AMRITAPURI, BENGALURU, COIMBATORE, CHENNAI

DEPARTMENT OF CIVIL ENGINEERING

B.Tech. in CIVIL ENGINEERING
(BTC-CIE)

CURRICULUM AND SYLLABI
(2023)

GENERAL INFORMATION

ABBREVIATIONS USED IN THE CURRICULUM

Cat	-	Category
L	-	Lecture
T	-	Tutorial
P	-	Practical
Cr	-	Credits
ENGG	-	Engineering Sciences (including General, Core and Electives)
HUM	-	Humanities (including Languages and others)
SCI	-	Basic Sciences (including Mathematics)
PRJ	-	Project Work (including Seminars)

AES	-	Aerospace Engineering
AIE	-	Computer Science and Engineering - Artificial Intelligence
BIO	-	Biology
CCE	-	Computer and Communication Engineering
CHE	-	Chemical Engineering
CHY	-	Chemistry
CSE	-	Computer Science and Engineering
CIE	-	Civil Engineering
CUL	-	Cultural Education
EAC	-	Electronics and Computer Engineering
ECE	-	Electronics and Communication Engineering
EEE	-	Electrical and Electronics Engineering
ELC	-	Electrical and Computer Engineering
HUM	-	Humanities
MAT	-	Mathematics
MEE	-	Mechanical Engineering
PHY	-	Physics

Vision

To excel in imparting quality education in Civil Engineering and moulding professionals to address the technological challenges and societal needs.

Mission

Mission 1: Foster professionally competent civil engineers through dedicated team effort, international academic collaborations and industrial exposure.

Mission 2: Achieve excellence in research through advanced laboratory facilities, collaborative projects with academia and industries

Mission 3: Provide life skills training; inculcate societal commitment through value based education and outreach programmes

Course Outcome (CO) – Statements that describe what students are expected to know, and are able to do at the end of each course. These relate to the skills, knowledge and behaviour that students acquire in their progress through the course.

Program Outcomes (POs) – Program Outcomes are statements that describe what students are expected to know and be able to do upon graduating from the Program. These relate to the skills, knowledge, attitude and behaviour that students acquire through the program. NBA has defined the Program Outcomes for each discipline.

PROGRAM OUTCOMES (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
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PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Program Educational Objectives (PEO)

PEO 1: Achieve excellence in Civil engineering skills to engage in diverse career choices
PEO 2: Develop an attitude of lifelong learning through research, multidisciplinary studies and professional organizations
PEO 3: Demonstrate the ability to function in a team environment along with leadership, communication and management skills.
PEO 4: Exhibit sensitivity in serving society as ethical and responsible professionals.

Program Specific Outcomes (PSO)

PSO 1: Apply the acquired engineering knowledge related to structures/ geotechnics/ transportation/ water & environment to address real-world problems.

PSO 2: Implement innovative ideas in design and development using computational and simulation tools

PSO 3: Apply concepts of design, construction, and management to ensure a sustainable and resilient infrastructure for the future

CURRICULUM

SEMESTER I

Cat.	Code	Title	L-T-P	CREDIT
HUM	23ENG101	Technical Communication	2-0-3	3
SCI	23MAT110	Calculus	2 1 0	3
ENGG	23CSE108	Problem Solving and Algorithmic Thinking	2 1 3	4
SCI	23PHY106	Engineering Physics - B	2 1 0	3
SCI	23PHY186	Engineering Physics Lab - B	0 0 3	1
ENGG	23CIE101	Engineering Drawing	2 0 3	3
ENGG	23EEE107	Basic Electrical and Electronics Engineering	3 0 0	3
ENGG	23EEE187	Basic Electrical and Electronics Engineering Lab	0 0 3	1
HUM	22ADM101	Foundations of Indian Heritage	2 0 1	2
		TOTAL		23

SEMESTER II

Cat.	Code	Title	L-T-P	CREDIT
SCI	23MAT128	Linear Algebra	2-1-0	3
SCI	23CHY108	Engineering Chemistry - A	2-1-0	3
SCI	23CHY188	Engineering Chemistry Lab	0-0-3	1
ENGG	23CIE111	Introduction to Computing	2-0-3	3
ENGG	23CIE112	Computer Aided Drafting	1-0-6	3
ENGG	23CIE181	Exploring Civil Engineering - Trends & Challenges	0-0-3	P/F
ENGG	23CIE113	Mechanics : Statics and Dynamics	2-1-0	3
ENGG	23CIE114	Basic Mechanical Engineering	2-0-0	2
ENGG	23MEE182	Manufacturing Practice-B	0-0-3	1
HUM	22AVP103	Mastery Over Mind	1-0-2	2
HUM	22ADM111	Glimpses of Glorious India	2-0-1	2
		TOTAL		23

SEMESTER III

Cat.	Code	Title	L-T-P	CREDIT
SCI	23MAT209	Differential Equations and Numerical Methods	3-1-0	4
ENGG	23CIE201	Solid Mechanics	2-1-0	3
ENGG	23CIE202	Fluid Mechanics	2-1-0	3
ENGG	23CIE203	Principles of Surveying	2-1-0	3
ENGG	23CIE204	Construction Engineering - Materials & Methods	2-1-0	3
SCI	23CIE205	Foundations of Data Science	2-1-0	3
ENGG	23CIE281	Experimental Learning - Mechanics of Materials	0-0-3	1
ENGG	23CIE282	Experimental Learning -Surveying	0-0-3	1
HUM	22ADM211	Amrita Value Program 1 Leadership from Ramayana	1-0-0	1
HUM	23LSE201	Life Skills for Engineers I	1 0 2	P/F
		TOTAL		22

SEMESTER IV

Cat.	Code	Title	L-T-P	CREDIT
SCI	23MAT225	Machine Learning Techniques for Civil Engineers	2 1 0	3
ENGG	23CIE211	Geology & Soil Mechanics	2 1 0	3
ENGG	23CIE212	Structural Analysis I	2-1-0	3
ENGG	23CIE213	Hydraulic Engineering	2-1-0	3
ENGG	23CIE214	Transportation Engineering I	2-1-0	3
ENGG	23CIE283	Experimental Learning -Hydraulics	0-0-3	1
ENGG	23CIE284	Experimental Learning -Construction Materials	0-0-3	1
HUM	23LSE211	Life Skills for Engineers II	1 0 2	2
HUM	22ADM201	Amrita Value Program II Strategic Lessons from Mahabharata	1-0-0	1
		TOTAL		20

SEMESTER V

Cat.	Code	Title	L-T-P	CREDIT
ENGG	23CIE301	Geotechnical Engineering	2-1-0	3
ENGG	23CIE302	Environmental Engineering I	2-1-0	3
ENGG	23CIE303	Behaviour & Design of Reinforced Concrete Structures	2-1-0	3
ENGG	23CIE304	Railways, Airports & Harbour Engineering	2-0-0	2
ENGG	23CIE305	Structural Analysis II	2-0-0	2
ENGG	23CIE306	BIM for Functional Planning	0-0-3	1
ENGG	23CIE381	Computation, Design & Detailing- R C Structures	0-0-3	1
ENGG	23CIE382	Experimental Learning - Geotechnics	0-0-3	1
PRJ	23CIE383	Experiential Learning I - Industry Internship	0-0-3	P/F
ENGG	23LIV390***	[Live-in - Labs]***		[3]
HUM	**23LSE301**	**Life Skills for Engineers III**	**1 0 2**	**2**
		TOTAL		18 [+3]

SEMESTER VI

Cat.	Code	Title	L-T-P	CREDIT
ENGG	23CIE311	Environmental Engineering II	2-1-0	3
ENGG	23CIE312	Behaviour & Design of Steel Structures	2-1-0	3
ENGG	23CIE313	Construction Management	2-1-0	3
ENGG	23CIE314	Professional Practices, Estimation & Costing	0-0-3	1
ENGG		Professional Elective I*		3
ENGG		Professional Elective II*		3
ENGG	23CIE384	Computation, Design & Detailing- Steel Structures	0-0-3	1
ENGG	23CIE385	Experimental Learning - Environmental Engineering	0-0-3	1
HUM	23LSE311	Life Skills for Engineers IV	1 0 2	2
HUM	23MNG300	Disaster Management		P/F
ENGG	23LIV490***	Live-in –Labs II***		[3]
		TOTAL		20 [+3]

SEMESTER VII

Cat.	Code	Title	L-T-P	CREDIT
ENGG	23CIE401	Hydrology & Water Resources Engineering	2-1-0	3
ENGG		Professional Elective III*		3
ENGG		Professional Elective IV*		3
ENGG		Professional Elective V*		3
ENGG	23CIE497	Capstone Project	0-0-3	1
ENGG	23CIE471	Introduction to Geotextile Engineering	2-1-0	3
PRJ	23CIE496	Comprehensive Assessment	0-0-3	1
	23LAW300	Indian Constitution		P/F
PRJ	23CIE495	Experiential Learning II - Industry Internship	0-0-3	P/F
PRJ	23CIE498	Minor Project	0-0-6	2
		TOTAL		19

SEMESTER VIII

Cat.	Code	Title	L-T-P	CREDIT
HUM		Free Elective I**		2
ENGG		Professional Elective VI*		3
PRJ	23CIE499	Major Project	0-0-30	10
		TOTAL		15
		TOTAL CREDITS		160

Verticals

Construction Engineering and Management

1	23CIE361	Concrete Technology
2	23CIE371	Sustainable Construction - Materials & Methods
3	23CIE363	Introduction to Architectural Science
4	23CIE369	Formwork Engineering Practices
5	23CIE368	Construction Equipment and Techniques
6	23CIE365	Construction Economics and Finance
7	23CIE373	Quality Control and Safety Management in Construction
8	23CIE374	BIM for Construction Management

Curriculum Structure -Vertical

Semester 6	2 Electives	1. Concrete Technology (Vertical core) 2. Sustainable Construction – Materials & Methods (Vertical core)
Semester 7	3 Electives	1. Architectural Science 2. Formwork Engineering & Practices (or) Construction Equipment and Techniques 3. Construction Economics and Finances (or) Quality Control and Safety Management in Construction
Semester 8	1 Elective	1. BIM for Construction Management (Project oriented course)

Sustainability Vertical

1	23CIE461	Introduction to Sustainability
2	23CIE462	Sustainable Material Management
3	23CIE463	Functional Efficiency in Buildings
4	23CIE464	Water Conservation and Sustainability
5	23CIE465	Sustainable Environmental Management
6	23CIE466	Sustainable Transportation
7	23CIE467	Socio-Economic Sustainability
8	23CIE468	Capstone Project on Sustainable Practices

Curriculum Structure -Vertical

Semester 6	2 Electives	1. Introduction to Sustainability (Compulsory) 2. Sustainable Material Management (Compulsory)
Semester 7	3 Electives	1. Functional Efficiency in Buildings (Compulsory) 2. Water Conservation and Sustainability (Elective) 3. Sustainable Environmental Management (Compulsory) 4. Sustainable Transportation (Elective) 5. Socio-Economic Sustainability (Elective)
Semester 8	1 Elective	1. Capstone Project on Sustainable Practices (Compulsory)

*Professional Elective - Electives categorised under Engineering, Science, Mathematics, Live-in-Labs, and NPTEL Courses. Student can opt for such electives across departments/campuses. Students with CGPA of 7.0 and above can opt for a maximum of 2NPTEL courses with the credits not exceeding 8.

** Free Electives - This will include courses offered by Faculty of Humanities and Social Sciences/ Faculty Arts, Commerce and Media / Faculty of Management/Amrita Darshanam -International Centre for Spiritual Studies).

*** Live-in-Labs - Students undertaking and registering for a Live-in-Lab project, can beexempted from registering for an Elective course in the higher semester.

PROFESSIONAL ELECTIVE COURSES (with Pre Requisite)				
Structural Engineering				
Cat.	**Code**	**Title**	**L-T-P**	**Credit**
ENGG	23CIE331	Advanced Concrete Design	2-1-0	3
ENGG	23CIE332	Advanced Steel Design	2-1-0	3
ENGG	23CIE333	Prestressed Concrete - Analyses, Design and Construction	2-1-0	3
ENGG	23CIE334	Structural Dynamics & Seismic Design	2-1-0	3
ENGG	23CIE335	Bridge Engineering	3-0-0	3
ENGG	23CIE336	Finite Element Methods	3-0-0	3
ENGG	23CIE473	Precast Members - Systems and Construction	2-1-0	3
ENGG	25CIE431	Design of Pre-engineered Buildings	2-1-0	3
Geotechnical Engineering				
Cat.	Code	Title	L-T-P	Credit
ENGG	23CIE341	Ground Improvement Techniques	2-1-0	3
ENGG	23CIE342	Advanced Foundation Engineering	2-1-0	3
ENGG	23CIE343	Environmental Geotechnology	3-0-0	3
ENGG	23CIE472	Geotechnics & Geosynthetic Engineering	2-1-0	3
ENGG	23CIE474	Deep Excavation and Tunnels	2-1-0	3
Environmental Engineering				
Cat.	Code	Title	L-T-P	Credit
ENGG	23CIE351	Advanced Environmental Engineering	3-0-0	3
ENGG	23CIE352	Industrial Waste Treatment	3-0-0	3
Construction Technology and Management				
Cat.	Code	Title	L-T-P	Credit
ENGG	23CIE361	Concrete Technology	3-0-0	3
ENGG	23CIE362	Repair and Rehabilitation of Structures	3-0-0	3
ENGG	23CIE363	Introduction to Architectural Science	3-0-0	3
ENGG	23CIE364	Sustainable Design of Buildings	3-0-0	3
ENGG	23CIE365	Construction Economics and Finance	3-0-0	3
ENGG	23CIE366	Safety for Professionals	2-1-0	3
ENGG	23CIE367	Building Information Modelling	2-0-3	3
ENGG	23CIE368	Construction Equipment and Techniques	2-1-0	3
ENGG	23CIE369	Formwork Engineering Practices	2-1-0	3
Transportation Engineering				
Cat.	Code	Title	L-T-P	Credit
ENGG	23CIE431	Pavement Design	2-1-0	3

ENGG	23CIE432	Urban Transportation Planning	3-0-0	3
ENGG	23CIE433	Traffic Engineering and Management	3-0-0	3

Hydraulics and Water Resources Engineering				
Cat.	Code	Title	L-T-P	Credit
ENGG	23CIE441	Ground Water Hydrology	3-0-0	3
ENGG	23CIE442	Water Resources Systems Planning and Design	3-0-0	3
ENGG	24CIE431	Hydropower and Irrigation Engineering	2-1-0	3

PROFESSIONAL ELECTIVE COURSES (without Pre Requisite /Open to all)				
Cat.	**Code**	**Title**	**L-T-P**	**Credit**
ENGG	23CIE451	Environmental Impact Assessment	3-0-0	3
ENGG	23CIE452	Remote sensing & GIS	3-0-0	3
ENGG	23CIE453	Transportation System Management and Control	3-0-0	3
ENGG	23CIE454	Geosynthetics Engineering	2-0-3	3
ENGG	23CIE475	Geospatial Techniques in practice	2-1-0	3

List of courses in Amrita Value Programme I & II			
Course Code	**Title**	**L-T-P**	**Credits**
22ADM201	Strategic Lessons from Mahabharatha	1-0-0	1
22ADM211	Leadership from Ramayana	1-0-0	1
22AVP210	Kerala Mural Art and Painting	1-0-0	1
22AVP218	Yoga Therapy and Lessons	1-0-0	1
22AVP212	Introduction to Traditional Indian Systems of Medicine	1-0-0	1
22AVP201	Amma’s Life and Message to the modern world	1-0-0	1
22AVP204	Lessons from the Upanishads	1-0-0	1
22AVP205	Message of the Bhagavad Gita	1-0-0	1
22AVP206	Life and Message of Swami Vivekananda	1-0-0	1
22AVP207	Life and Teachings of Spiritual Masters of India	1-0-0	1
22AVP208	Insights into Indian Arts and Literature	1-0-0	1
22AVP213	Traditional Fine Arts of India	1-0-0	1
22AVP214	Principles of Worship in India	1-0-0	1
22AVP215	Temple Mural Arts in Kerala	1-0-0	1
22AVP218	Insights into Indian Classical Music	1-0-0	1
22AVP219	Insights into Traditional Indian Painting	1-0-0	1
22AVP220	Insights into Indian Classical Dance	1-0-0	1
22AVP221	Indian Martial Arts and Self Defense	1-0-0	1
22AVP209	Yoga and Meditation	1-0-0	1

PROFESSIONAL ELECTIVES UNDER SCIENCE STREAM

CHEMISTRY				
Cat.	**Course Code**	**Title**	**L T P**	**Credit**
SCI	23CHY240	Computational Chemistry and Molecular Modelling	3 0 0	3
SCI	23CHY241	Electrochemical Energy Systems and Processes	3 0 0	3
SCI	23CHY242	Fuels and Combustion	3 0 0	3
SCI	23CHY243	Green Chemistry and Technology	3 0 0	3
SCI	23CHY244	Instrumental Methods of Analysis	3 0 0	3
SCI	23CHY245	Batteries and Fuel Cells	3 0 0	3
SCI	23CHY246	Corrosion Science	3 0 0	3
PHYSICS				
SCI	23PHY240	Advanced Classical Dynamics	3 0 0	3
SCI	23PHY241	Electrical Engineering Materials	3 0 0	3
SCI	23PHY242	Physics of Lasers and Applications	3 0 0	3
SCI	23PHY243	Concepts of Nanophysics and Nanotechnology	3 0 0	3
SCI	23PHY244	Physics of Semiconductor Devices	3 0 0	3
SCI	23PHY245	Astrophysics	3 0 0	3
MATHEMATICS				
SCI	23MAT240	Statistical Inference	3 0 0	3
SCI	23MAT241	Introduction to Game Theory	3 0 0	3
SCI	23MAT242	Numerical Methods and Optimization	3 0 0	3

FREE ELECTIVES

FREE ELECTIVES OFFERED UNDER MANAGEMENT STREAM				
Cat.	Course Code	Title	L T P	Credit
HUM	23MNG331	Financial Management	3 0 0	3
HUM	23MNG332	Supply Chain Management	3 0 0	3
HUM	23MNG333	Marketing Management	3 0 0	3
HUM	23MNG334	Project Management	3 0 0	3
HUM	23MNG335	Enterprise Management	3 0 0	3
HUM	23MNG336	Operations Research	3 0 0	3
HUM	23MEE321	Industrial Engineering	3 0 0	3
HUM	23MEE322	Managerial Statistics	3 0 0	3
HUM	23MEE323	Total Quality Management	3 0 0	3
HUM	23MEE324	Lean Manufacturing	3 0 0	3
HUM	23CSE321	Software Project Management	3 0 0	3
HUM	23CSE322	Financial Engineering	3 0 0	3
HUM	23CSE323	Engineering Economic Analysis	3 0 0	3
HUM	23CSE324	Information Systems	3 0 0	3

FREE ELECTIVES OFFERED UNDER HUMANITIES / SOCIAL SCIENCE STREAMS				
Cat.	Course Code	Title	L T P	Credit
HUM	23CUL230	Achieving Excellence in Life - An Indian Perspective	2 0 0	2
HUM	23CUL231	Excellence in Daily Life	2 0 0	2
HUM	23CUL232	Exploring Science and Technology in Ancient India	2 0 0	2
HUM	23CUL233	Yoga Psychology	2 0 0	2
HUM	23ENG230	Business Communication	1 0 3	2
HUM	23ENG231	Indian Thought through English	2 0 0	2
HUM	23ENG232	Insights into Life through English Literature	2 0 0	2
HUM	23ENG233	Technical Communication	2 0 0	2
HUM	23ENG234	Indian Short Stories in English	2 0 0	2
HUM	23FRE230	Proficiency in French Language (Lower)	2 0 0	2
HUM	23FRE231	Proficiency in French Language (Higher)	2 0 0	2
HUM	23GER230	German for Beginners I	2 0 0	2
HUM	23GER231	German for Beginners II	2 0 0	2
HUM	23GER232	Proficiency in German Language (Lower)	2 0 0	2
HUM	23GER233	Proficiency in German Language (Higher)	2 0 0	2
HUM	23HIN230	Hindi I	2 0 0	2
HUM	23HIN231	Hindi II	2 0 0	2
HUM	23HUM230	Emotional Intelligence	2 0 0	2
HUM	23HUM231	Glimpses into the Indian Mind - the Growth of Modern India	2 0 0	2
HUM	23HUM232	Glimpses of Eternal India	2 0 0	2
HUM	23HUM233	Glimpses of Indian Economy and Polity	2 0 0	2
HUM	23HUM234	Health and Lifestyle	2 0 0	2
HUM	23HUM235	Indian Classics for the Twenty-first Century	2 0 0	2
HUM	23HUM236	Introduction to India Studies	2 0 0	2
HUM	23HUM237	Introduction to Sanskrit Language and Literature	2 0 0	2
HUM	23HUM238	National Service Scheme	2 0 0	2
HUM	23HUM239	Psychology for Effective Living	2 0 0	2
HUM	23HUM240	Psychology for Engineers	2 0 0	2
HUM	23HUM241	Science and Society - An Indian Perspective	2 0 0	2
HUM	23HUM242	The Message of Bhagwat Gita	2 0 0	2
HUM	23HUM243	The Message of the Upanishads	2 0 0	2
HUM	23HUM244	Understanding Science of Food and Nutrition	2 0 0	2
HUM	23HUM245	Service Learning	2 0 0	2
HUM	23JAP230	Proficiency in Japanese Language (Lower)	2 0 0	2
HUM	23JAP231	Proficiency in Japanese Language (Higher)	2 0 0	2
HUM	23KAN230	Kannada I	2 0 0	2
HUM	23KAN231	Kannada II	2 0 0	2

HUM	23MAL230	Malayalam I	2 0 0	2
HUM	23MAL231	Malayalam II	2 0 0	2
HUM	23SAN230	Sanskrit I	2 0 0	2
HUM	23SAN231	Sanskrit II	2 0 0	2
HUM	23SWK230	Corporate Social Responsibility	2 0 0	2
HUM	23SWK231	Workplace Mental Health	2 0 0	2
HUM	23TAM230	Tamil I	2 0 0	2
HUM	23TAM231	Tamil II	2 0 0	2

Evaluation Pattern

THEORY COURSES

Following evaluation pattern will be followed for all **theory courses**

Assessment component	Theory Courses
Continuous Assessment (Quiz,Assignment,Seminar, Project etc)	30
Mid Term Exam	30
End Semester/Project	40

LAB COURSES

Following evaluation pattern will be followed for all **Lab courses**

Assessment component	Lab Courses
Continuous Assessment (Quiz,Assignment,Seminar, Project etc)	40
Mid Term Exam	20
End Semester/Project	40

P/F COURSES

Following evaluation pattern will be followed for all P/F courses

Assessment component	P/F Courses
Continuous Assessment (Quiz,Assignment,Seminar, Project etc)	40
Mid Term Exam	20
End Semester/Project	40

PROJECT

Following evaluation pattern will be followed for all Projects

Assessment component	Projects
Internal Reviews	60
External Review	40
Total	100

SYLLABUS

SEMESTER I

23ENG101	TECHNICAL COMMUNICATION	L-T-P-C: 2-0-3-3

Course Objectives:

- Learn the fundamentals of mechanics of writing
- Acquire the ability to draft formal correspondence and various technical documents
- Develop abilities in critical thinking and analysis
- Acquire skills of scanning for specific information, comprehension, and organization of ideas
- Enhance competency in technical presentation skills

Course Outcomes: The course will enable the student:

CO1	Apply the mechanics of writing in formal correspondence
CO2	Write technical documents with appropriate form and content
CO3	Organize technical information or ideas in a logical and coherent manner
CO4	Compose grammatically and stylistically accurate project reports/ term papers
CO5	Make effective technical presentations

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1									3		
CO2				1					2		
CO3									3		
CO4				1					2		
CO5								2	1		

Unit 1
Error Analysis
Mechanics of Writing: Grammar rules -articles, tenses, auxiliary verbs (primary & modal) prepositions, subject-verb agreement, pronoun-antecedent agreement, discourse markers and sentence linkers, impersonal passive, modifiers, phrasal verbs
General Reading and Listening comprehension - rearrangement & organization of sentences

Unit 2
Different kinds of written documents: Definitions- Descriptions- Instructions-Recommendations- User manuals - Reports – Proposals
Formal Correspondence: Writing Formal Letters/Emails
Punctuation
Scientific Reading & Listening Comprehension

Unit 3
Technical paper writing: Documentation style - Document editing – Proof reading - Organizing and Formatting
Tone and style
Graphical representation
Reading and listening comprehension of technical documents
Mini Technical project / Term paper (10 -12 pages)
Technical presentations

References

1. Hirsh, Herbert. L *Essential Communication Strategies for Scientists, Engineers and Technology Professionals.* II Edition. New York: IEEE press, 2002

2. Anderson, Paul. V. *Technical Communication: A Reader-Centred Approach.* V Edition. Harcourt Brace College Publication, 2003

3. Strunk, William Jr. and White. EB. *The Elements of Style* New York. Alliyan & Bacon, 1999.

4. Riordan, G. Daniel and Pauley E. Steven. *Technical Report Writing* Today VIII Edition (Indian Adaptation). New Delhi: Biztantra, 2004.

5. Michael Swan. *Practical English Usage* Oxford University Press, 2000

23MAT110	CALCULUS	L-T-P-C: 2-1-0-3

Course Objectives:
The following are the objectives of this course:

- Introduce the concepts of shifting and scaling of functions, their continuity, one- and two-sided limits, differentiability,
- Introduce tangents, normals, binormals, curvatures, minima and maxima of functions of single variables, and their applications,
- Introduce derivatives of functions of multiple variables and concepts of partial differentiation,
- Provide a strong foundation on the techniques of integration, evaluation of definite integrals and their engineering applications.

Course Outcomes:

CO1: To understand the concepts of shifting, scaling of functions, limits, continuity, and differentiability.
CO2: To learn definite integral, partial and total derivatives.
CO3: To learn the scalar and vector fields, gradient, divergence and curl of vector fields and their physical interpretations
CO4: To learn line integral, surface integral and volume integrals. To understand Greens Theorem, Divergence theorem and Stokes theorem.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2								
CO2	2	2	2								
CO3	2	2	2								
CO4	2	2	1								

Graphs: Functions and their Graphs. Shifting and Scaling of Graphs. (5 hrs)

Limit and Continuity: Limit of Functions. Continuous Functions, Discontinuities, Monotonic Functions. (5 hrs)

Graphing : Extreme Values of Functions, Concavity and Curve Sketching. (5 hrs).

Integration: Definite Integrals, The Mean Value Theorem for definite integrals, Fundamental Theorem of Calculus. (5 hrs)

Functions of severable variables: Functions, limit and continuity. Partial differentiations, total derivatives, differentiation of implicit functions and transformation of coordinates by Jacobian. Taylor's series for two variables. (10 hrs)

Vector Differentiation: Vector and Scalar Functions, Derivatives, Curves, Tangents, Arc Length, Curves in Mechanics, Velocity and Acceleration, Gradient of a Scalar Field, Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field. (10 hrs)

Vector Integration: Line Integral, Line Integrals Independent of Path.

Green's Theorem in the Plane, Surfaces for Surface Integrals, Surface Integrals, Triple Integrals – Gauss Divergence Theorem, Stoke's Theorem. (10 hrs)

Text Book

1. '*Calculus', G.B. Thomas Pearson Education, 2009, Eleventh Edition.*

References:

1. *'Calculus', Monty J. Strauss, Gerald J. Bradley and Karl J. Smith, 3rd Edition, 2002.*
2. *Advanced Engineering Mathematics, E Kreyszig, John Wiley and Sons, Tenth Edition, 2018.*
3. *Advanced Engineering Mathematics by Dennis G. Zill and Michael R.Cullen, second edition, CBS Publishers, 2012.*

23CSE108	PROBLEM SOLVING AND ALGORITHMIC THINKING	L-T-P-C: 2-1-3-4

Course Objectives

- This course provides the foundations of computational problem solving.
- The course focuses on principles and methods thereby providing transferable skills to any other domain.
- The course also provides foundation for developing computational perspectives of one’s own discipline.

Course Outcomes

CO 1: To apply algorithmic thinking to understand, define and solve problems
CO 2: To design and implement algorithm(s) for a given problem
CO 3: To apply the basic programming constructs for problem solving
CO 4: To understand an algorithm by tracing its computational states, identifying bugs and correcting them

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1												3	
CO2	3	2	3		3			3	3	3				1	
CO3	2	1												2	
CO4	1	1	2		2									2	

Syllabus

Unit 1
Problem Solving and Algorithmic Thinking Overview – problem definition, logical reasoning; Algorithm – definition, practical examples, properties, representation, algorithms vs programs.
Unit 2
Algorithmic thinking – Constituents of algorithms – Sequence, Selection and Repetition, input-output; Computation – expressions, logic; algorithms vs programs, Problem Understanding and Analysis – problem definition, input-output, variables, name binding, data organization: lists, arrays etc. algorithms to programs.
Unit 3
Problem solving with algorithms – Searching and Sorting, Evaluating algorithms, modularization, recursion. C for problem solving – Introduction, structure of C programs, data types, data input, output statements, control structures.

Text Book(s)
Riley DD, Hunt KA. Computational Thinking for the Modern Problem Solver. CRC press; 2014 Mar 27.

Reference(s)
Ferragina P, Luccio F. Computational Thinking: First Algorithms, Then Code. Springer; 2018.
Beecher K. Computational Thinking: A beginner's guide to Problem-solving and Programming. BCS Learning & Development Limited; 2017.
Curzon P, McOwan PW. The Power of Computational Thinking: Games, Magic and Puzzles to help you become a computational thinker. World Scientific Publishing Company; 2017.

23PHY106	ENGINEERING PHYSICS - B	L-T-P-C: 2-1-0-3

Course Objective: to expose the essentials of Newtonian mechanics, Wave optics and elemental Quantum Mechanics to the Engineering students to enable them to apply in their engineering applications.

CO1: To apply the principles of Newtonian mechanics to engineering problems
CO2: To understand the fundamentals of wave optics and it's applications in engineering
CO2: To understand the essentials of Quantum mechanics and apply it to simple applications

Syllabus

Classical Mechanics: Review of Newton's third law and Free Body diagrams. Rigid body dynamics: Centre of mass. Moment of inertia. Torque, angular momentum, and angular acceleration. Work, power, and energy. Conservation of momentum. Conservation of energy. Elastic and inelastic collisions. Circular motion: Radial and tangential forces. Centripetal acceleration and centripetal force. (15 Lectures)

Fundamentals of Wave optics: Theory of superposition -Qualitative: Superposition of two and many Wave trains of the Same Frequency and random phase, Vector addition of amplitudes, Fresnel and Fraunhofer Diffraction - Diffraction by a single and double Slit, intensity variation in single and double slit interference, Effect of increasing the number of Slits(Grating), Intensity distribution from an Ideal grating. Resolving power of grating and grating spectra. Principles of interferometry- Theory of Michelson's Interferometer and its applications.(15 Lectures)

Quantum mechanics: Wave function, Probability density, expectation values - Schrodinger equation – time dependent and independent, Linearity and superposition, expectation values, operators, Eigen functions and Eigen values. Application of 1D Schrodinger Wave equation: Free particle, Particle in a box, Finite potential well- Essentials of semiconducting materials (15 Lectures)

References:

1. Richard Wolfson, "Essential University Physics", Vols. 1 and 2. Pearson Education, Singapore, 2011.
2. Halliday D., Resnick R. and Walker J., "Fundamentals of Physics", Wiley Publications, 2008.
3. Francis A. Jenkins, Harvey E.White, "Fundamentals Of Optics" Forth edition- McGraw-Hill Publications.
4. Beiser A., "Concepts of modern physics", McGraw-Hill India, 2006.

23PHY186	ENGINEERING PHYSICS LAB - B	L-T-P-C: 0- 0-3- 1

Course Objective

- To introduce experiments for testing the understanding of physics concepts in the areas of mechanics, optics, solid state and quantum mechanics and electricity and magnetism.
- To make the student to acquire practical skills in finding properties of mater, optical properties, electrical characteristics of semiconductor materials and quantum behavior of materials
.

Course Outcomes

CO1: Be able to perform experiment to study elastic properties of materials.
CO2: Be able to design, perform experiments on dispersion, interference and diffraction.
CO3: Be able to design; perform experiments to measure semiconducting properties.
CO4: Perform experiment to study atomic spectrum of H_2 atom and quantum nature of light.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	1								
CO2	3	1	1								
CO3	3	1	1								
CO4	3	1	1								

List of Experiments:

1. Young’s modulus - non-uniform bending. [CO 1]
2. Rigidity modulus – moment of inertia of the disc and rigidity modulus of the wire using torsional oscillation. [CO 1]
3. Spectrometer- dispersive power of the material of prism. [CO 2]
4. Radius of curvature of given convex lens- Newton’s rings method. [CO 2]
5. Laser- wavelength of diode laser and mean size of Lycopodium particles. [CO 2]
6. Band gap of a semiconductor. [CO 3].
7. Solar cell - determining efficiency and fill factor. [CO 3].
8. Photoelectric effect - Planck’s constant and work function of the given metal. [CO 4]
9. Experiment to verify the quantum nature of hydrogen atom by measuring the wavelengths of spectral lines in Balmer series. [CO 4].

23CIE101	ENGINEERING DRAWING	L-T-P-C: 2-0-3-3

Course Objectives

The course is expected to enable the students,
To develop drawings using Bureau of Indian Standards (BIS).
To communicate effectively through drawings.
To enhance visualization skills, which will facilitate the understanding of engineering systems.

Course Outcome

CO1: Understand the engineering drawing standards and their usage.
CO2: To understand and summarise technical documents Interpret engineering drawings.
CO3: To construct and dimension geometric entities and improve coherent visualization skills.
CO4: Understand the concepts of orthographic projections and isometric projection.
CO5: Understand the floorplan section and elevation of simple floor buildings

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	3	1	2	3		3		1	
CO2	3	3	3	3		3	1	2	3		3			
CO3	3	3	3	3	3	3	1	2	3		3		1	
CO4	3	3	3	3		3	1	2	3		3		1	
CO5	3	3	3	3	3	3	1	2	3		3		1	

Syllabus

Unit 1
Basic principles of engineering drawing, Standards and conventions, Drawing instruments and their uses, Lettering and types of lines. Concept of scale in drawings, Dimensioning of drawings. Orthographic projections of points, lines

Unit 2
Orthographic projections of planes and solids. Sections of regular solids, Development of lateral surface of regular solids.

