turbines (Francis, Kaplan) –components, functioning, work done and efficiencies (theory only); applications of draft tube, surge tank.

Learning outcomes:

After completion of Unit-II, the student will be able to

- list the components of turbines (L-1).
- describe the functionality of the turbines (L-2).
- explain the significance of draft tube, surge tank (L-2).
- compute the work-done of turbines (L-3).

Unit-III: **8 L**

Performance of Turbines: Performance under unit head and specific conditions, expressions for specific speeds (no derivations), performance characteristic curves, cavitation in turbines, selection of turbines.

Learning outcomes:

After completion of Unit-III, the student will be able to

- define unit quantities and specific quantities of turbines (L-1).
- explain the selection of turbines (L-2).
- solve problems related to performance of turbines (L-3).
- draw performance characteristic curves for impulse and reaction turbines (L-3).

Unit-IV: **8 L**

Pumps: Rotodynamic Pumps (Centrifugal Pumps) – components, working, types, work done, efficiencies, specific speed (theory only), advantages of centrifugal pumps, pumps in series and parallel.

Learning outcomes:

After completion of Unit-IV, the student will be able to

- state the components of pumps (L-1).
- describe the functionality of the pumps (L-2).
- compute work done by and efficiencies of pumps (L-3).
- draw performance characteristic curves for pumps (L-3).

Unit-V: **8 L**

Functionality and working principles of Mono-block pump, submersible pump, jet pump, Tubular turbine, bulb turbine, lawn sprinkler.

Case Studies related to various Hydraulic Machines ***(for internal assessment only)***

Learning outcomes:

After completion of Unit-V, the student will be able to

- explain the functionality of various hydraulic machines (L-2).
- illustrate the working principles of various hydraulic machines (L-2).
- present case studies of various hydraulic machines (L-3).

Text Books

3. P.N. Modi and S.M. Seth, Hydraulics and Fluid Mechanics and Hydraulic Machines, 20/e, Standard Book House, 2015.
4. A.K. Jain, Fluid Mechanics, 12/e, Khanna publishers, 2014.

Reference Books

1. K. Subramanya, Hydraulic Machines, Tata McGraw Hill, 2017.
2. L. Victor, Streeter and E. Benjamin Wylie, Fluid Mechanics, 9/e, Tata McGraw Hill,2013.
3. M. Franck White, Fluid Mechanics, Tata McGraw Hill, 2014.

Program Elective (PE) -II

Course Code	Course Title	L	T	P	J	S	C
	PE-2: ADVANCED STRUCTURAL ANALYSIS	2	0	2	0	0	3
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	Fluid Mechanics	**Contact hours**				30	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

Course Description

The prerequisite for this course would be Mechanics of Solids and Structural Analysis. The effects produced in arches, cables, suspension bridges and framesdue to various loads are discussed. The student will be able to analyze statically determinate beams subjected to moving loads. Plastic analysis gives an insight into the structural behavior upto collapse. This course is a pre-requisite for Advanced Design of Steel Structures.

Course Objectives:

1. To analyze three hinged and two hinged arches subjected to various loads.
2. To analyze portal frames using moment distribution and Kani's method.
3. To construct influence line diagrams for determinate structures.
4. To assess the maximum shear force and bending moment in determinate structures under rolling loads.
5. To analyze cables and suspension bridges and to determine the collapse loads using plastic analysis.

Course Outcomes:

After completion of this course, the student will be able to

1. determine shear force, bending moment and normal thrust in three hinged and two hinged arches (L5).
2. construct BM diagram for portal frames (L6).
3. demonstrate influence lines for determinate structures (L2).
4. determine the forces in cables and suspension bridges (L5).
5. evaluate the shape factor and collapse loads (L5).

Unit I **8L**

Arches:

Three hinged Arch:

Introduction, Analysis of three hinged arch, B.M, S.F and normal thrust in three-hinged arches, Three hinged parabolic arch subjected to concentrated loads and uniformly distributed loads

Two hinged Arch:

Introduction, Analysis of two hinged arch, B.M, S.F and normal thrust in two-hinged arches, Two hinged parabolic arch subjected to concentrated loads and uniformly distributed loads

Learning outcomes
After completion of this unit, the student will be able to

- find reactions at the supports in Three-Hinged arch (L1).
- find B.M, S.F and Normal thrust in three-hinged parabolic arch subjected to concentrated and uniformly distributed loads (L1).
- find reactions at the supports in Two-Hinged arch (L1).
- find B.M, S.F and Normal thrust in two-hinged parabolic arch subjected to concentrated and uniformly distributed load (L1).

Unit II **10L**

Analysis of statically indeterminate frames

Moment distribution method: Analysis of single-storey, single bay portal frames under gravity and lateral loads.

Kani's method: Analysis of single-storey, single bay portal frames under gravity and lateral load

Learning outcomes
After completion of this unit, the student will be able to

- construct B.M and S.F Diagram by using moment distribution method (L3).
- analyse the beam for sway by Moment Distribution method (L4).
- construct B.M and S.F Diagram by using Kani,s method (L6).
- analyse the beam for sway by Kani,s method (L4).

Unit III **8L**

Influence lines and Rolling Loads

Introduction, Influence lines for reactions, shear force, and B.M for statically determinate beams, S.F and B.M at a point due to rolling loads(point loads and udl) in statically determinate beams, Absolute maximum B.M, Absolute maximum S.F in statically determinate beams.

Learning outcomes

After completion of this unit, the student will be able to

- construct influence lines for reactions (L3).
- construct influence lines for S.F (L3).
- construct influence lines for B.M (L3).
- determine Maximum B.M and S.F at a section (L5).
- determine Absolute maximum B.M and S.F (L5) .

Unit IV **10L**

Cables and Suspension Bridges:

Introduction, Analysis of Cables Under Concentrated Loads and Uniformly distributed Loads, Shape of Cable under Self-Weight, Stresses in suspended Wires due to Self-Weight, Anchorage of Suspension Cables, Stiffened Bridges, Bending moment and shear force for Three Hinged Stiffened Girders, Influence Lines for B.M and S.F in Three-Hinged Stiffening Girders, Suspension Bridges with Two-hinged Stiffening Girders.

Learning outcomes

After completion of this unit, the student will be able to

- analyse cables under uniformly distributed loads (L4).
- solve stresses in suspended wires due to self-weight (L3).
- construct influence lines for B.M and S.F in Three-Hinged Stiffening Girders (L6).
- construct influence lines for B.M and S.F in Two-Hinged Stiffening Girders (L6).

Unit V **8L**

Plastic Analysis:

Introduction, Shape factor, Plastic Hinge, Collapse Mechanisms, Static and Kinetic Theorems, Methods of analysis, Fixed and Continuous Beams.

Learning outcomes

After completion of this unit, the student will be able to

- examine possible plastic hinges (L4).
- estimate collapse load by static theorem(L6).
- estimate collapse load by kinetic theorem (L6).
- estimatePlastic moment for fixed beams (L6).
- estimatePlastic Moment for continuous beams (L6).

Text Book(s)

1. Vazirani and Ratwani, Analysis of Structures, Vol-II, 16/e, Khanna Publishers, 2015
2. G.S. Pandit, S.P. Gupta, R. Gupta, Theory of Structures-Vol II, 2/e, Tata McGraw-Hill,2003.

References

1.C.K. Wang, Statically Indeterminate Structures, Tata McGraw Hill, 2010.

2. J.S. Kinney, Indeterminate Structural Analysis, 1/e, Naroja Publishing, 1987.

3. Weaver and Gere, Matrix Methods of Framed Structures,2/e, CBS publisher, 1990.

4. Thandavamurthy, Structural Analysis, 2/e, Oxford University Press, 2011.

List of Experiments

1. Determination of horizontal thrust for various loads placed at various distances in an 3 hinged arch setup.
2. Determination of horizontal thrust for various loads placed at various distances in an 2 hinged arch setup.
3. Experimental demonstartion of sway in portal frames.
4. Plotting shear forces under rolling loads in a influence line setup.
5. Plotting bending moments under rolling loads in a influence line setup.
6. Experimental analysis of cable geometry and statics under various loading conditions.
7. Plastic hinge analysis in virtual lab

Course Code	Course Title	L	T	P	J	S	C
	PE-3: ADVANCED FOUNDATION ENGINEERING	3	0	0	0	0	3
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	Soil Mechanics	**Contact hours**				30	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

Course Description

This course describes the principles of design of shallow foundation and settlement analysis. It also covers designing of footings for different soil conditions. Basic principles of determination of bearing capacity and design of pile foundations using various methods are also covered in this course. Foundations on highly problematic soils like expansive soils and its design practices are also discussed**.**

Course Objectives:

1. To familiarise the fundamental concepts of foundation analysis and design.
2. To acquaintthe analysis of bearing capacity and settlement of foundations using different methods
3. To enable the proportionatingof different types of footings and develop beams on elastic foundations
4. To study the determination of the load carrying capacity and settlement of pile foundations and under reamed piles.
5. To train the identification of expansive soils and practice foundations on expansive soils.

Course Outcomes:

Students will be able to:

1. outline the design philosophy of foundation engineering – L2
2. interpret field and laboratory data to get design parameters for foundation analysis – L2
3. design the piles for various types of loadings– L4
4. identify the typical failure modes of common foundations - L3
5. solve foundation problems with the given procedures and the soil properties, and understand their limitations – L3

Unit I **7 L**

Introduction: Principles of Design of Foundations, Types of shear failures in foundation soils, Types of foundations, Design Loads, Basic Concepts of safe and allowable bearing capacity. Shallow Foundations

Learning outcomes:

After completion of Unit I, students will be able to

- demonstrate the principles of design of foundations-L2
- list the types of shear failures –L1
- identify the types of foundations, design loads-L3
- explain the basic concepts of safe and allowable bearing capacity-L2
- infer the concepts of shallow foundations-L2

Unit II **9 L**

Bearing Capacity Analysis: Bearing capacity theories – Terzaghi, Meyerhof, Skempton, Hansen, Vesic and IS Methods, Bearing capacity evaluation from Standard Penetration test and Plate load test.

Settlement Analysis: Uniform and Differential Settlements, Elastic and Consolidation Settlements, Penetration tests; Permissible settlements as per IS 1904-1978, causes of settlement, settlement Control.

Learning outcomes:

After completion of Unit II, students will be able to

- demonstrate the bearing capacity theories-L2
- evaluate the bearing capacity from Standard Penetration test and Plate load test-L2
- compare the uniform and differential settlements-L4
- apply the settlement codes in the design-L3
- identify the causes of settlement-L3

Unit III **9 L**

Proportioning of footings: Isolated column footings, Strip, combined Footings and Strap Footing. Raft Foundations: Bearing capacity of raft foundation, floating raft, Types of rafts, Beam on Elastic foundation and Conventional methods of Design, determination of modulus of subgrade reaction.