Unit 3
Introduction to isometric views and projections, Orthographic projections of isometric drawings. Simple Residential buildings and single storey public buildings such as office and bank with flat and sloped roof – Plan, Section and Elevation

Text Books:
Basant Agarwal and C M Agarwal., "Engineering Drawing", 2e, McGraw Hill Education, 2019

Reference Books:
Bhat N.D. and Panchal V.M. , " Engineering Drawing" , 53e, Charoatar PublishingHouse , 2019
James D. Bethune, "Engineering Graphics with AutoCAD 2023", P e ac h p i t press, 2022
K.R. Gopalakrishna, "Engineering Drawing", 2017, Subhas Publications Narayan
K.L. and Kannaiah P, Engineering Drawing, RadiartPublishing house,2012
John K.C., "Engineering Graphics for Degree", 1e, Prentice Hall India, 2009

23EEE107	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L-T-P-C: 3-0-0-3

Course Objective:

To impart knowledge on the fundamental concepts of Electric circuits, Machines, Electronics Circuits and Measuring Devices.

Course Outcomes:

CO1	Familiarize the basic concepts in electrical magnetic circuits
CO2	Understand the construction and working of various electrical machines and measuring devices
CO3	Illustrate the working of basic electronic circuits and their applications
CO4	Analyze the performance of DC and AC circuits

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1												
CO2	3	1									1			
CO3	3	1	1								1			
CO4	3	2	2											

Syllabus

Unit 1

Introduction to Electrical Engineering, Current and Voltage sources, Resistance, Inductance and Capacitance; Ohm's law, Kirchhoff's law, Energy and Power – Series parallel combination of R, L and C components, Voltage Divider and Current Divider Rules –Network Analysis – Mesh and Node methods, Superposition Theorem, Faraday's Laws of Electro-magnetic Induction, Self and Mutual Inductance, Generation of sinusoidal voltage, Instantaneous, Average and effective values of periodic functions, Phasor representation. Introduction to 3-phase systems.

Unit 2

Electrical Machines: Principles of DC machines and their classification, Single phase transformers- Construction, principle of operation, EMF Equation, Three phase induction motor- Construction, principle of operation. Applications of electrical machines

Unit 3

Voltage regulator, BJT- Transistor as a switch, 555 Timers, Operational Amplifiers – Inverting and Non-inverting amplifier – Instrumentation amplifiers.
Measuring devices- introduction to electro-mechanical, digital devices, sensors and actuators

Text Books

Alexander C K and Sadiku M N O, Fundamentals of electric circuits, 5th edition, New York, McGraw-Hill, 2013.
Adel S. Sedra, Kenneth Carless Smith, Tony Chan Carusone, "Microelectronic Circuits" 7th Edition, Oxford University Press, 2020

Reference Books

1. *Edward Hughes. "Electrical Technology".7th Edition, Pearson Education Asia,2011*
2. *Vincent Del Toro, 'Electrical Engineering Fundamentals', Prentice Hall of India Private Limited, 2003, 2nd Edition.*
3. *David A Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008.*

23EEE187 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB L-T-P-C: 0-0-3-1

Course Objective

- To understand the basics of electrical connections and analyse the performance of electrical machines and electronic circuits.

Course Outcome

CO1: To create basic electrical connections for domestic applications
CO2: To measure the various electrical parameters in the circuit
CO3: To Analyse the performance of electrical machines.
CO4: To Analyse basic electronic circuits.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3		2			2		3			1			
CO2	3				2			3			1			
CO3	3	1	2	2				3			1			
CO4	3	1	2					3						

LIST OF EXPERIMENTS:

Electrical

1. a) Wiring practices
   b) Study of Electrical protection systems.
2. Verification of circuit theorem
3. Experiment on DC machine
4. Experiment on single phase Transformer
5. Experiment on induction motor
6. VI characteristics of PN junction and Zener diode
7. Implementation of Half wave and Full wave rectifier using PN junction diode
8. Transistor as a switch
9. Experiment on Thyristor
10. Implementation of inverting and non-inverting amplifier using Op-amp

REFERENCES / MANUALS / SOFTWARE:
Lab Manuals

22ADM101	FOUNDATIONS OF INDIAN HERITAGE	L-T-P-C: 2-0-1-2

Course Objectives:

- To introduce students to the depths and richness of the Indian heritage and knowledge traditions, and to enable them to obtain a synoptic view of the grandiose achievements of India in diverse fields.
- To equip students with a knowledge of their country and its eternal values.

Course Outcomes

CO1	To understand of true essence of India’s cultural and spiritual heritage. Emancipating Indian histories and practices from manipulation, misunderstandings, and other ideological baggage thus, shows its contemporary relevance.
CO2	Understand the ethical and political strategic concepts to induce critical approach to various theories about India.
CO3	Familiarize students with the multidimension of man’s interaction with nature, fellow beings and society in general.
CO4	To understand and appreciate the socio-political and strategic innovations based on Indian knowledge systems. Gives an understanding of bringing Indian teaching into practical life

CO-PO Mapping:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				2				2			
CO2		1				1	1	3			
CO3						1	2	3			
CO4	3					3	3	3			

Syllabus:

Unit 1
Chapters 1-4
Educational Heritage of Ancient India
Life and Happiness
Impact of Colonialism and Decolonization
A timeline of Early Indian Subcontinent

Unit- 2
Chapters 5- 8
Pinnacle of Selflessness and ultimate freedom
Indian approach towards life
Circle of Life
Ocean of love; Indian Mahatmas.

Unit 3
Chapters 9 -12
Man's association with Nature
Celebrating life 24/7.

Metaphors and Tropes
Become A Strategic Thinker (Games / Indic activity)
Unit 4
Chapters 13 -16
India: In the Views of Other Scholars and Travellers
Personality Development Through Yoga.
Hallmark of Indian Traditions: Advaita Vedanta, Theory of oneness
Conversations on Compassion with Amma

Textbook

1. *Foundations of Indian Heritage- In-house publication*

Reference Book(s)

1. *The beautiful tree by Dharampal – Other India Press,Mapusa, 2000*
2. *Peasants and Monks in British India by William Pinch – University of California Press.1996*
3. *India, that is Bharat: Coloniality, Civilisation, Constitution by J Sai Deepak -Bloomsbury India, 2021*
4. *Awaken Children Dialogues with Mata Amritanandamayi, MAM Publications*
5. *Man, and Nature by Mata Amritanandamayi Devi , MAM Publications*
6. *What Becomes of the Soul After Death, Sri Swami Shivananda, Divine Life Society,1999*

SEMESTER II

23MAT128 **LINEAR ALGEBRA** **L-T-P-C: 2-1-0-3**

Course Objectives:

Understand the basic concepts of vector space, subspace, basis and dimension.
Familiar the inner product space. Finding the orthogonal vectors using inner product.
Understand and apply linear transform for various matrix decompositions.

Course Outcomes:

CO1: To Understand the basic concepts of vector space, subspace, basis and dimension.
CO2: To Understand the basic concepts of inner product space, norm, angle, Orthogonality and projection and implementing the Gram-Schmidt process, to obtain least square solution
CO3: To Understand the concept of linear transformations, the relation between matrices and linear transformations, kernel, range and apply it to change the basis and to transform the given matrix to diagonal form.
CO4: To understand the eigen values and eigen vectors and apply to transformation problems.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1								
CO2	3	3	2								
CO3	3	3	2								
CO4	3	2	1								

Vector Spaces: Vector spaces - Sub spaces - Linear independence - Basis – Dimension. (10 hrs)

Inner Product Spaces: Inner products - Orthogonality - Orthogonal basis - Gram Schmidt Process - Change of basis - Orthogonal complements - Projection on subspace - Least Square Principle. QR- Decomposition. (10 hrs)

Linear Transformations: Linear transformation - Relation between matrices and linear transformations - Kernel and range of a linear transformation - Change of basis. Symmetric and Skew Symmetric Matrices, Adjoint and Hermitian Adjoint of a Matrix. (10 hrs)

Eigen values and Eigen vectors: Eigen Values and Eigen Vectors, Diagonalization, Orthogonal Diagonalization, Quadratic Forms, Diagonalizing Quadratic Forms, Conic Sections. Similarity of linear transformations - Diagonalisation and its applications.
Solving system of equations using Guess iterative methods. Power method for eigenvalue and eigenvector. (12 hrs)

Text Book:

Howard Anton and Chris Rorres, "Elementary Linear Algebra", Tenth Edition, John Wiley & Sons, 2010.

References:

Nabil Nassif, Jocelyne Erhel, Bernard Philippe, Introduction to Computational Linear Algebra, CRC press, 2015.
Sheldon Axler, Linear Algebra Done Right, Springer, 2014.
Gilbert Strang, "Linear Algebra for Learning Data", Cambridge press, 2019.
Kenneth Hoffmann and Ray Kunze, Linear Algebra, Second Edition, Prentice Hall, 1971.
Mike Cohen, Practical Linear Algebra for Data Science, Oreilly Publisher, 2022.

23CHY108	ENGINEERING CHEMISTRY A	L-T-P-C: 2-1-0-3

Course Objective: The objective of the course is to impart knowledge on the concepts of chemistry involved in the application of engineering materials that are used in the industry/day-to day life.

Course Outcomes
After completion of the course, students will be able to,
CO1: characterize the solids using X-ray diffraction technique and analyse the materials using computational tools.
CO2: apply the fundamental principles of electrochemistry to illustrate the functioning of electrochemical energy systems.
CO3: apply the knowledge of chemistry to predict the type of corrosion in engineering materials and suggest suitable prevention methods.

CO-PO Mapping

Syllabus
Solid state
Crystalline and amorphous solids, isotropy and anisotropy, - Miller indices, space lattice and unit cell, Bravais lattices, the seven crystal systems and their Bravais lattices, X-ray diffraction - Bragg's equation and experimental methods (powder method and rotating crystal technique), types of crystals - molecular, covalent, metallic and ionic crystals - close packing of spheres – hexagonal, cubic and body centred cubic packing, elements of symmetry in crystal systems, defects in crystals – stoichiometric, non-stoichiometric, extrinsic and intrinsic defects. Vesta – for visualization of crystal structures.

Electrochemical energy system
Faradays laws, origin of potential, electrochemical series, reference electrodes, Nernst equation, introduction to batteries - classification - primary, secondary and reserve (thermal) batteries. Characteristics - cell potential, current, capacity and storage density, energy efficiency. Construction, working and application of Leclanche cell-Duracell, Li-MnO2 cell, lead acid batteries. Ni-Cd battery, Lithium ion batteries. Fuel cell - construction and working of PEMFC.

Corrosion control and metal finishing.
Introduction, causes and different types of corrosion and effects of corrosion, theories of corrosion - chemical corrosion, Pilling Bed-worth ratio, electrochemical corrosion and its mechanism, factors affecting corrosion - galvanic series. Corrosion control methods - cathodic protection, sacrificial anode, impressed current cathode. Surface coatings - galvanizing, tinning, electroplating of Ni and Cr, organic surface coatings - paints, constituents and functions. Anodising and electroplating of aluminium.

References:
1. Jain and Jain, "Engineering Chemistry", Dhanpat Rai Publishing company, 2015
2. Patrick M. Woodward, Pavel Karen, John S. O. Evans, Solid State Materials Chemistry, Cambridge University Press, 2021
3. Vladimir S. Bagotsky, Alexander M. Skundin, Yurij M. Volfkovich, Electrochemical Power Sources Batteries, Fuel Cells, and Supercapacitors, John Wiley and Sons, 2015
4. Sanjay K Sharma, Green corrosion chemistry, John Wiley and Sons, 2012
5. Philip A. Schweitzer, P.E, Fundamentals of Corrosion Mechanisms, Causes, and Preventative Methods, CRC Press, 2009.

23CHY188	ENGINEERING CHEMISTRY LABORATORY	0 0 3 1

Course Objectives:

- Using instrumental techniques to analyze the ions present in water.
- To understand the kinetics of chemical reactions and adsorption principles.
- To determine the rate of corrosion and its control.
- To synthesis nanoparticles and determine the surface charge of oxide particles.
- To estimate the amount of given substances using electrochemical methods.

Course Outcomes:

CO1	Analyze the ions present in the given sample water
CO2	Analyze the adsorption isotherm and determine the rate constant of a reaction
CO3	Apply the solid state chemistry principles for preparing nanoparticles and determining the surface charge on oxides.
CO4	Apply the fundamental principles of electrochemistry for the analysis of given substance and understand the corrosion kinetics

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO01	3	1			1	1		1						
CO02	3	1						1						
CO03	3	1						1						1
CO04	3	1						1						

Chemical Kinetics and surface chemistry – understanding the principle of adsorption, determining the rate constant of a reaction.
Electrochemistry – Evaluating the dissociation constant of acids, estimation of acid and ferrous ion present in water.
Corrosion and control – anodization and Tafel plot
Instrumentation techniques – Estimations of ions in water using flame photometer and UV-Visible spectrophotometer.
Solid state - Determination of point of zero charge of metal oxide.

List of Equipment required for meeting the COs

S. No.	List of Equipment
1.	Conductivity Bridge
2	Potentiometer
3.	UV-Visible spectrophotometer
4.	Colorimeter
5.	pH meter
6.	Flame photometer
7.	Weighing balance
8.	DC Power source
9	Multimeter

List of Exercises		
S.No.	**List of Exercises**	**CO mapping**
1.	Adsorption of acetic acid by charcoal	**CO2**
2.	Adsorption of dye on charcoal	**CO2**
3.	Determination of rate constant for acid catalyzed ester hydrolysis	**CO2**
4.	Estimation of ferrous ion by potentiometric titration	**CO1**
5.	Potentiometric titration of dibasic acid Vs strong base	**CO4**
6.	Conductometric titration of mixture of acid Vs NaOH	**CO4**
7.	Verification of B-L law by UV-spectrophotometer	**CO1**
8.	Determination of point of zero charge of metal oxide	**CO3**
9.	Synthesis of polyaniline conducting polymer via electrochemical polymerization	**CO4**
10.	Synthesis of silver nanoparticle by chemical reduction method	**CO3**
11.	Determination of sodium and potassium ions in water using Flame photometry	**CO1**
12.	Kinetics of electrochemical reactions - Construction of Tafel linear polarization curves	**CO4**
13.	Determination of optimum current density for the anodization of aluminium	**CO4**

23CIE111	INTRODUCTION TO COMPUTING	L-T-P-C: 2-0-3-3

Pre-Requisite(s): 22CSE100 Problem Solving and Algorithmic Thinking

Course Objectives

- This course provides the foundations of programming.
- Apart from the usual mechanics of a typical programming language, the principles and methods will form the main focus of this course.
- Shift from learn to program to programming to learn forms the core of this course.

Course Outcomes

CO 1: Understanding the basics of Python and its packages along with assignment statement, basics, control structures, function definitions.
CO 2: Understanding the basics of MATLAB and its toolboxes along with arithmetic and array operations, control and function files.
CO 3: Make use of the programming constructs appropriately and effectively while developing computer programs.
CO 4: Develop computer programs that implement suitable algorithms for problem scenarios and applications.

CO-PO Mapping

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1					1					1	
CO2	1	1	1					1					1	
CO3	1	1	1					1					1	
CO4	1	2	2					2					2	
CO5	2	3	2					3					2	

Syllabus

Unit 1: Python
Introduction to Programming and Python Languages, Python packages, Variables, Controls, Assignment Statement, Basic Types, Introduction to Lists, Loops, Strings, Tuples, Sets, Arrays. Introduction to Jupyter Notebook.

Unit 2: Python
Control Structures, Selection & Insertion, Sort, Recursion, Function definitions, Dictionaries & Files, Application of functions, Plotting in Python
Developing program for: Solving Polynomial Equations
Developing program for: Lagrange Interpolation, Numerical Integration: Newton-Cotes Integration formula.

Unit 3: Matlab
Introduction to MATLAB, Basics of programming using MATLAB and its Toolboxes, Arithmetic Operations, Arrays operations, Loops & execution Control, MATLAB files: Scripts & Functions, Plotting and Output, Iterative Methods, In-built MATLAB Functions
Developing program for: Errors in numerical computation, Numerical Differentiation, Solving linear Equation

Text Book(s)

1. *Ascher D, Lutz M. Learning Python. Second Edition, O'Reilly Media, 2003.*
2. *Attaway S. Matlab: A practical introduction to Programming and Problem Solving. Second Edition, Butterworth-Heinemann, 2011.*

Reference(s)

1. *Gupta R. Making use of Python. First Edition, John Wiley & Sons, 2002*
2. *Kiusalaas J. Numerical Methods in Engineering with Python. Second Edition, Cambridge University Press, 2010.*
3. *Vaingast S. Beginning Python Visualization: Crafting Visual Transformation Scripts, Apress, Second Edition, 2014.*
4. *Chapman SJ. MATLAB Programming for Engineers. 6th Edition, CL Engineering, 2019*
5. *Shampine LF, Gladwell I, Thompson S. Solving ODEs with MATLAB. Cambridge University Press, 2003.*

23CIE112	COMPUTER AIDED DRAFTING	L-T-P-C: 1-0-6-3

Course Objectives

- Demonstrate the importance of Computer Aided Drafting packages for industry practiceIntroduce standards and codes to produce engineering drawings
- Understand and interpret the engineering drawings
- Provide hands on training to become proficient with 2D Computer Aided drafting of single story buildings

Course Outcome

CO1: Appreciate the standard drawing codes and practices which is required for producing engineering drawings.

CO2: Construct accurate 2D geometry as per the dimensions following standard drawing practices with proper dimensioning using Computer Aided drafting software.

CO3: Create 2D representations of 3D objects as plan view, elevations, side views and sections / auxiliary views using Computer Aided drafting software.

CO4: Develop isometric drawings using orthographic views and single story buildings using Computer Aided drafting software.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1									3					
CO2					2				3					
CO3					2				3				1	
CO4					2				3				1	

Syllabus

Unit 1

Drawing standards - Introduction to CAD software - CAD user interface -Data input modes -Short keys- Coordinate systems. Units – Setting Limits– Draw Panel– Lines, Circles, Arcs, Ellipse, Rectangle, Polygons, Polylines, Splines-Status bar functions: Grid, Snap, Polar tracking, and Object snap.- Sketching basic geometric entities of usual civil engineering drawings

Unit 2

Modify panel: Move, Copy, Rotate, Offset, Mirror, Scaling, Trim, Extend, Erase, Explode, Fillet and Chamfering-Layer Properties: Freeze, Lock, Line type, Line weight- Hatch and Gradient- Text-Dimension styles . Conventional signs for sections for Civil Engineering drawing

Unit 3

Sketching with blocks and groups -Printing and Publishing drawings –, Detailed drawing of Components: Doors & Windows, footing, stair case Residential building- flat (Single and two floored) and pitched roof, Public building – hostels, dispensary etc.

Text Book(s)

1. *James D. Bethune, "Engineering Graphics with AutoCAD 2023", Peachpit press, 2022*
2. *Gopalakrishna, K.R., and Sudheer Gopalakrishna "Computer Aided Engineering Drawing", Subhas Publications, 2017.*

AUTO-CAD manual (In-House)

23CIE181	EXPLORING CIVIL ENGINEERING – TRENDS AND CHALLENGES	0-0-3-P/F

Course Objectives:

To give an understanding about the areas of specializations available in the field of Civil Engineering

To motivate the student to pursue a career in one of the many areas of Civil Engineering with deep interest and keenness.

To expose the students to the various avenues available for doing creative and innovative work by showcasing many monuments and inspiring projects of public utility.

Course Outcome:

CO 1: Understand the relationship between the knowledge of basic science to civil engineering practice.

CO 2: Understand the importance of different component fields within civil engineering.

CO 3: Understand the importance of civil engineering practice in the most ethical manner for sustainable development.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3											2	2	
CO2						1		3				2	2	
CO3						3						1	1	2

Syllabus

Overview of Civil Engineering - Basic Understanding and History of Civil engineering - Fundamentals of Civil Architecture and Town Planning - Industrial Case Studies of National Infrastructure projects - Current national planning for civil engineering/ infrastructure projects, scope of work involved in various branches of Civil Engineering–

Surveying &Geomatics, Structural Engineering - Introduction to Mechanics of Structure - Types of structures - Fundamentals of Building Materials - Sustainability in Construction - Construction and contract management, Geotechnical Engineering - Soil Mechanics - Rock Mechanics and Geology - Types of Foundations

Hydraulic and Water Resources Engineering - Fluid Properties - Water cycle and fluid mechanics - Water Resources Structures Engineering, Environmental Engineering &Sustainability - Water Treatment and Supply, Traffic & Transportation Engineering and Management - Major transport infrastructure developments in India - Pavement materials - Public transport systems, Avenues for entrepreneurial working, Creativity & Innovativeness in Civil Engineering.

Introduction to the civil engineering undergraduate curriculum map - the relationship between the courses in the curriculum.

PRACTICAL ACTIVITIES

- Bridge model construction
- House plan and model
- Stability of structures
- Dam Construction
- Entrepreneurial opportunities in civil engineering

Text Book(s)

Manabendra Saharia and Nagendra R. Velaga, " Introduction to Civil Engineering", AICTE,2023
ValdengraveOkumu, "An Introduction to Civil Engineering", CreateSpace Independent Publishers, 2014.
S. T. Mau and Sami Maalouf, "Introduction to Civil Engineering: A Student's Guide to Academic and Professional Success", Cognella, Inc; 2014
Bhavikatti. S. S., "Basic Civil Engineering", New Age International Publishers, 2010.
National Building Code of India, BIS, (2016)
Code of ethics - www.ieindia.org .

23CIE113	MECHANICS: STATICS AND DYNAMICS	L-T-P-C: 2-1-0-3

Course Objectives

To understand the procedure for analysis of static objects; concepts of force, moment, and mechanical equilibrium.
To analyze forces and moments in two and three dimensions due to concentrated and distributed forces in various systems such as beams, frames and trusses.
To analyze the bodies in motion using the basics of kinetics and kinematics.

Course Outcome

CO1: Able to analyze force systems in plane and also in space

CO2: Able to solve two- and three-dimensional rigid body static equilibrium problems.

CO3: Able to determine the centroid of planes, center of gravity of masses and evaluate their moment of inertia.

CO4: Able to evaluate velocity and acceleration of a particle in rectangular and cylindrical coordinate systems and angular velocity of rigid bodies that are in plane motion.

CO5: Able to solve the problems related to bodies in dynamic equilibrium and bodies undergoing forced and free vibration using the laws of kinetics.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3									2	3		
CO2	3	3			1						2	3		
CO3	3	3									2	3		
CO4	3	3									1	3		
CO5	3	3			1						1	3		

Syllabus

Unit 1
Principles of statics: Introduction to vector approach – free body diagrams –forces in plane – forces in space – concurrent forces - resolution of forces –equilibrium of particle.
Statics of rigid bodies in two dimensions and three dimensions: Moment of a force about a point – moment of a force about an axis – moment of a couple – equivalent force couple system – rigid body equilibrium – support reactions.

Unit 2
Applications of statics: Friction – contact friction problems. Analysis of trusses –method of joints – method of sections.
Properties of surfaces and solids - Centroid, Moment of inertia, Polar moment of inertia, Mass moment of inertia, Product of inertia and Principal moment of inertia.

Unit 3
Dynamics: Rectangular and cylindrical coordinate system - Combined motion of rotation and translation - Newton’s second law in rectilinear translation - D’Alembert’s principle - Concepts of Mechanical vibration - free and forced vibrations, resonance and its effects; Degree of freedom; Frequency and amplitude of free vibrations without damping and single degree of freedom system, examples, Validation of theory using SkyCiv software.

Text Book(s)

S. Timoshenko , D.H. Young , J.V. Rao , Sukumar Pati, "Engineering Mechanics" (In SI Units) (SIE) | 5th Edition , 2017

Beer, F. P. and Johnston, E. R., "Vector Mechanics for Engineers- Statics and Dynamics", 8/e, McGraw Hill International Book Co., 2008.
Shames, I. H, "Engineering Mechanics – Statics and Dynamics", 4/e, Prentice–Hall of India Pvt. Ltd., 2003.

Reference Books

Hibbeler, R. C., "Engineering Mechanics', 12/e, Pearson Education Pvt. Ltd., 2007.
Meriam, J. L., "Dynamics", 5/e, John Wiley & sons, 2003.
K. L. Kumar, "Engineering Mechanics", 3/e, Tata McGraw Hill, 2003.

23CIE114	BASIC MECHANICAL ENGINEERING	L-T-P-C: 2-0-0-2

Course Objective:

- Understand the fundamental concepts of thermodynamics and be able to define and apply the terms system, surroundings, boundary, thermodynamic equilibrium, properties, state, process, and cycle.
- Describe the principles of refrigeration, including mechanical refrigeration and the reversed Carnot cycle, and be able to calculate the coefficient of performance (COP) of a refrigeration system.
- Identify and define the various types of heat transfer, including conduction, convection, and radiation, and be able to apply the basic laws of heat transfer to practical applications.
- Understand the mechanical properties of metallic materials, including stress-strain curves, ductility, resilience, toughness, and hardness, and be able to classify metallic materials based on their properties and microstructures.
- Applying the necessary heat treatment methods to steels and explaining the properties, microstructures, and uses of different kinds of ferrous and non-ferrous alloys, such as cast iron, steel, brass, bronze, aluminium, nickel, and zinc alloys.
- Gain exposure by observing the laboratory experiments, including the performance study of refrigeration and air conditioning systems, microstructure analysis of ferrous and non-ferrous alloys, and weldability testing using ISO 17641 and a field visit to the manufacturing or fabrication industry.

Course Outcome

CO01 Comprehend the significance of thermodynamics in the fields of engineering and technology.

CO02 Apply the fundamental concepts and solve problems related to thermodynamics.

CO03 Distinguish the different types of heat transfer.

CO04 Identify metallic materials' significance in diverse engineering and technology fields.

CO05 Analyse and compare the properties of different types of ferrous and non-ferrous alloys.

CO06 Develop practical skills by observing laboratory experiments and through a field visit.

CO- PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO01	2					1					2	3		
CO02	2	2	1			1					3			3
CO03	1	3									1	2		
CO04	2					1					2	2		
CO05	2	1	1			1					2			2
CO06	3					1					3			

Syllabus

Unit 1

Introduction to Thermodynamic terms - System, Surroundings, Boundary, Thermodynamic Equilibrium, Properties, State, Process and Cycle, Energy Interactions - Heat and Work. Refrigeration: Mechanical Refrigeration and types – units of refrigeration –reversed Carnot cycle, COP, vapour compression cycle (only description and no problems); Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners. Working of summer and winter air-conditioning units. Modes and mechanisms of heat transfer – Basic laws of heat transfer – General discussion about applications of heat transfer.

Unit 2

Basic principles of crystalline materials, classification of metallic materials, Mechanical properties - stress-strain curves for ductile and brittle alloys. Ductility – Resilience and toughness. Hardness testing. Classification of cast iron and steels - properties, microstructures and uses of cast irons, plain carbon, alloy, stainless, heat resistant steels. Composition, properties, microstructures and uses of non-ferrous alloys - brass, bronze, aluminium, nickel and zinc alloys. Heat treatment of steels: annealing, normalizing, hardening and tempering.– Introduction to metal cutting – Residual Stresses – Weldability of metals. Introduction to manufacturing of cold forming of steels -Cold form sections-.

Unit 3

LAB **only demonstration**

1. Performance study of Refrigeration
2. Performance study of Air conditioning
3. Microstructure study of Ferrous and Non-Ferrous alloys
4. Effect of heat on hardened steel
5. Weldability study using ISO 17641 and 17642 Field visit to steel manufacturing/fabrication plant

Text Book

1. *Cengel Y. A. & Boles M. A., "Thermodynamics - an Engineering Approach", 8/e, Tata McGraw Hill, 2016*
2. *Callister W. D. - 'Materials Science and Engineering' - John Wiley & Sons – 2010 - 8 th Edition*

23MEE182	MANUFACTURING PRACTICE-B	L-T-P-C: 0-0-3-1

Course Objectives:

- Imparting the knowledge of general safety procedures that should be observed on the shop floor.
- Use modelling software to design and print simple geometry for additive manufacturing processes.
- Hands-on experience - arc welding and soldering operations.
- Use of different tools and accessories used for basic manufacturing processes.
- Familiarize with the essential pneumatic and electro-pneumatic components for automation and design pneumatic / electropneumatic circuits for the given simple application
- Understanding the functioning of various sub-systems of automobiles, such as the power train, steering system, suspension system, and braking system and realize the importance of recent developments in automotive technologies.

Course Outcomes

After successful completion of the lab course, students will be able to:

CO01 Practice safety procedures in a shop floor environment.
CO02 Select appropriate tools and methods for basic manufacturing processes.
CO03 Build simple geometries using additive manufacturing process.
CO04 Perform basic metals joining using welding and soldering.
CO05 Design, simulate and test simple pneumatic and electro pneumatic circuit for automation application
CO06 Understand the functioning of automotive systems and realize the importance of recent developments in automotive technologies.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	1			1			1		2			
CO2	2	3				2			2		3	1		
CO3	2	2	1		3	2			2	1	3		1	
CO4	2	3	2						2	1	3	2		
CO5	3	2	2		3				2	1	3		1	
CO6	3	2	2		3				3	1	3			1

Syllabus

1. **Additive Manufacturing Laboratory –12 hours**

Introduction to digital manufacturing. Introduction to Additive Manufacturing - types – additive manufacturing applications - Materials for 3D printing, CAD Modelling for Additive manufacturing, Slicing and STL file generation- G code generation - 3D printing of simple geometries.

2. **Mechanical Engineering Laboratory –12 hours**

Study of tools and equipment used for basic manufacturing processes.
Manual arc welding practice for making Butt and Lap joints - Soldering Practice
Introduction to Machine Tools and Machining Processes

3. **Automation lab –12 hours**

Design, simulate and test pneumatic and electro-pneumatic circuits. Introduction to PLC –PLC programming for automation applications.

4. **Automobile Engineering lab –9 hours**

Overview of automobiles – components –functioning of various sub-systems; Power train, steering system, suspension system and braking system. Introduction to electric vehicles, hybrid vehicles, alternate fuels. Introduction to E Mobility.

Reference Books:

Lab Manual

List of Equipment required for meeting the COs

Name of the lab.	List of Equipment
Additive Manufacturing Laboratory	1. Fused filament 3D printing machines 2. Modelling software & Computers (Minimum i5 Processor) 3. Slicing software
Mechanical Engineering Laboratory	1. Tools and accessories for welding & soldering. 2. SMAW welding power source with electrodes and safety equipment. 3. Soldering setup 4. Basic machine tools for process demonstration – Lathe, Drilling, Milling, Grinding and CNC.
Automation lab	1. Basic pneumatic kit 2. Basic electro-pneumatic kit 3. PLC trainer kit 4. Software : Fluid SIM/ Automation Studio
Automobile Engineering lab	1. Cut section/ Working model of 2-stroke and 4 -Stroke engine. 2. Cut section/ Working model of Braking Mechanism, Steering Mechanism, suspension System, Automobile Gearboxes & Differential Unit 3. Electric vehicle 4. Hybrid Vehicle.

List of Exercises

Name of the Lab.	List of Exercises	CO mapping
	General Workshop Safety Measures and Practices	CO01
Additive Manufacturing Laboratory	1. Introduction to sketching and CAD modelling for Additive manufacturing. 2. Conversation of CAD Model to STL file, slicing and G-code generation 3. Prototyping using 3D printing	CO02, CO03
Mechanical Engineering Laboratory	1. Manual arc welding practice- butt and Lap joint. 2. Soldering practice- wire joints 3. Introduction to basic Machine tools and Machining Process –Demonstration	CO01 CO02, CO04
Automation lab	1. Study of pneumatic actuators and control valves. 2. Design, simulate and testing of pneumatic circuits. 3. Design, simulate and testing of electro-pneumatic circuits 4. PLC programming for automation applications	CO05
Automobile Engineering lab	1. Demonstrating the working of various subsystems of automobiles- Power train, steering system, suspension system and braking system. 2. Demonstrate the working of electric and hybrid vehicles.	CO06

22AVP103	Mastery Over Mind	L-T-P-C 1-0-2-2

Course Objectives:

The course will enable the students to

- Mastery Over Mind (MaOM) is an Amrita initiative to implement schemes and organize university-wide programs to enhance health and wellbeing of all faculty, staff, and students (UN SDG -3)

- It gives an introduction to immediate and long-term benefits of MA OM meditation and equips every attendee to manage stressful emotions and anxiety, in turn facilitating inner peace and harmony.

- This course will enhance the understanding of experiential learning based on the University's mission: "Education for Life along with Education for Living" and is aimed to allow learners to realize and rediscover the infinite potential of one's true
- Being and the fulfilment of life's goals.

Course Outcomes:
After successful completion of the course, Students will be able to:

S.No.	Course Outcomes
CO01	To be able to describe what meditation is and to understand its health benefits
CO02	To understand the causes of stress and how meditation improves well-being
CO03	To understand the science of meditation
CO04	To learn and practice MAOM meditation in daily life
CO05	To understand the application of meditation to improve communication and relationships
CO06	To be able to understand the power of meditation in compassion-driven action

E. CO-PO Mapping: [affinity#: 3 – high; 2- moderate; 1- slightly]

COs	**Program Outcomes [POs]**										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO01							1	2	2		2
CO02			2		2			2	2		2
CO03					2		2	2	2		2
CO04			3		3	2	3	3	3		3
CO05			2		2		2	2	3		3
COO6			2				2	2	3		3

Unit 1:
Describe Meditation and Understand its Benefits (CO1)
A: Importance of meditation. How does meditation help to overcome obstacles in life *(Pre-recorded video with Swami Shubhamritananda Puri)*
Reading 1: Why Meditate? (Swami Shubamritananda ji)

Unit 2:
Causes of Stress and How Meditation Improves Well-being (CO2)
A: Learn how to prepare for meditation. Understand the aids that can help in effectively practicing meditation. Understand the role of sleep, physical activity, and a balanced diet in supporting meditation. (*Pre-recorded video with Dr. Ram Manohar)*
B: Causes of Stress. The problem of not being relaxed. Effects of stress on health. How meditation helps to relieve stress. Basics of stress management at home and the workplace. *(Pre-recorded video with Prof Udhaykumar)*
Reading 1: Mayo Clinic Staff (2022, April 29). *Meditation: A Simple, Fast Way to Reduce Stress.* Mayo Clinic. https://www.mayoclinic.org/tests-procedures/meditation/in-depth/meditation/art-20045858 (PDF provided)
Reading 2: 'Efficient Action.' Chapter 28 in *Amritam Gamaya* (2022). Mata Amritanandamayi Mission Trust.

Unit 3:

The Science of Meditation (CO3)
A: A preliminary understanding of the Science of meditation. What can modern science tell us about this tradition-based method? *(Pre-recorded video with Dr. Shyam Diwakar)*
B: How meditation helps humanity according to what we know from scientific research *(Pre-recorded video with Dr. Shyam Diwakar)*
Reading 1: Does Meditation Aid Brain and Mental Health (Dr Shyam Diwakar)
Reading 2: 'Science and Spirituality.' Chapter 85 in Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.

Unit 4:
Practicing MA OM Meditation in Daily Life (CO4)
Guided Meditation Sessions following scripts provided (Level One to Level Five)
Reading 2: 'Live in the Present Moment.' Chapter 71 in *Amritam Gamaya* (2022). Mata Amritanandamayi Mission Trust.

Unit 5:
Improving Communication and Relationships (CO5)
How meditation and mindfulness influence interpersonal communication. The role ofmeditation in improving relationship quality in the family, at the university and in theworkplace. *(Pre-recorded video with Dr Shobhana Madhavan)*
Reading 1: Seppala E (2022, June 30th) *5 Unexpected Ways Meditation Improves Relationships a Lot.* Psychology Today. https://www.psychologytoday.com/intl/blog/feeling-it/202206/5-unexpected-ways- meditation-improves-relationships-lot
Reading 2: 'Attitude.' Chapter 53 in *Amritam Gamaya* (2022). Mata AmritanandamayiMission Trust.

Unit 6
Meditation and Compassion-driven Action (CO6)
Understand how meditation can help to motivate compassion-driven action. *(Pre-recorded video with Dr Shobhana Madhavan)*
Reading 1: Schindler, S., & Friese, M. (2022). The relation of mindfulness and prosocialbehavior: What do we (not) know?. *Current Opinion in Psychology*, *44*, 151-156.
Reading 2: 'Sympathy and Compassion.' Chapter 100 in *Amritam Gamaya* (2022). MataAmritanandamyi Mission Trust.

Course Assessment Specification Table:

		CO1	CO2	CO3	CO4	CO5	CO6	Total
1	**Reflection**					10	10	20
2	**Group Activities**	20*						20
3	**Class Participation**				40			40
4	**Written Examination**	5	5	5		5		20

*The Group Activities could be related to CO1, CO2 or CO3 depending on the preference of the instructor

Text Books/Reference Books:

1. *Meditation and Spiritual Life-Swami Yatiswarananda, Ramakrishna Math*
2. The Complete Works of Swami Vivekananda Vol Vii by Advaita Ashram Mayavati Almora Himalayas
3. Dhyana Yoga-Holy Gita Swami Chinmayanda
4. Voice of God, Chandrasekharendra Saraswati, 68th Acharya of Sri Kanchi Kamakoti Peetam,
5. Hindu Dharma-Chandrasekharendra Saraswati, 68th Acharya of Sri Kanchi Kamakoti Peetam,
6. Mind: It's Mysteries and control-Swami Sivananda Saraswati
7. Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.
8. Books on Amma's teachings like Awaken children, From Amma's Heart etc.
9. The Science of Meditation: How to Change Your Brain, Mind and Body by Daniel Goleman and Richard. J. Davidson.
10.Allen, Cynthia (2020) The Potential Health Benefits of Meditation
11. Seppala E (2022, June 30th Unexpected Ways Meditation Improves Relationships a Lot.Psychology Today
12. Sharma, Hari (2022) Meditation: Process and Effects
13. Mayo Clinic Staff (2022, April 29). Meditation: A Simple, Fast Way to Reduce Stress.
14. Schindler, S., & Friese, M. (2022). The relation of mindfulness and prosocial behavior: Current Opinion in Psychology

22ADM111	GLIMPSES OF GLORIOUS INDIA	L-T-P-C: 2-0-1-2

Course Objectives:

- The course aims at introducing Bhārath in nutshell to the student, which includes the sources of Indian thoughts, eminent personalities who shaped various disciplines, India’s significant contribution to mankind, the current stature of India in geopolitics and the Indian approach to science and ecology.

Course Outcome Statements (Cos):

After the completion of the course, the student:

CO1 - Will be able to recognise the call of Upanishads and outstanding personalities for confronting the wicked in the real world while admiring the valour, pursuit and divinity in both classical and historical female characters of India.

CO2 - Will get introduced to Acharya Chanakya, his works, and his views on polity and nation to find synchrony between public and personal life, alongside understanding India's cultural nuances and uniqueness concerning the comprehension of God across major global communities.

CO3 - Will be able to appreciate Bhagavad Gita as the source of the Indian worldview through the various Yogic lessons enshrined in it, making it one of India's numerous soft powers, and also understand the faith-oriented mechanism of preserving nature.

CO4 - Will be informed about the enormous contribution of Indian civilisation over two and a half millennia to humanity and develop awareness about India's approach toward science, devoid of dogmas and rooted in humanism.

CO-PO- Mapping:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1			1	2				2			
CO2	2	1				1		3	1		
CO3	2		1	2	1	1		3			
CO4	2			3				3	2		

Unit-1

1. Chapter 1 – Face the Brutes
2. Chapter 2 – Role of Women in India
3. Chapter 3 – Acharya Chanakya
4. Chapter 4 – God and Iswara

Unit-2

5. Chapter 5 – Bhagavad Gita: From Soldier to Samsarin to Sadhaka
6. Chapter 6 – Lessons of Yoga from Bhagavad Gita
7. Chapter 7 – Indian Soft powers
8. Chapter 8 – Preserving Nature through Faith

Unit-3

9. Chapter 9 - Ancient Indian Cultures (Class Activity)
10. Chapter 10 - Practical Vedanta
11. Chapter 11 - To the World from India
12. Chapter 12 - Indian Approach to Science

Text Book:

1. *Glimpses of Glorious India- (In-house publication)*

Reference Course material:

1. *Fear Not: Be Strong (Swami Tathagatananda)*
2. *Essays on Gita (Sri Aurobindo)- Aurobindo Ashram*
3. *Indian Contribution to Science (Vijana Bharati Publication)*
4. *The Culture And Civilisation Of Ancient India In Historical Outline (D. D. Kosambi)*
5. *The Kautilya Arthashastra by Chankaya – Translation with critical and explanatory note by R P Kangle – Motilal Banarasidass Publishers- 1972*
6. *Chanakya Neeti – Strategies for success – Radhakrishnan pillai – Jaico Publishing house -2020.*
7. *Universal Message of the Bhagavad Gita: An exposition of the Gita in the Light of Modern Thought and Modern Needs. - Swami Ranganathananda, Advaita Ashrama Belur Math, 2000.*
8. *A Concise History Of Science In India – D M Bose, S N Sen, B V Subbarayappa,The Indian National Science Academy 1971.*
9. *Indian Culture and India's Future – Michel Danino - D.K. Printworld (P) Ltd -2011.*

SEMESTER III

23MAT209 DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS L-T-P-C: 3-1-0-4

Course Objectives:

- To model spatiotemporal variations in engineering systems and processes using differential equations
- To analyze and solve ordinary differential equations (ODE)
- To analyze stability of systems of first order ordinary differential equations
- To define Laplace transforms and utilize them to solve linear first and second order ODEs
- To understand partial differential equations and its applications in engineering.
- To Apply the numerical techniques for solving ODE and PDE.

Course Outcomes:

CO1: Define first-order ordinary differential equations and demonstrate ability to use techniques to solve them and apply these solutions in engineering contexts.
CO2: Reduce higher-order ordinary differential equations to a system of first-order differential equations, solve them using the method of eigenvector expansions and apply the solutions to engineering problems.
CO3: Define second-order ordinary differential equations and demonstrate ability to use techniques to solve them and apply these solutions in engineering contexts.
CO4: Define Laplace transforms and their inverses, apply their properties to solve linear ordinary differential equations.
CO5: Understand the types of partial differential equations arising from two-dimensional modeling. Use separation of variables to solve linear partial differential equations.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	1							
CO2	2	2	3	1							
CO3	2	2	2	2							
CO4	2	1	2	2							
CO5	2	2	2	1							

Syllabus:
One-Dimensional Modeling: Origin of Ordinary Differential Equations (1^{st} and 2^{nd} Order); First Order OD: Direct Integration, Integrating Factor – Linear and Nonlinear Equations; Systems of First Order ODEs. Stability. (12 hrs)
Second Order ODE: Homogeneous and Non-homogeneous – Linear equations with constant coefficients; Laplace Transforms: Definition, Properties and Inverse Laplace Transforms; Solution of Linear First and Second Order ODEs using Laplace Transforms. Fixed points, stability of fixed points.
Numerical methods for solving ODE: Euler's method, Improved Euler's method and Runge-Kutta method. (15 hrs)
Two-Dimensional Modeling: Partial Differential Equations, classifications of PDE, Separation of Variables: Fourier Series, arbitrary period, even and odd expressions, half range expressions. Fourier serious solutions of one dimensional Heat and wave Equations. Numerical methods for solving PDE: Finite difference method, solution of Laplace equation by FDM, Crank-Nicolson method. (15 hrs)

Textbook:

1. *Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India Pvt. Ltd., 2011*

References:

1. *Michael Greenberg, Advanced Engineering Mathematics, 2nd Edition, Pearson, 2011*
2. *Bruce A. Finlayson, Introduction to Chemical Engineering Computing, John Wiley & Sons, 2006.*
3. *Engineering Mathematics, Srimanta Pal and Subodh C Bhunia, Oxford university press, 2015.*
4. *Advanced Engineering Mathematics, Wylie and Barrett, 6^{th} Edition, McGraw Hall India, 2015.*

23CIE201	SOLID MECHANICS	L-T-P-C: 2-1-0-3

Course Objectives

- To explain the properties of materials and concepts of stress and strain
- To illustrate the deformational characteristics of elements and components.
- To highlight the response of structural elements under various loading conditions.

Course Outcome

CO1: Understand the concepts of mechanics of deformable solids and apply them to problems on the strength andstability of structural elements and mechanical components.
CO2: Evaluate the shear force, bending moment and stress variation in structural elements subjected to static loads.
CO3: Understand the basic principles and analyze problems pertaining to structural members subjected to axial load, torsion, bending, transverse shear, and combination loading.
CO4: Develop the necessary theoretical background necessary for courses in structural analysis and design.
CO5: Develop and program basic MATLAB coding for solving structural members under various type of loading and validation using available software.

CO-PO Mapping

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO														
CO1	3	3									1	3		
CO2	3	3									1	3		
CO3	3	3									1	3		
CO4	3	3									1	3		1
CO5					2						2	2	3	

Syllabus

Unit 1

Simple Stresses and Strains- Concept of stress and strain, Elasticity and plasticity – Types of stresses and strains, Hooke’s law– stress – strain diagram for ductile and brittle materials including mild steel, aluminum, torr steel – Working stress – Factor of safety – Lateral strain, Poisson’sratio and volumetric strain – Elastic moduli and the relationship between them – principal stresses and Mohr’s circle.
Bars of varying section – composite bars –thermal stresses – strain energy in tension, compression and shear - resilience – stresses due to impact and suddenly applied load.

Unit 2

Different types of beam – statically determinate beams - shear force and bending moment diagrams - relationship between intensity of loading, shear force and bending moment. Theory of simple bending - Stress distribution at a cross-section due to bending moment for statically determinate beams. Shear stress distribution. Shear center and Unsymmetrical bending.
Torsion of circular solid and hollow shafts – combined bending moment and torsion on shafts.

Unit 3

Deflection of beams – double integration method –Area Moment method – Conjugate beam method. Theory of columns – members subjected to axial load and bending moment – Euler’s theory for long columns – assumptions and limitations – Rankine’s formula, Thin cylinders.

Introduction to basic MATLAB coding for solving structural members under various type of loading and validation using available software

Text Book(s)

Gere, J.M. and Goodno.B.J., "Mechanics of Materials", CL Engineering, 2012.
Beer, Johnston, DeWolf, Mazurek., "Mechanics of Materials", McGraw-Hill Education, 2013

Reference(s)

Timoshenko, S.P., and Young, D.H., "Elements of Strength of Materials", East West Press, New Delhi, 2003.
Popov E.P., "Mechanics of Materials", Prentice Hall India, New Delhi, 2002
Crandall, S.H.., Dahal, N.C., and Lardener,T.J., "An Introduction to Mechanics of Solids", McGraw hill Books Co, 1985, 2nd Edition 2017
Nash W.A. "Strength of Materials", McGraw Hill Book Company, 2006

23CIE202	FLUID MECHANICS	L-T-P-C: 2-1-0-3

Course Objectives

a. To develop basic knowledge about properties of fluid and fluid flow.
b. To explain the hydrostatic pressure, principle of buoyancy and stability of floating bodies.
c. To explain the conservation principles of mass, momentum and energy equations in fluid flow along with their applications.
d. Exposure on the methods to estimate the flow and losses in pipe network under various conditions.
e. To explain the concepts of dimensional analysis and model testing

Course Outcome

CO1: Explain the behavior of fluids under various flow conditions
CO2: Analyze the hydrostatic forces, conditions of buoyancy and stability of various floating bodies.
CO3: Apply mass, momentum and energy equations in the measurement of fluid flow.
CO4: Solve pipe network problems by considering major and minor losses.
CO5: Calculate laminar flow characteristics through pipes and parallel plates.
CO6: Formulate dimensional analysis using various methods and apply the concept of similarities.

CO-PO Mapping

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO														
CO1	3	3										3		
CO2	3	3										3		
CO3	3	3										3		
CO4	3	3										3	1	
CO5	3	3										3	1	
CO6	3	3	1									3	1	

Syllabus

Unit 1

Elementary concepts – properties - concept of gauge and absolute pressure, measurement of pressure using manometers of different types.
Hydrostatic force on solid surfaces - center of pressure – buoyancy and stability of submerged and floating bodies - metacentric height - period of oscillation.
Types of flow, definitions and explanations of unsteady, steady, non-uniform, laminar and turbulent flows, rotational and irrotational flows. Stream function, potential function. Path line, streak line and streamline – continuity equation – derivation, application of one dimensional steady flow – circulation and vorticity - Basic flow fields such as uniform flow, source, sink, doublet, vortex flow, spiral flow – superposed flows.

Unit 2

Derivation of Bernoulli’s energy equation and Euler’s equation, examples illustrating the use of energy equation.
Flow meters - venturimeter, Orifice meter, nozzle, derivation of equations of discharge, pitot tubes – applications to flow measurements- notches and weirs.
Laminar flow through circular pipe – shear stress, pressure gradient, velocity profile, Hagen-poiseuille's equation, power calculations, laminar flow between parallel plates - Couette flow and Poiseuille flow.
Flow in closed conduits – friction loss and flow calculations, turbulent flow, Reynolds number, Darcy-Weisbach equation. Use of Moody’s diagram, minor losses – pipe networks – pipes in parallel and series - equivalent length – pipe network analysis using EPANET.

Unit 3

Analysis – Rayleigh's method – Buckingham Pi-theorem – Hydraulic Similitude – model analysis – dimensionless numbers – Model testing of partially submerged bodies – Distorted models and scale effects.

Text Book(s)

Streeter Victor L and E. Benjamin Wylie, "Fluid Mechanics", Tata McGraw Hill, 2010.
Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics including Fluid Machines", Standard Publishers & Distributors, 2015.

Reference(s)

Cengel and Cimbala, "Fluid Mechanics", Tata McGraw Hill Publishers, 2017.
Som S K, Gautam Biswas and Suman Chakrabarty, "Introduction to Fluid Mechanics and Fluid Machines", Tata Mc-Graw Hill Education Pvt.Ltd, Third Edition.
N.N.Pillai, "Fluid Mechanics and Fluid Machines", Universities Press, 2009.
Subramanya K., "Theory and Applications of Fluid Mechanics", Tata McGraw Hill Publishing Co, 1993.
J. F. Douglas, J. M. Gasiorek and J. A. Swaffield., "Fluid Mechanics", Pearson Education, 2008.
White, Frank.M., "Fluid Mechanics", Tata McGraw Hill, 2011.
L. A. Rossman., "EPANET 2.0 Users Manual", U.S. Environmental Protection Agency, 2000.

23CIE203	PRINCIPLES OF SURVEYING	L-T-P-C: 2-1-0-3

Course Objectives

1. To highlight the importance of linear/angular measurement methods in site plan preparation
2. To impart basic skills of levelling and theodolite survey.
3. To explain about errors in measurements and their adjustments in a traverse.
4. To provide an exposure on the use of minor and modern instruments in surveying

Course Outcome

CO1: Understand the principles, types and methods of surveying, to apply them in practice with minimum or no error
CO2: Analyse and rectify the errors in the horizontal-linear and horizontal-angular measurements to calculate area.
CO3: Analyse and evaluate the measurements in leveling to obtain reduced levels, contour lines and earthwork estimation.
CO4: Analyse and evaluate the horizontal and vertical coordinates using a theodolite
CO5: Understand and use minor instruments and advanced technologies in surveying.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2						1				3		
CO2	3	3						1				2		
CO3	3	3						1				3		
CO4	3	3						1				3		
CO5	3	2			1			1				3		

Syllabus

Unit 1
Introduction - classification of surveys – reconnaissance - principle of working from whole to part – provision of control – conventional signs.
Principles, linear, angular and graphical methods: Chain survey – instruments – principles of chain survey – field book – plotting – tie line and check line. Compass survey – types of compass – types of bearings – dip and declination – local attraction – traversing – plotting - error of closure. Plane table survey - two point problem – three point problem – errors in plane tabling.

Unit 2
Levelling – levelling instruments and its adjustments – fly levelling – booking - corrections for refraction and curvature – reciprocal levelling – longitudinal levelling and cross sectioning – contour surveying – definition – characteristics, methods and uses of contouring – plotting.
Areas and volumes – earthwork volume calculation.
Triangulation and Trilateration: Theodolite surveying – study of theodolite and its adjustments - measurement of horizontal angles - vertical angles – intervisibility of heights and distances – theodolite traverse –triangulation – network - calculation of co-ordinates – corrections – traversing conditions for closure.

Unit 3
Tangential system – direct reading tacheometer - subtense bar – trigonometric levelling.
Curves – elements of simple, compound, transition and reverse curves - vertical curves - curve setting by various methods.
Minor instruments: hand levels – clinometer – Ceylon ghat tracer – hypsometer – pantagraph – ediograph – box sextant - telescopic alidade.
Modern field survey systems: EDM - total station - introduction to photogrammetry -electro-magnetic spectrum - remote sensing - global positioning systems - Geographic information systems – advantages and applications.

Text Book(s)
Kanetkar T.P. and Kulkarni S.V., "Surveying and Levelling", Vol I & II, Vidyarthi Griha Prakashan, 2006.
Arora K.R., "Surveying", Vol I & II, Standard Publishers, 2010.

Reference(s)
Bannister, A. and Baker, R., "Solving Problems in Surveying", Addison Wesley Longman, 1996.
R.Agor, "Textbook of Surveying and Levelling", Khanna Publishers,2012.
S.K Duggal, "Surveying", Vol 1 & 2, McGraw Hill Education, 2013.
R.Subramanian, "Surveying and Levelling", Oxford University Press, 2012.
Pradip Kumar Guha, "Remote Sensing for the Beginner", Affiliated East West Press, 2003

23CIE204 CONSTRUCTION ENGINEERING -MATERIALS AND METHODS L-T-P-C: 2-1-0-3

Course Objectives

To expose students to the various building and general construction materials and products.
To impart knowledge of common construction systems and methods.

Course Outcome

CO1: Understand role of building regulations and materials in construction.
CO2: Identify and select appropriate materials for construction of buildings.
CO3: Understand and recommend options in substructure and superstructure construction.
CO4: Choose suitable finishes and services for buildings.
CO5: Identify the uses of modern construction materials.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3				2	1							3
CO2	3	3						1						3
CO3	3	3												3
CO4	3	3	2											3
CO5	3	3			2	1								2

Syllabus

Unit 1
Buildings and structures in general - Functional requirements of buildings and necessity of byelaws, NBC, Loads on buildings. Role of materials in construction, Introduction to structures and properties of materials.
Lime, cement – types, properties. Concrete - Concrete making materials, properties in fresh and hardened state, durability, special concrete. Masonry materials – stone, brick, block, mortar.

Unit 2
Soils & Excavations - shoring. Foundations - deep and shallow foundations, basements. Wall construction - Load bearing and partition walls, arches, lintels, scaffolding.
Concrete construction – Types of steel reinforcement, RCC, framed construction, Expansion and construction joints - precast concrete. Structural Steel - types and properties; steel components; steel construction.
Timber and allied products, wood construction. Roofing - Flat and pitched roofs, formwork.

Unit 3
Glass and glazing. Windows and doors. Floor and ceiling finishes. Building finishes – Plastering, pointing, painting, stucco, natural stone, adhered veneer.
Interpreting building drawings and specifications
Building services - vertical transportation, plumbing. Damp proofing materials and techniques.
Use of Light gauge steel, Aluminium, Polymers, Plastics, Composites, Sealants, Adhesives, Smart materials. Introduction to sustainable building products

Term projects
- Setting out of building plans.
- Reading and Interpreting building drawings
- Report on visit to construction sites

Text Book(s)

Duggal, S.K, "Building materials", New Age International Publishers, 2019.
Punmia, B.C., Ashok Kumar Jain, Arun Kumar Jain, "Building Construction", Laxmi Publications; 2016.

Reference(s)

Gambir. M.L. and Neha Jamwal, "Building Materials Products, Properties and Systems", McGraw Hill Education, 2017.
Arora, S.P. and Bindra, S.P., "Building Construction", Dhanpat Rai Publications, 2010.
National Building Code, Bureau of Indian Standards, New Delhi, 2016.
Mehta, Scarborough, Armpriest, "Building Construction: Principles, Materials, and Systems", Pearson Education India, 2011.
Mamlouk, Zaniewski, "Materials for Civil and Construction Engineers", Pearson Education India, 2014.

23CIE205	FOUNDATIONS OF DATA SCIENCE	L-T-P-C: 2-1-0-3

Course Outcomes:

CO1: Understand the various data visualization methods.
CO2: Understand the basics of the descriptive statistics.
CO3: Understand and apply the basic concepts of correlations and regressions to the given data.
CO4: Understand and apply the basic concepts of sampling techniques and simple hypothetical testing to the given data.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2											1	
CO2	2	2											1	
CO3	2	3											2	
CO4	2	3											2	

.

Syllabus:

Unit 1

Introduction, Causality and Experiments, Data Preprocessing: Data cleaning, Data reduction, Data transformation, Data discretization. Visualization and Graphing: Visualizing Categorical Distributions, Visualizing Numerical Distributions, Overlaid Graphs, plots, and summary statistics of exploratory data analysis. (15 hrs).

Unit 2

Randomness, Probability, Introduction to Statistics, Sampling, Sample Means and Sample Sizes, Descriptive statistics – Central tendency, dispersion, variance, covariance, kurtosis, five-point summary, Distributions, Bayes Theorem, Error Probabilities; Permutation Testing, Statistical Inference. (15 hrs)

Unit 3

Hypothesis Testing, Decisions and Uncertainty, Comparing Samples, A/B Testing, P-Values, Causality, Frequency Analysis, Assessing Models, Estimation, Prediction, Confidence Intervals, Inference for Regression, Classification, Graphical Models, Updating Predictions. (15 hrs)

Textbook(s)

Adi Adhikari and John DeNero, "Computational and Inferential Thinking: The Foundations of Data Science", e-book.

Reference(s)

1. *Data Mining for Business Analytics: Concepts, Techniques and Applications in R, by Galit Shmueli, Peter C. Bruce, Inbal Yahav, Nitin R. Patel, Kenneth C. Lichtendahl Jr., Wiley India, 2018.*
2. *Rachel Schutt & Cathy O'Neil, "Doing Data Science" O' Reilly, First Edition, 2013.*

23CIE281 EXPERIMENTAL LEARNING – MECHANICS OF MATERIAL L-T-P-C: 0-0-3-1

Course Objectives

To highlight the mechanical properties of material under various loading conditions.
To obtain the response of structures under various loading conditions.

Course Outcome

CO1: Conduct experiments to validate physical behaviour of material and prepare laboratory reports on the interpretation of experimental results
CO2: Conduct experiments on strength and stability of structural elements.
CO3: Conduct experiments to analyse the structural members subjected to axial load, torsion, transverse shear, bending and combination loading

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1				2		1	1	1			1	1		
CO2				3		1	1	1			1	1		
CO3				3		1	1	1			1	1		

List of Experiments

1. Tension test on metals
2. Tensile test on thin wires – Mild steel and Copper
3. Compression test – Wood specimen and brick
4. Hardness test on Ferrous and non-ferrous material - Rockwell Hardness test - Brinell Hardness test
5. Double shear test on mild steel rods
6. Deflection test on beams
7. Impact test on metal specimens – Izod and Charpy
8. Flexural test on timber beams
9. Test on helical Spring - Open coiled and close coiled
10. Torsion test
11. Column Buckling

23CIE282	EXPERIMENTAL LEARNING – SURVEYING	L-T-P-C: 0-0-3-1

Course Objectives

- To impart knowledge in linear/angular measurement using various surveying instruments.
- To learn booking and determination of reduced levels of accessible and inaccessible points.
- To provide an exposure on the use of minor and modern instruments in surveying

Course Outcome

- Compute area of field using linear and angular measurements.
- Determine the elevations of different points using various methods
- Understand the usage of minor and modern instruments in surveying

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2			1	2		1				2		
CO2	3	3				1		1				2		
CO3	3	3				1		1				3		

Syllabus

1. Chain & Compass survey- Traversing and plotting of details
2. Plane table survey - three-point problem
3. Levelling - Plane of collimation & Rise and fall method
4. Contour surveying
5. Theodolite surveying - Measurement of angles and traversing
6. Heights and distances by tacheometry and solution of triangles (single plane and double plane)
7. Total Station – Traversing and Area Calculation
8. Demo: Planimeter, Mapping using GPS, Study of Minor instruments, and Study of modern surveyinstruments – automatic levels.

22ADM211	LEADERSHIP FROM RAMAYANA	L-T-P-C: 1-0-0-1

Course Objectives

Through a study of the Rāmāyaṇa, the student should gain a deeper understanding of the ethical grandeur of Indian culture, and be inspired to follow the ideals of the characters depicted therein.

Course Outcomes:

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

CO1	Appreciate the significance of *Rāmāyaṇa* as an *itihāsa,* and important aspects of *Bālakāṇḍa*.
CO2	Understand the family values and ideal human relationships portrayed in the *Ayodhyakāṇḍa* and *Aranyakāṇḍa* of *Rāmāyaṇa*.
CO3	Understand *dharma* and its nuances, emphasizing its applicability in an individual's life through *Kishkindhakāṇḍa* and *Sundarakāṇḍa* of Ramayana.
CO4	Appreciate the triumph of *dharma* over *adharma* through *Yuddhakāṇḍa* of *Rāmāyaṇa*
CO5	Appreciate the spiritual values from *Rāmāyaṇa* in resolving personal and social conflicts through varied effective presentations of important episodes of the *Rāmāyaṇa.*

Mapping of course outcomes with program outcomes:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1						2	3	3	3		3			
CO2						3	3	3	2		3			
CO3						2	3	3	3		3			
CO4						3	3	3	3		3			
CO5						3	3	3	2		3			

Syllabus

Unit 1

An overview of Valmiki's epic. Introdcution to the content and structure of the epic text and it's principal characters.

Bala-Kāṇḍa: Preparing for the renowned mission.

Unit 2

Ayodhya-Kāṇḍa: Harbinger of an Entire Tradition of Nobleness.

Araṇya-Kāṇḍa: Tale of the forest life.

Unit 3

Kishkindha-Kāṇḍa: The Empire of Holy Monkeys.

Sundara-Kāṇḍa: Heart of the Ramayana

Unit 4
Yuddha-Kāṇḍa:The most popular part of the Ramayana

Uttara-Kāṇḍa: An attempt to explain the untold stories.

Unit 5
Ramayana and Modern-day learning

Ecological Awareness in the Ramayana

Different Ramayana: Epic that connects the world.

TEXT BOOKS/REFERENCES:

1. *Leadership Lessons from the Ramayan*a, ASCSS
2. Rajagopalachari. C, *The Ramayana*
3. Valmiki, *The Ramayana*, Gita Press

Evaluation Pattern

Assessment	Internal	End Semester
Mid Term Examination	30	
*Continuous Assessment (CA)	30	
End Semester		40

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23LSE201	Life Skills for Engineers I	L-T-P-C: 1-0-2-P/F

Pre-requisite: An open mind and the urge for self-development, basic English language skills, knowledge of high school level mathematics.

Course Objectives

- Assist students in inculcating Soft Skills and developing a strong personality
- Help them improve their presentation skills
- Support them in developing their problem solving and reasoning skills
- Facilitate the enhancement of their communication skills

Course Outcomes

CO1 - Soft Skills: To develop greater morale and positive attitude to face, analyse, and manage emotions in real life situations, like placement process.
CO2 - Soft Skills: To empower students to create better impact on a target audience through content creation, effective delivery, appropriate body language and overcoming nervousness, in situations like presentations, Group Discussions and interviews.
CO3 - Aptitude: To analyze, understand and employ the most suitable methods to solve questions on arithmetic and algebra.
CO4 - Aptitude: To investigate and apply suitable techniques to solve questions on logical reasoning and data analysis.
CO5 - Verbal: To infer the meaning of words and use them in the right context. To have a better understanding of the basics of English grammar and apply them effectively.
CO6 - Verbal: To identify the relationship between words using reasoning skills. To develop the capacity to communicate ideas effectively.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1							2	3	3		3
CO2								2	3		3
CO3		3		2							
CO4		3		2							
CO5									3		3
CO6								3	3		3

Syllabus

Soft Skills

Soft Skills and its importance: Pleasure and pains of transition from an academic environment to work-environment. New-age challenges and distractions. Learning to benefit from constructive criticisms and feedback, Need for change in mindset and up-skilling to keep oneself competent in the professional world.
Managing Self: Knowing oneself, Self-perception, Importance of positive attitude, Building and displaying confidence, Avoiding being overconfident, Managing emotions, stress, fear. Developing Resilience and handling failures. Self-motivation, Self-learning, and continuous knowledge up-gradation / Life-long learning. Personal productivity - Goal setting and its importance in career planning, Self-discipline, Importance of values, ethics and integrity, Universal Human Values.

Aptitude

Problem Solving I
Numbers: Types, Power Cycles, Divisibility, Prime, Factors & Multiples, HCF & LCM, Surds, Indices, Square roots, Cube Roots and Simplification.
Percentage: Basics, Profit, Loss & Discount, and Simple & Compound Interest.
Ratio, Proportion & Variation: Basics, Alligations, Mixtures, and Partnership.
Averages: Basics, and Weighted Average.
Data Interpretation: Tables, Bar Diagrams, Venn Diagrams, Line Graphs, Pie Charts, Caselets, Mixed Varieties, Network Diagrams and other forms of data representation.

Verbal

Vocabulary: Familiarize students with the etymology of words, help them realize the relevance of word analysis and enable them to answer synonym and antonym questions. Create an awareness about the frequently misused words, commonly confused words

and wrong form of words in English.
Grammar (**Basic**): Help students learn the usage of structural words and facilitate students to identify errors and correct them.
Reasoning: Stress the importance of understanding the relationship between words through analogy questions.
Speaking Skills: Make students conscious of the relevance of effective communication in today's world through various individual speaking activities.

References:

1. Students" Career Planning Guide, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
2. Soft Skill Handbook, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
3. Adair. J., (1986), "Effective Team Building: How to make * winning team", London, U.K
4. Gulati. S., (1006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
5. The hard truth about Soft Skills, by Amazon Publication.
6. Verbal Skills Activity Book, CIR, AVVP
7. English Grammar & Composition, Wren & Martin
8. Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
9. Cracking the New GRE 2012
10. Kaplan's – GRE Comprehensive Programme
11. Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
12. Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.
13. How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma.
14. How to Prepare for Data Interpretation for the CAT, Arun Sharma.

<u>Evaluation Pattern</u>

Assessment	Internal	External
Continuous Assessment (CA)* – Soft Skills	30	-
Continuous Assessment (CA)* – Aptitude	10	25
Continuous Assessment (CA)* – Verbal	10	25
Total	50	50
Pass / Fail		

*CA - Can be **presentations, speaking activities and tests.**

SEMESTER IV

23MAT225	MACHINE LEARNING TECHNIQUES FOR CIVIL ENGINEERS	L-T-P-C: 2-1-0-3

Pre-Requisite(s): Probability & Statistics, Introduction to Computing, Foundation of Data Science

Course Objectives

1. To understand the basics of machine learning and its need for Civil Engineering.
2. To learn the concept of supervised learning, unsupervised learning with reinforcement learning.
3. To be able to apply the techniques to build models for different applications in Civil Engineering.

Course Outcome

CO1: Understanding the basics of machine learning and its real-world applications.
CO2: Understanding the concept of supervised learning, unsupervised learning with reinforcement learning
CO3: Apply the techniques to build models for different applications in Civil Engineering.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2	2				1						1	
CO2	1	2	2				1						2	
CO3	2	3	3				2						3	

Syllabus

Unit 1
Introduction of Machine Learning (ML), Historical context, Necessities, ML in modern civil engineering, Real-world application examples. Recapitulation of linear regression, Logistic regression, Model evaluation

Unit 2
Adaline, Backpropagation, Neural Networks Learning, Learning rate, Unsupervised Learning, Clustering, Reinforcement Learning, Overview of DL
Applications: Density-based clustering Rainfall-runoff modelling, Soil strength prediction.

Unit 3
Supervised Learning, Decision Tree, Bayes Classifier, Bayesian Networks, k-Nearest Neighbour, Support Vector Machines and Kernel Machines.
Applications: Soil Classification, Gap acceptance characteristics of traffic, Forecasting.

Text Book(s)
Kevin Murphy, Machine Learning: A probablistic perspective, MIT Press, 2012
Trevorhastie, Robert Tibshirani, Jerome Ffriedman, The Elements of Statistical Learning, Springer 2009 (freely available online)

Reference(s)
Murad, Yasmin, Husam, Abu Hajar and Iftikhar Azim, eds. Machine learning applications in Civil Engineering, Vol 16648714.Frontiers Media SA, 2022

23CIE211	GEOLOGY & SOIL MECHANICS	L-T-P-C: 2-1-0-3

Course Objectives

To explain the influence of geological conditions of the earth on construction practices.
To provide an exposure to the concept of three phase system and apply it for estimation of soil properties.
To elucidate the role of water in soil behavior and its applications in soil stresses, permeability and seepage.
To explain the volume-change behavior in soil and consolidation settlement.
To explain the concepts and methods to determine shear strength parameters and stress changes in soil.