Learning outcomes:

After completion of Unit III, students will be able to

- illustrate the proportioning of footings-L2
- explain the bearing capacity of raft foundation-L2
- list the types of rafts-L1
- develop beam on elastic foundation and conventional methods of design-L3
- determine the modulus of subgrade reaction-L3

Unit IV **9 L**

Deep Foundations: Pile Foundations: Types, load capacity- dynamic formulae, static formula; pile load tests- Vertical load test, lateral load test, Cyclic load test; settlement of piles and pile groups, negative skin friction on single pile and pile groups;

Well Foundations: Types, Bearing Capacity of well foundations, Tilts and Shifts: precautions, Remedial measures

Learning outcomes:

After completion of Unit IV, students will be able to

- list the types of pile foundation-L1
- determine the load capacity of pile and under reamed foundations-L3
- estimate the settlement of piles and pile groups-L3
- apply IS codes for designing pile foundation-L3
- classify the types of well foundations-L2

Unit V **8 L**

Foundations in Expansive Soils: Introduction, Identification of expansive soils, Swell potential and swelling pressure, Active depth, Foundation Problems, Foundation practices in expansive soils, Soil Replacement and 'CNS' concepts.

Learning outcomes:

After completion of Unit V, students will be able to

- identify expansive soils–L3
- explain the foundation problems-L2
- formulate the foundation practice in expansive soils-L3
- infer swell potential and swelling pressure-L2
- illustrate the concepts of soil replacement and CNS concepts-L2

Text Books:

1. Foundation Analysis and Design by J.E. Bowles, Mc Graw Hill Publishing Co, 2001.
2. Foundation Design by W.C. Teng, John Wiley, New York, 1962.

Reference Books

1. Analysis and Design of Substructures by Swami Saran, Oxford &IBH Publishing Co, 2006.
2. Foundation Engineering by P.C. Vargheese, Prentice Hall of India, 2005.

NPTEL LINKS

1. **Shallow foundations** **http://nptel.ac.in/courses/105107120/**
2. **Pile foundations** **http://nptel.ac.in/courses/105107120/13**

	Course Code	Course Title	L	T	P	J	S	C
		PE-2: PAVEMENT ANALYSIS AND DESIGN	3	0	0	0	0	3
	Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
	Course Pre-requisite(s)	None	**Contact hours**				30	
	Course Co-requisite(s)	None	**Date Approved**					
	Alternate Exposure							

Course Description

The course aims to make the students learn the principles of highways, their components and design of flexible and rigid pavements. The course also focusses different types of stresses that are developed in the pavement structures. Further, students will getacquainted with treatment for failures and remedial measures during maintenance of pavements.

Course Objectives

1. Demonstrate factors affecting pavement design
2. Impart knowledge on stress solutions for One, Two- and Three-Layered Systems in flexible pavements
3. Familiarize stresses and deflections in rigid pavements due to loading and temperature
4. Enable design of flexible pavements
5. Explain design of rigid pavements.

Course Outcomes

After completion of the course the student will be able to

1. list various factors affecting design **[L1]**
2. identify stresses in flexible pavements in One, Two- and Three-LayeredSystems**[L3]**
3. summarize the stresses due to loading and temperature in rigid pavements **[L2]**
4. explain design of flexible pavements. **[L2]**
5. demonstrate design of rigid pavements.**[L2]**

Unit I **10L**

Factors Affecting Pavement Design: Variables Considered in Pavement Design, Types of Pavements, Functions of Individual Layers, Classification of Axle Types of Rigid Chassis and Articulated Commercial Vehicles, Legal Axle and Gross Weights on Single and Multiple Units, Tire Pressure, Contact Pressure, EAL and ESWL Concepts, Traffic Analysis: ADT, AADT, Truck Factor, Growth Factor, Lane Distributions & Vehicle Damage Factors.

Learning Outcomes:

After the completion of Unit, students will be able to

- list out variables considered in pavement design[L1]
- classify different layers in rigid flexible pavements along with their functions[L2]

- define the concepts of EAL, ESWL, ADT and AADT[L1]
- explaintruck and growth factors[L2]
- develop knowledge on Lane Distributions & Vehicle Damage Factors**[L3]**

Unit II **8L**

Stresses In flexible Pavement: Visco-Elastic Theory and Assumptions, Layered Systems Concepts, Stress Solutions for One, Two- and Three-Layered Systems, Fundamental Design Concepts

Learning Outcomes:

After the completion of Unit, students will be able to

- developan understanding on visco-elastic theory and its assumptions[L3]
- findhow the concept of layered system works[L1]
- identify stress solutions for single layered system[L3]
- explainthe concepts of two- and three-layered systems[L2]
- listconcepts of flexible pavement**[L1]**

Unit III **8L**

Stresses in Rigid Pavements: Westergaard's Theory and Assumptions, Stresses due to Curling, Stresses and Deflections due to Loading, Frictional Stresses, and Stresses in Dowel Bars & Tie Bars

Learning Outcomes:

After the completion of Unit, students will be able to

- explainWestergaard's theory along with its assumptions[L2]
- classifydifferent stresses on rigid pavements[L2]
- demonstrate stresses and deflections due to loading on rigid pavements[L2]
- explain the concept of frictional stresses[L2]
- develop knowledge on stresses in dowel bars &tie bars**[L3]**

Unit IV **8L**

Design of Flexible Pavements: Factors effecting Design. Deflection studies in Flexible Pavements. Present Serviceability Index. IRC guidelines for Flexible Pavements. Pavement Performance and methods- AASHTO and Asphalt Institute Method. Need for Overlays, Overlays design methods

Learning Outcomes:

After the completion of Unit IV, students will be able to

- listvarious factors effecting design of flexible pavement[L1]
- summarize variousdeflection studies in flexible pavement[L2]
- explain Flexible Pavement design as per IRC Guidelines [L2]
- compare AASHTO and Asphalt Institute Method[L2]
- demonstratedesign of overlays using different methods**[L2]**

UnitV **8L**

Design of Rigid Pavements: Factors effecting Design - Wheel load & its repetition, subgrade strength & proportion, strength of concrete - modulus of elasticity. Reinforcement in slab. Design of joints. Design of Dowel bars. Design of Tie bars. IRC and AASHTO methods of Rigid Pavement design

Learning Outcomes:

After the completion of Unit, students will be able to

- identifydifferent factors effecting the design of rigid pavement[L3]
- illustrate reinforcement in slabs[L2]
- explain design ofjoints, Dowel and Tie bars in Rigid Pavements[L2]
- demonstrate expertiseon IRC method of Rigid Pavement Design[L2]
- develop knowledge on AASHTO method of Rigid Pavement Design[L3]

Text Book(s):

- Yoder, E.J., and Witczak, `Principles of Pavement Design', 2/e. John Wiley and Sons, 1975
- Khanna S.K., Justo C.E.G., Veeraragavan A., Highway Engineering, 9/e, Nemchand and Bros, Roorkee, 2017

References:

1. Haas and Hudson, Pavement Management System, McGraw Hill Book Co., New York, 1978
2. IRC: 37-2012, Guidelines for the Design of Flexible Pavements.
3. IRC: 58-2015, Guidelines for the Design of Rigid Pavements.

Course Code	Course Title	L	T	P	J	S	C
	PE-3: OPEN CHANNEL HYDRAULICS	3	0	0	0	0	3
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	Fluid Mechanics	**Contact hours**				30	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

Course Description

The prerequisite for this course would be fluid mechanics.This course helps the learner to acquire the comprehensive knowledge of open channel hydraulics. This course provides the concepts of hydraulically efficient channel sections of uniform flow. The learner will gain the knowledge and able to apply the principles of specific energy and critical depth. The learner will understand the over view of gradually varied flow and rapidly varied flow of hydraulic jump and flood routing through channel.

Course Objectives:

1. to explain types of flows, velocity distribution in open channels
2. to teach the significance of specific energy, specific force, section factor, and channel transitions.
3. to compute hydraulically efficient channel sections, to outline the features of GVF profiles.
4. to impart the significance of hydraulic jump in energy dissipation.
5. to explain the flood routing through reservoir and channel.

Course Outcomes:

On successful completion of the course, the student will be able to

1. Classify types of channels, flows, GVF profiles (L-2).
2. Solve problems related to uniform flow in open channels, hydraulically efficient sections, GVF, hydraulic jump (L-3).
3. Familiarise specific energy, Critical energy, section factor, GVF, RVF, surges.
4. Explain the use of channel transitions, compound channels, irrigation canals, flow characteristics of spillway, weir, sluice gate, flood routing through reservoirs and channels (L-2).
5. Derive GVF differential equation (L-4).

Unit-I: **9 L**

Introduction, types of channels, classification of flows, velocity distribution, pressure distribution, specific energy, critical depth – calculation, section factor, channel transitions.

Learning outcomes:

After completion of Unit-I, students will be able to

- define section open channel, factor (L-1).
- classify the types of flows in open channels (L-2).
- illustrate the characteristics of channel transitions (L-2).

Unit-II: **9 L**

Uniform Flow: Chezy's equation, Manning's formula, velocity distribution, uniform flow computations, hydraulically efficient channel sections, Specific Energy, Specific Force, Critical Flow, Compound channel section, Irrigation canal.

Learning outcomes:

After completion of Unit-II, students will be able to

- compute required channel dimensions (L-3).
- draw the velocity distribution in channels (L-3).
- compute hydraulically efficient channel sections (L-3).
- compute the specific energy, critical depth for channel sections (L-3).

Unit-III: **8 L**

Gradually Varied Flow (GVF): Differential equation for GVF, classification and features of flow profiles, control sections, simple numerical solutions of GVF problems.

Learning Outcomes:

After completion of Unit-III, students will be able to

- derive GVF differential equation (L-3).
- classify various GVF surface profiles (L-2).
- explain about control section, transitional depth (L-2).
- solve Gradually Varied Flow problems in channels (L-3).

Unit-IV: **8 L**

Rapidly Varied Flow: Hydraulic jump in horizontal rectangular, use of jump as energy dissipator, location of jump, ogee spillway, sharp crested weir, broad crested weir, sluice gate flows.

Learning Outcomes:

After completion of Unit-IV, students will be able to:

- explain the significance of Hydraulic jump (L-2).
- calculate the energy dissipation, location of jump (L-3).
- explain the flowcharacteristics of spillway, weir, sluice gate (L-2).

Unit-V: **8 L**

Flood Routing through reservoirs and flood routing through channel, Muskingum method of flood routing.

Learning Outcomes:

On successful completion of the course, the student will be able to:

- explain the flood routing through reservoir (L-2).
- explain the flood routing through channel (L-2).

- calculate the flood routing through channels using Muskingum method (L-3).