Course Outcome

CO1: Identify and classify rocks using basic geologic features and to apply those concepts on rock engineering projects and understand the role of geology in construction processes.
CO2: Ability to classify soil with reference to their characteristics and the calculated index and engineering properties and relate compaction of soil to its properties.
CO3: Analyze and evaluate permeability characteristics of soils and estimate seepage through soils.
CO4: Analyze stress distribution in soil and evaluate consolidation properties along with settlement
CO5: Analyze the shear strength of soil and factors influencing its magnitude.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1						2	1					3		
CO2	3	3		2								3		
CO3	3	3										3		
CO4	3	3		2								3		
CO5	3	3										3		

Syllabus

Unit 1
General geology – Weathering - Geological work of wind and water. Mineralogy, Petrology - Three–fold classification of rocks and their characteristic features. Structural geology - Types and classification of structures (Folds and faults) and their effect on civil engineering projects, Rock mass classification systems – intact rocks & rock mass discontinuities- classifications based on (a) stand-up time, (b) Rock quality designation (RQD), (c) Rock structure rating (RSR), (d) Rock mass rating (RMR), (e) Rock mass quality (Q-system), (f) Geological strength index (GSI) & (g) Modulus of jointed rock mass.
Geology in Civil Engineering - Tunnels, dams, reservoirs, bridges, runways, roads and buildings.
Origin and formation of soils. Soil structure and clay mineralogy – Adsorbed water – Mass- volume relationship – Relative density.
Index Properties of Soils: Grain size analysis – Sieve and hydrometer methods – Consistency limits and Indices – I.S. Classification of soil.

Unit 2
Compaction: Mechanism of compaction – factors affecting – effects of compaction on soil properties – Field compaction equipment - compaction control.
Permeability: Soil water – capillary rise – flow of water through soils – Darcy's law- Permeability – Factors affecting permeability – Laboratory determination of coefficient of permeability –Permeability of layered systems.
Seepage through soils: Total, neutral and effective stresses –Quick sand condition – Seepage through soils –Flownets: characteristics and uses.

Unit 3
Stress distribution in soils: Boussinesq's and Westergaard's theories for point loads and areas of different shapes – Newmark's influence chart.
Consolidation: Stress history of clay; *e*-*p* and *e*-log *p* curves, Standard 1-d Consolidation Test, Computation of Consolidation Settlement, Rate of One-Dimensional Consolidation theory of Terzaghi, Settlement Analysis

Shear strength of soils: Stress-Strain Curve, Mohr-Coulomb Failure theory, Laboratory measurement of Shear Strength, Shear strength of Saturated Cohesive Soils, Pore pressure Coefficients, Shear strength of Granular Soils.

Text Book(s)

Richard E Goodman, " Introduction to Rock Mechanics", Second Edition, Wiley, 1980.
Venkat Reddy,.D., "Engineering Geology", Vikas Publishing House, 2010.
Gopal Ranjan and A.S.R. Rao, "Basic and Applied Soil Mechanics", New Age International Publishers, 2005.

Reference(s)

Blyth F.G.H. and M. H. De Freitas, "Geology for Engineers", 7th Edition, Elsevier Science, 2006.
Parbin Singh., "Engineering and General Geology", S.K. Kataria and Sons, 2009.
Das, B.M., "Principles of Geotechnical Engineering", CL Engineering, 2013.
P. Purushothama Raj, "Soil Mechanics & Foundation Engineering", Pearson, 2nd Edition.
T.W. Lambe and Whitman, "Soil Mechanics", Wiley, 2008.
Manoj Dutta and Gulhati S.K, "Geotechnical Engineering", Tata McGraw Hill Publishers, 2005.
B. C. Punmia, Jain, A. K. & Jain, A. K., "Soil Mechanics & Foundations", Firewell Media, 2005.

23CIE212	STRUCTURAL ANALYSIS I	L-T-P-C: 2-1-0-3

Course Objectives

To impart knowledge on different methods of analyzing determinate and indeterminate structures.
To explain the structural behavior and analysis of cables and arches.
To introduce the matrix methods of structural analysis

Course Outcome

CO1: Analyze the determinate and indeterminate structures by applying the energy principles
CO2: Categorize the structures and analyze the structural elements using force and displacement method of analysis
CO3: Analyze the response in structural elements for the moving loads using method of influence line diagram.
CO4: Calculate the internal forces in arch and cable structures by applying the basic engineering knowledge.
CO5: Structural analysis of selected structural elements like beams, trusses and frames using MATLAB and validation using available software.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	1	1							3	3		
CO2	3	3	1	1							3	3		
CO3	3	3	1	1							3	3		
CO4	3	3	1	1							3	3		
CO5					3						3		3	

SyllabusUnit 1
Statically indeterminate structures - degree of static and kinematic indeterminacies. Introduction to force and displacement methods of analysis.
Energy principles – Castigliano’s theorems - Engessor’s theorem - Maxwell Betti’s theorem - Principle of least work – Method of virtual work (unit load method) - applications in statically determinate and indeterminate structures (analysis of Propped cantilever and fixed beams).

Unit 2
Cables-maximum tension-types of supports-forces in towers-suspension bridges with three and two hinged girders.
Theory of Arches-Eddy’s theorem-analysis of three hinged and two hinged arches-settlement and temperature effects.

Unit 3
Moving loads and influence lines – influence lines (IL)for statically determinate and indeterminate beams for reaction, SF and BM-effect of moving loads-concentrated and uniformly distributed loads-load position for maximum BM and SD-equivalent UDL.
IL for determinate structures-truss, arch and suspension bridge.

Structural analysis of selected structural elements like beams, trusses and frames using MATLAB and validation using available software.

Text Book(s)

Devdas Menon, "Structural Analysis", Narosa Book Distributers Pvt Ltd, 2010.
S P Gupta and G S Pundit, "Theory of Structures", Vol I & II, Tata McGraw Hill, 2017

Reference(s)

Hibbeler, R. C., "Structural Analysis", Pearson, 2008.
Wang C.K., "Intermediate Structural Analysis"Tata McGraw - Hill Education 2010.
Norris C.H, Wilbur J.B. and Utku.S., "Elementary Structural Analysis", Tata McGraw Hill, 2016.
Sujit Kumar Roy and Subrata Chakrabarty, "Fundamentals of Structural Analysis",S.Chand& Co., 2010.
S. B. Junnarkar and H. J. Shah, "Mechanics of Structures Vol. II", 20th Edition, Charotar Publishing House, 2008.
Reddy C.S., Basic Structural Analysis, Tata McGraw Hill, New Delhi, 2010.
L.S.Negi and R.S.Jangid, Structural Analysis, Tata McGraw Hill, 2004.
D S PrakashRao, "Structural Analysis - A Unified Approach", Universities Press (India) Ltd.

23CIE213	HYDRAULIC ENGINEERING	L-T-P-C: 2-1-0-3

Course Objectives

To explain the concepts of momentum principles and its applications in the working of pumps and turbines.
To understand the open channel flow for different flow conditions and the hydraulic design of channels.
To understand the concepts of specific energy, critical flow and their applications
To understand the various irrigation canal systems.

Course Outcome

CO1: Apply the linear momentum principle to evaluate the forces exerted by the jet on inclined, curved and stationary bodies.
CO2: Apply the principles of basic engineering to analyze and choose suitable hydraulic machinery.
CO3: Select most economical channel section and to analyze uniform flow.
CO4: Apply the principles of energy to analyze non-uniform flow conditions in open channel.
CO5: Understand the general aspects of irrigation canals and design the irrigation canal systems for field conditions

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3										3		
CO2	3	3	1									3		
CO3	3	3	1									3		
CO4	3	3	1									3		
CO5	3	3	1									3		

Syllabus

Unit 1
Impulse momentum principle – application – impact of jet - force exerted by a jet on normal, inclined and curved surfaces for stationary and moving cases – torque in rotating machines – jet propulsion.
Hydroelectric power: low, medium and high head plants - Power house components – Microhydel schemes. Turbines - classifications – construction and working of Pelton Wheel, Francis and axial flow reaction turbines - selection of turbines – draft tube.
Classification of pumps – Centrifugal pumps – types and working – characteristics. Reciprocating pumps - types and working – selection of pumps.

Unit 2
Open channel flow - Comparison with pipe flow, Types of channels - Classification of flow, uniform flow – Uniform flow using Chezy's and Manning's formulae - Most efficient channel section – Circular, Rectangular and Trapezoidal channel sections, open channel section for constant velocity at all depths of flow. Specific energy and critical depth, Specific force curve, critical flow computation.
Non-uniform flow, Gradually Varied Flow, Dynamic equation for gradually varied flow, Different forms of the dynamic equation, Flow profiles in prismatic channels, integration of the varied flow equation - Computation of the length of the backwater curve and afflux. Rapidly Varied Flow- Hydraulic Jump, Hydraulic jump equations for a rectangular channel - Practical applications.

Unit 3

Rivers - behaviour - Control and training. Design of stable channels in India - problem in India - Classification of irrigation canals, Canal alignment, Design procedure for an irrigation channel - Considerations for fixing longitudinal section of a channel - Cross sections of an irrigation channel, Maintenance of canals, Canals in alluvial soils, Silting in canals, Scour and protection against scour. Canal lining - losses in irrigation canals, Advantages and disadvantages of lining, Types of lining. Water logging - Causes and preventive measures. Designof lined canals - irrigation canals - Kennedy's Theory- Lacey's Theory.

Text Book(s)

Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics including Fluid Machines", Standard Book House, 2017.
Garg, S. K., "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, 2006.

Reference(s)

Chow V.T., "Open Channel Hydraulics", McGraw Hill, Inc.. 2009.
Rajput R K ,"Fluid Mechanics and Hydraulic Machines", S Chand Publishers, 2016.
N.N.Pillai, "Fluid Mechanics & Fluid Machines", Universities Press, Third Edition, 2009.
K.Subramanya, "Flow in Open Channels", Tata McGraw Hill, 1997.
M. Hanif Chaudhry, "Open Channel Flow", Prentice Hall of India, 2007.
K. G. Rangaraju, "Flow Through Open Channels", Tata McGraw Hill, 2001.
Jagdish Lal, "Hydraulic Machines including Fluidics", Metropolitan Book Co, 2016.
P.N.Modi, "Irrigation, Water Resources, and Water power Engineering", Standard Publishers Distributors, 2014.

23CIE214	Transportation Engineering I	L-T-P-C: 2-1-0-3

Course Objectives

To introduce the historical road development activities in India
To highlight the important factors in highway alignment
To introduce the design approaches for flexible and rigid pavements
To explain the basic principles of traffic engineering and design of intersections

Course Outcome

CO1: Explain the history of road development in India
CO2: Carry out geometric deign of highways
CO3: Analyse the suitability of materials for construction of pavements
CO4: Design of Flexible and Rigid Pavements
CO5: Explain the principles of Traffic Engineering and conduct surveys
CO6: Perform analysis and design of intersections

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1		1			2						3		
CO2	3	2	3	2		2					3	3	1	2
CO3	3	2	1	2			1				3	3		
CO4	3	2	3	3			1				3	3	3	3
CO5	3	2	3	3							3	3		
CO6	3	2	3	3							3	3	2	2

Syllabus

Unit 1
Highway development and planning - Classification of roads. Road development in India - Salient features of first, second, third and fourth road development plans in India. Current road projects in India - NHDP, PMGSY and Bharatmala project. Highway alignment and project preparation.
Geometrical Design – highway cross section elements, sight distance, design of horizontal alignment and design of vertical alignment.

Unit 2
Pavement Materials – Aggregate and Bitumen - desirable properties, tests, requirements for different types of pavements. Bituminous Mix Design-Marshall Mix Design.
Pavement Design Introduction – types of pavements and their use. Flexible pavements - factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC. Rigid pavements-components and functions; factors affecting design and performance of rigid pavements; stresses in rigid pavements; design of rigid pavements as per IRC. Softwares for the pavement design

Unit 3
Traffic engineering and control: Introduction - Road user, vehicle and traffic characteristics. Speed and volume studies. Design of at-grade intersections – roundabouts and signalized intersections. Traffic regulation and control
• traffic signs and road markings. Parking Facilities -Multimodal transportation - ITS and automated highways

Text Book(s)

Khanna, S. K., Justo, C. E. G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017.
L. R. Kadiyali and N.B. Lal 'Principles and Practices of Highway Engineering', Khanna, Publishers, 7th Edition 2019.
Kadiyali, L. R., "Traffic Engineering and Transportation Planning", Khanna, Publishers, 2008.Chakraborty, P. and Das, A., ' Principles of Transportation Engineering, PHI Learning, 2017.

Reference(s)

Papacostas, C. S. and Prevedouros, P. D, "Transportation Engineering and Planning", Prentice Hall, 2009.
Chandola, S. P., "A Text Book of Transportation Engineering", S Chand & Co. Ltd., 2001.
IRC 73- 1990, "Geometric Design Standards for Rural (Non-Urban) Highways"
IRC 37- 2018, "Guidelines for the Design of Flexible Pavements"
IRC 58-2015, "Guidelines for the Design of Plain Joined Rigid Pavements for Highways"
IRC SP 41-1994, "Guidelines for the Design of At-Grade Intersections in Rural and Urban Areas"

23CIE283	EXPERIMENTAL LEARNING - HYDRAULICS	L-T-P-C: 0-0-3-1

Course Objectives

To impart knowledge in measuring pressure and discharge of fluid flow using various instruments
To highlight the major and minor Losses in pipe flow
To train the students in performance analysis of Hydraulic Turbines and Pumps

Course Outcome

CO1: Conduct experiments to understand the principles and working of different hydraulic machines like pumps and turbines.
CO2: Examine and analyze fluid flow through various discharge and pressure measuring instruments.
CO3: Prepare laboratory reports on the interpretation of experimental results.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3		3				3	3		3	3	1	
CO2	3	3		3				3	3		3	3	1	
CO3	3	3		3				3	3		3	3		

Syllabus

1. Study of instruments: pressure gauge - piezometer - manometer-pressure transducers - pilot tubes - currentmeter.
2. Verification of Bernoulli’s equation.
3. Determination of Coefficient of discharge for a small orifice by a constant head method.
4. Determination of Coefficient of discharge for an external mouth piece by variable head method.
5. Calibration of Triangular Notch
6. Determination of friction factor of pipes
7. Impact of jet on vanes
8. Calibration of Venturimeter, Orificemeter, rotameter and watermeter
9. Determination of metacentric height
10. Performance test on Pelton wheel turbine and Francis turbine.
11. Efficiency test on centrifugal pump and reciprocating pump.

23CIE284	EXPERIMENTAL LEARNING - CONSTRUCTION MATERIALS	L-T-P-C: 0-0-3-1

Course Objectives

To deal with experimental determination and evaluation of mechanical characteristics and behavior of metallic and non-metallic structural materials.
Introduce to experimental procedures and common measurement instruments, equipment and devices.To provide students with information concerning practical application of mechanical characteristics.
To evaluate the quality and suitability of construction materials

Course Outcome

CO1: Compute engineering values from laboratory measures and identify failure modes of construction materials.
CO2: Analyze stress versus strain curve for modulus and other related attributes
CO3: Prepare the laboratory reports on the interpretation of experimental results

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1			3				3	3		1	1		1
CO2	1			3				3	3		1	1	2	1
CO3				3					3		2	1	1	

Syllabus
List of Experiments:
Tests on cement
1. Fineness, Normal consistency, Initial and Final Setting times, Specific gravity, Compressive strength, Soundness

Tests on fine aggregate
2. Grain size distribution – Uniformity coefficient and fineness modulus, Specific gravity, Density, Void ratio, Bulking & Absorption

Tests on coarse aggregate
3. Grain size distribution – Uniformity coefficient and fineness modulus, Specific gravity, Density, Void ratio, Absorption, Crushing & Impact values, Flakiness & Elongation, Los Angel's Abrasion test
4. Concrete mix proportioning approaches

Test on fresh and hardened concrete
5. Workability test - Slump test, Compaction factor test, Flow table test, Vee-Bee Consistometer,
6. Use of water reducing admixtures
7. Compressive strength, Split tensile strength, Flexure test on beams, Modulus of elasticity
8. Tests on bricks – Crushing strength, water absorption and efflorescence
9. Basic tests on unmodified bitumen and modified binders with polymers.

Reference(s)
Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO, etc. corresponding to materials used for Civil Engineering applications
Kyriakos Komvopoulos (2011), Mechanical Testing of Engineering Materials, Cognella
E.N. Dowling (1993), Mechanical Behaviour of Materials, Prentice Hall International Edition

22ADM201 **STRATEGIC LESSONS FROM THE MAHABHARATA** **L-T-P-C: 1-0-0-1**

Course Objectives

Through a study of the Mahabharata, the student should gain a deeper understanding of the ethical grandeur of Indian culture, and be inspired to follow the ideals of the characters depicted therein.

Course Outcomes:

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

CO1	Understanding the impact of *itihasas* on Indian civilization with a special reference to the *Adiparva* of Mahabharata.
CO2	Enabling students to importance of fighting *adharma* for the welfare of the society through Sabha and Vanaparva.
CO3	Understanding the nuances of dharma through the contrast between noble and ignoble characters of the epic as depicted in the Vana, Virata, Udyoga and Bhishma parvas.
CO4	Getting the deeper understanding of the Yuddha Dharma through the subsequent Parvas viz., Drona, Karna, Shalya, Sauptika Parvas.
CO5	Making the students appreciative of spiritual instruction on the ultimate triumph of dharma through the presentations of the important episodes of the MB with special light on Shanti, Anushasana, Ashwamedhika, Ashramavasika, Mausala, Mahaprasthanika and Swargarohana Parvas.

Mapping of course outcomes with program outcomes:

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

Syllabus

Unit 1

Introduction and Summary of the Mahabharata

A Preamble to the Great Itihasa

Unbroken Legacy

Unit 2

Dharmic Insights of a Butcher

The Vows We Take

Kingship and Polity Acumen

Unit 3

Karna – The Maestro that Went Wide off the Mark

Tactics of Krishna

Yajnaseni

Unit 4

Popular Regional Tales

Maha Prasthanam – The Last Journey.

Unit 5

Mahabharata - An All-Encompassing Text

Mahābhārata- Whats and WhatNots

Nyayas in Mahabharata

TEXT BOOKS/REFERENCES:

Leadership Lessons from the Mahabharat, ASCSS

Rajagopalachari. C, *The Mahabharata*

Evaluation Pattern

Assessment	Internal	End Semester
Mid Term Examination	30	
*Continuous Assessment (CA)	30	
End Semester		40

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23LSE211	Life Skills for Engineers II	L-T-P-C: 1-0-2-2

Pre-requisite: An inquisitive mind, basic English language skills, knowledge of high school level mathematics.

Course Objectives

- Assist students in inculcating Soft Skills and developing a strong personality
- Help them improve their presentation skills
- Aid them in developing their problem solving and reasoning skills
- Facilitate them in improving the effectiveness of their communication

Course Outcomes

CO1 - Soft Skills: To develop greater morale and positive attitude to face, analyse, and manage emotions in real life situations, like placement process.
CO2 - Soft Skills: To empower students to create better impact on a target audience through content creation, effective delivery, appropriate body language and overcoming nervousness, in situations like presentations, Group Discussions and interviews.
CO3 - Aptitude: To analyze, understand and employ the most suitable methods to solve questions on arithmetic and algebra.
CO4 - Aptitude: To investigate and apply suitable techniques to solve questions on logical reasoning and data analysis.
CO5 - Verbal: To learn to use more appropriate words in the given context. To have a better understanding of the nuances of English grammar and become capable of applying them effectively.
CO6 - Verbal: To be able to read texts critically and arrive at/ predict logical conclusions. To learn to organize speech and incorporate feedback in order to convey ideas with better clarity.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1							2	3	3		3
CO2								2	3		3
CO3		3		2							
CO4		3		2							
CO5									3		3
CO6								3	3		3

Syllabus

Soft Skills

Communication: Process, Language Fluency, Non-verbal, Active listening. Assertiveness vs. aggressiveness. Barriers in communication. Digital communication
Presentations: Need, importance, preparations, research and content development, structuring and ensuring flow of the presentation. Ways and means of making an effective presentation: Understanding and connecting with the audience – using storytelling technique, managing time, appropriate language, gestures, posture, facial expressions, tones, intonations and grooming. Importance of practice to make an impactful presentation.

Aptitude
Problem Solving II
Equations: Basics, Linear, Quadratic, Equations of Higher Degree and Problems on ages.
Logarithms, Inequalities and Modulus: Basics
Time and Work: Basics, Pipes & Cistern, and Work Equivalence.
Time, Speed and Distance: Basics, Average Speed, Relative Speed, Boats & Streams, Races and Circular tracks.
Logical Reasoning: Arrangements, Sequencing, Scheduling, Venn Diagram, Network Diagrams, Binary Logic, and Logical Connectives.

Verbal

Vocabulary: Aid students learn to use their vocabulary to complete the given sentences with the right words. Usage of more appropriate words in different contexts is emphasized.

Grammar (**Basic-intermediate**): Help students master usage of grammatical forms and enable students to identify errors and correct them.
Reasoning: Emphasize the importance of avoiding the gap (assumption) in arguments/ statements/ communication.
Reading Comprehension (**Basics**): Introduce students to smart reading techniques and help them understand different tones in comprehension passages.
Speaking Skills: Make students be aware of the importance of impactful communication through individual speaking activities in class.
Writing Skills: Introduce formal written communication and keep the students informed about the etiquette of email writing.

References:

1. Students" Career Planning Guide, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
2. Soft Skill Handbook, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
3. Adair. J., (1986), *"Effective Team Building: How to make * winning team"*, London, U.K
4. Gulati. S., (1006) "Corporate Soft Skills", New Delhi, India: Rupa & **Co.**
5. The hard truth about Soft Skills, by Amazon Publication.
6. Verbal Skills Activity Book, CIR, AVVP
7. English Grammar & Composition, Wren & Martin
8. Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
9. Cracking the New GRE 2012
10. Kaplan's – GRE Comprehensive Programme
11. Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
12. Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.
13. How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma.
14. How to Prepare for Data Interpretation for the CAT, Arun Sharma.

Evaluation Pattern

Assessment	**Internal**	**External**
Continuous Assessment (CA)* – Soft Skills	30	-
Continuous Assessment (CA)* – Aptitude	10	25
Continuous Assessment (CA)* – Verbal	10	25
Total	50	50

*CA - Can be **presentations, speaking activities and tests.**

SEMESTER V

23CIE301	GEOTECHNICAL ENGINEERING	L-T-P-C: 2-1-0-3

Course Objectives

To familiarize various destructive and non-destructive methods of soil investigation.
Introduce the significance and application of slope stability and earth pressure theories.
To explain the estimation of safe bearing capacity and settlement consideration for various foundation systems.
To highlight the selection criteria and analysis of shallow foundation systems.
To explain the need and types of deep foundation systems and their analyses.

Course Outcome

CO1: Identify and suggest site investigation program to evaluate soil behaviour and obtain design parameters.
CO2: Analyze the stability of natural/man-made slopes.
CO3: Analyze the stability of retaining walls.
CO4: Estimate allowable bearing pressures and load carrying capacities of shallow foundation systems.
CO5: Estimate allowable bearing pressures and load carrying capacities of deep foundation systems.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2				1	1							
CO2	3	3	2	1								3		2
CO3	3	3	2									3		2
CO4	3	3	3									3		2
CO5	3	3	3									3		

Syllabus

Unit 1

Soil Exploration: Need – Methods of soil exploration – Boring and Sampling methods – Field tests – Penetration Tests – Plate load test – Pressuremeter – Planning of programme and preparation of soil investigation report.
Liquefaction Analysis: Introduction to liquefaction of soil, Critical Void Ratio Concept, Liquefaction resistance, Evaluation of liquefaction potential.

Unit 2

Earth Slope Stability: Infinite and finite earth slopes-types of failures, Factor of safety of infinite slopes, Stability analysis by Swedish Arc method, Standard Method of Slices, Bishop's Simplified method, Taylor's Stability Number.
Earth Pressure Theories: Rankine's theory of earth pressure, Earth pressure in layered soils, Coulomb's earth pressure theory, Culmann's graphical method, Friction Circle Method.
Toe Walls, Types of Retaining Walls & Modes of Failure-Rigid retaining walls, Flexible retaining walls and MSE retaining walls. IS Recommendation
Brief discussion on ground improvement methods: Soil Nailing, Gabion Walls, Sand Compaction Piles and Stone Columns.

Software Applications: 2-dimensional Finite Element Software: Description of the Software & methodology:

- Determining Factor of safety for the slopes

Unit 3

Shallow Foundations: Types - choice of foundation – Location of depth – Safe Bearing Capacity – Terzaghi, Meyerhof, Skempton and IS Methods. Bearing Capacity calculations based on various Field Test and Settlement, Design of a footing in soil based on settlement and bearing capacity criteria, Analysis and design of raft based on settlement and bearing capacity criteria

Pile Foundation: Types of piles, Pile load tests, Load carrying capacity of piles based on Static pile formulae & Dynamic pile formulae, Load carrying capacity of pile groups in sands and clays, Settlement of pile groups, IS Recommendations. Basics of Laterally loaded piles & Under-reamed piles.

Well Foundations: Types – Components of well foundation – functions and design. Design Criteria – Sinking of wells – Tilts and shifts.

Software Applications: 2-dimensional Finite Element Software: Description of the Software & methodology:

- Settlement and Bearing capacity analysis of shallow foundation

Text Book(s)

Venkat Reddy, D., "Engineering Geology", Vikas Publishing House, 2010.
Gopal Ranjan and A.S.R. Rao, "Basic and Applied Soil Mechanics", New Age International Publishers, 2005.

Reference(s)

Blyth F.G.H. and M. H. De Freitas, "Geology for Engineers", 7th Edition, Elsevier Science, 2006.
Parbin Singh., "Engineering and General Geology", S.K. Kataria and Sons, 2009.
Das, B.M., "Principles of Geotechnical Engineering", CL Engineering, 2013.
P. Purushothama Raj, "Soil Mechanics & Foundation Engineering", Pearson, 2nd Edition.
T.W. Lambe and Whitman, "Soil Mechanics", Wiley, 2008.
Dutta, M., and Gulhati S.K, "Geotechnical Engineering", Tata McGraw Hill Publishers, 2005.
B. C. Punmia, Jain, A. K. & Jain, A. K., "Soil Mechanics & Foundations", Firewell Media, 2005.

23CIE302	ENVIRONMENTAL ENGINEERING - I	L-T-P-C: 2-1-0-3

Pre Requisite(s): Nil

Course Objectives

To discuss the current status of Indian Environment and responsible Government agencies.
To explain the different water quality parameters and their significance.
To explain the different water treatment options for domestic consumption.
To explain the different techniques of solid waste management

Course Outcome

CO 1: Understand the impact of humans on environment and environment on humans and be conversant with basic environmental legislation

CO 2: Analyze the water quality from different source and estimate the water quantity for domestic purpose

CO 3: Select and design the most appropriate technique for the treatment of water

CO 4: Understand the most appropriate technique for the treatment of solid waste

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3											1	
CO2	3	3	3	1	1	1		1	1	1		2		
CO3	3	2	3										2	
CO4	2	2			1									1

Syllabus

Unit 1

Introduction to current status of Indian environment – Land, Water and Air. Energy and Food security. Role of Government authorities in water supply, sewerage disposal, solid waste management and monitoring/control of environmental pollution – related legislation.
Water: Sources of water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water supply systems, Need for planned water supply schemes, Water demand industrial and agricultural water requirements – Design period - Population forecasting

Unit 2

Components of water supply system; Intake structures -Transmission of water, Types of pipe conduits- distribution system, Pumps, Various valves used in W/S systems, service reservoirs and design. Computer aided design of water supply system
Water Treatment Units: Conventional surface water treatment flow charts - Principles of coagulation, flocculation and sedimentation - Design principles -Filtration - Principles –Classification: slow sand filters and rapid sand filters. Disinfection - methods and disinfectants

Unit 3

Design of complete water treatment - Design of Primary sedimentation tank and secondary sedimentation tank - Design of Sand filter unit.
Introduction to advanced water treatments - polishing treatments.
Introduction to Air Pollution and control devices, Municipal Solid Wastes management and Noise Pollution

Text Book(s)
Birdie G.S and Birdie J. S, "Water Supply and Sanitary Engineering", DhanpatRai& Sons, 9th Edition, 2018
Garg S. K, "Environmental Engineering", Vol. I and II, Khanna Publishers, 33rd Edition

Reference(s)
Gilbert Masters, "Introduction to Environmental Engineering and Science" Prentice Hall, New Jersey, 3rd Edition.
P. AarneVesilind, Susan M. Morgan, "Introduction to Environmental Engineering" by, Belmont, CA : Thomson/Brook/Cole, c2004, 3rd Edition.
Peavy, H.s, Rowe, D.R, Tchobanoglous, G. "Environmental Engineering", Mc-Graw - Hill International Editions, New York, Indian Edition,2017
Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi.
Tchobanoglous, Theissen& Vigil, "Integrated Solid Waste Management". McGraw Hill Publication, Indian edition.

23CIE303	BEHAVIOUR & DESIGN OF REINFORCED CONCRETE STRUCTURES	L-T-P-C: 2-1-0-3

Course Objectives

To equip the students with basic understanding of theory and application of analysis and design of reinforced concrete structures. Understand the behavior and design of reinforced concrete components and systems subjected to gravity loads according to Indian standard building code requirements

Course Outcome

CO1: Apply knowledge of material properties, understanding design philosophies and methodologies.
CO2: Apply knowledge of design philosophies to design and analyze simple structural elements.
CO3: Evaluate, analyze and design structural elements in a building.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3										2	3		
CO2	3	2	2									3		
CO3	3	3	3		2			2	1			3	3	2

Syllabus

Unit 1

Introduction to R.C structures – Review of basic material properties - Concrete and Reinforcing steel. Modeling of RC buildings using ETABs – Demands on structural elements - Design philosophies - Working stress method (WSM), Ultimate load method (ULM), Limit state method (LSM).. Behavior in Flexure, Shear and Torsion, design for bond - development length, splicing, curtailment. Serviceability requirements. Analysis and design with and without shear reinforcement.

Unit 2

Analysis of Beams using Working Stress Method - Design of Beams using Limit State Method - singly and doubly reinforced rectangular and flanged sections. Design of one-way slabs and two-way rectangular slabs (wall-supported) - as per IS 456: 2000. Design of Compression Members: effective length, short columns subject to axial compression with and without uniaxial / biaxial eccentricities. Design for Torsion – Overview of design for combined actions (torsion- shear-axial-flexure) – Design of beam-column joint – Preparation of Design sheets for different structural elements

Unit 3

Introduction to types of footing. Design of isolated footing for axially loaded & eccentrically loaded columns and combined footing. Introduction to prestress-concrete

Text Book(s)

Pillai S.U. and Menon D, "Reinforced Concrete Design", Tata McGraw Hill, 2009.
M.L.Gambhir , " Design of Reinforced Concrete Structures", PHI learning, 2009.

Reference(s)

Park and Paulay, "Reinforced Concrete Structures", Wiley India (P) Ltd, 2010
Varghese P.C., "Limit State Design of Reinforced Concrete", PHI Learning, 2013
P.Dayaratnam, "Design of Reinforced Concrete Structures",Published by Medtech, New Delhi 2018
Jain A.K., "Reinforced Concrete - Limit State Design- 7th Edition", Nem Chand & Bros., 2012
Sinha S.N., "Reinforced Concrete Design", Tata McGraw Hill, 2014.
BIS Codes (IS 456-2000, IS 875-1987Part (I&II), SP 16-1980, SP24-1983, SP34-1999)
Arthur H Nilson, "Design of Concrete Structures", Tata McGraw-Hill Publications, 2005

23CIE304	RAILWAYS, AIRPORTS & HARBOUR ENGINEERING	L-T-P-C: 2-0-0-2

Course Objectives

To explain the importance of the various components of a railway track
To impart knowledge on the design of various geometric elements of a railway track
To highlight the factors in site selection for an airport
To explain the design guidelines for various elements of a harbor

Course Outcome

CO1: Identify and explain the role of different components in a railway track
CO2: Design the geometric elements of a railway track
CO3: Assess the suitable location for an airport and design the landing area
CO4: Specify design guidelines for the various elements within the harbor

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1		2			2					1	3		
CO2	3	3	2					1			1	3	1	2
CO3	3	3	2			2		1				3	1	2
CO4	1		2			1						3		2

Syllabus

Unit 1
Railway Engineering: Components and Geometrical Design of Railways – Horizontal Curves, Radius, Super elevation, Cant Deficiency, Transitional Curves, Different types of Gradients, Grade Compensation, Points and Crossings and their Design; Signaling & Interlocking.

Unit 2
Airport Engineering – Factors affecting site selection and spacing of airports. Components of an airport and their functions. Typical layout. Geometrical Design Considerations – Taxiways, Runways and Aprons. Basic Runway Length and corrections - Runway Orientation.

Unit 3
Harbour engineering - Requirements of ports and harbours - classification of harbours. Selection of site and planning of harbours. Various component and general layout. Principles of harbour design, turning basin, harbour entrances, breakwaters, berthing structures - jetties, fenders, piers, wharves. Docks and Repair Facilities.

Text Book(s)
Satish Chandra and M. M Agarwal", Railway Engineering", Oxford university Press, Second Edition 2013.
Rangwala, "Airport Engineering", Charotar Publishing House, 17th Edition 2018.

Reference(s)
Arora and Saxena, "Railway Engineering", Dhanpat Rai Publications, 2011.
R Srinivasan, "Harbour, Dock and Tunnel Engineering", Charotar Publishing House, 2012.
Khanna S K, Arora, M G and Jain S S., "Airport Planning and Design", Nem Chand and Bros, 2009.
Oza, H. P and Oza, G. H., "Dock and Harbour Engineering", Charotar Book House, 2011

23CIE305	STRUCTURAL ANALYSIS II	L-T-P-C:2-0-0-2

Prerequisite(s): 23CIE212 Structural Analysis I

Course Objectives

Introduce to the approximate methods for analyzing Multi-storey frames.
To make the student familiar with latest computational techniques used in structural analysis software.

Course Outcome

CO1: Analyze the multistory frames using approximate methods.
CO2: Apply flexibility matrix method to analyze the beams, frames and truss system.
CO3: Analyze the beams, frames and truss system using stiffness matrix method.
CO4: Understand the basics of Finite element analysis of structural elements

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	1	1							3	3		
CO2	3	3	1	1							3	3		
CO3	3	3	1	1							3	3		
CO4					3						3		3	

Syllabus

Unit 1
Slope deflection method-application to the analysis of statically indeterminate beams with and without settlement of supports –rigid pointed plane frames with and without side sway
Analysis of continuous beams-theorem of three moments
Sway and non-sway analysis by moment distribution method and Kani's method (introduction level)

Unit 2
Approximate Methods of Analysis of Multistoried Frames: Analysis for vertical loads – substitute frames - loading conditions for maximum moments in beams and columns – portal method and cantilever method for lateral load analysis.

Unit 3
Matrix methods of structural analysis – stiffness and flexibility matrices for elements and structures- analysis of continuous beams, simple rigid jointed frames and plane trusses by stiffness and flexibility method.
Introduction to FEM, Development of MATLAB code for the analysis of structural elements and validation using available software.

Text Book(s)
Devdas Menon, "Structural Analysis", Narosa Book Distributers Pvt Ltd, 2010.
Devdas Menon, "Advanced Structural Analysis", Narosa Book Distributers Pvt Ltd, 2017.
G S Pundit &S P Gupta , "Structural Analysis- A matrix Approach", Tata McGraw Hill, 2017

Reference(s)

Hibbeler, R. C., "Structural Analysis", Pearson, 2008.
Wang C.K., "Intermediate Structural Analysis"Tata McGraw - Hill Education 2010.
Norris C.H, Wilbur J.B. and Utku.S., "Elementary Structural Analysis", Tata McGraw Hill, 2016.
Sujit Kumar Roy and Subrata Chakrabarty, "Fundamentals of Structural Analysis",S.Chand& Co., 2010.
Reddy C.S., Basic Structural Analysis, Tata McGraw Hill, New Delhi, 2010.

23CIE306	BIM FOR FUNCTIONAL PLANNING	L-T-P-C: 0-0-3-1

Course Objectives

To develop graphical skills for communicating concepts, ideas and designs
To train students for preparing and interpreting 2D & 3D drawings for conventional structures

Course Outcome

CO1: Prepare the functional plan of the residential, commercial and public building as per building development rules
CO2: Prepare the building information models.
CO3: Prepare the detailed plan, manually and using IT tool for different buildings according to the given requirements and site conditions

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3		1		1	2		3	3		1		3	3
CO2	1		3		3			3	3		3		3	3
CO3	1		3		3	3		3	3	3	3		3	3

Syllabus
Developing BIM 3D models
Building Information modelling - Creating Levels and Grids, Walls Modelling, Object Modification, Doors and Windows, Floors and Roofs, Curtain, Stairs and Ramps, Dimensions and Constraints, Annotation and Documentation. Importing and modifying families of objects and elements

Functional planning – Building development rules - Space planning of buildings – Design process – planning principles. Preparation of drawings as per building development rules

- Residential building- flat and pitched roof, economic domestic units, cottages, bungalows
- Public building – small public utility shelters, dispensaries, banks, schools, offices, libraries, hostels, restaurants, commercial complexes, factories etc.
- Preparation of site plans and service plans as per Building Rules

Text Book(s)

Shaw, Kale and Patki, "Building Drawing with an Integrated Approach to Built Environment", McGraw Hill Education; 2017.
Karen Kensek and Douglas Noble, Building Information Modelling: BIM in Current and Future Practice Wiley; 1st edition (15 August 2014)
Balagopal T S Prabhu, "Building Design and Civil Engineering Drawing", Spades Publishers, 2008.

Reference(s)

SP 7: National Building Code of India, Bureau of Indian Standards, 2016.
G. Muthu Shoba Mohan, "Principles of Architecture", Oxford University Press, 2006.
Crosbie, M.J. and Callender, J.H., "Time-Saver Standards for Architectural Design Data", McGraw Hill Education2017.
Sham Tickoo, "Autodesk Revit architecture 2010 for architects and designers", CADCIM Technologies, 2009.

23CIE381	COMPUTATION, DESIGN & DETAILING- RC STRUCTURES	L-T-P-C: 0-0-3-1

Pre Requisite:

Course Objectives

To equip the students with basic understanding of detailing of RC structural elements

Understand the implication of detailing in the behaviour of building

Course Outcome

CO1: Apply the knowledge of design to detail beams and slabs

CO2: Apply the knowledge of design to detail columns and footings

CO3: Analyze, design and detail structural elements in a multi-storey building using a commercially available software

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3										2	3		
CO2	3	2	2									3		
CO3	3	3	3		2			2	1			3	3	2

Syllabus

Unit1

Preparation of Design basis report - recap of elevations, plan and section of buildings - Introduction to functions of detailing – Structural drawing for detailing – General detailing requirement – bar bending schedule - Transport, storage, fabrication, assembly and placing of steel reinforcement - Typical structural drawings - Welding

Unit2

Detailing of (a) beams: singly, doubly, and T beams, (b) slabs: one-way, two-way, corners held down, and corners held up, (c) columns: axially loaded and bi-axially loaded, (d) beam-column joint: exterior, interior, corner, (e) footing: isolated and combined footing and (f) staircase.

Unit3

Computer aided analysis, design, and detailing: Multi-Storey frame analyses

Text Book(s)

N. Krishna Raju, "*Structural Design and Drawing – Reinforced Concrete and Steel*", Universities Press, 2005.

M.L.Gambhir, "*Design of Reinforced Concrete Structures*", PHI Learning, 2009.

Pillai S.U. and Menon D*, "Reinforced Concrete Design",* Tata McGraw Hill, 2009.

Reference(s)

D.Krishnamoorthy, "*Structural Design & Drawing- Vol-I&II*", CBS Publishers, 2012.

Karve, Shah, "*Illustrated Design of R. C. Buildings (G*+3)", Standard Publishers Distributors, 2008.

Park and Paulay, *"Reinforced Concrete Structures",* Wiley India (P) Ltd, 2010

Varghese P.C., *"Limit State Design of Reinforced Concrete",* PHI Learning, 2013

P.Dayaratnam, *"Design of Reinforced Concrete Structures",*Published by Medtech, New Delhi 2018

Jain A.K., *"Reinforced Concrete - Limit State Design- 7th Edition",* Nem Chand & Bros., 2012

Sinha S.N., *"Reinforced Concrete Design",* Tata McGraw Hill, 2014.

BIS Codes (IS 456-2000, IS 875-1987Part (I&II), SP 16-1980, SP24-1983, SP34-1999)

Arthur H Nilson*, "Design of Concrete Structures",* Tata McGraw-Hill Publications, 2005

23CIE382	EXPERIMENTAL LEARNING - GEOTECHNICS	L-T-P-C: 0-0-3-1

Course Objectives

To give an exposure on the laboratory tests for determination of Index and Engineering properties of soil.
Provide students the basic knowledge to carry out field investigations and to identify soils in geotechnical engineering practice.

Course Outcome

CO1: Conduct experiments to find the index and engineering properties of different types of soil.
CO2: Prepare laboratory reports on the interpretation of experimental results.
CO3: Assess the strength parameters of soil using various field tests.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3		3				3	3		3	3	1	1
CO2	3	3		3				3	3		3	3	1	
CO3	3	3		3				3	3		3	3	1	1

List of experiments

- Grain Size Distribution
- Atterberg’s limits and indices
- Determination of field density (a) sand replacement method (b) core cutter method
- Determination of coefficient of permeability by (a) Constant head method; (b)Variable head method
- Consolidation test
- Compaction test (IS light compaction)
- California Bearing Ratio test
- Direct Shear Test
- Triaxial Test
- Unconfined compressive strength test
- Demonstration of Laboratory vane shear test & Field tests – Standard Penetration Tests/Plate Load Test

23CIE383	EXPERIMENTAL LEARNING I - INDUSTRY INTERNSHIP	0-0-3-P/F

Course Objectives

To expose students to the industry working environment and get acquainted with the organization structure, business operations and administrative functions.

To have hands-on experience so that they can relate and reinforce the teaching-learning process.

To promote cooperation and to develop synergetic collaboration between industry and the institution

To set the stage for future recruitment by potential employers.

Course Outcome

CO1: Work in actual working environment**.**
CO2: Utilize technical resources
CO3: Prepare technical documents and give oral presentations related to the work completed.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2			2	2	2		2	2	2	2	2	2
CO2		2			2			2			2			
CO3								2	3					

Students have to undergo minimum of one-week practical training in Civil Engineering related organizations of their choice with the approval of the department. At the end of the training student will submit a report as per the prescribed format to the department.

23LIV390	LIVE-IN-LABS I	L-T-P-C: 0-0-9-3

Course Objectives

- Identify and analyse the various challenge indicators present in the village by applying concepts of Human Centered Design and Participatory Rural Appraisal.
- User Need Assessment through Quantitative and Qualitative Measurements
- Designing a solution by integrating Human Centered Design concepts
- Devising proposed intervention strategies for Sustainable Social Change Management

Course Outcome

CO1: Learn ethnographic research and utilise the methodologies to enhance participatory engagement.
CO2: Prioritize challenges and derive constraints using Participatory Rural Appraisal.
CO3: Identify and formulate the research challenges in rural communities.
CO4: Design solutions using human centered approach.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1		3		3		1		3	3		3
CO2		3					3	3	3		
CO3		3				1		3	3		3
CO4	3		3			3	3	3	3		3

Syllabus

This initiative is to provide opportunities for students to get involved in coming up with technology solutions for societal problems. The students shall visit villages or rural sites during the vacations (after 4th semester) and if they identify a worthwhile project, they shall register for a 3-credit Live-in-Lab project, in the fifth semester.
Thematic Areas

- Agriculture & Risk Management
- Education & Gender Equality
- Energy & Environment
- Livelihood & Skill Development
- Water & Sanitation
- Health & Hygiene
- Waste Management & Infrastructure

The objectives and the projected outcome of the project will be reviewed and approved by the department chairperson and a faculty assigned as the project guide.

23LSE301	Life Skills for Engineers III	L-T-P-C: 1-0-2-2

Pre-requisite: Willingness to learn, communication skills, basic English language skills, knowledge of high school level mathematics.

Course Objectives

- Help students understand corporate culture, develop leadership qualities and become good team players
- Assist them in improving group discussion skills
- Help students to sharpen their problem solving and reasoning skills
- Empower students to communicate effectively

Course Outcomes

CO1 - Soft Skills: To improve the inter-personal communication and leadership skills, vital for arriving at win-win situations in Group Discussions and other team activities.
CO2 - Soft Skills: To develop the ability to create better impact in a Group Discussions through examination, participation, perspective-sharing, ideation, listening, brainstorming and consensus.
CO3 - Aptitude: To identify, investigate and arrive at appropriate strategies to solve questions on geometry, statistics, probability and combinatorics.
CO4 - Aptitude: To analyze, understand and apply suitable methods to solve questions on logical reasoning.
CO5 - Verbal: To be able to use diction that is more refined and appropriate and to be competent in spotting grammatical errors and correcting them.
CO6-Verbal: To be able to logically connect words, phrases, sentences and thereby communicate their perspectives/ideas convincingly.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1								3	3	2	3
CO2									3	2	2
CO3		3		2							
CO4		3		2							
CO5									3		3
CO6								3	3		3

Syllabus
Soft Skills
Professional Grooming and Practices: Basics of corporate culture, key pillars of business etiquette – online and offline: socially acceptable ways of behavior, body language, personal hygiene, professional attire and Cultural adaptability and managing diversity. Handling pressure, multi-tasking. Being enterprising. Adapting to corporate life: Emotional Management (EQ), Adversity Management, Health consciousness. People skills, Critical Thinking and Problem solving.
Group Discussions: Advantages of group discussions, Types of group discussion and Roles played in a group discussion. Personality traits evaluated in a group discussion. Initiation techniques and maintaining the flow of the discussion, how to perform well in a group discussion. Summarization/conclusion.

Aptitude
Problem Solving III
Geometry: 2D, 3D, Coordinate Geometry, and Heights & Distance.
Permutations & Combinations: Basics, Fundamental Counting Principle, Circular Arrangements, and Derangements.
Probability: Basics, Addition & Multiplication Theorems, Conditional Probability and Bayes' Theorem.
Statistics: Mean, Median, Mode, Range, Variance, Quartile Deviation and Standard Deviation.
Logical Reasoning: Blood Relations, Direction Test, Syllogisms, Series, Odd man out, Coding \& Decoding, Cryptarithmetic Problems and Input - Output Reasoning.

Verbal
Vocabulary: Create an awareness of using refined language through idioms and phrasal verbs.
Grammar (**Upper Intermediate-Advanced**): Train Students to comprehend the nuances of Grammar and empower them to spot errors in sentences and correct them.
Reasoning: Enable students to connect words, phrases and sentences logically.
Oral Communication Skills: Aid students in using the gift of the gab to interpret images, do a video synthesis, try a song interpretation or elaborate on a literary quote.

Writing Skills: Practice closet tests that assess basic knowledge and skills in usage and mechanics of writing such as punctuation, basic grammar and usage, sentence structure and rhetorical skills such as writing strategy, organization, and style.

References:

1. Students" Career Planning Guide, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
2. Soft Skill Handbook, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
3. Adair. J., (1986), *"Effective Team Building: How to make * winning team"*, London, U.K
4. Gulati. S., (1006) "Corporate Soft Skills", New Delhi, India: Rupa & **Co.**
5. The hard truth about Soft Skills, by Amazon Publication.
6. Verbal Skills Activity Book, CIR, AVVP
7. English Grammar & Composition, Wren & Martin
8. Public Sector – Engineer Management Trainee Recruitment Exam (General English)
9. Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
10. Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
11. Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.
12. How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma.
13. How to Prepare for Data Interpretation for the CAT, Arun Sharma.
14. How to Prepare for Logical Reasoning for the CAT, Arun Sharma.
15. Quantitative Aptitude for Competitive Examinations, R S Aggarwal.
16. A Modern Approach to Logical Reasoning, R S Aggarwal.
17. A Modern Approach to Verbal & Non-Verbal Reasoning, R S Aggarwal.

Evaluation Pattern

Assessment	Internal	External
Continuous Assessment (CA)* – Soft Skills	30	-
Continuous Assessment (CA)* – Aptitude	10	25
Continuous Assessment (CA)* – Verbal	10	25
Total	50	50

*CA - Can be **presentations, speaking activities and tests.**

Course Outcomes:

CO # 1 - Soft Skills: To understand the preparation of a suitable resume (including video resume). They would also have acquired the necessary skills, abilities and knowledge to presentthemselves confidently. They would be sure-footed in introducing themselves and facing interviews.

CO # 2 - Soft Skills: To analyse every question asked by the interviewer, compose correct responses and respond in the right manner to justify and convince the interviewer of one's right candidature through displaying etiquette, positive attitude and courteous communication.

CO # 3 - Aptitude: To interpret, critically analyze and solve logicalreasoning questions. They will have acquired the skills to manage time while applying methods to solve questionson arithmetic, algebra, logical reasoning, and statistics and data analysis and arrive at appropriate conclusions

CO # 4 – Verbal: To understand and use words, idiomsand phrases, interpret the meaning of standard expressions and compose sentences using the same.

CO # 5 - Verbal: To decide, conclude, identify andchoose the right grammatical construction

CO # 6 – Verbal: To examine, interpret and investigate arguments, use inductive and deductive reasoning to support, defend, prove or disprove them. They will also havethe ability to create, generate and relate facts / ideas / opinions and share / express the same convincingly to the audience / recipient using their communication skills in English.

Team work: Value of team work in organisations, definition of a team, why team, elements of leadership, disadvantages of a team, stages of team formation. Group development activities: Orientation, internal problem solving, growth and productivity, evaluation and control. Effective team building: Basics of team building, teamwork parameters, roles, empowerment, communication, effective team working, team effectiveness criteria, common characteristics of effective teams, factors affecting team effectiveness, personal characteristics of members, team structure, team process, team outcomes.

Facing an interview: Foundation in core subject, industry orientation / knowledge about the company, professional personality, communication skills, activities before interview, upon entering interview room, during the interview and at the end. Mock interviews.

Advanced grammar: Topics like parallel construction, dangling modifiers, active and passive voices, etc.

Syllogisms, critical reasoning: A course on verbal reasoning. Listening comprehension advanced: An exercise on improving listening skills.

Reading comprehension advanced: A course on how to approach advanced level of reading, comprehension passages. Exercises on competitive exam questions.

Problem solving level IV: Geometry; Trigonometry; Heights and distances; Co-ordinate geometry; Mensuration.

Specific training: Solving campus recruitment papers, national level and state level competitive examination papers; Speed mathematics; Tackling aptitude problems asked in interview; Techniques to remember (In mathematics). Lateral thinking problems. Quick checking of answers techniques; Techniques on elimination of options, estimating and predicting correct answer; Time management in aptitude tests; Test taking strategies.

TEXTBOOK(S)

A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.
Adair. J., (1986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
The Hard Truth about Soft Skills, by Amazone Publication.
Data Interpretation by R. S. Aggarwal, S. Chand
Logical Reasoning and Data Interpretation – Niskit K Sinkha
Puzzles – Shakuntala Devi
Puzzles – George J. Summers.

REFERENCE(S)

Books on GRE by publishers like R. S. Aggrawal, Barrons, Kaplan, The Big Book, and Nova.
More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.
The BBC and British Council online resources
Owl Purdue University online teaching resources
www.the grammarbook.com - online teaching resources www.englishpage.com- online teaching resources and other useful websites.

SEMESTER V I

23CIE311	ENVIRONMENTAL ENGINEERING – II	L-T-P-C: 2-1-0-3

Pre Requisite(s): Nil

Course Objectives

To explain

- the concepts of typical waste water collection and treatment system
- the design of a typical waste water collection system
- the different treatment techniques for treating domestic waste water

Course Outcome

CO 1: To understand the concepts of typical waste water collection and treatment system
CO 2: To Design and estimate for a typical waste water collection schemes
CO 3: To Design the most appropriate technique for the treatment of domestic wastewater.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	1	1	1						2		
CO2	2	3	3		1								1	
CO3	3	2	3					1	1	1				1

Syllabus

Unit 1

Waste water- Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification and design of Storm water.

Unit 2

Sewage and Sullage, Disposal of waste water on water bodies and land – effluent discharge standards- self purification of streams– oxygen sag curve – sewage farming - National River cleaning plans .
Wastewater treatment scheme - Objectives – Selection of unit operation and process – aerobic and anaerobic treatment systems-suspended and attached growth systems.

Unit 3

Activated sludge process and its types – Design of conventional activated sludge process-recycling of sewage – quality requirements for various purposes- Sludge treatment and disposal. Computer Aided Design of waste water collection and treatment system.

Text Book(s)

Birdie G.S and Birdie J. S, "Water Supply and Sanitary Engineering", DhanpatRai& Sons, 9th Edition, 2018
Garg S. K, "Environmental Engineering", Vol. I and II, Khanna Publishers, 33rd Edition

Reference(s)

Gilbert Masters, "Introduction to Environmental Engineering and Science" Prentice Hall, New Jersey, 3rd Edition.
P. AarneVesilind, Susan M. Morgan, "Introduction to Environmental Engineering" by, Belmont, CA : Thomson/Brook/Cole, c2004, 3rd Edition.
Peavy, H.s, Rowe, D.R, Tchobanoglous, G. "Environmental Engineering", Mc-Graw - Hill International Editions, New York, Indian Edition,2017
MetCalf and Eddy. "Wastewater Engineering, Treatment, Disposal and Reuse", Tata McGraw-Hill, New Delhi, Indian Edition
Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public
Health and Environmental Engineering Organization, Ministry of Urban Development
Standard method for the examination of water and waste water, APHA, AWWA, WPCF Publication.

23CIE312	BEHAVIOUR & DESIGN OF STEEL STRUCTURES	L-T-P-C:2-1-0-3

Course Objectives
To equip the students with basic understanding of theory and analysis of steel buildings
Understand the Steel's material properties
Understand the behavior and design of connections and structural steel elements subjected to different actions.

Course Outcome

CO1	Design the connections considering load combinations and deflection limitations.
CO2	Design members subjected to tension & Compression and built up members incorporating flexure, shear, deflection and bearing
CO3	Analyze the plastic behaviour of structural steel and design of beams and portal frames
CO4	Estimate the load on the truss due to dead weight, live load and wind load

PO / *CO*	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2	1								3		
CO2	3	2	2									3		
CO3	3	2	2									3	2	2
CO4	2	2	2		1			1	1			3	2	2

Syllabus

Unit1
Introduction to different structural systems, load paths, loads on buildings, and serviceability requirement – Hands-on: Modelling of steel buildings using commercially available software - Introduction to fabrication, erection aspects and inspection of completed structure. – Introduction to structural steel sections, material property, geometric properties, classes of sections, stresses, residual temperature stresses in rolled steel sections, loads. Introduction to Tubular sections. Types of connections - rigid, semi rigid. Limit state design method – basic concepts, partial safety factors, load combinations, deflection limitations as per IS 800. Analysis and design of bolted and welded connections to resist direct force and moment. Design of tension members - single and double angle ties – concepts of net section including shear lag effects and block shear.

Unit2
Plastic behaviour of structural steel – shape factor – plastic hinge concept – collapse load – methods of plastic analysis – plastic analysis of beams and portal frames. Analysis and design of laterally restrained & unrestrained simple & compound beams - Design for flexure, shear, bearing and check for serviceability criteria.

Unit3
Design of axially loaded and eccentrically loaded compression members – built up columns and lacings. Industrial roofs – Introduction to steel roof systems – various elements – loads – wind load estimation for plane roof trusses. Hands-on: Analysis and Design of warehouse

Text Book(s)
Subramanian N, *"Design of Steel Structures limit states method",* Oxford University Press, 2016
Duggal, SK, *"Limit State Design of Steel Structures",* Tata McGraw Hill, 2017

Reference(s)
Ramchandra and Gehlot, *"Limit State Design of Steel Structures",* Scientific Publishers, 2015
Dayaratnam P, *"Design of Steel Structures",* S Chand & Co., 2012
Aryaand Ajmani, *"Design of Steel Structures",* Nem Chand Brothers, 2007
BIS codes (IS800-2007,IS875-1987-PartsI,II,IS875-2016-PartsIII,SP:6–Part1to6)
Emil Smith and Robert Scanlan, *"Wind Effects on Structures"* Wiley-Interscience,1996.
Edwin Gaylord, *"Design of Steel Structure",*TataMcGraw Hill Publishing Company Limited, 2010.
Segui, WT *"Design of Steel Structures",* Cengage Learning, 2007
Bhavikatti, S. S. *"Design of Steel Structures (by Limit State Method as Per IS: 800—2007)"* IK International, 2010

23CIE313	CONSTRUCTION MANAGEMENT	L-T-P-C: 2-1-0-3

Course Objectives

To provide a basic idea on construction dynamics - various stakeholders, project objectives, processes and resources required.

To develop an ability to plan, control and monitor construction projects with respect to time and cost

To provide an insight on how construction projects are administered with respect to contract structures and issues

Course Outcome

CO1: Apply knowledge of network scheduling techniques to identify critical activities
CO2: Apply knowledge of construction procedures in assessing different contract options
CO3: Assess quality and safety aspects in project environment
CO4: Take decisions on inventory and transportation of construction materials.
CO5: Select appropriate equipment for various construction activities

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3			1					1		1	2	3
CO2		3								3				3
CO3		2	1			3								3
CO4	2	3								2		1		3
CO5	2	3								2		1		3

Syllabus

Unit 1

Construction management environment - Construction activities and sequence. Construction planning - Network scheduling - Bar chart, linked bar chart, work-breakdown structures, activity-on-arrow diagrams - event based networks. Critical path method. PERT network analysis. Introduction to Precedence networks.

Unit 2

Network compression - Time-cost study. Resource management. Construction procedure – contracts – types – bidding process – contract conditions - specifications – Quality management-Principles-TQM. Construction safety.

Unit 3

Materials management - inventory control. Transportation model and application for distribution of materials. Construction equipment - selection factors - planning of equipment – equipment for excavation, transport, hoisting, piling, and concrete construction. Basics of Lean Construction and BIM in project management. Introduction to project management softwares.

Demonstration and Hands on exercises: Project Scheduling using project management softwares.
(Enterprise, WBS, Calender, Scheduling, Critical Path, and Report generation)

Text Book(s)

Kumar Neeraj Jha, "Construction Project Management", Pearson Education, 2015.
R. L. Peurifoy and Schexnayder, "Construction Planning, Equipment, and Methods", Tata McGraw Hill, 2018.

Reference(s)

Gahlot, P. S. and Dhir, B. M., "Construction Planning and Management", New Age International, 2018.Chitkara, K. K. "Construction Project Management - Planning, Scheduling and Control", McGraw Hill Education, 2019.
Jerome D. Wiest, Ferdinand K. Levy, "A Management guide to PERT / CPM", PHI Learning, 2009.
Managing Quality, Dale B. G, Fourth Edition, Blackwell Publishing, Oxford, 2013.
Reese. C.D and Eidson J.V, Handbook of OSHA Construction Safety and Health, Second Edition, CRC Press, Boca Raton, 2006

23CIE314	PROFESSIONAL PRACTICE, ESTIMATION & COSTING	L-T-P-C: 0-0-3-1

Course Objectives

To provide students with theoretical and practical base to enable them to measure, cost and specify construction resources

To develop the skill to assess the monetary value of a facility/property.

To make the students understand the types of roles they are expected to play in the society as practitioners.

Course Outcome

CO1: Understand the ethics governing the profession and recognize the roles of stakeholders in professional practice.

CO2: Quantify the items of work and estimate material requirement for construction

CO3: Derive the cost rates and build up the overall cost of the structure.

CO4: Apply the technical specifications for various works to be performed for a project.

CO5: Understand and apply the basic principles for valuation of properties.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2					3	3			2		3	
CO2	3	3			2			3			3		3	
CO3	3	3			2			3			3		3	
CO4	3	3						3			3		3	
CO5	3	3						3			2		3	

Syllabus

Unit 1

Professional Practice – Respective roles of various stakeholders: Government; Standardization Bodies; professional bodies; Clients/ owners; Developers; Consultants; Contractors; Manufacturers/ Vendors/ Service agencies.

Ethics – Definition, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Professional Responsibility, Conflict of Interest, Environmental breaches, Negligence.

Unit 2

Estimation - Measurements for various items- Introduction to the process of Estimation; Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; Material survey-Thumb rules for computation of materials requirement for different materials for buildings, Use of Computers in quantity surveying; BIM and quantity take-offs.

Unit 3

Specifications - Types, requirements and importance. Detailed specifications for common building materials and items of work as per I.S specifications - Preparation of conveyance statement - Calculation of quantities of materials for items of work - Analysis of rate for items of works required for civil engineering works. - Preparation of abstract of estimate of civil engineering works. Percentage breakup of the cost, cost sensitive index.

Valuation - Purposes -Types of values – concept of time-value of money - sinking fund - years purchase - Depreciation - obsolescence – Methods of valuation - valuation of land and building . – Marketable and non-marketable properties.

Exercises / Term Work Assignments:

- Types of estimate - plinth area method - cubic rate method - unit rate method - bay method - approximate quantity from bill method - comparison method - cost from materials and labour - preparation of detailed estimate

- Preparation of detailed estimate using Centre line method
- Preparation of detailed estimate using Long wall - short wall method
- Preparation of detailed estimate for R.C.C Structures.
- Preparation of detailed estimate for Steel Structures.
- Preparation of detailed estimate for roads
- Preparation of detailed estimate for sanitary and water supply works
- Preparation of valuation report.
- Assignments on:
    - market survey of basic materials
    - rate analysis
    - specifications
    - simple estimates.

Text Book(s)

Chakraborti, M., "Estimation, Costing, Specification and Valuation in Civil Engg", Chakraborti , 2008.
B.N. Dutta " Estimating& Costing in Civil Engineering Theory and Practice", UBS Publishers & Distributors Limited, 2016.

Reference(s)

Rangwala, Estimating, Costing and Valuation, Charotar Publishing House, 2017.
B.S. Patil, Legal Aspects of Building and Engineering Contracts, 1974.
The National Building Code, BIS, 2016
RERA Act, 2017
Vee, Charles &Skitmore, Martin (2003) Professional Ethics in the Construction Industry, Engineering Construction and Architectural management, Vol.10, Iss2, pp 117-127, MCB UP Ltd
American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Study and Application
Ethics in Engineering- M.W.Martin&R.Schinzinger, McGraw-Hill
Engineering Ethics, National Institute for Engineering Ethics, USA
www.ieindia.org
Engineering ethics: concepts and cases – C. E. Harris, M.S. Pritchard, M.J.Rabins
Kohli, D.D and Kohli,R.C, "A text book of Estimating and Costing (Civil)", S.Chand& Company Ltd., 2004.
IS : 1200 – 1974 – Parts 1 to 25, Methods of Measurement of Building and Civil Engineering Works, Bureau of Indian Standards, New Delhi.
Standard Data Books of Central Public Works Departments and Public Work Department of States.

23CIE384 COMPUTATION, DESIGN & DETAILING - STEEL STRUCTURES L-T-P-C:0-0-3-1

Course Objectives

To equip the students with basic understanding of detailing of structural steel elements

Understand the implication of detailing in the behaviour of building

Course Outcome

CO1: Apply the knowledge of design to detail connections

CO2: Apply the knowledge of design to detail axial members, beams, and columns

CO3: Analyze, design and detail structural elements in a steel warehouse using a commercially available software

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3										2	3		
CO2	3	2	2									3	3	
CO3	3	3	3		2			2	1			3	3	3

Syllabus

Unit1

Draughting practice - Key Plan and General Arrangement – Basic Detailing Conventions - Shop drawings - Erection Drawings - Detailing Quality Control and Assurance

Unit2

Detailing Bolts and bolted joints – Detailing Welds and Welded joints - Detailing of beams – columns – panel zones – braces-roof system - Steel buildings—case studies

Unit3

Computer aided analysis, design and detailing: warehouse building with roof truss.

Text Book(s)

N. Krishna Raju, "*Structural Design and Drawing – Reinforced Concrete and Steel*", Universities Press, 2005.

D.Krishnamoorthy, "*Structural Design & Drawing- Vol-III*", CBS Publishers, 2015

MYH Bangash, *"Structural detailing in steel - A comparative study of British, European and American codes and practices"* Thomas Telford Publishing 2000

_________, "*Detailing for Steel Construction"* ASIC 2009.

Reference(s)

BIS Codes (IS 800-2007, IS 875-1987Part (I&II), SP 38-1987, SP40-1987, SP47-1988)

_________, "Joints in Steel Construction: Moment Resisting Joints to Eurocode 3", SCI Assessment

_________, "Joints in Steel Construction: Simple Joints to Eurocode 3", SCI Assessment.

23CIE385	EXPERIMENTAL LEARNING - ENVIRONMENTAL ENGINEERING	L-T-P-C: 0-0-3-1

Course Objectives

- To impart knowledge in measuring the different physical water quality parameters
- To impart knowledge in measuring the different chemical water quality parameters
- To impart knowledge in measuring the optimum coagulant dose, Dissolved oxygen and Biochemical oxygen demand

Course Outcome

CO 1: Conduct experiments to understand, analyze and report the different physical water quality parameters

CO 2: Conduct experiments to understand, analyze and report the different chemical water quality parameters

CO 3: Conduct experiments to understand, analyze and report the optimum coagulant dose, Dissolved oxygen and Biochemical oxygen demand

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3		3				3	3		3	2		
CO2	3	3		3				3	3		3	2		
CO3	3	3		3				3	3		3	2		

List of Experiments

1. Physical characterization of water: Turbidity, Electrical Conductivity, pH
2. Analysis of solids content of water: Dissolved, Settleable, suspended, total, volatile, inorganic etc.
3. Alkalinity and acidity, Hardness: total hardness, calcium and magnesium hardness
4. Analysis of ions: chloride, sulphate, sulphide, iron and manganese
5. Optimum coagulant dose
6. Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD)

Reference(s)

Standard method for the examination of water and waste water, APHA, AWWA, WPCF Publication.

23LSE311	Life Skills for Engineers IV	L-T-P-C: 1-0-2-2

Pre-requisite: Willingness to learn, communication skills, basic English language skills, knowledge of high school level mathematics.

Course Objectives

- Help students understand corporate culture, develop leadership qualities and become good team players
- Assist them in improving group discussion skills
- Help students to sharpen their problem solving and reasoning skills
- Empower students to communicate effectively

Course Outcomes

CO1 - Soft Skills: To improve the inter-personal communication and leadership skills, vital for arriving at win-win situations in Group Discussions and other team activities.
CO2 - Soft Skills: To develop the ability to create better impact in a Group Discussions through examination, participation, perspective-sharing, ideation, listening, brainstorming and consensus.
CO3 - Aptitude: To identify, investigate and arrive at appropriate strategies to solve questions on geometry, statistics, probability and combinatorics.
CO4 - Aptitude: To analyze, understand and apply suitable methods to solve questions on logical reasoning.
CO5 - Verbal: To be able to use diction that is more refined and appropriate and to be competent in spotting grammatical errors and correcting them.
CO6-Verbal: To be able to logically connect words, phrases, sentences and thereby communicate their perspectives/ideas convincingly.

CO-PO Mapping

po / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1								3	3		2
CO2							2	3	3		2
CO3		3		2							
CO4		3		2							
CO5									3		3
CO6								3	3		3

Syllabus

Soft Skills

Teamwork: Value of teamwork in organizations, Definition of a team. Why team? Effective team building. Parameters for a good team, roles, empowerment and need for transparent communication, Factors affecting team effectiveness, Personal characteristics of members and its influence on team. Project Management Skills, Collaboration skills.
Leadership: Initiating and managing change, Internal problem solving, Evaluation and co-ordination, Growth and productivity, Importance of Professional Networking.
Facing an interview: Importance of verbal & aptitude competencies, strong foundation in core competencies, industry orientation / knowledge about the organization, resume writing (including cover letter, digital profile and video resume), being professional. Importance of good communication skills, etiquette to be maintained during an interview, appropriate grooming and mannerism.

Aptitude

Problem Solving IV

Sequence and Series: Basics, AP, GP, HP, and Special Series.
Data Sufficiency: Introduction, 5 Options Data Sufficiency and 4 Options Data Sufficiency.
Logical reasoning: Clocks, Calendars, Cubes, Non-Verbal reasoning and Symbol based reasoning.
Campus recruitment papers: Discussion of previous year question papers of all major recruiters of Amrita Vishwa Vidyapeetham.
Competitive examination papers:Discussion of previous year question papers of CAT, GRE, GMAT, and other

management entrance examinations.
Miscellaneous: Interview Puzzles, Calculation Techniques and Time Management Strategies.
Verbal
Vocabulary: Empower students to communicate effectively through one-word substitution. Grammar: Enable students to improve sentences through a clear understanding of the rules of grammar.
Reasoning: Facilitate the student to tap his reasoning skills through Syllogisms, critical reasoning arguments and logical ordering of sentences.
Reading Comprehension (Advanced): Enlighten students on the different strategies involved in tackling reading comprehension questions.
Public Speaking Skills: Empower students to overcome glossophobia and speak effectively and confidently before an audience.
Writing Skills: Practice formal written communication through writing emails especially composing job application emails.