Text Books

1. K. Subramanya, Flow in Open Channels, 5/e, Tata McGraw Hill, 2015.
2. VenTe Chow, Open-Channel Hydraulics, McGraw-Hill, 2009.

Reference Books

1. P.N. Modi and S.M. Seth, Hydraulics and Fluid Mechanics and Hydraulic Machines, 20/e, Standard Book House, 2015.
2. A.K. Jain, Fluid Mechanics, 12/e, Khanna publishers, 2014

Program Elective (PE) -III

<table>
<tr><th>Course Code</th><th>Course Title</th><th>L</th><th>T</th><th>P</th><th>J</th><th>S</th><th>C</th></tr>
<tr><td></td><td>PE-3: ADVANCED REINFORCED CONCRETE STRUCTURES</td><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Course Owner</td><td>Department of Civil Engineering</td><td colspan="4">Syllabus version</td><td colspan="2">1.0</td></tr>
<tr><td>Course Pre-requisite(s)</td><td>Mechanics of Solids, Structural Analysis and Design of Reinforced Concrete Structures.</td><td colspan="4">Contact hours</td><td colspan="2">30</td></tr>
<tr><td>Course Co-requisite(s)</td><td>None</td><td colspan="4">Date Approved</td><td colspan="2"></td></tr>
<tr><td>Alternate Exposure</td><td colspan="7"></td></tr>
</table>

Course Description

This is an advanced course useful for the student to enable them the design of advanced RCC structuresThe student will be able to design RCC staircases, retaining walls, and water tanks. The course also includes the design of slab bridges and flat slabs.

Prerequisite: Mechanics of Solids, Structural Analysis and Design of Reinforced Concrete Structures.

Course objectives:

1. To enable the design of staircases.
2. To demonstrate the design of retaining walls.
3. To familiarize the design methodology of flat slabs.
4. To enable the design of water tanks resting on ground.
5. To train on the design of simple bridge deck slab.

Course outcomes:

After completion of this course, the student will be able to

1. design a staircase (L6)
2. design a cantilever and counterfort retaining walls (L6).
3. analyze and design flat Slabs (L4).
4. design water tanks resting on ground (L6).
5. design a bridge deck slab (L6).

Unit I **8L**

Design of Staircases:

Introduction, Principles of Design, Applied Loads, Design of Stairs Spanning Transversely(Horizontally) and Stairs spanning Longitudinally.

Learning Outcomes:

After completion of this unit, the student will be able to

- summarize the different components of staircases (L2).
- design of stairs spanning transversely (L6).
- design of stairs spanning longitudinally (L6).

Unit II **8L**

Retaining Walls:

Types of retaining walls, forces on retaining walls, stability requirements, Preliminary proportioning of cantilever/counterfort retaining walls, Design of cantilever and counterfort retaining walls.

Learning Outcomes:

After completion of this unit, the student will be able to

- list the various forces acting on retaining walls (L1).
- explain the stability check for retaining walls (L2).
- design of cantilever retaining wall (L6).
- design of counterfort retaining wall (L6).

Unit III **8L**

Design of Flat Slabs:

Direct Design Method – Distribution of Moments in column strips and middle strip – moment and shear transfer from slabs to columns – shear in flat slabs – check for one way shear – Introduction to equivalent frame method. Limitation of direct design method – Distribution of moments in column strips and middle strip

Learning Outcomes:

After completion of this unit, the student will be able to

- illustrate the different components of flat slabs (L2).
- outline the distribution of moments in column and middle strips (L2).
- design a flat slab using direct design method (L6).

Unit IV **8L**

Design of Water tanks: Introduction, Design Requirement, Methods of Analysis, Design of Circular tanks resting on ground, Rectangular tanks resting on ground.

Learning Outcomes:

After completion of this unit, the student will be able to

- classify the water tanks (L2).

- estimate the reinforcement required for circular water tanks resting on ground (L3).
- design of rectangular water tanks resting on ground (L6).

Unit V **10L**

Design of slab bridge

Design loads for bridges: Introduction, load distribution theories, Design loads- Dead load, Vehicle Live Load, Impact Effect, Wind Loading, Longitudinal forces.

Slab bridges: Introduction, Wheel load on slabs, Effective Width Method-Slab supported on Two Edges (Simply Supported Slabs), Dispersion length, Design of slab bridges.

Learning Outcomes:

After completion of this unit, the student will be able to

- identify different types of wheel loads (L3).
- estimate maximum live load intensity. (L3).
- design a simple bridge deck slab(L6).

Text Books:

1. P.C.Varghese, Advanced Reinforced Concrete Design, 2/e, Prentice Hall of India, 2010.
2. S.S.Bhavikatti, Advance R.C.C Design(R.C.C. Volume- II),2/e, New Age International Publishers, 2012.

References:

1. Pillai and Menon, Reinforced Concrete Design, 3/e, Tata McGraw Hill, 2017.
2. T.R.Jagadeesh and M.A.Jayaram, Design of Bridge Structures, 2/e, Prentice Hall of India, 2014.
3. P.C.Varghese, Limit State Design of Reinforced Concrete, 2/e,Prentice Hall of India, 2015.

	Course Code	Course Title	L	T	P	J	S	C

	PE-2: ROCK MECHANICS	3	0	0	0	0	3
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	Soil Mechanics	**Contact hours**				30	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

Course Description

This course mainly provides an understanding of the engineering properties of rocks, geological and engineering rock classifications, rock failure theories, in-situ stresses in rock, and the fundamental concepts and principles of rock mechanics. This will help to understand the design aspects of various structures in/on rock like tunnels and other underground openings, slopes etc. The course also covers the in-situ tests on rocks through various methods to test the suitability of rock at foundation level. It also covers the methods to improve the properties of rock mass by reinforcing, grouting and with supports.

Course objectives:

1. To familiarize the concepts of structural geology of rocks and the classification of rock masses
2. To demonstrate the testing of rock samples in the laboratory
3. To acquaint the Rock Quality Designation and its necessity
4. To study the insitu strength of the rocks
5. To expose how to improve the properties of rock masses

Course Outcomes:

At the end of this course, student will be able to:

1. explainthe concepts of structural geology and classification of rock masses – L2
2. take part in the laboratory and field testing for a given project / construction – L4
3. classify the rocks based on Rock Quality Designation – L2
4. choose appropriate methods to improve the stability of rock mass – L3
5. estimate the foundation capacity in rock mass- L3

Unit I: **8 L**

Physical and structural geology, faults and shear zones - treatment -engineering classification -need -classification of intact rock and insitu rock masses -insitu state of stress mapping of joints.

Learning outcomes:

After completion of Unit I, students will be able to

- infer the concepts of physical and structural geology, faults and shear zones-L2
- explain the treatment of faults and shear zones in rocks-L2
- classify the intact rock and insitu rock masses -L2

- demonstrate the insitu state of stress mapping of joints-L1
- identify the need of engineering classification of rocks-L3

Unit II: **8 L**

Laboratory Testing: Rock sampling – Determination of density, Porosity and Water absorption – Uniaxial Compressive strength – Tensile strength – Shear Strength – Flexural strength – Swelling and slake durability – permeability – point load strength – Dynamic methods of testing – Factors affecting strength of rocks, Deformation and failure of rocks.

Learning outcomes:

After completion of Unit II, students will be able to

- list the various laboratory tests of rocks-L1
- determine the density, porosity and water absorption of rocks-L3
- explain the testing procedure of rock samples-L2
- infer the factors affecting the strength of rocks-L2
- explain the deformation and failure of rocks-L2

Unit III: **8 L**

Rock Mass Classification: Classification by Rock Quality Designation, Rock structure Rating, Geomechanics and NGI classification systems. Applications.

Learning outcomes:

After completion of Unit III, students will be able to

- explain the Rock Quality Designation (RQD) -L2
- classify the rocks based on RQD-L2
- demonstrate the rock structure rating-L2
- list the Geomechanics and NGI classification system-L1
- apply the knowledge of RQD and classification system-L3

Unit IV: **9 L**

In situ testing: Necessity and Requirements of in – situ tests – Types of in – situ tests – Flat jack Technique – Hydraulic Fracturing Technique, In-situ Permeability test, Pressure Tunnel Test, Plate Load Test, Shear Strength Test, Radial Jack Test, Goodman Jack Test and Dilatometer Test.

Learning outcomes:

After completion of Unit IV, students will be able to

- infer the necessity and requirement of insitu tests of rocks-L2
- list the types of insitu tests-L1
- determine the insitu strength of rocks-L3
- explain the working procedures of different insitu tests-L2

Unit V: **9 L**

Methods of Improving Rock Mass properties: Rock Reinforcement – Rock bolting – Mechanism of Rock bolting – Principles of design – Types of rock bolts, Cable anchorage. Pressure grouting – grout curtains and consolidation grouting, Shot creating.

Learning outcomes:

After completion of Unit V, students will be able to

- identify the methods of improving the properties of rock mass-L3
- explain the principles and design of rock bolting-L2
- list the types of rock bolting-L1
- demonstrate the pressure grouting technique-L2
- infer grout curtains and consolidation grouting-L2

Textbooks:

1. Goodman, R.E. "Introduction to Rock Mechanics" John Wiley & Sons, New York, 2010.
2. John A.Franklin and Maurice B. Dusseault "Rock Engineering Applications" Mc Graw Hill, Inc. 1991.

References:

1. Kiyoo Mogi "Experimental Rock Mechanics" Taylor& Francis Group, UK, 2007.
2. Jaeger, J.C., Cook, N.G. and Zimmerman, R.W. "Fundamentals of Rock Mechanics" Blackwell pub.,2012.

NPTEL Links

Module 1: **https://nptel.ac.in/courses/105106055/**
https://nptel.ac.in/courses/105106055/2

Module 2: **https://nptel.ac.in/courses/105106055/6**

https://nptel.ac.in/courses/105106055/7

Module 3: **https://nptel.ac.in/courses/105106055/11**

https://nptel.ac.in/courses/105106055/12

Module 4: **https://nptel.ac.in/courses/105106055/6**

https://nptel.ac.in/courses/105106055/7

Module 5: **https://nptel.ac.in/courses/105106055/34**

https://nptel.ac.in/courses/105106055/35

Course Code	Course Title	L	T	P	J	S	C
	PE-3: REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEMS	3	0	0	0	0	3
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	None	**Contact hours**				30	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

Course Description

Remote Sensing (RS) is the science and art of obtaining information about an object, area orphenomenon, using either recording or real time sensing devices that are not in physicalcontact with the object.Geographic Information Systems (GIS) and their applications emphasis on cartographic concepts, strengths and limitations of different GIS data formats, spatial statistics, and spatial analysis. Students use a variety of specialized GIS tools to solve spatial problems and map spatial phenomena.