References:

1. Students" Career Planning Guide, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
2. Soft Skill Handbook, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
3. Adair. J., (1986), *"Effective Team Building: How to make * winning team"*, London, U.K
4. Gulati. S., (1006) "Corporate Soft Skills", New Delhi, India: Rupa & **Co.**
5. The hard truth about Soft Skills, by Amazon Publication.
6. Verbal Skills Activity Book, CIR, AVVP
7. English Grammar & Composition, Wren & Martin
8. Public Sector – Engineer Management Trainee Recruitment Exam (General English)
9. Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
10. Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
11. Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.
12. How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma.
13. How to Prepare for Data Interpretation for the CAT, Arun Sharma.
14. How to Prepare for Logical Reasoning for the CAT, Arun Sharma.
15. Quantitative Aptitude for Competitive Examinations, R S Aggarwal.
16. A Modern Approach to Logical Reasoning, R S Aggarwal.
17. A Modern Approach to Verbal & Non-Verbal Reasoning, R S Aggarwal.

Evaluation Pattern

Assessment	Internal	External
Continuous Assessment (CA)* – Soft Skills	30	-
Continuous Assessment (CA)* – Aptitude	10	25
Continuous Assessment (CA)* – Verbal	10	25
Total	50	50

23MNG300	DISASTER MANAGEMENT	L-T-P-C: 0-0-3-P/F

Course Objective

To provide an awareness on the types and impacts of disaster and concepts of disaster management

Course Outcome

CO1: Analyze relationship between Development and Disaster
CO2: Understand impact of Disasters and realization of societal responsibilities
CO3: Apply Disaster management principles

.

CO-PO Mapping

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO														
CO1	2	3				3	2		3		2			3
CO2	2	3				3	2	2	2		2			3
CO3	2	3				2	2				2			3

Syllabus

Unit 1

Introduction - Concepts and definitions. Disasters - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); man-made disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.)

Unit 2

Hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility. Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.)
Disaster Impacts - Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health,psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

Unit 3

Disaster Risk Reduction (DRR) - Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Text Book(s)

R. Subramanian, Disaster Management, Vikas Publishing House (2018)

Reference(s)

Bhandari and Rajendra Kumar, Disaster Education and Management, Springer, 2016.
NIDM publications, https://nidm.gov.in/books.asp
http://ndma.gov.in/ (Home page of National Disaster Management Authority)
http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation

Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and PsychosocialSupport in Emergency Settings. Geneva: IASC

23LIV490	LIVE-IN-LAB II	L-T-P-C: 0-0-0-3

Course Objectives

- Proposal writing in order to bring in a detailed project planning, enlist the materials required and propose budget requirement.
- Use the concept of CoDesign to ensure User Participation in the Design Process in order to rightly capture user needs/requirements.
- Building and testing a prototype to ensure that the final design implementation is satisfies the user needs, feasible, affordable, sustainable and efficient.
- Real time project implementation in the village followed by awareness generation and skill training of the users (villagers)

Course Outcome

CO1: Learn co-design methodologies and engage participatorily to finalise a solution
CO2: Understand sustainable social change models and identify change agents in a community.
CO3: Learn Project Management to effectively manage the resources
CO4: Lab scale implementation and validation
CO5. Prototype implementation of the solution

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	3	3		1	3	3	3		3
CO2								3	3		
CO3								3	3	3	
CO4	3		3				3	3	3		3
CO5			1					3	3		

Syllabus

The students shall visit villages or rural sites during the vacations (after 6th semester) and if they identify a worthwhile project, they shall register for a 3-credit Live-in-Lab project, in the fifth semester.
Thematic Areas

- Agriculture & Risk Management
- Education & Gender Equality
- Energy & Environment
- Livelihood & Skill Development
- Water & Sanitation
- Health & Hygiene
- Waste Management & Infrastructure

SEMESTER VII

23CIE401 HYDROLOGY & WATER RESOURCES ENGINEERING L-T-P-C: 2-1-0-3

Course Objectives

To explain the relevance of various components of hydrologic cycle, which impacts the spatial and temporal distribution of water resources.

To provide an insight on the groundwater resources under different hydro-geological conditions and movement of groundwater.

To impart the knowledge about design of various water resources infrastructure

Course Outcome

CO1: Understand and quantify the hydrological processes
CO2: Apply basics of storm hydrology to estimate the catchment rainfall and runoff for various hydrological applications.
CO3: Understand and apply the reservoir planning characteristics and operational practices for various purposes.
CO4: Comprehend the channel flow theories and apply in design of irrigation water distribution systems

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2										2		
CO2	3	3	2	2								2	1	
CO3	3	3	2									2	1	
CO4	2	2										2		

Syllabus

Unit 1

Introduction to Hydrology – Hydrologic cycle – hydrologic processes – water balance equation - global water balance – applications.
Precipitation – forms of precipitation – monsoons in India – precipitation measurement – rain gauge network – areal precipitation – rainfall intensity-duration-frequency (IDF) relationships – depth-area-duration (DAD) relationships.
Evaporation – evaporation process - measurement methods – evaporimeters - analytical methods – mass transfer method – energy budget method – combination method. Evapotranspiration – measurement methods – empirical equations – potential and actual evapotranspiration.
Infiltration – rainfall hyetograph - measurement – infiltration capacity – infiltration indices.

Unit 2

Runoff – runoff volume – SCS-CN method – hydrographs – factors affecting runoff hydrograph – components of hydrograph – base flow separation – effective rainfall – unit hydrograph – flow duration curve – floods – rational method – flood frequency – design flood – design storm – risk, reliability and safety factor.
Flow measurement – methods – velocity area method – dilution method – stage-discharge curve.
Groundwater and well hydrology – types of aquifers - aquifer properties – Darcy’s law –

Unit 3

Dams – classification – design considerations. Gravity dam – forces on gravity dam – stress analysis. Spillways – components – types – hydraulic jump.
Reservoirs – capacity estimation methods – mass curve – sequent peak algorithm – performance indices – storage-yield-performance function – reservoir operation for irrigation, hydropower and flood control.
Irrigation – water requirement of crops – duty and delta – soil-water relationship – root zone soil water – irrigation requirement – types of irrigation.

Introduction to Hydrologic Modelling System (using HEC-HMS) - River Analysis System (using HEC-RAS)

Text Book(s)

Subramanya K, 'Engineering Hydrology', 4th Edition, McGraw Hill Education (India), New Delhi, 2013
Ragunath, H M, 'Hydrology-Principles, Analysis and Design, Wiley Eastern Ltd., 2006
Todd, D K, 'Groundwater Hydrololgy' John Wiley & Sons, 2006

Reference(s)

Chow V T, Maidment D R, Mays L W, 'Applied Hydrology', Tata-McGraw Hill Education, New Delhi, 2010.
Linsley R K, Franzini J B, Freyberg D L, Tchobanoglous G, 'Water Resources Engineering', 4th Edition, McGraw Hill, 1992
Singh V.P, Elementary hydrology, Prentice Hall, Englewood Cliffs, New Jersey, 1992.
USACE, "Hydrologic Modelling System HEC-HMS: Technical Reference Manual, Hydrologic Engineering Centre, US Army Corps Engineers, 2000.
USACE, "River Analysis System: Hydraulic Reference Manual, Hydrologic Engineering Centre, US Army Corps Engineers, 2016.

23CIE497	CAPSTONE PROJECT	L-T-P-C:0-0-3-1

Course Objectives
Improve the design capability of the student to handle practical problems through proper guidance and ensure students are industry ready after graduation.

Course Outcome
CO1: Apply the engineering knowledge acquired to make preliminary investigations and do functional and/or structural design of a facility.
CO2: Estimate the material and/or cost requirement involved in a project.
CO3: Present the project with clarity, following ethical norms in oral and written mode
CO4: Develop a team and effectively participate in the team to execute the project
CO5: Address environmental / social / engineering problems through the project

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3								3		
CO2										3			3	
CO3							3	3	3		3			
CO4							3	3						
CO5					3	3	3	3			3			3

Students are required to conceive a design problem in any one of the disciplines of Civil Engineering such as, Design of an RC structure, Design of a wastewater treatment plant, Design of a foundation system, and Design of traffic intersection. Group of students comprising of not more than four are allowed to form a team and work on the project. At the end of the course, each group should submit a complete report on the design problem consisting of the data given, the design calculations, specifications if any and complete set of drawings, which follow the design.

23CIE471	INTRODUCTION TO GEOTEXTILE ENGINEERING	L-T-P-C: 2-1-0-3

Prerequisite(s): 23CIE211 Geology and Soil Mechanics

Course Objective

- To acquire knowledge about the types and functions of various geosynthetics and their manufacturing process.
- To understand the design principles of reinforced soil structures.

Course Outcome

CO1: Testing and valuation of various properties of geosynthetics used in soil structures
CO2: Principle of soil reinforcement and design of reinforced soil retaining structures
CO3: Design of drains for consolidation

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3								1	3		1
CO2	3	2	3								1	3		1
CO3	3	2	3								1	3		1

Syllabus

Unit 1

Geosynthetics classifications- functions- applications- raw materials used. Different types of Geosynthetics- manufacturing, system- Design and sustainability. Various properties of Geosynthetics, physical properties, mechanical properties, hydraulic properties & endurance properties- Mechanism of filtration and drainage functions & their applications. Background of reinforced earth, mechanism and concepts- Basis of reinforced earth wall design-

Unit 2

Geogrid reinforced soil walls, geocell wall, gabion wall. Model for single and multi-layer reinforced slopes, guidelines for design of reinforced slopes, software for reinforced soil slopes. Design of basal reinforced embankment, placement of Geosynthetics, construction procedure, widening of existing road embankments.

Unit 3

Consolidation techniques, Development of design chart for prefabricated vertical drains, ground instrumentation and monitoring, Design of encased stone columns, geocell/geofoam systems. Bearing capacity of Geosynthetics reinforced soil system, geocell reinforced sand overlaying soft clay- Applications, advantage, function of geofoam, physical, mechanical and thermal properties of geofoam, design of embankment using geofoam, geofoam reinforced soil walls.

Text book(s)

Shukla, S.K. and Yin, J.-H. (2006). Fundamentals of Geosynthetic Engineering. Taylor and Francis, London, UK.
Koerner, R. M.(2012). Designing with Geosynthetics, 6th Edition,Vol. 1 and 2,Xlibris corp., 914 p.
Giroud, J.P.(1984)."Geotextiles and Geomembranes. Definitions, Properties and Design," Selected Papers, Revisions and Comments, 4th ed., IFAIPublishers, 325 p.

Reference(s)

Holtz, R. D., Christopher,B. R. and Berg, R. R.(1997) Geosynthetic engineering,Bitech publishers Ltd., 452p.
Hausmann, M. R.(1990).Engineering Principles of Ground Modification, McGraw-Hill Publishing Company, New York, 632 p.
Ingold, T.S.(1982). Reinforced Earth, Thomas Telford Ltd., London, 141 p.
Shukla, S.K. (2002). Geosynthetics and Their Applications. Thomas Telford Publishing, London, UK.

Evaluation Pattern

Assessment	Internal	End Semester
Mid Semester	30	
*Continuous Assessment (CA)	30	
End Semester		40

*CA - Can be Quizzes, Assignment, Projects and Reports

23CIE496	COMPREHENSIVE ASSESSMENT	L-T-P-C: 0-0-3-1

Course Objectives

To provide overview of all Civil Engineering topics covered in the curriculum
To assess the overall knowledge level of Civil Engineering topics and guide them to take corrective measures where deficiencies are identified.

Course Outcome

CO1: Review and apply the engineering knowledge acquired to different situations.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3			1					1	3	3	3

Syllabus

Review of the following topics of civil engineering:
- Characteristics of various engineering materials.
- Basics of Engineering Mechanics and Solid Mechanics.
- Various classical methods in analysis of structures.
- Matrix methods of analysis of structures.
- Overview of Design of RCC and Steel Structures.
- Overview on Fluid Mechanics and Machinery.
- Overview of Elements of Irrigation and Hydraulic Structures.
- Overview on Surveying.
- Overview on Water Supply and Sewerage.
- Overview of Transportation Engineering covering Roads, Railway, Docks and Airport Engineering.
- Overview of Aspects of Geotechnical Engineering.
- Principles of Construction Engg. & Management

Students need to submit a complete report on the any construction related project starting from site clearing till the completion of the project.

Reference(s)
Vazirani V.N., Chandola S.P., "Concise Handbook of Civil Engineering", S Chand, 3rd Revised edition, 2000
Khanna P.N, "Indian Practical Civil Engineers Handbook", UBS Publishers' Distributors Ltd, Second edition

23LAW300	INDIAN CONSTITUTION	L-T-P-C: P/F

Course Objectives

- To know about Indian constitution
- To know about central and state government functionalities in India
- To know about Indian society

Syllabus

Unit 1
Historical Background – Constituent Assembly Of India – Philosophical Foundations Of The Indian Constitution – Preamble – Fundamental Rights – Directive Principles Of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies For Citizens.

Unit 2
Union Government – Structures of the Union Government and Functions – President – Vice President – PrimeMinister – Cabinet – Parliament – Supreme Court of India – Judicial Review.

Unit 3
State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – JudicialSystem in States – High Courts and other Subordinate Courts.

Text Book(s)
Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi. R.C.Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi.

Reference(s)
Sharma, Brij Kishore, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi.

23CIE495	EXPERIMENTAL LEARNING II - INDUSTRY INTERNSHIP	0-0-3- P/F

Course Objectives

To expose students to the industry working environment and get acquainted with the organization structure, business operations and administrative functions.

To have hands-on experience so that they can relate and reinforce the teaching-learning process.

To promote cooperation and to develop synergetic collaboration between industry and the institution.

To set the stage for future recruitment by potential employers.

Course Outcome

CO1: Work in actual working environment**.**
CO2: Utilize technical resources
CO3: Prepare technical documents and give oral presentations related to the work completed.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2			2	2	2		2	2	2	2	2	2
CO2		2			2			2			2			3
CO3								2	3				2	3

Students have to undergo minimum of two-week practical training in Civil Engineering related organizations of their choice but with the approval of the department. At the end of the training student will submit a report as per the prescribed format to the department.

23CIE498	**MINOR PROJECT**	**L-T-P-C: 0-0-6-2**

Course Objectives

To work on a topic in the field of Civil Engineering which could involve theoretical and/or fabrication and/or experimental and/or computational work.

Course Outcome

CO1: Apply the engineering knowledge acquired to do literature survey and make preliminary studies to investigate an engineering problem.
CO2: Present the project with clarity, following ethical norms in oral and written mode
CO3: Develop a team and effectively participate in the team to execute the project
CO4: Address environmental / social / engineering problems through the project

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3								3		
CO2							3	3	3		3			3
CO3							3	3				2		3
CO4					3	3	3	3			3	3	2	3

The student is expected to start the initial planning and preparation for the final semester project. They have to identify their team, project advisor and, plan the objectives, scope, methodology and the work schedule. A detailed literature review is also expected in this phase.

SEMESTER VIII

23CIE499	MAJOR PROJECT	L-T-P-C 0-0-30-10

Course Objectives

To work on a topic in the field of Civil Engineering which could involve theoretical and/or fabrication and/or experimental and/or computational work or as a capstone design.

Course Outcome

CO1: Create a set up through proper design and investigate the system using the engineering knowledge acquired
CO2: Estimate and manage the time, material and cost aspects of the project
CO3: Present the project with clarity, following ethical norms in oral and written mode
CO4: Develop a team and effectively participate in the team to execute the project
CO5: Address environmental / social / engineering problems through the project

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3								3		
CO2										3			3	3
CO3							3	3	3		3			
CO4							3	3						
CO5					3	3	3	3			3			3

Depending on the satisfactory performance of students in ‘Minor project’, they can continue the work for the ‘Project’. Students eligible for distinction and those who are aiming higher studies will be encouraged to continue with the research oriented works. Instead of research oriented projects, students will also have the option of doing Capstone designs as the requirement for ‘Project’, preferably with guidance from an industry mentor.

PROFESSIONAL ELECTIVE COURSES (With Prerequisites)

23CIE331	ADVANCED CONCRETE DESIGN	L-T-P-C 2-1-0-3

Prerequisite(s): 23CIE303 Basic Reinforced Concrete Design

Course Objectives
The course focuses on understanding the behavior, design and detailing of reinforced concrete retaining walls, storage structures and Bridge components according to the Indian standard building code requirements and on par with current Industry practices

Course Outcome
CO1: Design the structural elements in a building
CO2: Analysis Design of earth retaining and liquid retaining systems
CO3: Design Bridge super structure

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PSO1	PSO2	PSO3
CO1	3										2	3	2	
CO2	3	2	2									3	2	
CO3	3	3	3		2			2	1			3	2	2

Syllabus

Unit 1
Design of buildings, Design of staircase - Design of long columns – Design of Structural walls - Design of corbels – Grid slabs – Slabs at grade - Design of Spherical and Conical Domes – detailing – Preparation of design sheets for structural elements

Unit 2
Earth Retaining structures - Retaining walls- types - cantilever and counterfort - Analysis of earth retaining structures using commercially available software - design of retaining wall - drainage and construction details. Liquid Retaining structure - Water tanks - types - square, rectangular, circular - Analysis of water retaining structures using commercially available software- Design of underground and elevated tanks - design of staging. Design of circular silo using Jansen's theory - Preparation of design sheets for earth and water retaining structures

Unit 3
Introduction to bridge and its components - Analysis of bridge deck using commercially available software- Bridges - Slab Bridge - Design of single span slab bridge - Tee Beam Bridge with cross girders.
Term Project

Text Book(s)
Jain A.K., "Reinforced Concrete - Limit State Design- 7th Edition", Nem Chand & Bros., 2012
Varghese P.C., "Advanced Reinforced Concrete Design", PHI, 2010.
N.KrishnaRaju, "Design of bridges", Oxford University Press, 2019.

Reference(s)
N. Krishnaraju, "Advanced Reinforced Concrete Design", CBS Publisher, 2016
R.D. Anchor., "Design of Liquid Retaining Concrete Structures – Second edition" British Library Cataloguing in Publication Data, 1992.
D.Johnson Victor, "Essentials of bridge engineering", Oxford University Press, 2019.
Mosley. B., John B., & Ray Hulse "Reinforced Concrete Design to Eurocode-2"Red Globe Press, 2012.
BIS codes (IS 456 -2000, IS 4995 – 1978 Part (I&II), IS 3370- 2009 Part I&II), IS3370 – 1967 Part IV, IS1893-2016 PART 1, IS13920-2016, SP16-1980, SP24-1983, SP34-1999)
IRC Codes (IRC 5 – 2015, IRC 6-2017, IRC 112-2011, IRC SP105-2015, IRC SP13-2004)

23CIE332	ADVANCED STEEL DESIGN	L-T-P-C 2-1-0-3

Prerequisite(s): 23CIE312 Basic Steel Design

Course Objectives
To understand the behavior and analysis of steel structures subjected to combined loads. To understand the design and detailing of steel structures according to the INDIAN STANDARD building code requirements and on par with current Industry practices.

Course Outcome
CO1: Design the eccentrically loaded compression members and their base plates.
CO2: Analyze and design the plate girder, gantry girder and its components
CO3: Evaluate, analyze and design the PEB and its components.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3										2	3		
CO2	3	2	2									3	3	3
CO3	3	3	3		2			2	1			3	3	3

Syllabus

Unit 1
Introduction to beam-column - behavior - strength interaction - design of beam column - beam column subjected to combined forces – column bases - slab base - gusseted base -moment resistant base plate - Seismic Requirement for framed buildings - Design of members in braced frames – Design of members in un-braced frames - Introduction to Composite Construction – Shear Connectors – Composite beams – Introduction to fatigue behaviour of members.

Unit 2
Bolted and Welded plate girders – analysis and design using IS 800-2007- curtailment of flange plates – stiffeners –Web yielding, web crippling, bearing stiffeners. Introduction to hybrid girders - analysis and design of gantry girder - design of girder splice.

Unit 3
Analysis and design of Pre-engineered Building design of purlins and wall girts using Channel and Angle sections; cold formed steel purlin– Design of wind bracings. Screws and rivets in cold formed steel construction. Types of connections, Behaviour of local elements, Analysis, Design and Detailing. Cold Formed Steel Members: Effective width and Direct Strength Design methods.

Text Book(s)
Subramanian N, *“Design of Steel Structures limit states method”,* Oxford University Press, 2016
Duggal, SK, *“Limit State Design of Steel Structures”,* Tata McGraw Hill, 2017
Wei-Wen Yu and Roger A .Laboube, *Cold-Formed Steel Design,* Fourth Edition, Structures, John Wiley & Sons, 2010.

Reference(s)
Ramchandra and Gehlot, *“Limit State Design of Steel Structures”,* Scientific Publishers, 2015
Dayaratnam P, *“Design of Steel Structures”,* S Chand & Co., 2012
Aryaand Ajmani, *“Design of Steel Structures”,* Nem Chand Brothers, 2007
BIS codes (IS800-2007, IS875-1987-Parts I, II, IS875-2016-PartsIII, SP:6–Part 1 to 6)
Emil Smith and Robert Scanlan, *“Wind Effects on Structures”* Wiley-Interscience,1996.
Edwin Gaylord, *“Design of Steel Structure”,*TataMcGraw Hill Publishing Company Limited, 2010.

Segui, WT *"Design of Steel Structures",* Cengage Learning, 2007
Bhavikatti, S. S. *"Design of Steel Structures (by Limit State Method as Per* IS 800—2007*)"* IK International, 2010
G.W.Owens and P.R.Knowles*,"Steel Designers'Manual",*JohnWiley&Sons,2012
Lin and Breslar*, "Design of Steel Structures",* John Wiley & Sons*, 1968.*

23CIE333 PRESTRESSED CONCRETE - ANALYSES, DESIGN AND CONSTRUCTION L-T-P-C:2-1-0-3

Prerequisite(s): 19CIE303 Basic Reinforced Concrete Design

Course Objectives

The objective is to equip the students with basic understanding of theory and application of analysis and design of prestressed concrete structures. The course focuses on understanding the behavior and design of reinforced concrete components and systems subjected to gravity loads according to the Indian standard code requirements and on par with current Industry practices.

Course outcomes

CO1: Understand the concept of prestressing and apply it suitably in construction.
CO2: Analyse and design the prestressed concrete members for ULS and SLS of flexure, shear and torsion
CO3: Design the pre-stressed concrete pipes and tanks

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PSO1	PSO2	PSO3
CO1	3	1	2	1								3		3
CO2	3	2	2									3		3
CO3	3	2	2									3	2	3

Syllabus

Unit 1
Historical developments – Basic principles of prestressing – Classification and types – Advantages over ordinary reinforced concrete – Materials – High strength concrete and high tensile steel – Methods of prestressing – Analysis of sections of stresses by stress concept, strength concept and load balancing concept – Location of pressure line - Losses of prestress in post -tensioned and pre-tensioned members.

Unit 2
Basic assumptions for calculating flexural stresses – Permissible stresses in steel and concrete as per IS 1343– Design of sections of Type I and Type II pre tensioned and post-tensioned beams –Factors influencing deflections – Short term deflections of uncracked members – Prediction of long term deflections due to creep and shrinkage – Check for serviceability limit state of deflection. Determination of anchorage zone stresses in pre tensioned and post-tensioned beams by IS 1343– design of anchorage zone reinforcement – Check for strength limit based on IS 1343– Layout of cables in pre tensioned post-tensioned beams – Design for shear based on IS 1343.

Unit 3
Analysis and design of composite beams - Shrinkage strain and its importance.
Partial prestressing – Definition, methods of achieving partial prestressing, merits and demerits of partial prestressing.
Circular prestressing- Design of Prestressed Concrete Pipes and water tanks

Text Book(s)
N. Krishna Raju, "Prestressed Concrete", Tata McGraw Hill, 6th Edition, 2018.
Naaman, A.E., "Prestressed Concrete Analysis and Design - Fundamentals," 3rd Edition, Techno Press, 2012.

Reference(s)
Edward. G .Nawy, Prestressed Concrete, Prentice Hall, 5 th Edition, 2010.
Arthur. H. Nilson, Design of Prestressed Concrete, John Wiley and sons, 2 nd Edition, 1987
T.Y. Lin, Ned H. Burns, "Design of Prestressed Concrete Structures", John Wiley & Sons, 2010.
P. Dayaratnam, "Prestressed Concrete", Oxford & IBH, 2018.
R. Rajagopalan, "Prestressed Concrete", Narosa publishers, 2017.
IS 1343-2012, "Code of Practice for Prestressed Concrete", 2012.
ACI 318-14 Building Code Requirements for Structural Concrete and Commentary, 2014
PCI Design Handbook, Seventh Edition, 2017

23CIE334	STRUCTURAL DYNAMICS & SEISMIC DESIGN	L-T-P-C:2-1-0-3

Prerequisite(s): 23CIEXXX Structural Analysis II**,** 23CIEXXX Basic Reinforced Concrete Design

Course Objectives
To explain basic concepts related to dynamics of single degree of freedom systems
To explain basic concepts related to dynamics of multiple degree of freedom systems
To introduce code provisions to estimate seismic demand as per relevant code
To explain provisions related to seismic design of buildings as per relevant code

Course Outcome
CO1: Explain the importance of structural dynamics with basic terminology
CO2: Assess and analyse the single DOF and 2 DOF structures and its responses
CO3: Understand the development of seismic design and engineering seismology
CO4: Understand the concept of analysis and design of earthquake resistant simple framed structures.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2				1					2			
CO2	3	2	2					2				2		
CO3	3					1					2	2		2
CO4	3	3	3	1	2	2		2				2	3	3

Syllabus

Unit1 Structural Dynamics
Introduction to dynamic – Need for structural dynamics – Degrees of Freedom – Damping – Equations of Motion – Single Degree of Freedom system – Free vibration response of undamped and damped system – Forced vibration response (Harmonic loading) – Response to Impulse – Duhamel Intergral – Multi Degree of Freedom system – Equation of Motion – Free vibration response – Orthogonality - Forced vibration response – Direct Integration Techniques (Newmark gamma – beta method) – Hands-on: Program to estimate response of a building for a given ground motion.

Unit2 Earthquake Engineering
Engineering Seismimology – Earthquakes and Ground motion – Seismic waves –History of Seismic Design – Idealization of Buildings – Response Spectra – Design Spectra – Move to Lateral Displacement – Estimating Displacement Demand – Performance-based design – Resilience-based Design

Unit3 Code Provisions
Basics of Capacity Design – Failure Mechanism – Provisions of IS 1893 part 1 (2016) to estimate lateral force demand on buildings – Equivalent Static Method and Dynamic Method – Provisions of IS 13920 (2016) – Introduction to seismic retrofit of buildings

Textbook(s)
Mario Paz,"Structural Dynamics", Spinger, 2007
Pankaj Agarwal and Manish Shrikhande, "Earthquake ResistantDesignofStructures",PHI Learning, 2009
Reference book(s)
Anil K Chopra,"Dynamics of Structures: Theory and Applications to Earthquake Engineering",Pearson Education, 2008
Duggal SK, "Earthquake Resistant Design of Structures", Oxford University Press, 2013
IS1893(1) 2016, Criteria for Earthquake Resistant structures General Provisions and Buildings
IS15988 (2013), Seismic Evaluation and Strengthening of Existing Reinforced Concrete Buildings — Guidelines
IS 13920 (2016), Ductile Design and Detailing of RC Structures subject to Seismic Forces –Code of Practice

23CIE335	BRIDGE ENGINEERING	L-T-P-C: 3-0-0-3

Prerequisite(s): 23CIE303 Behaviour & Design of Reinforced Concrete Structures, 23CIE333 Prestressed Concrete - Analyses, Design And Construction and 23CIE312 Behaviour & Design of Steel Structures

Course Objectives

The course focuses on understanding the behavior and design of various bridge components according to the Specification of Indian Road Congress code requirements and on par with current Industry practices

Course Outcome

CO1: Understand the need and importance of preliminary investigation on bridge construction site.
CO2: Familiarize the specification of road bridges and loads to be considered.
CO3: Design components of different types of bridges and assess load carrying capacity of bridges.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3										2	2		
CO2	3	2	2									2		
CO3	3	3	3		2			2	1			1	3	3

Syllabus

Unit 1
Components of bridges - Classification of bridges – Importance and investigation for bridges – Hydrology - design flood discharge, linear waterway and scour depth – Choice of Bridge Type, subsoil exploration, location of piers and abutments. Specification of road bridges – width of carriage way, IRC loads to be considered, calculation of live load by effective width method.

Unit 2
General Design Consideration – design of pipe culvert, design of Slab Bridge, design of T-beam Bridge, design of box culverts – Components and design principles of RC balanced cantilever bridge and Prestress concrete bridges.
Type of sub structures – Forces acting on substructures – Design of abutments, piers – Types of Foundations

Unit 3
Importance of bearings - types of bearings- design of elastomeric bearings – joints – types of joints. Construction and maintenance of bridges - Assessment of load carrying capacity of bridges - Lessons from bridge failures.

Text book(s)
D.Johnson Victor, "Essentials of bridge engineering", Oxford University Press, 2019.
N.Krishna Raju, "Design of bridges", Oxford University Press, 2019.
Mosley. B., John B., & Ray Hulse "Reinforced Concrete Design to Eurocode-2"Red Globe Press, 2012.

Reference book(s)

E.J. O'Brien and D.L. Keogh, "Bridge deck analysis", Spons Architecture,1999.
Raina,V.K. "Concrete Bridge Practice", Shroff Pub & Dist. Pvt. Ltd, 2007.
Ponnuswamy,S., "Bridge Engineering", Tata McGraw - Hill Education, 2007.
IRC Codes (IRC 5 – 2015, IRC 6-2017, IRC 112-2011, IRC SP105-2015, IRC SP13-2004,IRC SP37 -2010 , IRC SP114-2018, MORT&H)

23CIE336	FINITE ELEMENT METHODS	L-T-P-C: 3-0-0-3

Prerequisite(s): 23CIE305 Structural Analysis II

Course objectives

- Explain the fundamental concepts of finite element method and solve structural problems by selecting a suitable element, developing stiffness & force matrices and incorporating boundary conditions.
- Use mathematical and approximate methods to solve the boundary value problems

Course Outcome

CO1: Solve boundary value problems using various approximate methods
CO2: Develop mathematical formulations for structural systems
CO3: Analyse the structural elements like truss, beam etc by formulating stiffness matrix

CO PO Mapping

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

Syllabus

Unit 1
Boundary value problems and the need for numerical discretisation: Introduction, examples of continuum problems, history of finite element method.
Weighted residual methods: Approximation by trial functions, weighted residual forms, piecewise trial functions, weak formulation, Galerkin method, examples of one-, two- and three-dimensional problems.
Variational methods: Variational principles, establishment of natural variational principles, approximate solution of differential equations by Rayleigh-Ritz method, the use of Lagrange multipliers, general variational principles, penalty functions, least-square method.

Unit 2
Isoparametric formulation: The concept of mapping, isoparametric formulation, numerical integration, mapping and its use in mesh generation.
Higher order finite element approximation: Degree of polynomial in trial functions and rate of convergence, the patch test, shape functions for C0 and C1 continuity, one-, two- and three-dimensional shape functions.

Unit 3
Coordinate Transformation: Transformation of vectors and tensors, transformation of stiffness matrices, degree of freedom within elements, condensation, condensation and recovery algorithm, substructuring, structural symmetry.
Formulation of stiffness matrix, member approach for truss and beam element, node numbering, assembly of element equations, formation of overall banded matrix equation, boundary conditions and solution for primary unknowns, Equilibrium and compatibility in solution- applications to truss and beam.

Text book(s)
Rao. S.S., "Finite Element Method in Engineering", Elsevier, 2011.
Reddy, J.N., "An Introduction to the Finite Element Method", Tata McGraw Hill, 2005.

Reference book(s)

Bathe K.J., "Finite Element Procedures in Engineering Analysis", Prentice Hall of India, 1996.
Cook R.D., Malkus D.S., Plesha M.F., and Witt.R.J., "Concepts & Applications of Finite Element Analysis", Wiley India, 2007.
Chandrupatla T.R. & Belegundu A.D., "Introduction to Finite Elements in Engineering", Prentice Hall of India, 2007.
Zienkiewics O.C. & Taylor R.L.and Zhu, J.Z., "The Finite Element Method: Its Basis and Fundamentals", Butterworth-Heinemann, 2005.

23CIE473	Precast Members - Systems and Construction	L-T-P-C:2-1-0-3

Pre requisite: 23CIE212 Structural Analysis I and 23CIE303 Basic Reinforced Concrete Design

Course Objectives

To provide insight into analysis and design of Precast System
To provide exposure to the production/construction of Precast System

Course Outcome

CO1: Introduce concept related to precast system
CO2: Explain concept related to production, storage, and logistics of precast elements
CO3: Assess the design loads on precast structural elements
CO4: Analysis and design of precast structural systems

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3												3
CO2	3	3									1			3
CO3	3	3			1						2			3
CO4	3	3				2					2			3

Syllabus

Unit1
Introduction to Precast and its elements:
Introduction – current scenario and constraints, the difference between precast vs conventional construction methods, needs, types, features, Advantages (for owners, architects, engineers, contractors, end users) and Limitations, Residential, Commercial & Industrial Applications of precast, Materials used, Code provisions and clauses.
Major elements (Beam, slab, wall, column, foundation, staircase, roof elements, façade) : Classification, Types and shapes, selection, application, erection, advantages, Infra works -Pipes & drains, duct bank, baggage handling tunnel, culvert and sleeper, facia element, pavement and channel.

Precast Structural System, Production, Storage and Logistics:
Structural System: Skeletal System, Portal Frame system, Large Panel system, Cell Block system and hollow block system, Guide lines of selection – Residential & office buildings, Industrial Buildings, Commercial buildings, Structural Stability and Structural Behaviour
Plant and Production: Introduction -Types & Process, Production – Design and shop drawings, check lists, Moulding, Casting and its types, Concreting, Curing, Demoulding and inspection.
Storage, Delivery, Handling- introduction and types of equipment, lifting devices, Erection and installation - Horizontal components, vertical components, special elements, Quality Inspection and Tolerance

Unit2
Modelling, Analysis and design of Wall system
Design Basis Criteria: Geometric parameters and Occupancy, Location and Associated Parameters, Systems and material specifications, analysis tools, Loads and Load Combinations – gravity loads, lateral loads (seismic and wind). Using commercially available software, Modelling, Analysis and Design of structural elements for RC Wall system: Design of RC wall, beam, slab & staircase, Design for stripping, stacking, transportation and erection for all elements.