Course Objectives:
The purpose of this course is to

1. Familiarize about the concept of GIS, its components, along with its advantages
2. Focus about different available data formats in GIS
3. Impart knowledge on spatial data structures details and input, management and output processes
4. Explain different possible areas of GIS application
5. Impart the knowledge of GIS in implementing in various case studies

Course Outcomes:
The student will be able to

1. show knowledge on RS-GIS concepts and terminology along with various commercially available GIS software**[L1]**
2. develop skills in collecting, editing different types of GIS data**[L3]**
3. demonstrate expertise on database management in RS- GIS**[L2]**
4. summarize the applications of GIS**[L2]**
5. Interpret case studies with GIS applications**[L3]**

Unit-I **8L**
Overview of remote sensing: Introduction Definitions of remote sensing and related terminology, Historical Perspective, Principles of remote sensing, components of remote sensing, Energy source and electromagnetic radiation, Energy interaction, Spectral response pattern of earth surface features.

Learning Outcomes:
After the completion of Unit, students will be able to

- **define** various terminology used in Remote Sensing**[L1]**
- **Summarize**the historical perspective of Remote Sensing**[L2]**

- **explain** the principles and components of remote sensing**[L2]**
- **develop**knowledge on Electro Magnetic Radiation**[L3]**
- **outline** various energy interactions in related to Electro Magnetic Radiation**[L2]**

Unit- II **9 L**

Remote sensing technology: Classification of Remote Sensing Systems, Energy recording technology, Aerial photographs, Photographic systems – Across track and along track scanning, Multispectral remote sensing, Thermal remote sensing, Indian space programme - Research and development. Characteristics of remote Sensing data, Photogrammetry – Satellite data analysis – Visual image interpretation, Digital image processing –Image rectification, enhancement, transformation

Learning Outcomes:

After the completion of Unit, students will be able to

- **classify** systems in Remote Sensing and energy recording technologies**[L2]**
- **identify** the historical perspective of Remote Sensing**[L3]**
- **outline**the developments in Indian Space Program**[L2]**
- **interpret** satellite data (remote sensing data)**[L2]**
- **Develop**knowledge on process involved in digital image processing**[L3]**

Unit - III **8 L**

Introduction to Geographical Information System (GIS): Introduction-Definitions of GIS - The Evolution of GIS, Components of GIS, Approaches to the study of GIS, Major application areas of GIS, Map scale, Classes of maps, The Mapping process, Plane Coordinate systems and transformations, Geographic Co-ordinate systems on earth, Map projection, Classificationof map projections, aspects of map projections, Establishing a spatial framework for mapping locations on earth: Geo-referencing.

Learning Outcomes:

After the completion of Unit, students will be able to

- **Classify**and **explain** different components of GIS**[L2]**
- **identify** different application areas of GIS**[L3]**
- **define** terms and concepts related to GIS**[L1]**
- **develop**knowledge on map projections and their classifications**[L3]**
- **explain** the process of geo-referencing**[L2]**

Unit - IV **9 L**

Application of GIS system and Remote Sensing:GIS Concepts – Spatial and non-spatial data, Vector and raster data structures, analysis, Database management – GIS software, Monitoring and management of environment, Conservation of resources, Sustainable land use &, Coastal zone management

Learning Outcomes:

After the completion of Unit students will be able to

- **Classify different**data in GIS**[L2]**
- **compare** vector and raster data structures**[L2]**
- **outline**concepts of Database Management System**[L2]**
- **Identify** usage of GIS in day to day activities**[L3]**

Unit- V **8 L**

Case Study: A case study in GIS implementation, the consultant, the client, the initial applications, types of GIS analysis used for case study.

Learning Outcomes:

After the completion of Unit, students will be able to

- **choose** a case study of their interest **[L3]**
- **apply** the knowledge of GIS in analyzing the case study**[L3]**

List of Experiments:

1. Map Composition in ArcGIS and m ArcGIS to Illustrator
2. Joining Tables to Boundary Files
3. Visualizing Data in ArcScene and Working with Data
4. Geoprocessing,GeoCoding and Georeferencing
5. Geodatabase Creation,
6. Project Work – to demonstrate their expertise on GIS

Text Book(s):

- Lillesand, T.M. and Kiefer, R.W, Remote Sensing and Image Interpretation, 6/e, John Wiley and sons, New York, 2011
- GolfriedKonechy, Geoinformation: Remote sensing, Photogrammetry and Geographical Information Systems, 1/e, CRC press, 2002

References:

- Burrough, P.A. and McDonnell, R.A., Principles of Geographic Information Systems,3/e, Oxford University Press, New York, 2001.
- Lintz, J. and Simonet, Remote sensing of Environment, Addison Wesley Publishing Company, New Jersey, 1977
- NPTEL Web course on Remote Sensing: https://nptel.ac.in/courses/105108077/
- NPTEL Web course on GIS in Civil Engineering: https://nptel.ac.in/courses/105102015/

	Course Code	Course Title	L	T	P	J	S	C
		PE-2: SANITARY ENGINEERING	3	0	0	0	0	3
	Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
	Course Pre-requisite(s)	None	**Contact hours**				30	
	Course Co-requisite(s)	None	**Date Approved**					
	Alternate Exposure							

Course Description

Sanitation is one of the most important aspects of community well-being as it protects human health, extends life spans, and is documented to provide benefits to the economy. The main purpose of sanitation is to maintain such environments as will not affect the public health in general. Thus this course provides basic information on functionality of different sewerage systems. Further, helps to learn various design considerations to design all unit operation involved in waste water treatment process and sludge disposal techniques.

Course objective

1. to study different sewerage systems and various sewer appurtenances.
2. to familiarize with the characteristics of sewage
3. to impart the principles involved in primary and secondary treatment of sewage
4. to acquaint the decomposition process of sewage under anaerobic and facultative conditions
5. to study various disposal techniques in sludge treatment

Course Outcomes

1. differentiate the types of sewerage systems and explain the working principle of every sewer appurtenance –L4.
2. analyze the characteristics of sewage –L4
3. select an appropriate treatment method to design various units in sewage treatment – Ll3
4. test the efficiency of designed treated units under anaerobic condition –L4
5. explain the functionality of sanitary fittings-L4

Module I **8L**

Introduction to Sanitary Engineering: Sanitation, conservancy and water carriage system, sewerage systems, relative merits,Quantity of sanitary sewage, factors affecting sanitary sewage, determination of quantity of storm water sewage, sewers, sewer appurtenances, sewage pumping, types of sewers, design of sewers, construction; testing, sewer appurtenances manholes, sewage pumping.

Learning Outcomes:
- compare conservancy and water carriage system –L2
- explain various types of sewers and sewer appurtenances –L2
- calculate the capacity of various types of sewers–L4

Module II **8 L**

Quality and Characteristics of Sewage**:** Characteristics of sewage, decomposition of sewage, physical and chemical analysis of sewage, problems on BOD. Natural Methods of Wastewater Disposal**,** disposal by dilution, types of receiving waters for dilution, self-purification of natural streams, oxygen sag curves, disposal by land treatment, comparison of disposal methods, sewage sickness; reuse of treated sewage.

Learning Outcomes**:**
- illustrate the characteristics of sewage-L2
- analyse and interpret the physico-chemical Characteristics of sewage-L4
- explain the concept of oxygen –sag curve-L2
- compare various sewage disposal methods -L2

Module III **11 L**

Primary & secondary Treatment of Sewage**:** Screens, grit chamber, grease traps, skimming tanks, sedimentation tanks,Trickling filters and ASP trickling filters, operational problems and remedies, activated sludge process vs. trickling filter process, methods of aeration, diffused air system, mechanical aeration, combined system, sludge bulking, sludge volume index.

Learning Outcomes:
- illustrate various components in primary treatment of sewage –L2
- analyze the working principle of every unit in treatment process-L4
- calculate various design parameters of waste water treatment units-L4

Module IV **8 L**

Miscellaneous Methods**:** Septic tank, septic tank effluent disposal, imhoff tank introduction, oxidation ditch, stabilization pond (oxidation pond), aerobic lagoons, anaerobic lagoons, facultative ponds, Rotating Biological Contractor. (RBC)

Learning Outcomes:
- analyze the mechanism of anaerobic/facultative treatment methods –L4
- make use of recommended design consideration to design a septic tank-L3
- Test the efficiency of designed Rotating Biological Contractor-L4

Module V **7 L**

Sludge Disposal & sanitary fittings **:** Anaerobic sludge digestion process, factors effecting sludge digestion, sludge digestion tanks, sludge thickening, sludge conditioning, methods of dewatering the sludge, methods of sludge disposal. Basic Sanitary fittings and functionalities, plumbing systems, maintenance of sanitary installations.

Learning Outcomes:

- explain various sludge disposal techniques –L2
- analyze the porces of sludge digestion –L4
- identify the basic sanitary installations for a building-L3

Text Book(s)

1. P.N. Modi (2008), Sewage treatment & Disposal and waste water Engineering – Environmental Engineering (Vol.II) – Standard Book House
2. Met Calf and Eddy, Wastewater Engineering Treatment, Disposal and Reuse, Tata McGraw Hill, 2010

References

1. Ruth F. Weiner and Robin A. Matthews (2003), Environmental Engineering,Butterworth- Heineman
2. S.C. Rangwala, Water Supply and Sanitary Engineering,1/e, Charotar, 2005.
3. Peavy, H.S, Rowe, D.R., and G. Tchobanoglous (1995), Environmental Engineering, McGraw HillInc.,NewYork.
4. https://nptel.ac.in/syllabus/105105048/

Program Elective (PE) -IV

Course Code	Course Title	L	T	P	J	S	C
	PE-4: ADVANCED DESIGN OF STEEL STRUCTURES	3	0	0	0	0	3
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	*Mechanics of Solids, Structural Analysis and Design of Steel Structures*	**Contact hours**				30	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

Course Description

This is an advanced course useful for the student to enable them the design of advanced Steel structuresThe student will be able to design various components of plate girders under different loading condition.The design of column foundations and gantry girders will be helpful in designing industrial structures.

Course Objectives

1. To train on the design of welded plate girder without stiffeners.
2. To train on the design of welded plate girder with stiffeners.
3. To enable the design of truss members.
4. To demonstrate the designof column bases.
5. To familiarizewith the design of Gantry Girder.

Course Outcomes

After completion of this course, the student will be able to

1. design a welded plate girder without stiffeners (L6).
2. design a welded plate girder with stiffeners (L6).
3. design of membersin a truss (L6).
4. design of column bases. (L6).
5. design of Gantry Girder (L6).

Unit I **8L**

Welded Plate Girders: Components of a plate girder, economical depth, design of flanges, design of cross section of plate girders, design of connection.

Learning Outcomes

After completion of this unit, students will be able to

- Listthe various components of a plate girder (L1).
- find the economical depth and thickness of plate girder (L1).
- design of plate girders without stiffeners (L6).

Unit II **8L**

Welded Plate Girders: Web stiffeners - design of vertical, horizontal and bearing stiffener, web splice.

Learning Outcomes

After completion of this unit, students will be able to

- classify various types of stiffeners (L2).
- design various types of stiffeners (L6).
- design of splices (L6).

Unit III **8L**

Roof Trusses: Types of trusses, economical spacing of roof trusses, loads on roof trusses, estimation of wind load on roof trusses as per IS:875, design of members of roof truss and joints, design of purlins.

Learning Outcomes

After completion of this unit, students will be able to

- determine the wind load on roof trusses (L5).
- design purlins of roof truss (L6).
- design roof joints (L6).

Unit IV **8L**

Column Foundations: Slab base, gusset base and grillage foundations for axially loaded columns.

Learning Outcomes

After completion of this unit, students will be able to

- outline various types of Column bases (L2).
- design column bases (L6).
- design grillage foundation (L6).

Unit V **10L**

Gantry Girder: Introduction - loading consideration and maximum load effect - selection of gantry girder – design of gantry girders for primary loads only.

Learning Outcomes

After completion of this unit, students will be able to

- distinguish between the loadson gantry girder (L4).
- choose the effective section for gantry girder (L3).
- design the gantry girder (L6).

Text Book(s)

1. S.K. Duggal, Limit state Design of steel structures, 2/e, Tata McGraw Hill, 2017.
2. N. Subramanyam, Design of Steel Structures, 2/e, Oxford University Press, 2016.

References

1. V.L. Shah and Veena Gore, Limit State Design of steel structures IS:800- 2007, Structures Publications, 2012.
2. M.L. Gambhir, Fundamentals of Structural Steel Design, McGraw Hill Education, 2013.
3. Ramachandra and V. Gehlot, Design of Steel Structures, 2/e, Scientific Publishers, 2015

	Course Code	Course Title	L	T	P	J	S	C
		PE-4: GROUND IMPROVEMENT TECHNIQUES	3	0	0	0	0	3
	Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
	Course Pre-requisite(s)	Soil Mechanics	**Contact hours**				30	
	Course Co-requisite(s)	None	**Date Approved**					
	Alternate Exposure							

Course Description

The course introduces the need for ground improvements and brief descriptions of methods used for cohesive and cohesionless soils. Detailed procedures of ground improvement techniques such as compaction, vibro-floatation and stone column, preloading, soil nailing and reinforced earth, dewatering techniques, and deep soil mixing will be covered in this course. Basic concepts of soil reinforcement using different types of geosynthetics and their wide applications are also discussed. The various grouting materials and their techniques are also covered in this course.

Course Objectives:

1. To familiarize the various types of improvement methods of engineering properties of soils.
2. To study the need and various methods of dewatering for ground improvement
3. To expose the various methods of insitu densification of cohesive and cohesion less soils
4. To acquaintthe concept of reinforcement and various applications of reinforcement for soil
5. To demonstrate the different grouting techniques and materials for stabilisation of soil

Course Outcomes:

Students will be able to:

1. illustrate the importance of ground improvement techniques – L2
2. explain various drainage and dewatering techniques to reduce the consolidation time – L2
3. identify the various insitu densification process for cohesionless and cohesive soils-L3
4. apply the principles of soil reinforcement and confinement in the constructions – L3
5. demonstrate the stabilization of soils using grouting techniques –L2

8 L

Unit I

Introduction: Role of ground improvement in foundation engineering,methods of ground improvement, geotechnical problems in alluvial, laterite and black cotton soils, selection of suitable ground improvement techniques based on soil condition.

Learning outcomes:

After completion of Unit I, students will be able to

- infer the need of ground improvement in foundation engineering-L2
- identify the various methods of ground improvement-L3
- distinguish the various geotechnical problems in alluvial, laterite and black cotton soil-L4
- choose the method of ground improvement technique based on soil type-L1
- solve the various problems of soil with the knowledge of ground improvement-L3

9 L

Unit II

Drainage and Dewatering: Drainage techniques, well points, vacuumand electro osmotic methods, seepage analysis for twodimensional flow-fully and partially penetrating slots in homogenous deposits (Simple cases only), Analysis methods for dewatering of soils.

Learning outcomes:

After completion of Unit II, students will be able to

- list the various types of dewatering technique-L1
- explain the need of dewatering in the construction process-L2
- select the type of dewatering technique based on the existing ground table-L3
- illustrate the working procedure of well points, vacuum and electro osmosis methods-L2
- analyse the seepage for two dimensional fully and partially penetrating slots in homogeneous deposits-L4

9 L

Unit III

Insitu Treatment of Cohesionless and Cohesive Soils: Insitu densificationof cohesionless and consolidation of cohesive soils, dynamic compaction and consolidation, vibrofloation, sand pile compaction, preloading with sand drains and fabric drains, stone columns, lime piles, installation techniques only - relative merits of various methods and their limitations.

Learning outcomes:

After completion of Unit III, students will be able to

- distinguish the various insitu densification process for cohesionless and cohesive soils-L3
- explain the working mechanism of dynamic consolidation and compaction, vibroflotation and sand pile compaction-L2
- analyse the working of procedure with sand drains and fabric drains, stone columns and lime piles-L3
- outline the installation techniques of various insitu densification methods-L2
- summarize the merits and limits of various insitu densification methods-L2

8 L

Unit IV

Earth Reinforcement: Concept of reinforcement, types of reinforcementmaterial, applications of reinforced earth, use of geotextiles for filtration, drainage and separation in road and other works, use of Geogrids, Geocells, Geomats.

Learning outcomes:

After completion of Unit IV, students will be able to

- demonstrate the concepts of reinforcement-L2
- explain the different types of reinforcement-L2
- apply the concepts of reinforcement to solve soil problems-L3
- explain the use of geotextiles for filtration, drainage and separation-L2

8L

Unit V

Grout Techniques: Types of grouts, types of grouting, grouting equipment and machinery,injection methods, grout monitoring, stabilisation with cement, lime and chemicals, stabilisation of expansive soils, Permeation grouting, Compaction grouting, Displacement grouting.

Learning outcomes:

After completion of Unit V, students will be able to

- list the types of grouts-L1
- identify the grouting equipment and machinery-L3
- explain the stabilisation of soils with cement, lime and chemicals-L2
- classify the different injection methods-L2
- analyse the stabilisation of expansive soils-L4

Text Book(s)

1. R.M. Koerner, Construction and Geotechnical Methods in Foundation Engineering, Tata McGraw Hill, 1994.
2. Dr.P. Purushothama Raj, Ground Improvement Techniques, Tata McGraw Hill,2016.

References

1. M.P. Moseley, Ground Improvement Block, IE Academic and Professional, Chapman and Hall, 2004.
2. J.E.P. Jones, Earth Reinforcement and Soil Structure, Butterworths, 1996.

NPTEL Links

Unit 1:
https://nptel.ac.in/courses/105108075/
https://nptel.ac.in/courses/105108075/2
https://nptel.ac.in/courses/105108075/3
Unit 2:
https://nptel.ac.in/courses/105108075/12
https://nptel.ac.in/courses/105108075/13
https://nptel.ac.in/courses/105108075/14
Unit 3:
https://nptel.ac.in/courses/105108075/7
https://nptel.ac.in/courses/105108075/8
https://nptel.ac.in/courses/105108075/6
Unit 4:
https://nptel.ac.in/downloads/105106052/
Unit 5:
https://nptel.ac.in/courses/105108075/21

	Course Code	Course Title	L	T	P	J	S	C
		PE-4: TRANSPORTATION INFRASTRUCTURE ENGINEERING	3	0	0	0	0	3
	Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
	Course Pre-requisite(s)	None	**Contact hours**				30	
	Course Co-requisite(s)	None	**Date Approved**					
	Alternate Exposure							

Course Description

This course imparts the student's knowledge of planning, design, construction and maintenance of railway tracks. The students acquire proficiency in the application of modern techniques such as GIS, GPS and remote sensing in Railway Engineering. The student develops skills on airport planning and design with the prime focus on runway and taxiway geometrics. Students become conversant with the definition, purpose, location and materials of coastal structures such as piers, breakwaters, wharves, jetties, quays and fenders. The students acquire knowledge on site reconnaissance for location and planning of harbours.

Course Objectives:
The purpose of this course is to
1. Familiarize about the history of non-highway transportation i.e. Railways, Air Transportation, Harbour and Dock Engineering
2. Enable to design railway infrastructure along with design and analysis of railway track system
3. Explain about layout and design of airport
4. Familiarize on the orientation of the runways and geometrical design of the airport infrastructure,
5. Impart knowledge on planning of a seaport and its infrastructure and aids

Course Outcomes:
Students will be able to
1. summarizethe history of the railway development in India, track alignments, construction and maintenance**[L2]**
2. apply the concepts in designing of railway tracks, curves, crossings, signalling and interlocking**[L3]**
3. list the elements of airport engineering and design airport terminals along with runways**[L1]**
4. demonstrate knowledge on helipads, windrose diagrams and air traffic control**[L2]**
5. develop knowledge on harbour and dock engineering such as different types, functional design, navigational aids, types of signals, buoys, beacons, wharves, piers and Bulkheads, Dolphins, Fender and other mooring devices**[L3]**

Unit I **8 L**
Learning Outcomes:
After the completion of Unit, students will be able to
- identify components of permanent way and explain their functions[L3]
- compare between railways and roadways[L2]
- summarizethe engineering surveys for track alignment[L2]
- developknowledgeon track construction, maintenance and drainage[L3]
- outlinelatest happenings the field of Railways Engineering**[L2]**

Unit II **9 L**

Railways – Geometric Design, Points and Crossings, Signalling and Interlocking: Gradient and grade compensation on curves, speed on curves, super elevation and negative super elevation, widening of gauge on curves, types of stations and station yards, station equipment's, types of points switch and crossings, design calculation of turnout, various types of track junctions, signalling and interlocking, different types of signals, their working and location, control systems of signals, track circuiting.

Learning Outcomes:

After the completion of Unit, students will be able to

- define concepts of gradient and grade compensation[L1]
- developknowledge on aspects of geometric design of tracks[L3]
- classifydifferent types of stations and yards[L2]
- identify difference between points, switches and crossings and their usage[L3]
- explainaspects in signaling and interlocking**[L2]**

Unit III **9 L**

Airport Engineering: Layout and Design: Introduction, classification of airports, factors influencing site selection, components of airport landing areas, terminal area and terminal buildings, cross sectional components of runway and taxiway, components, drainage, airport zoning, clear zone, approach zone, buffer zone, turning zone, clearance over highways and railways.