Unit3
Joints Connections for RC Wall system, Modelling, Analysis, Design of the Frame system:
Joints connections for RC wall system – Wall to foundation, wall to wall horizontal connection, wall to wall vertical

connection, beam to wall connection, beam to beam connection, slab to wall – progressive collapse, diaphragm action & slab to beam connection, staircase to beam or wall connection.
Modelling, Analysis and design for Frame system and its connections: Using commercially available Modelling, Analysis and Design for frame system (foundation, column, beam, slab etc.)
Prestressed concrete and Preventive Measures and case studies

Prestressed Concrete, Various types of slab design and its check, Slab to beam connection
Preventive Measures – Testing requirements, water tightness, temporary supports, MEP-related preventive measures, progressive collapse – introduction and design, common defects and remedies Case Studies - Residential Project, Commercial Project

TEXT BOOKS/ REFERENCES

1. IS 15916 – 2000, Building Design and Erection Using Prefabricated Concrete
2. IS 13920 – 2016, Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces
3. Robert E. Englekirk, Seismic Design of Reinforced and Precast Concrete Buildings,
4. M Levitt, Precast concrete: materials, manufacture, properties, and usage
5. Leslie D. Martin, Christopher J. Perry, PCI Design Handbook: Precast and Prestressed Concrete, Sixth Edition, 2004
6. Helmut Kuch, Jörg-Henry Schwabe, Ulrich Palzer, Manufacturing of Concrete Products and Precast Elements: Processes and Equipment, Verlag Bau+Technik; 1st edition, 2013
7. Kim S. Elliott, Precast Concrete Structures: From Theories and Research to Strategies and Interventions, CRC Press,2019
8. Alfred Steinle, Hubert Bachmann, Mathias Tillmann, Precast Concrete Structures, Ernst & Sohn Verlag GmbH & Co. KG, 2019
9. Hubert Bachmann, Alfred Steinle Precast Concrete Structures Wissenschaften GmbH & Co. KG, Berlin, Germany 2012

Evaluation Pattern

Assessment	Internal	End Semester
Mid Semester	30	
*Continuous Assessment(CA)	30	
End Semester		40

•CA– Can be Quizzes, Assignment, Projects, and Reports

25CIE431	Design of Pre-engineered Buildings	L-T-P-C: 2-1-0-3

Course Objectives

To provide insight into analysis and design of pre-engineered buildings
To provide exposure to materials/sections used in pre-engineered buildings

CO Code	Course outcome statement
CO1:	Describe the specifications of hot-rolled and cold-formed steel members used in pre-engineered buildings
CO2:	Compute various loads acting on pre-engineered buildings and select the proper framing configuration and lateral load resisting systems
CO3:	Analyse and optimize design of an industrial pre-engineered building and its connections, using a modelling software
CO4:	Design cold-formed elements that constitute the secondary framing of a pre-engineered building
CO5:	Evaluate the practical fabrication and erection aspects in the design and construction of a pre-engineered building

CO-PO Mapping

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3											2	2	1
CO2	3	2	2									2	3	
CO3	3	3	3		3			2	1		2	3	3	
CO4	3	2	2		3						2	2	3	
CO5	2	2	3		3	2	2	3	3	3	3	2	1	2

Unit 1
Introduction to PEB -- Standard Terminologies and Components: Primary and secondary framing, Roofing, Cladding, Accessories -- Materials and Sections Used: Built-up tapered sections, Cold-formed steel, Bracings, Insulation, Ventilation, Drainage, Expansion, Acoustics, Coatings -- Applications of PEBs: Warehouses, Industrial Buildings, Commercial Spaces -- Layout and Load Path: PEB layout planning, Load distribution, Typical load flow path -- Primary and Secondary Components: Columns, Rafters, Purlins, Girts, Bracing systems -- Special Systems: Jack beams, Jack portals, Soldier columns, Lattice girders, Cable trays, Pipe racks -- Roof & Wall Systems: Types of roofing sheets, Wall panels, Openings in roof and walls -- Load Considerations: Dead, Live, Snow, Collateral, Wind, Seismic, Crane, Mezzanine, Temporary (Erection and Handling), and Thermal loads.
Unit 2
Types of Connections in PEBs: Rafter to column, Beam-beam/column, Splices, Base connections, Gantry girder connections -- Codes of Practice: Indian Standards-IS 800, IS 801, IS 875 series, American Standards: AISC 360, MBMA Manual, AISI S100; Structural Design Parameters: Inputs from client, Loads and Load combinations, Structural modelling using software; Design of Primary & Secondary Members:

Analysis, Section selection, Deflection & drift checks; Design of Special Structures: Gantry girders, Mezzanine floors, Decking sheets, Crane systems; Column reactions and Base connection design: Base plates and Anchor Bolts – Overview of Footing, Pedestal, Tie beams and Grade slab.

Unit 3

Anchor Bolt (AB) & General Assembly (GA) drawings – Good for Construction (GFC) Drawings – Fabrication & Erection drawings – Bill of Quantities (BOQ) and Material Planning Sheet (MPS) – As-Built drawings -- Stakeholders of a PEB: Role of Design Engineers & Manufacturers responsibilities – Pre-Bid and Post-bid conditions – Shop fabrication – Methods of rolling – Quality tests – Scheme and Sequence of Erection – Good Engineering practices.

Textbooks:

1. Subramanian, Narayanan. *Steel Structures: Design and Practice*. Oxford University Press, 2010.
2. Sai Ram, K. S. *Design of Steel Structures*. New Delhi: Pearson Education India, 3rd Edition, 2022.

References:

1. Tamboli, Akbar R., ed. *Handbook of Steel Connection Design and Details*. 2nd ed. New York: McGraw-Hill Education, 2016.
2. Bureau of Indian Standards (BIS). *IS 800:2007 – General Construction in Steel – Code of Practice.* New Delhi: BIS, 2007.
3. Bureau of Indian Standards (BIS). *IS 1893 (Part 1): 2016 – Criteria for Earthquake Resistant Design of Structures: General Provisions and Buildings.* New Delhi: BIS, 2016.
4. Bureau of Indian Standards (BIS). *IS 1893 (Part 4): 2015 – Criteria for Earthquake Resistant Design of Structures: Industrial Structures Including Stack-Like Structures.* New Delhi: BIS, 2015.
5. Bureau of Indian Standards (BIS). *IS 875 (Parts 1–5) – Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures.* New Delhi: BIS, 1987–1989.
6. Bureau of Indian Standards (BIS). *SP 6(1): 1964 – Handbook for Structural Engineers: Structural Steel Sections.* New Delhi: BIS, 1964.
7. Bureau of Indian Standards (BIS). *National Building Code of India 2016 (Volume 1 & 2).* New Delhi: BIS, 2016.
8. Metal Building Manufacturers Association (MBMA). *Metal Building Systems Manual*. 2024 ed. Cleveland, OH: MBMA, 2025.
9. American Institute of Steel Construction (AISC). Steel Construction Manual. 16th ed. Chicago, IL: AISC, 2016.
10. Panda, Santosh Kumar. *Pre-Engineered Metal Building Structure Installation Handbook*. Lambert Academic Publishing, 2023. ISBN 978-6206152873.
11. Chawla, Harish Lal. *Need for Pre Engineered Construction – A Way Forward*. Iterative International Publishers, 2025. ISBN 9370205683

Evaluation Pattern (2019 & 2023 Curriculum)

Assessment	Marks
Mid-term exam	30
Continuous assessment (Term project, Assignments, Quizzes)	30
End semester exam	40

GEOTECHNICAL ENGINEERING

23CIE341	GROUND IMPROVEMENT TECHNIQUES	L-T-P-C: 2-1-0-3

Prerequisite(s): 23CIE211 Geology and Soil Mechanics

Course Objective
Introduction to the necessity, identification, and process of ground improvement, finding alternative methods and suggesting recommendations.

Course Outcome
CO1: Evaluate the various ground improvement techniques using mechanical methods such as compaction, vibroflotation, preloading etc.
CO2: Analyze the various types of drainage techniques, pre-compression methods and grouting.
CO3: Examining the effectiveness of chemical additives and reinforcing materials in ground improvement.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2									2	3		2
CO2	3	2	2								2	3		2
CO3	3	2	3								2	3		2

Syllabus

Unit 1
Objective of ground improvement, in-situ ground improvement methods, Introduction to soil improvement without the addition of many materials, Surface compaction, Compaction methods: moisture density relations – compactive efforts – field methods – surface compaction, deep compactions- vibro-probes, Stone columns.

Unit 2
Drainage methods: seepage, ground water seepage control – filter requirements, methods of dewatering – deep bored wells. Precompression & Vertical Drains: Compressibility of soils & consolidation, Preloading and surcharge fills - precompression principles, preloading methods, monitoring of compression, Vertical drains, Dynamic consolidation & Consolidaion by Electro-osmosis. Grouting and injection methods: principles, selection of methods and requirements. Aspects of grouts, types of grouts and chemical applications.

Unit 3
Stabilization methods: mechanical, use of admixtures- cement, lime, chemical methods of stabilization of soils – Reinforcing materials, reinforced earth retaining walls, reinforced embankments, soil nailing, Geosynthetics- types, general applications, types of geotextiles and geogrids, physical and strength properties of geotextiles and geogrids, Behavior of soils on reinforcing with geotextiles and geogrids, design aspects with geotextiles and geogrids.

Text book(s)
Moseley, "Text Book on Ground Improvement", Blackie Academic Professional, Chapman & Hall, 1994.
Purushothama Raj P., "Ground Improvement Techniques" Laxmi Publications, 2005.

Reference(s)
Shashi K. Gulati and Manoj Dutta, "Geotechnical Engineering", Tata Mcgraw Hill, 2005.
Boweven R., "Text Book on Grouting in Engineering Practice", John Wiley and Sons, 1981.
Jewell R.A., Soil reinforcement with geotextiles- CIRIA Special Publication, Thomas Telford, 1996.
Donald H Gray Robbin B Sotir, "Text Book on Biotechnical and Soil Engineering Slope Stabilization", Wiley International, 1996.

Rao G.V. & Rao G.V.S. “Text Book on Engineering with Geotextiles”, Tata Mcgraw Hill, 1990.
Robert M. Koerner, Construction & Geotechnical methods in Foundation Engineering”, McGraw Hill, 1986.

23CIE342	ADVANCED FOUNDATION ENGINEERING	L-T-P-C: 2-1-0-3

Prerequisite(s): 23CIE211 Geology and Soil Mechanics & 22CIE301 Geotechnical Engineering

Course Objectives

The student should be able to conduct a site investigation by himself.
After site investigation one should be able to finalize the footing and propose the safe bearing capacity
To understand the mechanism of load transfer mechanism in deep foundations
To have basic idea of machine foundations

Course Outcome
CO1: Become confident to propose the safe bearing capacity (SBC) for any soil in any situations.
CO2: To be able to design and analyse SBC of Shallow foundation
CO3: To be able to design and analyse SBC of deep foundation
CO4: To be able to analyse retaining wall, sheet pile and brace cut
CO5: To be able to design and analyse machine foundations

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3				3		2			3		1
CO2	3	3	3						2			3		1
CO3	3	3	3						2			3		1
CO4	3	3	3						2			3		1
CO5	3	3	3						2			3		1

Syllabus

Unit 1
Subsurface Exploration: Boring, Sampling, SPT, CPT, Geophysical methods, Bore log and soil report. Shallow Foundations: Bearing capacity theories-Terzaghi, Meyerhoff, Hansen; SBC based on SPT, layered soils, eccentric and inclined loads. Bearing capacity on slopes, Foundation settlements

Unit 2
Design of Combined and Raft Foundations: Design of combined footings by Conventional and elastic line methods. Pile Foundations: Load transfer mechanism, Pile capacity in various soil types, negative skin friction, group action, settlements, laterally loaded vertical piles. Drilled Piers and Caissons: Design considerations, bearing capacity equations, Settlements, Lateral loads, Types of caissons, stability analysis.

Unit 3
Design of Retaining walls: Lateral earth pressure, Retaining wall stability. Sheet Pile Walls: Cantilever and Anchored sheet pile walls. Braced Cuts: Pressure envelopes and design of various components Machine Foundations: Free and forced vibration with and without damping, Elastic half space for rigid footings. Vibration analysis of foundations subjected to vertical, sliding and rocking modes, Design criteria for machine foundations.

Text book(s)

Varghese P.C., "Foundation Engineering", Prentice-Hall of India Private Ltd, 2009.
Swami saran, "Soil dynamics and Machine Foundations", Galgotias, 2012.

Reference(s)

Ninan P Kurian, "Design of Foundation Systems", Narosa Publishers, 2009
ShamsherPrakash, "Soil Dynamics", McGraw Hill, 1981.
Tomlinson M.J., "Foundation Design & Construction", Prentice-Hall, 2003.
Joseph E. Bowles, "Foundation Analysis & Design", Tata McGraw Hill, 1996.
Coduto, "Geotechnical Engineering Principles and Practices", PHI, New Delhi, 2010.
Srinivasalu and *Vaidyanathan, "Handbook of Machine Foundations", Tata McGraw Hill, 2004.*
Swami Saran, "Analysis and Design of Substructures", Oxford & IBH, 2008.

23CIE343	ENVIRONMENTAL GEOTECHNOLOGY	L-T-P-C: 3-0-0-3

Prerequisite(s): 23CIE211 Geology & Soil Mechanics

Course Objectives

To explain the effects of pollution on soil and its impact on soil properties.
Introduce to the mechanisms of groundwater contamination
Give an exposure to rules and regulations on waste handling and management
Introduction to design of landfill and soil remediation methods.

Course Outcome

CO1: Understand the effect of pollution on the various properties of soil and analyze the problems posed by them**.**
CO2: Analyze the different types of wastes, their generation and effects
CO3: Understand the general principles of groundwater contamination management
CO4: Apply the knowledge of engineering judgement to analyze and design engineering landfill.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3			3						3		2
CO2	3	3	3			3						3		2
CO3	3	3	3			3						3		2
CO4	3	3	3			3						3		2

Syllabus

Unit 1
Environmental cycles- Soil and water- Environmental interaction relating to geotechnical problems- Effect of pollution on soil- water behaviour
Origin, nature and distribution of soil - Soil fabric and structure- Basic structural units of clay minerals- Isomorphous substitution- Kaolinite mineral- Montmorillonite mineral- Illite mineral- Electric charges on clay minerals- Ion exchange capacity- Diffused double layer- Adsorbed water- Soil structure- Methods for the identification of minerals (introduction only)
Effect of drying on Atterberg limits- Shrinkage, swelling and cracking characteristics of soil - Electrochemical characteristics of soil-water System - Sensitivity of soil to environment - Soil-water-air interaction - Activity, sensitivity, causes of sensitivity- Influence of exchangeable cations, pH and organic matter on properties of soils- Permeability of soils- Hydraulic conductivity of different types of soils- Darcy' s law and its validity- Factors affecting permeability

Unit 2
Sources, types and composition of different wastes - Characteristics and classification of hazardous wastes- Generation rates- Potential problems in soils due to contaminants
Ground water flow - Sources of ground water contamination- Contaminant transport - Pollution of aquifers by mining and liquid wastes- Ground water pollution downstream of landfills - Transport mechanisms
CPCB rules and regulations on waste handling and management- Criteria for selection of sites for waste disposal- Disposal techniques-Disposal systems for typical wastes
Ground modification and waste modification techniques in waste management- Ground modification- Mechanical modification, hydraulic modification, chemical modification

Unit 3
Liners and covers for waste disposal- rigid and flexible liners- Leachate and gas collection system - Engineered landfills (including basal liner and cover liner systems)- components- design criteria
Hydrological design for ground water pollution control
Soil contamination and remediation technology for both ground and aquifers

Reference(s)
Mitchell J. (2005), "Fundamentals of soil behaviour", Third Edition, ISBN: 978-0-471- 46302-3, John Wiley and Sons.
Robert M. Koerner (1996), "Construction and Geotechnical methods in Foundation Engineering", McGraw Hill Book Co., ISBN: 0070664382, 9780070664388.
Abdel M.O. Mohamed and Hogan E. Antia (1998), "Developments in Geotechnical Engineering", ISBN: 978-0-444-89847-0, Elsevier.
Hari D. Sharma and Krishna R. Reddy (May 2004) "Geoenvironmental Engineering – Site Remediation, Waste Containment, Emerging waste management technologies", ISBN: 978-0-471-21599-8, John Wiley and sons.
Daniel D.E. (1993), "Geotechnical Practice for Waste Disposal", ISBN 978-0-412-35170-9, Chapman and Hall.
Hsai Yang Fang and John Daniel (2013) "Introduction to Environmental Geotechnology", CRC press, Second Edition ISBN-13: 9781439837306, Taylor and Francis.

23CIE472	Geotechnics and Geotextile engineering	L-T-P-C: 2-1-0-3

Prerequisite(s): 23CIE211 Geology and Soil Mechanics

Course Objective
To acquire knowledge about types and functions of various geosynthetics and their manufacturing process. To understand the design principles of reinforced soil structures.

Course Outcome
CO1: Testing and valuation of various properties of geosynthetics used in soil structures
CO2: Principle of soil reinforcement and design of reinforced soil retaining structures
CO3: Design of drains for consolidation

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3								1	3		1
CO2	3	2	3								1	3		1
CO3	3	2	3								1	3		1

Syllabus

Unit 1

Background of reinforced earth, mechanism and concepts- Basis of reinforced earth wall design- Geosynthetics classifications-functions- applications- raw materials used. Different types of Geosynthetics- manufacturing, system- Design and sustainability. Various properties of Geosynthetics, physical properties, mechanical properties, hydraulic properties & endurance properties-Nano material. Mechanism of filtration and drainage functions & their applications

Unit 2

Geogrid reinforced soil walls, geocell wall, gabion wall. Model for single and multi-layer reinforced slopes, guidelines for design of reinforced slopes, software for reinforced soil slopes. Design of basal reinforced embankment, placement of Geosynthetics, construction procedure, widening of existing road embankments.

Unit 3
Consolidation techniques, Development of design chart for prefabricated vertical drains, ground instrumentation and monitoring, Design of encased stone columns, geocell/geofoam systems. Bearing capacity of Geosynthetics reinforced soil system, geocell reinforced sand overlaying soft clay- Applications, advantage, function of geofoam, physical, mechanical and thermal properties of geofoam, design of embankment using geofoam, geofoam reinforced soil walls.

Text book(s)
Koerner, R. M.(2012). Designing with Geosynthetics, 6th Edition,Vol. 1 and 2,Xlibris corp., 914 p.
Giroud, J.P.(1984)."Geotextiles and Geomembranes. Definitions, Properties and Design," Selected Papers, Revisions and Comments, 4th ed., IFAIPublishers, 325 p.
Shukla, S.K. and Yin, J.-H. (2006). Fundamentals of Geosynthetic Engineering. Taylor and Francis, London, UK.
Shukla, S.K. (2002). Geosynthetics and Their Applications. Thomas Telford Publishing, London, UK.

Reference(s)
Holtz, R. D., Christopher,B. R. and Berg, R. R.(1997) Geosynthetic engineering,Bitech publishers Ltd., 452p.
Hausmann, M. R.(1990).Engineering Principles of Ground Modification, McGraw-Hill Publishing Company, New York, 632 p.
Ingold, T.S.(1982). Reinforced Earth, Thomas Telford Ltd., London, 141 p.

Evaluation Pattern

Assessment	Internal	End Semester
Mid Semester	30	
*Continuous Assessment (CA)	30	
End Semester		40

*CA - Can be Quizzes, Assignment, Projects and Reports

23CIE474	Deep Excavation and Tunnels	L-T-P-C: 2-1-0-3

Pre-requisites

23CIE211 Geology & Soil Mechanics, 23CIE301 Geo technical Engineering

Course Objectives

To provide insight into underground structures
To provide exposure to the rock strength and design considerations.

Course Outcome

CO1: Comprehend the different soil investigation techniques, rock mass classifications, components of different underground structures and their functions
CO2: Design and apply different construction methodologies for tunnels, Caverns and shafts in different soil and rock conditions.
CO3: Evaluate the suitability of different excavation supports such as sheet piles, soldier piles, diaphragm walls and tunnel support for different soil and rock conditions
CO4: Create an instrumentation monitoring plan for tunnel construction
CO5: Comprehend the use of different software tools in deep excavations and apply code provisions for mitigating water ingress and seepage in excavations and tunnels

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	3								2	3		3
CO2	3	1	2								2	3		3
CO3	3	1	3								2	3		3
CO4	3	1	1					2			2	3		3
CO5	3	1	1		3						2	3		3

Syllabus

Unit 1

Introduction to underground constructions and tunnelling:- General Description of Various Tunnels and other underground structures, Components of a tunnel, Stress around an underground opening, Methods of excavations, Subsurface investigation

Surface investigation, Sampling Techniques, Laboratory and in-situ testing of soil and rock, Indian standard codes

Unit 2

Construction, challenges and solutions for Caverns, shaft and underground stations:- Factors affecting the choice of method of tunnel construction, Cut and cover method, Bored method, Drill and blast method, Sequential excavation method and shaft method, Norwegian tunnel boring method (NTM), New Austrian tunnel boring method (NATM), Methods of construction of caverns and shafts and underground stations, Challenges and solutions for execution of these methods, Different types of Tunnel boring machines

Design methodology, Instrumentation and monitoring for tunnels:- Rock mass classification, Geotechnical and geological inputs for design, Empirical, semiempirical and joint set analysis, Numerical 2D modelling and final support recommendations, Need for Instrumentation and monitoring in tunnels, Types of Instruments - Planning and execution

Unit 3

Support systems and design software for tunnels:- Need for pre-excavation support system, Fore piling, Bolts and Anchors, Shotcrete, wire meshes, lattice girders and integrated support systems, Different types of retaining structures and their applicability. Secant piles, Sheet piles, contiguous piles and soldier piles and D wall. Requirement of investigation to be carried out for underground structure, Preparation geotechnical interpretation report for design of retaining structure, Numerical analysis to be performed for temporary / permanent retaining system, Introduction to software to be used in embedded retaining system, Case studies.

Introduction to interpretation using Rock data, Introduction to necessary software's and their practical application & case studies

TEXT BOOKS/ REFERENCES

1. CIRIA -C760 "Guidance on Embedded retaining wall design"

2. Jaeger, J.C., Cook, N.G.W, Zimmerman, R.W. (2007). Fundamentals of Rock Mechanics, 4th Edition. Blackwell, U.K., 475 p.

3. Goodman, R.E. (1989). Introduction to Rock Mechanics, 2nd Edition. John Wiley and Sons, New York, NY, 562 p.

Evaluation Pattern

Assessment	Internal	End Semester
Mid semester	30	
*Continuous Assessment (CA)	30	
End Semester		40

•CA – Can be Quizzes, Assignment, Projects, and Reports

ENVIRONMENTAL ENGINEERING

23CIE351	ADVANCED ENVIRONMENTAL ENGINEERING	L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE302 Environmental Engineering I, 19CIE311 Environmental Engineering II

Course Objectives

To discuss the various air pollutants and their control strategies
To discuss the waste water treatment options for removal of nitrogen and phosphorus
To discuss the waste water treatment options for removal of emerging contaminants

Course Outcome
CO1: Analyze the air pollutants and select the most appropriate technique for the treatment of air pollutants
CO2: Analyze the waste water quality and design the treatment unit for removal of nitrogen and phosphorus
CO3: Analyze the quality of water and design the treatment unit for removal of emerging contaminants

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3				1				1		
CO2	3	3	3	3	1	1			1			2		
CO3	3	2	3		1			1		1		2		

Syllabus

Unit 1
Instrumental methods for analysis of contaminants in air, water and soil - colorimetry, Chromatography, spectroscopy, electrochemical probes
Indoor and outdoor air pollution – meteorology-influence of solar radiation and wind fields - lapse rate and stability conditions - characteristics of stack plumes - effective stack height.
Characteristics and health effects of various air pollutant particulates (PM2.5, PM10) and gaseous pollutants (CO, NOx, SOx, etc)- their behaviour in atmosphere – monitoring.
Photochemical reactions - secondary pollutants.
Control devices for Particulate and Gaseous pollutants – applications.

Unit 2
Advances in waste water treatment – Aerobic Suspended growth Process - Process for biological nitrogen removal – design criteria – anoxic, aerobic process design – sequencing batch reactor (SBR) – process analysis - Process for biological phosphorus removal – design criteria.
Aerobic attached growth Process – Rotating biological contactor, Activated Biofilter – Fluidized bed bioreactor (FBBR) design criteria.
Anaerobic suspended and attached growth process - Up flow anaerobic sludge blanket reactor.

Unit 3
Tertiary treatment – emerging contaminants removal - disinfection of waste water- waste water recycling – Water reuse. Advances treatment units – Removal of organic and inorganic colloidal and suspended solids – Removal of dissolved organic constituents – Removal of dissolved inorganic constituents – Filtration – Membrane filtration – Adsorption - Distillation processes

Text book(s)

Metcalf and Eddy, "Waste Water Engineering Treatment Disposal Reuse", Tata McGraw Hill, 2002.

Reference(s)

Clarence, J. Velz, "Applied Stream Sanitation", Krieger Pub Co., 1984.
C. S Rao, "Environmental Pollution Control Engineering", New Age Publications, 2006.
Nevers, Noel De, "Air Pollution Control Engineering", McGraw-Hill, 1999.

23CIE352	INDUSTRIAL WASTE TREATMENT	L-T-P-C: 3-0-0-3

Prerequisite(s): 19CIE302 Environmental Engineering I, 19CIE311 Environmental Engineering II

Course Objectives

To discuss the characteristics of Industrial wastes and pollution prevention strategies
To discuss the Preliminary treatment of industrial waste water from different industries
To discuss the Effluent generation and treatment for textile, paper, dairy and fertilizer industry,

Course Outcome

CO1: Understand the characteristics of Industrial wastes and develop a holistic view on pollution prevention strategies
CO2: Analyze and design the Preliminary treatment unit for industrial waste waters.
CO3: Analyze and design the treatment scheme for textile, paper, dairy and fertilizer industry

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3			3		2		3				2		
CO2		3	3					2		2			2	
CO3	2	3	3	2	3				2					

Syllabus

Unit 1
Nature and characteristics of Industrial wastes - prevention versus control of industrial pollution - Linkage between technology and pollution prevention - tools for clean processes - reuse, recycle, recovery, source reduction, raw material substitution, toxic use reduction and process modification - separation technologies as tools for waste minimization - Flow sheet analysis - Energy and resource audits - waste audits.

Unit 2
Preliminary treatment of industrial waste water – volume reduction – strength reduction – neutralization –equalization and proportioning.
Treatment of industrial waste - suitability of different techniques - disposal of industrial waste.

Unit 3
Effluent generation from textile industry – paper industry – dairy – fertilizer – thermal power plants - effluent characteristics - treatment.
Membrane process, ion exchange process, Reverse osmosis, Ultra filtration, electrolysis.
Study of damages caused by industrial pollution in India.

Reference(s)

Nelson Leonard Nemerow, "Industrial waste treatment – contemporary practice and vision for the future", Elsevier, Singapore, 2007
Gerard Kiely, "Environmental Engineering", McGraw Hill, 2009.
Sincero A. P. and Sincero G. A., "Environmental Engineering - A Design Approach", Prentice Hall, 1996.
Mahajan S. P., "Pollution Control in Process Industries", Tata McGraw Hill, 2001.
Babbitt H. E, "Sewerage & Sewage Treatment", Nabu Press, 2010.
Abbasi S. A, and Ramasami E, "Biotechnical Methods of Pollution Control", Universities Press (India) Ltd., 1999.

CONSTRUCTION TECHNOLOGY & MANAGEMENT

23CIE361	**CONCRETE TECHNOLOGY**	**L-T-P-C: 3-0-0-3**

Prerequisite(s): 23CIE204 Construction Engineering

Course Objectives

To highlight the fundamental concepts and behavioural aspects of various materials in concrete, types of concrete and their manufacture and applications.
To introduce concrete mix proportioning for various conditions using Indian standards and ACI standards

Course Outcome

CO1: Select the suitable ingredients for concrete and suggest suitable laboratory test to check its property.
CO2: Evaluate the properties of ordinary concrete and special concrete based on the destructive and non -destructive tests.
CO3: Evaluate durability related issues in concrete and suggest preventive measures.
CO4: Apply the modern methods in concrete manufacturing
CO5: Proportion the concrete mixtures to meet performance requirements.

CO-PO Mapping

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO														
CO1	2	1	2			2					1			3
CO2	1	1	1			1					1			3
CO3	2	1	2			1					1			3
CO4		1	1			2					1	2		3
CO5	2	2	2			2					2	2		3

Syllabus

Unit 1
Materials: cement - different types - chemical composition and physical properties - tests on cement - I.S. specifications - aggregates - classification - mechanical properties and tests as per I.S. - alkali aggregate reaction - grading requirements - heavy weight - light weight - normal weight - aggregate - sampling of aggregate - water - quality of water - admixtures - accelerators - retarders - water reducing agents – super plasticizers- use of silica fumes
Properties of fresh concrete - workability - factors affecting workability - tests for workability - segregation and bleeding.

Unit 2
Properties of hardened concrete - factors affecting strength of concrete - strength of concrete in compression, tension and flexure - stress- strain characteristics and elastic properties - shrinkage and creep - durability of concrete - permeability - chemical attack - sulphate attack - resistance to abrasion and cavitation - resistance to freezing and thawing - resistance to fire - marine atmosphere - quality control - frequency of sampling - test specimens - statistical analysis of test results - standard deviation - acceptance criteria
Manufacture of concrete - measurement of materials - storage and handling - batching plant and equipment - mixing - types of mixers - transportation of concrete - pumping of concrete - placing of concrete - under water concreting - compaction of concrete - curing of concrete - ready mixed concrete

Unit 3
Mix proportioning - nominal mixes - design mixes - factors influencing mix design - A.C.I method - I.S method - design for high strength mixes.
Special concretes - lightweight concrete - high density concrete - vacuum concrete - shotcrete - Fibre reinforced concrete-polymer concrete - ferrocement - high performance concrete - self compacting concrete.
Introduction to Non-destructive test methods.

Text book(s)
Neville.A.M. and Brooks.J.J., "Concrete Technology", Pearson Education, 2006.
Santha Kumar, A. R., "Concrete Technology", Oxford University Press, 2018.

Reference(s)
Mehta, P.K. and Monteiro, P.J.M., "Concrete - Microstructure, Properties and Materials", McGraw Hill Education, 2017.
Shetty, M. S, "Concrete Technology-Theory and Practice", S. Chand & Co., New Delhi, 2018.
A.M. Neville, "Properties of Concrete", Pearson Education, 2012.

23CIE362	REPAIR AND REHABILITATION OF STRUCTURES	L-T-P-C: 3-0-0-3

Prerequisite(s): 23CIE204 Construction Materials & Methods

Course Objectives

To explain the mechanisms of degradation of structures
To introduce field monitoring and non-destructive evaluation of structures.
To give an exposure on the materials and techniques for strengthening or upgrading existing structural systems.

Course Outcome

CO1: Apply the knowledge of construction materials and techniques to analyze building durability problems
CO2: Evaluate the common defects and distress in construction through diagnostic procedures
CO3: Select suitable materials and methods for protection and repair.
CO4: Apply maintenance and strengthening approaches to situations
CO5: Analyze and develop report for simple maintenance and repair problems.
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CO-PO Mapping

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO														
CO1	3	2										2		3
CO2	2	2		1	3							1		3
CO3	3	3										1		3
CO4	3	2				1					1	1		3
CO5	1	1	1	1				1	1	1	1	1		3

Syllabus

Unit 1
Durability: Life expectancy of different types of buildings – influence of environmental elements such as heat, moisture, precipitation and frost on buildings- Effect of biological agents like fungus, moss, plants, trees, algae - termite control and prevention - chemical attack and impact of pollution on building materials and components- Aspects of fire damage and assessment.

Unit 2
Building failures – causes and effects - cracks in buildings – types, classification. Investigation and condition assessment – Semi-destructive and Non destructive testing methods.
Common defects in buildings and control measures - maintenance philosophy - phases of maintenance.
Materials for repair - special mortar and concretes, concrete chemicals, admixtures, special cements and high grade concrete.

Unit 3
Techniques for repair - surface repair – material selection – surface preparation - rust eliminators and polymer coatings for rebars – repair methods of cracks in concrete and masonry - epoxy injection. Guniting and shotcreting. Waterproofing methods.
Strengthening measures- flexural strengthening, beam shear capacity strengthening, column strengthening, shoring, under pinning and jacketing
Conservation of historic buildings -materials and methods - examples.

Text book(s)

Peter H. Emmons, "Concrete Repair and Maintenance", Galgotia Publications, 2010.
Vidivelli.B., "Rehabilitation of Concrete Structures", Standard Publishers, 2009.

Reference(s)

James Douglas, Bill Ransom, "Understanding Building Failures", Taylor & Francis Group, 2007.
Philip.H.Perkins,"Repair, Protection and Water proofing of Concrete Structures", E & FN Spon, 1997.
SP : 25 - 1984, "Causes and prevention of cracks in buildings", BIS
Santhakumar.A.R., "Concrete Technology", Oxford University Press, 2018.
Sidney M. Johnson, "Deterioration, Maintenance and Repair of Structures", Krieger Publishing Company, 1980.

23CIE363	INTRODUCTION TO ARCHITECTURAL SCIENCE	L-T-P-C: 3-0-0-3

Prerequisite(s): 23CIE204 Construction Materials & Methods

Course Objectives

To highlight the basic concepts of architectural composition in the development of built environment.
To expose the students to the concepts of functional design of buildings in tropical climates.
Assessing comprehension of the course through case studies given as project work.

Course Outcome

CO1: Apply knowledge of architectural design principles to critically evaluate building form and space
CO2: Apply knowledge of thermo-physical properties of materials in evaluating heat flow through buildings
CO3: Evaluate quality of indoor climate based on thermal comfort indices and suggest control methods
CO4: Evaluate the natural and artificial lighting of indoor spaces
CO5: Apply knowledge of behavior sound in free field and enclosures to analyze acoustical features.