Learning Outcomes:

After the completion of Unit, students will be able to

- list various factors influencing site selection for airport[L1]
- explaincomponents of airport[L2]
- identifycross sectional components of runway and taxiway[L3]
- developknowledge on airport zoning[L3]
- find clearance over highways and railways as per norms**[L1]**

Unit IV **8 L**

Airport Planning and Air Traffic Control: Hangers and helipads, turning radius, taxiway as per Indian standards, wind rose diagram, runway orientation, landing aids, air traffic control, airfield marking and lighting- sign, aircraft parking system, flight planning and operations, design standards, planning and design of airport as per Indian condition.

Learning Outcomes:

After the completion of Unit, students will be able to

- developknowledge on Hangers and helipads, turning radius[L3]
- interpret taxiway as per Indian standards[L2]
- develop the influence of wind rose diagram on runway orientation[L3]
- explainaircraft parking system, flight planning and operations[L2]
- make use of design standardsas per Indian conditions**[L3]**

Unit V **8 L**

Harbours Docks and Management: Dock, different types, functional design and various types and their usage, navigational aids, necessity and type of signals and different types of dredges and their applications, classification and requirements of harbours, classification and construction, wharves, piers and bulkheads, dolphins, fender and other mooring devices, typical layout of existing harbours.

Learning Outcomes:
After the completion of Unit, students will be able to

- classifydifferent types of ports and harbours[L2]
- develop knowledge onfunctional design and their usage[L3]
- explain the necessity and type of signals[L2]
- extendknowledge on wharves, piers and bulkheads, dolphins, fender and other mooring devices[L2]
- explain typical layouts of existing harbours**[L2]**

Text Book(s):

- Ashford N.J., MumayizS.A., and PWright.H., Airport Engineering: Planning, Design and Development of 21stCentury Airports, 4/e, John Wiley and Sons,2011
- Subhash C. S, and Arora S, A course in Railway Engineering, 7/e, Dhanpat Rai and sons, Delhi, 2009
- Srinivasan R., Harbour, Dock and Tunnel Engineering, 1/e, Charotar Publications, 2016

References:

- Agarwal M.M., Indian Railway Track, 5/e, Prabha and Co, 2007
- Anita K.F., “Railway Track”, 1/e, New Book Company, 2000
- Young S.B., and Wells A.T., Airport Planning and Management, 6/e, McGraw-Hill,2011
- NPTEL Video Course for Transportation Engineering II https://nptel.ac.in/courses/105107123/

<table>
<tr><td>Course Code</td><td>Course Title</td><td>L</td><td>T</td><td>P</td><td>J</td><td>S</td><td>C</td></tr>
<tr><td></td><td>PE-4: ADVANCED WATER RESOURCES ENGINEERING</td><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Course Owner</td><td>Department of Civil Engineering</td><td colspan="4">Syllabus version</td><td colspan="2">1.0</td></tr>
<tr><td>Course Pre-requisite(s)</td><td>Fluid mechanics and water resources engineering</td><td colspan="4">Contact hours</td><td colspan="2">30</td></tr>
<tr><td>Course Co-requisite(s)</td><td>None</td><td colspan="4">Date Approved</td><td colspan="2"></td></tr>
<tr><td>Alternate Exposure</td><td colspan="7"></td></tr>
</table>

Course Description

The prerequisite for this course would be fluid mechanics and water resources engineering. This course helps the learner to acquire the comprehensive knowledge of gravity dams, earth dams, spillways. The learner will gain the knowledge on the principles of stability analysis of gravity dams and seepage analysis of earth dams. This course introduces the over view of spillways and design principles of stilling basins. The learner will gain the knowledge of design principles to design the minor irrigation structures of canal regulation works and cross drainage works.

Course Objectives:
1. to explain the forces acting on gravity dam, seepage analysis of earth dam
2. to teach the principles of stability analysis and theories of subsurface flow
3. to solve the problems related to stability analysis of gravity dam and earth dam.
4. to design the Canal Regulator and Cross Drainage structures

Course Outcomes:
At the end of course the students will be able to
1. estimate the forces acting on gravity dams (L-2)
2. check the stability of gravity dams and earth dams (L-3)
3. apply the stability criteria of dams (L-4)
4. compute the required thickness of impervious floor (L-4)
5. design the Canal Regulator and Cross Drainage structures (L-6)

Unit - I: **9 L**
Gravity Dams: Classification of dams, gravity dams: forces acting, elementary profile, safety criteria, stability analysis of gravity dam including earthquake effects, construction joints, openings in dams-galleries, foundation treatment of gravity dam.

Learning outcomes:
After completion of Unit-I, students will be able to

- find the forces acting gravity dams (L-2)
- explain the safety criteria for stability analysis (L-2)
- solve problems related to stability analysis of gravity dam ((L-3)
- explain the drainage galleries and construction joints of gravity dams (L-2)

Unit – II: **9 L**

Earth Dams: Types, causes for failure of earth dams, phreatic line, seepage analysis for homogeneous dams, stability analysis of earth dam by slip circle method, seepage control in earth dams.

Learning outcomes:

After completion of Unit-II, students will be able to

- list the causes for failure of earth dams (L-1)
- explain the phreatic line (L-2)
- analyze the seepage flow through earth dams ((L-3)
- solve problems related to stability analysis of earth dam (L-3)

Unit – III: **9 L**

Spillways: Essential requirements, spillway capacity, components, types of spillways and their working, profile of ogee spillway, spillway crest gates, energy dissipation below spillway, use of hydraulic jump as energy dissipator – design of stilling basins – IS standard basins.

Learning outcomes:

After completion of Unit-III, students will be able to

- list the essential requirements of spillway (L-1)
- classify the types of spillways (L-2)
- Compute the profile of ogee spillway ((L-3)
- design the energy dissipation below spillway - stilling basins (L-3)

Unit – IV: **9 L**

Diversion Head Works: Location and components, weirs and barrages, causes of failure of weirs, design of impervious floor of weirs on permeable foundation, Bligh's, Lane's and Khosla's theories, hydraulic design of vertical drop weir,

Learning outcomes:

After completion of Unit-IV, students will be able to

- list the components of Diversion Head works (L-1)
- explain the causes of failure of weirs (L-2)
- apply the Bligh's, Lane's and Khosla's theories (L-3)
- design the vertical drop weir (L-3)

Unit – V: **9 L**

Canal Regulatory Works: Canal regulator – hydraulic design of canal head regulator and cross regulator.

Cross Drainage Works: Types, factors affecting the suitability of each type, hydraulic design of Aqueduct and Syphon Aqueduct (Type-III), Canal outlet and canal escape.

Learning outcomes:

After completion of Unit-V, students will be able to

- list the types of Cross Drainage Works (L-1)
- explain the suitability of Cross Drainage Works (L-2)
- design the canal head regulator and canal cross regulator (L-4)
- design the Aqueduct and Syphon Aqueduct (Type-III) (L-4)

Text Book(s)

1. P.N. Modi, Irrigation Water Resources and Water Power Engineering, Standard Book House, Delhi
2. B.C.Punmia and Pande B.B.Lal, Irrigation and Water Power Engineering, Laxmi Publications Pvt. Ltd., New Delhi

Reference books :

1. S.K.Garg, Irrigation Engineering, and Hydraulic Structures, Khanna Publishers, Delhi
2. Ch.Satyanarayana Murty, Water Resources Engineering, New Age International, Delhi
3. K.R. Arora, Irrigation, Water Power and Water Resources Engineering, Standard Book Publishing, Delhi

Course Code	Course Title	L	T	P	J	S	C
	PE-5: CONSTRUCTION MANAGEMENT WITH AI APPLICATIONS	3	0	0	0	0	3
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	None	**Contact hours**				30	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

Course Description

This course Construction Management focuses planning, scheduling and monitoring of construction projects. Complexresearch and development projects can be managed effectively if the project managers have the means to plan and control the schedules and costs of the work required to achieve their technical performance objectives. AI in the Construction directions to cultivate a critical point of view of the technologies, feasibility, effort and impact. Students will be guided to identify and address the perception gap between what AI in AEC Industry.

Course Objectives:

1. To facilitate the basics tools used in construction projects.
2. To impart the idea about planning and scheduling of activities.
3. To explain about the time cost trade off model.
4. To demonstrate about principals of Construction Management with BIM Technology.
5. To familiarize the case studies on Planning and Design with ANN.

Course Outcomes:

At the end of the course the students will be able to

1. **Choose** best method to implement in construction projects.**[L-1]**
2. **Interpret**on various time estimates in construction projects.**[L-2]**
3. **Identify** the optimum time corresponding to optimum cost by cpm cost model analysis.**[L-3]**
4. **Plan** and develop management solutions to construction projects.**[L-3]**
5. **Choose**best approach in planning and design of projects.**[L-1]**

MODULE – I **5 hours**

Introduction to AI inConstruction Management: Introduction to Artificial Intelligence Technique by Artificial Neural Network. Planning, Scheduling and controlling,Barcharts, Origin of PERT and CPM, PERT and CPM networks and Problems, Comparison, Event, Activity, Rules fordrawing networks Numbering the events (Fulkerson's law), Dummy activities, Work Break-down structure.

Learning outcomes:

After completion of Module – I, students will be able to

- **Outline**Bar Charts and Milestone charts.**[L-2]**
- **Identify** weaknesses in Barcharts.**[L-3]**
- **Apply** network rules for developing networks.**[L-3]**
- **Make use of** Fulkerson's law fornumbering the events.**[L-3]**
- **Infer** PERT and CPM networks.**[L-2]**

MODULE – II **6 hours**

CPM-PERT-Network Analysis: Time estimate-Expected time, Earliest allowable occurrence time, Latest allowable occurrence time, slack and Problems,Problems on Network Analysis,project duration, probability of completion, Start and Finish time estimates, Floats and Problems, Project scheduling, Critical and sub-critical path.
Updating – Process of updating; when to update

Learning outcomes:

After completion of Module – II, students will beable to

- **Outline**PERT and CPM networks.**[L-2]**
- **Interpret**expected time for determining project duration.**[L-2]**
- **Make use of** slack and float for determining critical path.**[L-3]**
- **Apply**Process of updating for update progress of a project.**[L-3]**

MODULE – III **6 hours**

CPM Cost Model & Resources allocations, resource scheduling: Cost Analysis; direct and indirect costs,

operation time, Normal and crash times and costs,Problems on cost analysis,Optimising project cost, crash limit, Free float limit,Optimization Resource smoothening. Resource levelling. AI Applications in Construction Projects Site Overhead Cost Estimating and Safety Performance, Cash Flow Prediction Using Neural Networks

Learning outcomes:

After completion of Module – III, students will beable to

- **Summarize** direct and indirect costs in a project**[L-2]**
- **Interpret**the total cost require for execution of the project.**[L-2]**
- **Choose** optimum time required for execution of the project using crashing technique.**[L-1]**
- **Apply**AI applications in Cost overruns of the construction projects.**[L-3]**

MODULE – IV **6 hours**

Introduction to Management and Basics of BIM: Scope of Construction Management; Significance of Construction Management, Concept of Scientific Management; Safety in Construction, Qualities of Manager. Basics of Modern Project management systems such as BIM. Use of Building Information Modelling (BIM) in project management.

Learning outcomes:

After completion of Module – IV, students will beable to

- **Infer**Scope of Construction Management**[L-2]**
- **Relate**Scientific Management in construction**[L-2]**
- **Interpret**workflow strategy by BIM**[L-2]**
- **Classify**roles performed by effective construction managers**[L-2**

MODULE – V **5 hours**

Case Studies – Planning and Design, Intelligent Planning of Construction Projects, Neural Network System for Vertical Formwork Selection.

Learning outcomes:

After completion of Module – V, students will beable to

- **Infer**on planning selection methods with Neural Network System. **[L-2]**
- **Interpret** onPlanning and Design requirements for execution of the project**.[L-1]**
- **Relate** types of formwork selection based on Construction. **[L-1]**

Laboratory Experiments

1. AI Applications in Project Planning.
2. AI for Better Design of Buildings Through Generative Design.
3. AI Applications of Energy Simulation of Building
4. Integration of ASR (Automatic Speech Recognition) with BIM.
5. AI Applications in Crane usage Optimization.
6. Onsite Safety and Health Monitoring using BIM.

Text Books:

1. Dr. B. C. Punmia and K. K. Khandelwal, Project Planning and Control with PERT and CPM, 4/e, Laxmi Publications, 2016.
2. Kumar NeerajJha, Construction Project Management: Theory and Practices, 2/e, Pearson Education, 2015
3. Erick Sudjono, "Artificial Intelligence in Construction Management: Evolutionary Fuzzy Hybrid Neural Network as decision-making machine" (2008).
4. SamuiPijush and Kothari DwarkadasPralhaddas(2012) "Artificial Intelligence in Civil Engineering", LAP Lambert Academic Publishing.

References:

1. Dr. P. N. Modi, Rajeev Modi, PERT and CPM - Project Evaluation Review Technique and Critical Path Method, 5/e, Standard Book House, 2012.
2. L. S.Srinath, PERT and CPM Principles and Applications, 3/e, Affiliated East-West Press, 2001.
3. SamuiPijush and Kothari DwarkadasPralhaddas(2012) "Artificial Intelligence in Civil Engineering", LAP Lambert Academic Publishing.
4. Dr. Ibrahim Al-Ani, "A.I. and Expert Systems: Applications in Civil Engineering", LAP LAMBERT Academic Publishing.

5. U.K. Shrivastava, Construction Planning and Management, 2/e, Galgotia Publications - New Delhi, 2000.
6. Kerzner H., Project Management- A systems approach to planning, scheduling and controlling, 10/e, John Wiley & Sons, Inc., New Jersey, USA, 2009.
7. NPTEL Web Course- Principles of Construction Management- https://nptel.ac.in/courses/105104161/

Program Elective (PE) -V

	Course Code	**Course Title**	**L**	**T**	**P**	**J**	**S**	**C**
		PE-5: PRESTRESSED CONCRETE	3	0	0	0	0	3
	Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
	Course Pre-requisite(s)	Mechanics of Solids, Structural Analysis and Design of Reinforced Concrete Structures	**Contact hours**				30	
	Course Co-requisite(s)	None	**Date Approved**					
	Alternate Exposure							

Course Description

Prestressed concrete is often preferred in construction of bridges and buildings.This course discusses on various materials used,types of prestressing system and prestressing losses. The student will be able to design prestressed concrete members including end block as per Indian Standard code.

Course objectives

1. To familiarize different prestressing methods.
2. To explainthe analysis of prestressed concrete beams.
3. To demonstrate various losses in prestressed concrete members.
4. To impart the design of prestressed concrete members.
5. To enable design of end block.

Course Outcomes

After completion of this course, the student will be able to

1. distinguish between different prestressing methods (L4).
2. analyze prestressed concrete beams for flexure(L5).
3. estimate various losses in prestressed concrete members (L5).
4. design prestressed concrete beams (L6).
5. construct stress distribution diagram in end block (L6).

Unit I **8L**

Introduction and Systems of prestressing

Introduction:

Basic concepts of prestressing, Historical Development, Need for high strength steel and concrete, Terminology, Advantages of prestressed concrete, Applications of prestressed concrete.

Systems of prestressing:

Classification of prestressed concrete. Pre tensioning techniques - long line system (Hoyer system), post - tensioning Techniques (a) Freyssinet system and (b) Gifford Udall system.

Learning Outcomes:

After completion of this unit, the student will be able to

- outline materials used in prestressed concrete (L2).
- list applications of prestressed concrete (L1).
- distinguish between different prestressing systems (L4).

Unit II **8L**

Analysis of prestress and Bending stresses:

Basic assumptions, Analysis of prestress, Resultant stresses at a section, Pressure line or thrust line and internal resisting couple, Concept of load balancing, Stresses in tendons, Cracking moment.

Learning Outcomes:

- explain basic assumptions in prestressed concrete members (L2).
- estimate the resultant stresses at a section (L5).
- determine the location of thrust (L5).

Unit III **10L**

Losses of Prestress:

Nature of losses of Prestress, Loss due to elastic deformation of concrete, Loss due to shrinkage of concrete, Loss of prestress due to creep of concrete, Loss of prestress due to relaxation of stress in steel, Loss of prestress due to friction, Loss due to Anchorage slip, Total losses allowed for in design.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the reasons for losses (L5).
- discuss various losses in prestressed concrete members (L3).
- estimate various losses in prestressed concrete members (L5**).**

Unit IV **8L**

Design of prestressed concrete sections:

Design of sections for flexure.

Learning Outcomes:

After completion of this unit, the student will be able to

- design width and depth of beam (L3).
- determine the profile of cable and its eccentricity (L5).
- evaluate the maximum horizontal spacing of cables (L5).

Unit V **8L**

Anchorage zone stresses in post-tensioned members:

Introduction, Stress distribution in end block, Investigations on anchorage zone stresses, comparative analysis, Anchorage zone reinforcement.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain anchorage zone of post tensioned members (L3).
- construct stress distribution diagram in end blocks (L3).
- design of anchorage reinforcement (L3).

Text Book(s):

1. N. Krishna Raju, Prestressed concrete, 4/e, Tata McGraw Hill, 2012.
2. G.S. Pandit, Prestressed concrete, CBS Publishers, 2014.

References:

1. P. Dayaratnam, Prestressed Concrete Structures, Oxford and IBH Publishing Company, 2014.
2. T.Y. Lin, and H. Ned, Burhns, Design of Prestressed Concrete Structures, 3/e, John Wiley and Sons, 2010.
3. H. Arthur, Nilson, Design of prestressed concrete, Wiley India Pvt.ltd, 2011.
   J.R. Libby, Modern prestressed concrete,CBS Publishers, 2007

Course Code	Course Title	L	T	P	J	S	C
	PE-5: GEOSYNTHETICS	3	0	0	0	0	3
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	None	**Contact hours**				30	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

Course Description

Geosyntheticsare made of eco-environmental biodegradable polymeric resins or natural materials that maintain their needed performance such as durability, design strength, hydraulic property, etc., during the service period. The use of geosynthetics is, though, still novel in the field of civil engineering and construction industry, its use is nevertheless increasing every year in sectors such as reinforcement of fill, management of pore water pressure, foundations and pavements. These products are mainly categorized in to Geotextiles, Geogrids, Geomembranes,Geocomposites

Course Learning Objectives:

1. To familiarize the evolution of new construction materials in geotechnical engineering and to initiate geosynthetic materials.
2. To expose the properties and applications of different types of materials of geosynthetics.
3. To acquaint the concepts of application of geotextiles for the functions of separation, reinforcement, stabilization, filtration, drainage and moisture barriers.
4. To demonstrate the designing criteria of reinforced earth retaining walls, gabions, pond liners, covers for reservoirs, canal liners, landfill liners, caps and closures, dams and embankments.
5. To study the additional advantages of geocomposites, geowebs and geocells, and moisture barriers and natural geotextiles etc. for applications to meet various functions.

Course Outcomes

After completion of this course the student will be able to

1. demonstrate the various applications and different types of geosynthetic materials – L2
2. explain the concepts of geosynthetics for the functions of separation, reinforcement, stabilization, filtration, drainage and moisture barriers – L2
3. illustrate survivability requirements of geosynthetics in the field of roads and role of geosynthetics in sub grade soil – L2

4. outline the design considerations of reinforced earth retaining walls and gabions – L2
5. select suitable geomembrane for pond liners, covers for reservoirs, canal liners, landfill liners, caps and closures – L3

Unit I: ` **8 L**

Geosynthetics: Introduction to Geosynthetics – Basic description – Polymeric materials– Uses and Applications. Properties and classification Geotextiles – Geogrids – Geomembranes – Geocomposites.

Learning Outcomes:

After completion of Unit-1, Students will be able to

- evaluate the suitability of Geosynthetics materials in geotechnical engineering-L3
- demonstrate the Polymer chemistry-L2
- explain the uses and applications of Geosynthetics-L2
- classify the various types of Geosynthetics-L3

Unit II: **8 L**

Geotextiles: Geotextiles as Separation – Reinforcement – Stabilization – Filtration – Drainage and Moisture barriers. Geogrids: Suitability for Reinforcement – Stabilization – Design considerations Gabions – Construction methods.

Learning Outcomes:

After completion of Unit-II, Students will be able to

- explain the various applications of Geotextiles and Geogrids-L2
- demonstrate the suitability of Geotextiles for Separation – Reinforcement – Stabilization – Filtration – Drainage-L2
- illustrate the suitability of Geogrid for Reinforcement – Stabilization-L2
- explain the suitability and application of Gabions-L2
- demonstrate the various Construction methods of Gabions.-L2

Unit III: **9 L**

Use of Geosynthetics in Roads: Geosynthetics in road ways- applications- role of sub grade conditions-survivability-application in paved roads.Geosynthetics for separation and reinforcement in flexible pavements, Use of geosynthetics for construction of heavy container yards and railway lines

Learning Outcomes:

After completion of Unit-III, Students will be able to

- explain the various applications of geosynthetics in pavements.-L2
- apply the geosynthetic materials for sub grade soil to improve its performance-L3
- examine the survivability of geosynthetics in Pavements.–L4

- demonstrate the Use of geosynthetics for construction of heavy container yards and railway lines-L2

Unit IV: 9 L

Reinforced Earth Retaining Walls: Components, Different types of walls like wrap-around walls, full-height panel walls, discrete-facing panel walls, modular block walls Design methods as per BS-8006 and FHWA methods Construction methods for reinforced soil retaining walls, Stability Analysis.

Learning Outcomes:

After completion of Unit-IV, Students will be able to

- explain the concept of Reinforced Earth Retaining Wall over conventional Retaining wall-L2
- explain the various types of Reinforced Earth Retaining Wall-L2
- indentify various components of Reinforced Earth Retaining Wall-L3
- demonstrate the design considerations as per BS-8006FHWA methods-L2
- illustrate and Determine the External stability and internal stability-L2

Unit V: 8 L

Geomembranes: Pond Liners – Covers for Reservoirs – Canal Liners – Landfill Liners– Caps and closures, moisture barriers. Geocomposites: An added advantage – Geocomposites in Separation – Reinforcement – Filtration – Geocomposites as Geowebs and Geocells.

Learning Outcomes:

After completion of Unit-V, Students will be able to

- explain the various applications of Geomembranes-L2
- demonstrate the Geomembranes as liner and covers for different hydraulic bodies-L2
- illustrate the Geocomposites and its added advantages over single geosynthetic material-L2

Text book(s):

1. ‘An Introduction to Soil Reinforcement and Geosynthetics’ by G.L.SivakumarBabu (2009), Universities Press (India) Pvt. Ltd.
2. ‘Engineering with Geosynthetics’, by G. Venkatappa Rao and GVS Suryanarayana Raju – Tata McGraw Hill Publishing Company Limited – New Delhi.

References:

1. ‘Designing with Geosynthetics by Robert M. Koerner, Prantice Hall, and Eaglewood Cliffs, NJ 07632.
2. ‘Construction and Geotechnical Engineering using Synthetic Fabries’ by Robert M. Koerner and Josoph P. Welsh. John Willey and Sons, New York.

NPTEL Links

Module 1: https://nptel.ac.in/downloads/105106052/

https://nptel.ac.in/courses/105108075/module8/Lecture24.pdf

Module 2: https://nptel.ac.in/courses/105101143/downloads/Lecture%2016.pdf

Module 3: https://nptel.ac.in/courses/105101143/downloads/Lecture%2020.pdf

https://nptel.ac.in/courses/105101143/20

Module 4: https://nptel.ac.in/courses/105108075/module8/Lecture31.pdf

https://nptel.ac.in/courses/105101143/27

Module 5: https://nptel.ac.in/courses/105108075/23

Course Code	Course Title	L	T	P	J	S	C
	PE-5: ROAD SAFETY AUDITING	3	0	0	0	0	3
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	None	**Contact hours**				30	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

Course Description

The prime objective of the Roads Safety Audit is to address the safe operation of a roadway and to ensure high level of safety for all its users. This course exposes the various road safety policies nationally as well as internationally. Further, it attempts to address the problems relating to urban road safety, identifying the indicators of safety in urban areas and provide a comprehensive solution for urban road safety audit.

Course Objectives

1. To explain different types of road accidents and causes
2. To impart the road transport policies to prevent accidents
3. To demonstrate road safety auditing techniques
4. To focus on prioritizing of road safety improvement methods
5. To familiarise on safety audit procedures

Course Outcomes:

students will be able to

1. identify different types of road accidents and causes**[L3]**
2. interpret the road transport policies to prevent collisions **[L2]**
3. organize road safety audits**[L3]**
4. identify accidents hot spots and recommend corrective measure**[L3]**
5. apply the knowledge of road safety audit **[L3]**

Unit I **8 L**

Road Safety Policy-I: The scale and nature of the road accident problem in the India and how it compares internationally. Road Safety responsibilities. Definition of road accidents and accident causation

Learning Outcomes:

After the completion of Unit, students will be able to

- identify the scale and nature of road accident problem[L3]
- compareroad accident scenario in India and outside India[L2]
- listvarious responsibilities of road safety[L1]
- defineroad accidents[L1]
- summarizecauses of accidents[L2]

Unit II **9 L**

Road safety policy-II: Role of road safety in national and local transport policy, managing the safety process, urban and rural road safety management, road safety research and recent road safety developments with special emphasis on pedestrian safety.

Learning Outcomes:
After the completion of Unit, students will be able to

- compare the role of road safety in national and local transport policy[L2]
- planhow to manage safety process[L3]
- classifyurban and rural road safety management[L2]
- explain research on road safety[L2]
- tellrecent road safety developments[L1]

Unit III **9 L**
Collision Prevention and reduction-I: Road accidents, causes, recorded cases, method of recording, accident data, storing of accident data, the use of accident data, the use of accident data and interpretation of accident data.

Learning Outcomes:
After the completion of Unit, students will be able to

- listvarious causes of road accidents[L1]
- demonstratemethods of recording road accidents[L2]
- explainthe methods of storing accident data[L2]
- identify the use of accident data[L3]
- interpretthe accident data for better understanding**[L2]**

Unit IV **8 L**
Collision Prevention and reduction-II: Selecting and prioritizing locations for investigation, statistical analysis of accidents, in depth analysis of individual locations, defining the road accident problem, difference between site and route analysis, area wide road safety schemes, options for treating for accident problems, monitoring the effectiveness of measures and estimating accident savings and economic benefits. Importance of road markings, traffic signs and signals, traffic control devices.

Learning Outcomes:
After the completion of Unit, students will be able to

- illustratemethods for Selecting and prioritizing locations for investigation[L2]
- solvethe accident data statistically[L3]
- comparesite analysis and route analysis[L2]
- identifyoptions for treating for accident problems[L3]
- explainthe importance of road markings, traffic signs and signals, traffic control devices[L2]

Unit V **8 L**
Safety Audits: The road safety audit procedure, and what are aims and objectives, roles and responsibility. History of road safety audit, road safety audit and design standards.Road safety audit tasks, various stages of safety audits, common identifiable problems. Structure of a road safety audit report,identity common problems, Case studies.

Learning Outcomes:
After the completion of Unit, students will be able to

- outline the road safety audit procedure along with aims and objectives[L2]
- define concepts of transportation system[L1]
- listvarious stages of safety audits along with common identifiable problems[L1]
- interpret the structure of a road safety audit report[L2]
- applythe concepts of road safety using case studies[L3]

Text Book(s):

1. Khanna S.K., Justo C.E.G., Veeraragavan A., Highway Engineering, 9/e, Nemchand and Bros, Roorkee, 2017
2. Kadiyali, L.R., Traffic Engineering and Transport Planning, 9/e, Khanna Publishers, 2018
3. Belcher, M., Proctor, S., Cook, P., Practical Road Safety Auditing,3/e, ICE Publishing, 2015

References:

1. Papacostas, C.A., Fundamentals of Transportation Engineering, 3/e, Prentice-Hall of India Private Limited, New Delhi, 2001
2. Garber, N.J., and Hoel, LA., Traffic and Highway Engineering, 5/e, Cengage learning, 2018
3. IRC SP 88: Manual on road safety Audit (2010)

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**S**	**C**
	PE-5: AIR POLLUTION & ITS CONTROL	3	0	0	0	0	3
Course Owner	Department of Civil Engineering	**Syllabus version**				1.0	
Course Pre-requisite(s)	None	**Contact hours**				30	
Course Co-requisite(s)	None	**Date Approved**					
Alternate Exposure							

Course Description

Air pollution is a major contributor to global warming and climate change. In fact, the abundance of carbon dioxide in the air is one of the causes of the greenhouse effect. But the excessive concentration of these gases in the atmosphere is the cause of the recent climate change. The meteorological parameter plays a key role in control of air pollution. Thus this course imparts knowledge on the basic causes of air pollution and their control of indoor/particulate/gaseous air pollutant and its emerging trends

Course Objective is

1. to study various air pollutants and to compare various air quality standards.
2. to introduce the mechanism of various plume behaviours.
3. to study various effects of air pollutant and to recollect various case histories
4. to familiarize with various methods of controlling air pollution
5. to impart the basics of noise pollution and its control and prevention methods

Course Outcomes:

1. classify various types of air pollutants –L2
2. explain the mechanism of plume behaviour -L2
3. summarize the effects of air pollution on humans, plants and materials–L4
4. paraphrase various controlling methods of air pollutions-L5
5. evaluate various sources of noise pollution and their preventive methods-L5

Module -I **8 L**

Basic Introduction: Air Pollution and its definition, Factors influencing air pollution, Sources and Classification of air pollutants –natural and manmade, primary and secondary air pollutants. National & International air emission standards.

Learning Outcomes:

- identify various sources of air pollution –L2
- classify the Air Pollutants –L2
- compare the national & International air emission standards- L2

Module–II **8 L**

Meteorology: Importance of meteorological parameters, stability conditions, types of inversions lapse rate, mixing depth, mixing height, atmospheric dispersion, plume behaviour - effective stack height Gaussian plume models.

Learning Outcomes:

- Outline the importance of meteorological parameters-L2
- Classify the types of inversions-L2
- Analyze the plume behavior from stacks –L4
- Make use of Gaussian plume models-L3

Module–III **8 L**

Effects and sampling procedures: Effect of air pollution on humans, plants and materials. Basic Principles of Sampling, Source and Ambient Sampling, Analysis of air Pollutants. Air pollution episodes (India & Abroad)

Learning Outcomes:

- summarize the effect of air pollution on humans, plants and materials-l2
- acquaint with sampling procedure-l3
- analyze the air pollutants- l4
- summarize the Air Pollution episodes (India & Abroad)-L2

Module–IV **8 L**

Noise pollution: Sources of Noise Pollution, Effects, Assessment procedures, Standards of noise pollution, Control Methods and Prevention.

Learning Outcomes**:**

- Identify the Sources of Noise pollution –L3
- Analyze the effect of Noise pollution-L4
- Assess the Noise Pollution-L5
- Explain various Controlling methods of noise pollution-L4

Module–V **8 L**

Air Pollution Control: Selection Criteria for Equipment, Principles of Control Measures, Particulates Control by Gravitational, Centrifugal, Filtration, Scrubbing, Electrostatic Precipitation, Gaseous Pollutant Control by Adsorption, Absorption, Condensation, Combustion.

Learning Outcomes:

- summarize the selection criteria for equipments-l2
- explain the methods of particulate matter control –l4
- importance of different control methods –l5
- justify the best method for Gaseous Pollutant Control –L5

Text books

1. M.N. Rao and H.V.N. Rao, Air Pollution, Tata McGraw, 2017.
2. C.S. Rao, Environmental Pollution Control, 2/e, Wiley Eastern, 2006.

References:

1.Colls, J., Air Pollution: Measurement, Modelling and Mitigation, CRC Press, 2009
2.Heumann. W.L., “Industrial Air Pollution Control Systems”, McGraw Hill, New Yark, 2007.
3.Anjaneyulu, D., “Air Pollution And Control Technologies”, Allied Publishers, Mumbai, 2002
4. https://nptel.ac.in/courses/105102089/8