CO-PO Mapping

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO														
CO1	3	2	2						1			1		1
CO2	3	3				2						1	1	2
CO3	3	3	2			1			1			2		2
CO4	3	3	2			1			1			1		2
CO5	3	3	2									1		1

Syllabus

Unit 1

Principles of architectural design: Factors influencing architectural development-examples. Primary elements – Form and Space.
Organizing principles in architecture – symmetry – hierarchy – axis, linear, concentric, radial – asymmetric grouping- Primary and secondary masses. Principles of architectural composition – unity – balance- proportion – scale – rhythm – harmony – contrast.
Role of colour, texture, shapes/forms in architecture. Forms related to materials and structural systems. Architecture as part of the environment.

Unit 2
The Thermal Environment: Climatic elements: classification of climates. Earth'sthermal balance. Thermal balance of human body – thermal comfort indices – comfort zone.
Thermo-physical properties of building materials: resistance and transmittance - solar gainfactor. Heat flow through buildings – thermal transmittance of structural elements - periodic heat flow. Sun-building relationship.
Design criteria for control of climate – passive and active approaches.

Unit 3
The Luminous Environment: Types of visual tasks – principles of day lighting – day light factor - evaluation of lighting by windows, skylights. Artificial lighting – illumination requirements –lamps and luminaries. Design of artificial lighting – Lumen method – Point by point method.
The Sonic Environment: Physics of sound – airborne and structure borne propagation –behavior of sound in free field and enclosures – design criteria for spaces – acoustical defects – sound reduction,sound insulation and reverberation control – acoustic materials – types and fixtures.

Potential case studies

1. Critical review based on architectural design principles - ancient/monumental/modern buildings
2. Case study on thermal or visual comfort audit for a commercial/office building
3. Exposure to Energy simulation tools

Text book(s)

Francis D.K.Ching, "Architecture-Form, Space and Order", John Wiley NP, 2015
Steven V. Szokolay., "Introduction to Architectural Science - The Basis of Sustainable Design", Routledge, 2014.

Reference(s)

Muthu Shobha Mohan, "Principles of Architecture", Oxford University Press, 2006.
Koenigseberger., "Manual of Tropical housing and Building – Climatic Design", Universities Press, 2010.
Bureau of Indian standards, Handbook on Functional Requirement of Buildings – SP:41(S and T) – 1987
Krishnan, "Climate Responsive Architecture", McGraw Hill Education, 2017.

23CIE364	SUSTAINABLE DESIGN OF BUILDINGS	L-T-P-C: 3-0-0-3

Course Objective

Promote an approach to project conception and evaluation that is based on an appreciation of the needs of society, with orientation towards industry and standard practices.

Course Outcome

CO1: Analyse the influence of climate on comfort levels in built environment
CO2: Assess building energy issues and suggest design options
CO3: Propose strategies for water conservation and waste recycling
CO4: Apply green project management concepts in building construction

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3				2					2	2		3
CO2	3	3	2		1	3			2		2	2	2	3
CO3	2	3	2			3					2	2		3
CO4	2	3	2		1	3			2		2	2		3

Syllabus

Unit 1
Introduction to Sustainability: Overview of Sustainability and Green buildings, Selection of site –preservation and planning.
Climatology: Basics of climatology, Influence of climate on buildings, Earth –Sun relationship.
Heat transfer in buildings: Conduction/Convection/radiation heat transfer
Comfort in Buildings: Thermal comfort - Strategies for Thermal comfort. Visual comfort –Enhancement strategies for Daylighting and Artificial lighting. Building Acoustics – defects and prevention of sound transmission. Indoor Air Quality - integrated approach for IAQ management
Sustainable building materials: Features of sustainable building materials and sustainable alternatives.

Unit 2
Resource and waste management in buildings:
Energy efficiency –Energy efficiency in building envelope, energy simulation, Energy management system –lighting and renewable energy and Energy Audit.
Water Efficiency –Planning and design of water management system, Rain water harvesting, Water efficient design and fixtures, Treatment and reuse, Water efficient landscape system.
Waste management –Types of waste and its treatment methods, Construction and demolition waste management, Waste management in residential, commercial buildings, healthcare facilities.

Unit 3
Green project management and Life Cycle Assessment of Buildings:
Green building evolution and Different phases of Green building project management. Life cycle assessment and its types –Modelling and Analysis, Greenhouse gas emission
Sustainability rating systems: Green building rating systems-LEED, BREEAM and others, Indian Green building rating systems –IGBC & GRIHA, IGBC criteria for certification.

Potential case studies
1.Case study on thermal comfort audit for a commercial building
2.Energy audit for commercial building
3.Exposure to Energy simulation tools

Text Book
"Sustainable Building Design Manual- Volume II", Published by TERI, New Delhi, 2009.

Reference(s)

Kibert, C.J., "Sustainable Construction: Green Building Design and Delivery", Wiley, 2022.
Steven V. Szokolay., "Introduction to Architectural Science - The Basis of Sustainable Design", Routledge, 2014.
Sandy Halliday, "Sustainable Construction", Routledge, (Taylor & Francis Group), 2013.
Dejan Mumovic and Mat Santamouris (Ed), "A Handbook of Sustainable Building Design and Engineering", Routledge, 2021
Francis D. K. Ching, Ian M. Shapiro, "Green Building Illustrated", Wiley, 2020.

23CIE365	CONSTRUCTION ECONOMICS AND FINANCE	L-T-P-C: 3-0-0-3

Prerequisite(s): 23CIE313 Construction Management

Course Objective

To expose the students to the concepts of construction finance such as comparing alternatives proposals,evaluating alternative investments, cost estimating and management of accounting.

Course Outcome

CO1: Apply time-value of money concept to compare alternatives
CO2: Analyse equipment cost and replacement alternatives.
CO3: Prepare different types of cost estimates
CO4: Understand the financial management procedures and estimate the financial ratios

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3								2				3
CO2	3	3								2				2
CO3	2	3								2				2
CO4	3	3								2				3

Syllabus

Unit 1
Engineering economics : Basic principles – Time value of money, Quantifying alternatives for decision making, Cash flow diagrams, Equivalence- Single payment in the future (P/F, F/P), Present payment compared to uniform series payments (P/A, A/P), Future payment compared to uniform series payments (F/A, A/F), Arithmetic gradient, Geometric gradient. Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value.

Unit 2
Comparison of alternatives: Present, future and annual worth method of comparing alternatives, Rate of return, Incremental rate of return, Break-even comparisons, Capitalized cost analysis, Benefit-cost analysis.
Depreciation, Inflation and Taxes
Equipment economics: Equipment costs, Ownership and operating costs, Buy/Rent/Lease options, Replacement analysis.

Unit 3
Cost estimating: Types of Estimates, Approximate estimates – Unit estimate, Factor estimate, Cost indexes, Parametric estimate, Life cycle cost.
Financial management: Construction accounting, Chart of Accounts, Financial statements – Profit and loss, Balance sheets, Financial ratios, Working capital management.

Text book(s)
Bose, D. C., "Fundamentals of Financial management", 2nd ed., PHI, New Delhi, 2011.
Prasanna Chandra, "Projects: Planning, Analysis, Selection, Financing, Implementation and Review", McGraw-Hill Education, 2019.

Reference(s)
Gould, F. E., "Managing the Construction Process", 4th ed., Pearson Education, 2012.
Harris, F. , McCaffer, R. and Edum-Fotwe, F., "Modern Construction Management", 6th ed., Wiley India, New Delhi, 2012.
Jha, K. N., "Construction Project Management, Theory and Practice", Pearson, New Delhi, 2015.
Peurifoy, R. L. and Oberlender, G. D., "Estimating Construction Costs", 6th ed., McGraw-Hill, 2015.

23CIE366	SAFETY FOR PROFESSIONALS	L-T-P-C: 2-1-0-3

Course Objectives

- To provide an overview of the fundamentals of workplace occupational safety and health, covering numerous workplace risks and risk mitigation strategies.
- To develop a grasp of national and international safety and health rules and standards.
- To understand the importance of safe work systems as well as key parts of various incident investigation approaches and emergency response processes.

Course Outcomes

- **CO1:** Understand and interpret the significance of occupational health and safety. CO2: Assess safety metrics and safety performances.
- **CO2:** Understand the need for safety regulations and legislation at the national level and infer their importance.
- **CO3:** Evaluate workplace hazards and incidents using various analysis and investigation techniques.
- **CO4**: Understand the Safety and health management system and identify its fundamental requirements.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	POll	PSO1	PSO2	PSO3
CO1			3			3						1	1	3
CO2			3			3						1	1	3
CO3	1		3			3	2							3
CO4	2	1	3	3		3		1	1		2	1	1	3
CO5	1		3			3			2	2	3			3

Syllabus

Unit 1
Significance of occupational safety and health at workplace - Classification of incidents -Calculation of safety metrics - Safety legislation in India - Safety in design.

Unit 2
Workplace hazards and control - Role of the working environment in safety -Safe systems ofwork -Hazardous material handling - Hazard analysis techniques.

Unit 3
Process safety management -Occupational health and hygiene -Incident investigationprocedures —Safety and health management systems.

Textbooks/Reference books:

1. *Reese. C.D and Eidson J.V, Handbook of OSHA Construction Safety and Health,Second Edition, CRC Press, Boca Raton, 2006.*
2. *Reese, Charles D.. Occupational Safety and Health: Fundamental Principles and Philosophies. United States, CRC Press, 2017.*
3. *Jimmie W. Hinze "Construction Safety", Prentice Hall of India, 1997.*
4. *Harris .F, McCaffer .R and Edum-Fotwe .F, Modern Construction Management, SixthEdition, Blackwell Publishing, Oxford, 2006.*
5. *Holt S. J, Principles of Construction Safety, Blackwell Publishing, Oxford, 2008.*

23CIE367	BUILDING INFORMATION MODELLING	L-T-P-C: 2-0-3-3

Course Objectives

- To highlight the use of BIM models based on real-world construction projects
- To explain the modelling and analysis using BIM software.
- To give an overview of clash detection and avoidance using BIM
- To give an exposure on BIM 4D and 5 D models.

Course Outcome

CO1: Create BIM model for effective coordination during planning, design and execution.
CO2: Identify clash and avoid it's occurrence.
CO3: Apply the concept of BIM 4D for project scheduling
CO4: Apply the concept of 5D BIM for quantity takeoff and estimation

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3		3	1				2	2		3	2
CO2	3	2	3		3					3	2		3	3
CO3	3	2	3		3					3	2		3	3
CO4	3	2	3		3					3	3		3	3

Syllabus

Unit 1
Building Information Modeling – Introduction & Process, Evolution of BIM, BIM Model -of various buildings like Commercial & Residential, WTP, Transportation, Airports. Isometric View – Introduction, Examples and Problems. 3D Modeling

Design Authoring – Workflow, Discipline Based Modeling, Architectural, Engineering Analysis, Structural Analysis, HVAC, Electrical, Plumbing, Energy Analysis, Lighting Analysis, Design Review. Views in Model, Visualization Modes, Walkthrough & Fly through the Model, Layers & Properties, AR, VR & MR.

Unit 2
Clash Check, Types of Clashes, Federated Model - Clash avoidance process, Clash Detection Process – Introduction, Clash Detection - Priority Matrix, Clash Detection – Rules, Clash Detection – Report, Clash Detection – Grouping, Clash Detection - Roles & Responsibilities, Clash Detection Process – Demo.

CDE, Level of Development (LOD)- Level of Detail & Level of Information, LOD - for all elements- Chart & Matrix

Unit 3
Project Schedule, 4D BIM Modeling, Construction Analysis, 3D Control & Planning, BIM for Safety, Disaster & Risk Analysis, Digital Fabrication, Phase Planning, As-built/Record Models.

5D BIM and Quantity Take off with UOM, Exercise & Demo, Quantity Take Off, 5D – Estimation and Analysis, Cost Control, Asset Information Model, COBie and Deliverables, Space Attributes, Asset Attributes and Asset requirement, Infrastructure System, Information Exchange with Facility Management.

Industrialization of Construction through BIM – DfMA, IoT in BIM, Data analytics using AI and ML, Smart Infrastructure, Digital Twin –Connected Infrastructure.

TEXT BOOKS / REFERENCES:

1. Karen Kensek and Douglas Noble, *Building Information Modelling: BIM in Current and Future Practice* Wiley; 1st edition (15 August 2014)
2. Andre Borrmann, Markus Konig, Christian Koch, JakobBeetz, *Building Information Modelling,* Springer 2015
3. Rafael Sacks, Chuck Eastman, Ghang Lee, Paul Teicholz , *BIM Handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers,* Wiley; 3rd edition (2 October 2018)
4. ISO 19650 – 2018 Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM)

23CIE368	CONSTRUCTION EQUIPMENT AND TECHNIQUES	L-T-P-C: 2-1-0-3

Course Objectives

To provide insight into functions and operations of different construction equipment.
To provide exposure to the maintenance and safety of equipment during construction.

Course Outcome

CO1: Explain the working principles of construction equipment.
CO2: Ability to select appropriate equipment for earth moving, tunneling, concreting, mining and quarrying
CO3: Assess equipment performance and implement maintenance practices.
CO4: Apply safety norms during equipment utilization

CO-PO Mapping

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO														
CO1	3	3										2		
CO2	3	3								1		3		3
CO3	3	3			1					2		1		2
CO4	3	3				2				2		1		1

Syllabus

Unit 1
Basics and Hydraulics of Construction Equipment:
Introduction to Construction Equipment- Functions, Operations of Construction Equipment- Introduction to Four & Two Stroke Engine and their components- Introduction and Components to Automobiles. Introduction to Principles of Hydraulic- Calculation of Pressure, Force & Flow- Components of a Hydraulic System- Basic layout of Hydraulic System- Applications of Hydraulics- Strand Jack Operation

Unit 2
Concreting, Earth Moving, Road Making and Quarry/Mining Equipment:
Operations of a Batching Plant - Introduction and Components of Concrete Pump & Placer- Concrete Pipeline- Laying and Cleaning- Bulldozer- Classification and Components- Classification, Components and Attachments of Excavator- Backhoe Loader- Classification & components- Introduction and classification to Hot mix Plant- Process of Asphalt Paver-PQC Paver- Classification & Components- Motor Grader- Classification & Components- Horizontal Movement Vehicles- Quarry/Mining.
Tunnelling Equipment / Piling Equipment:
Introduction to Tunnel Boring Machines- Details and Operation of a Hard-Rock TBM- Details of Earth Pressure Balance (EPB) TBM- Details and operation of Slurry TBM & Components- Hydraulic Grabs- Piling Rig.

Unit 3
Equipment Life Cycle Management:
Life Cycle of an Equipment- Equipment Performance Parameters - Introduction to Maintenance- Types of Maintenance- Maintenance Practices
Mechanization and Digitalisation in Construction and Safety in Construction Equipment:
Importance of Digital Analytics- Digital Solution in Construction Projects- Importance of Mechanisation - Railway Track Construction- Rebar Processing Machine- Operation of Mechanised Equipment- Introduction to 3D Concrete Printer- Importance of Safety- Various PPE & Purpose- Safety of Men & Machines at Work- Safety During Construction Activities- Safety with Tools & Tackles.

TEXT BOOKS/ REFERENCES

1. R.L.Peurifoy, C.J. Schexnayder, R.L.Schmitt. and A.Shapira, Construction Planning, Equipment, and Methods, McGraw Hill Education, 2018.
2. F. Harris, Modern Construction and Ground Engineering Equipment and Methods, Second Edition, Longman, London, 1994.
3. D.G. Gransberg, C.M. Popescu and R.C. Ryan, Construction Equipment Management for Engineers, Estimators, and Owners, CRC Press, 2006.
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4. D.A.Day and N.B.H. Benjamin, Construction Equipment Guide, Second Edition, Wiley, New Jersey, 1991.
5. J.E.Schaufelberger andG.C.Migliaccio, Construction Equipment Management, Routledge, 2019

23CIE369	**FORMWORK ENGINEERING PRACTICES**	**L-T-P-C: 2-1-0-3**

Course Objectives

- To give an exposure on the basic concepts, types and parameters to be considered for the selection of formwork
- To give an overview on recent advancements in formwork.
- To explain the special formworks and its selection criteria.

Course Outcome

CO1: Understand different types of formwork and prepare the configurations.
CO2: Design formwork and do the quantity take off
CO3: Identify special formwork for various applications.
CO4: Understand basics of scaffolding and apply in field conditions

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2										1		2
CO2	3	3	3									1		3
CO3	3	3		1	1							1		3
CO4	3	3										1		3

Syllabus

Unit 1

Introduction and Basics of Formwork - General Objectives, Classification, Benefits, Areas of competitiveness, Selection of Formwork, Selection of Materials, Materials, Accessories and Consumables, Application of Tools.
Types of Formwork – Formwork for Foundation, Wall, Columns, Slab and Beam. Conventional Drawings, Vertical Application of Conventional Foundation Formwork, Formwork System – Components, Assembly, De-shuttering, Flex System, Heavy Duty Tower System, Safety of Work, Formwork for Stairs, Load Bearing Tower.
Formwork Planning and Monitoring- Configuration, Scope, Strategy & Costing of Formwork, Productivity.

Unit 2

Design Concepts in Formwork - Design Loads, Pressures on Concrete, Design Methods & Assumptions.
Formwork Design - Vertical & Horizontal Applications – concepts, Slab Design, wall formwork, Checks. Formwork Drawing Concept and Preparation Guidelines, General Layout and Detailed Drawings, BOQ Calculation and Checklist.
Formwork Quantity take off and Cost Estimation - schedule of formwork, Mobilization distribution, BOQ, Quantity Calculation, Cost optimization. BIM for planning operations.
Modular Formwork – Introduction, Advantages and Limitations, Vertical and Horizontal Application, Shuttering & De-shuttering, Application, Aluminum formwork - Drawings & Components, Activities.

Unit 3

Special Formwork and Various Applications - Tunnel formwork, 3D design Details, High rise construction, Various climbing system, Table lifting system, Bridge construction systems, Project Application.
Building and Erecting Using the Formwork and Formwork Failures - Formwork Assembly for Wall & Column Panels, Stop end & Box outs., Equipment and Layout, Formwork Erection and Safety, Inspection and Corrections, Plant and Machinery, Codal and Contractual Requirements.

Basics of Scaffolding- 'Modular scaffold Installation sequence, Tie and material specification, 'Ladder safety, Loading Classification, application, 'Components of LTMS, 'Access scaffold Do's and Don’ts. Innovation and Global practices.

TEXT BOOKS/ REFERENCES:

1. Kumar NeerajJha, *Formwork for concrete structures*, McGraw Hill Education, 2017.
2. Austin, C.K., *Formwork for Concrete*, Cleaver -Hume Press Ltd., London, 1996.
3. Hurd, M.K., *Formwork for Concrete*, Special Publication No.4, American Concrete Institute, Detroit, 2005
4. Concrete Formwork Systems – Awad. Hanna- University of Wisconsin –Copy right Marcel Dekkel Inc.
5. *Formwork – A guide to Good Practice* –Concrete Society –U.K 2nd Edition 1995
6. Robert L. Peurifoy and Garold D. Oberlender, *Formwork For Concrete Structures*, McGraw -Hill , 2010.
7. Tudor Dinescu and Constantin Radulescu, *Slipform Techniques*, Abacus Press, Turn Bridge Wells, Kent, 1984.

TRANSPORTATION ENGINEERING

23CIE431	PAVEMENT DESIGN	L -T-P-C: 2-1-0-3

Prerequisite(s): 23CIE214 Transportation Engineering I

Course Objectives

Introduce to the quality assessment procedures for pavement materials
To explain the stress analyses and design methods of flexible and rigid pavements
To explain the role of various joints in a rigid pavement and its design

Course Outcome
CO1: Evaluate the constituents of flexible and rigid pavements
CO2: Analyse the stresses in flexible pavement
CO3: Design the structure of a flexible pavement
CO4: Analyse the stresses in rigid pavement
CO5: Design the structure of a rigid pavement

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		2	2	3							1	3		
CO2	2	2	3	2							1	3		
CO3	2	2	3	2							1	3	2	2
CO4	2	2	3	2							1	3		-
CO5	2	2	3	2							1	3	2	2

Syllabus

Unit 1
Introduction - Types and component parts of pavements, factors affecting design and performance of pavements, functions and significance of different layers of a pavement. Test conducted to assess the properties of subgrade soil, aggregate and bitumen. Design of bituminous mixes by Marshall method.

Unit 2
Stress analyses and methods of flexible pavement design - stresses and deflections in homogeneous masses. Burmister's 2-layer, 3-layer and multi-layer theories. Wheel load stresses - ESWL of multiple wheels, repeated loads and EWL factors - empirical, semi-empirical and theoretical approaches for flexible pavement design. Design of flexible pavements as per IRC. Softwares for pavement design

Unit 3
Stresses analysis and methods of rigid pavement design - types of stresses and causes, factors influencing stresses, general conditions in rigid pavement analysis. Types of stresses - wheel load stresses, warping stresses, friction stresses, combined stresses. Functions of various types of joints in cement concrete pavements – design of longitudinal, contraction and expansion joints as per IRC recommendations. Pavement evaluation and rehabilitation.

Text book(s)
Yoder and W Nitezak, "Principles of Pavement Design", John Wiley, 1975.
Khanna S. K. and Justo, C E G, "Highway Engineering", Nem Chand and Bros, 2017.

Reference(s)
Yang. H. H., "Pavement Analysis and Design", Pearson Education, 2010.
David Croney, "The Design and Performance of Road pavements", McGraw Hill, 1997.
Haas R., Hudson W. R., and Zaniewski, J., "Pavement Management System", McGraw Hill Book Co, 1994.

IRC 37- 2018, "Guidelines for the Design of Flexible Pavements"
IRC 58-2015, "Guidelines for the Design of Plain Joined Rigid Pavements for Highways"
IRC 81-1991, "Guidelines for Strengthening of Flexible Road Pavements using Benkelman Beam Deflection Technique".

23CIE432	URBAN TRANSPORTATION PLANNING	L-T-P-C: 3-0-0-3

Prerequisite(s): 23CIE214 Transportation Engineering I

Course Objectives

To explain the urban travel characteristics and concept of travel demand
To explain the different methods adopted for estimating the number of trips generated
Introducing to forecasting the probable zones to which the generated trips are being distributed
To explain methods for proportioning of trips shared across public and private modes
To discuss the various methods to forecast the number of trips distributed across alternate routes

Course Outcome

CO1: Evaluate urban transport problems using the travel demand concept
CO2: Develop trip distribution and trip generation models
CO3: Estimate mode choice and develop traffic assignment models

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1				1						3	3	2
CO2	3	3		2	1							3	3	2
CO3	3	2			1	1						3	3	2

Syllabus

Unit 1
Urban Transportation Planning Process & Concepts - Transportation problems, urban travel characteristics, evolution of transportation planning process, concept of travel demand. Demand function - Independent variables, travel attributes, assumptions in demand estimation. Sequential, recursive and simultaneous processes.
Transportation Survey and Analysis - Definition of study area, zoning, types and sources of data. Type of surveys
• Road side interviews, Home interview surveys.

Unit 2
Trip Generation Analysis - Trip classification, factors influencing productions and attractions, trip rate analysis, multiple regression models, category analysis.
Trip Distribution Analysis - Trip distribution models, Growth factor models, Gravity models, Opportunity models.

Unit 3
Mode Split Analysis: Mode choice behaviour, Trip end and trip interchange models, Probabilistic models, Utility functions, Logit models.
Traffic assignment – Elements of transportation networks, Minimum Path Algorithms. Assignment methods – All or Nothing assignment, Capacity restrained assignment and Multi path assignment.

Text book(s)
Kadiyali, L. R., "Traffic Engineering and Transport Planning", Khanna Publishers, 2013.
Hutchinson B. G., "Principles of Urban Transportation System Planning", McGraw Hill, 1974

Reference(s)

O' Flaherty C. A., "Traffic Planning and Engineering", Elsevier India, 2006.
Khisty C. J. and Iall. B. K., "Transportation Engineering - An Introduction", Prentice Hall, 2002.
Bruton M.J., "Introduction to Transportation Planning", Hutchinson of London, 1992.
Papacostas, C S, and Prevedouros. P. D, "Transportation Engineering and Planning", Prentice Hall, 2009.
Dicky J. W., "Metropolitan Transportation Planning", Taylor & Francis, 1983.

23CIE433	TRAFFIC ENGINEERING AND MANAGEMENT	L-T-P-C: 3-0-0-3

Prerequisite(s): 23CIE214 Transportation Engineering I

Course Objectives

1. The components of a traffic stream
2. Data collection through traffic surveys
3. The fundamental relationships of traffic flow
4. Capacity estimation of different types of intersections
5. The contributory factors and analyses of accidents
6. The traffic flow at a microscopic level

Course Outcome

CO1: Understand the road traffic components and their characteristics in traffic engineering
CO2: Conduct different types of traffic engineering studies and perform basic statistical analysis of traffic data
CO3: Use speed-flow relationships and analyse the capacity of different kinds of intersections
CO4: Understand elements of road safety and approaches to accident studies
CO5: Use different distribution models and analyse traffic flow characteristics

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2									1	3		
CO2	3	3	1	3		1	1				1	3		
CO3	2	2	1	2		2	1				1	3	2	2
CO4	3	2	1	2		2	1				1	3		2
CO5	3	3	1	3		2	1				1	3	2	2

Syllabus

Unit 1
Introduction - Objectives and scope of traffic engineering - Components of road traffic: vehicle, driver and road. Road user and vehicle characteristics and their effect on road traffic. Traffic manoeuvre. Traffic Surveys - Objectives, methods, equipment's used for data collection, analysis and interpretation. Traffic Forecast: General travel forecasting principles, different methods of traffic forecast, Softwares for statistical analysis

Unit 2
Concept of Design vehicle units and determination of PCU under mixed traffic conditions. Traffic Stream Characteristics - Relationship between Speed, Flow and Density. Determination of design hourly volume. Highway Capacity: Factors affecting capacity, level of service; Capacity studies - Capacity of different highway facilities including unsignalised and signalised intersections

Unit 3
Accident Analysis - Analysis of individual accidents and statistical data, Methods of representing accident rate. Factors in traffic accidents - influence of roadway and traffic conditions on traffic safety.
Shock waves, Queuing theory and applications. Probabilistic Aspects of Traffic Flow -Vehicle arrivals, distribution models, gaps and headway distribution models; gap acceptance merging parameters, delay models.

Text book(s)

Elena S. Prassas, Roger P. Roess, William R. McShane, "Traffic Engineering", Pearson, 2010.Kadiyali, L. R., "Traffic Engineering and Transport Planning", Khanna Publishers, 2013.

Reference(s)

O' Flaherty C. A., "Traffic Planning and Engineering", Elsevier India, 2006.
Fred L. Mannering, Scott S. Washburn, and Walter P. Kilareski, "Principles of Highway Engineering andTraffic Analysis", Wiley, 2011.
Pignataro, L., "Traffic Engineering - Theory and Practice", Prentice Hall, 1973.
Institute of Transportation Engineers, "Transportation and Traffic Engg. Hand Book", 6th edition, 2009.IRC-SP41, Guidelines for the Design of At-Grade Intersections in Rural and Urban Areas, 1994.
Leonard Evans, "Traffic Safety", Science Serving Society, 2004.
Michael, A. P. Taylor, William Young, and Peter W. Bonsall, "Understanding Traffic Systems", AshgatePublishing, 2000.
Mike Slinn, Paul Matthews, Peter Guest, "Traffic Engineering Design - Principles and Practice", Butterworth-Heinemann, 2005.

23CIE453	TRANSPORTATION SYSTEM MANAGEMENT AND CONTROL	L-T-P-C: 3-0-0-3

Course Objectives

To explain different types of intersections and traffic control devices
To elucidate the concept of Transportation System Management
To explain the need for traffic management and various strategies adopted for an effective traffic management

Course Outcome

CO1: Understand the need for channelization and compare the different forms of intersections.
CO2: Analyse and Design of signalized intersections
CO3: Compare the different methods for traffic demand management.
CO4: Suggest alternatives for effective traffic management

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		2	2	1							1	3	2	2
CO2	3	2	3	1							1	3	2	2
CO3		2	3	1		1					1	3	2	2
CO4		2	3	1		1					1	3	2	2

Syllabus

Unit 1
Traffic Engineering Facilities and Control: Control of Traffic Movements through Time Sharing and Space Sharing Concepts – Design of Channelizing Islands - T, Y, Skewed, Staggered, Roundabout, Mini-Round about and other At-Grade Crossings and Provision for Safe Crossing of Pedestrians and Cyclists; Grade Separated Intersections, their warrants.

Traffic Control Devices: Traffic Signs and Signals, Principle of Signal Design, Webster's Method, Redesign of Existing Signals including Case Studies; Signal System Coordination.

Unit 2
Combination and Interactions, Input Assessment and Evaluation, Monitoring and Surveillance, Study of following TSM Actions with respect to: Problems Addressed, Conditions for Applications, Implementation Problems, and Evaluation and Impact Analysis. Public Transportation and HOV Treatment, Toll discounts for Car Pools during Peak periods, Park and Ride, Carpooling, Exclusive Bus & Two-wheeler Lanes, Priority at Ramp Terminals, Bus Transfer Stations, Limited Skip & Stop Bus Services & Shared Rides.

Unit 3
Demand Management: Staggered Working hours, Flexible Work hours, High Peak Period Tolls, Shuttle Services, Circulation Services and Extended Routes.
Traffic Operations Improvements: On-Street, Parking ban, Freeway Ramp Control and Closure, Travel on Shoulders, One-way Streets, Reversible Lanes, Traffic Calming, Right Turn Phase, Right Turn Lanes, Reroute Turning Traffic.

Text book
Kadiyali, L. R., "Traffic Engineering and Transport Planning", Khanna Publishers, 2013.

Reference(s)
Institute of Transportation Engineers, "Transportation and Traffic Engineering Hand Book", 6th edition, 2009.
Salter, R.J., "Highway Traffic Analysis and Design", Palgrave Macmillan, 1996.
Louis J. Pignataro, Edmund J. Cantilli, "Traffic Engineering – Theory and Practice", Prentice Hall, 1973.
IRC- SP41-1994: Guidelines for the Design of At-Grade Intersections in Rural and Urban Areas.

23CIE454	Geosynthetics engineering	L-T-P-C: 2-0-3-3

Prerequisite(s): nil

Course Objective
Understand the importance of geosynthetics in Civil Infrastructure development. To be able to design reinforced geo-structures

Course Outcome
CO1: Understand different types of geosynthetics.
CO2: Design of geosynthetics for geotechnical challenges
CO3: understand usage of geosynthetics for drainage functions.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3									2	3		
CO2	3	2	3										3		
CO3	3	2	3									2	3		

Syllabus

Unit 1

Geosynthetics: Introduction– Types, applications, Manufacturing, Testing. Retaining structures: Types, Load transfer mechanisms, IS code-based Design, Stability analysis, Testing methods. Design of reinforced soil retaining walls supporting sloped backfill, bridge abutments.

Unit 2

Slope stability analysis: Finite and infinite slopes- Modes of failures- In-situ slope stabilization- Design of reinforced slopes- Embankments on soft soils

Facing elements: Construction procedure, design of Geosynthetics wrap around faced wall, geogrid reinforced soil walls, geocell wall, gabion wall

Unit 3
Drainage facilitation by geosynthetics: Accelerated consolidation of soft clays using geosynthetics - Geosynthetic encased stone columns for load support- Filtration - Erosion control. Natural geosynthetics and their applications - Geosynthetics for construction of municipal and hazardous waste landfills.

List of experiments:-

- Physical properties:- Density, Thickness & Specific gravity
- Tensile strength :- Trapezoidal tear strength
- Drop cone test
- Grab strength
- Direct shear
- Pullout test
- Permittivity and Transmittivity
- Interface friction between Geotextile and soil
- Water absorption capacity & swell
- Bursting strength test

Text book(s)
Koerner, R. M.(2012). Designing with Geosynthetics, 6th Edition,Vol. 1 and 2,Xlibris corp., 914 p.

Giroud, J.P.(1984)."Geotextiles and Geomembranes. Definitions, Properties and Design," Selected Papers, Revisions and Comments, 4th ed., IFAIPublishers, 325 p.
T.W. Lambe and Whitman, "Soil Mechanics", Wiley, 2008.
Shukla, S.K. and Yin, J.-H. (2006). Fundamentals of Geosynthetic Engineering. Taylor and Francis, London, UK.

Reference(s)

Holtz, R. D., Christopher,B. R. and Berg, R. R.(1997) Geosynthetic engineering, Bitech publishers Ltd., 452p.
Hausmann, M. R.(1990).Engineering Principles of Ground Modification, McGraw-Hill Publishing Company, New York, 632 p.
Ingold, T.S.(1982). Reinforced Earth, Thomas Telford Ltd., London, 141 p.
Das, B.M., "Principles of Geotechnical Engineering", CL Engineering, 2013

Evaluation Pattern

Assessment	Internal	End Semester
Mid Semester	30	
*Continuous Assessment (CA)	30	
End Semester		40

*CA - Can be Quizzes, Assignment, Projects and Reports

23CIE475	GEOSPATIAL TECHNIQUES IN PRACTICE	L-T-P-C: 2-1-0-3

Course Objectives

- Expose to the geospatial application in the construction industry
- Explain the basic concepts of Remote Sensing and EM Spectra and the different types of satellites and sensors.
- Illustrate the construction project survey using geospatial data.
- Explain different types of geospatial instruments and techniques in practice
- Develop knowledge using GIS data and working with GIS software.

Course Outcomes

CO1: To comprehend different geospatial techniques in the construction industry
CO2: To carry out survey/process geospatial data for determining the accurate geographic coordinates, distances, establish location and alignments in construction projects.
CO3: To comprehend the application of geospatial instruments like LIDAR, drones, etc.
CO4: To carry out basic conversions from non-spatial to spatial formats.
CO5: To create a map layout with all essential cartographic elements in GIS environment.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1						3					1	1		
CO2	1	2	3	3	3	3			2		2	3		1
CO3						3					1	1		
CO4	2	2	3	3	2	1					1	1		
CO5	1	2	3	3	3	3			2		2	3		1

Syllabus

Unit 1
Geospatial in Day to Day Life, Spatial thinking, Evolution of location technology and importance of geography and maps. Need for spatial information, Terminologies, logic, language and formats of spatial technology. Location perspective of construction industry, Overview of Geospatial technology in tenders, Design and execution and Construction lifecycle management.
Fundamentals and components of Geospatial Engineering, Surveying and Conventional survey equipment Vs Modern surveying equipment Components. Advanced geospatial solutions, Overview of components, working and signal structure of Global navigation System. Codes, Phase and Phase modulation, Pseudo range and carrier phase measurements. Error sources, methods, and benefits of GNSS, Single and double differencing, Applications and Processing of GNNS data.

Unit 2
Scanning and Remote Sensing Technologies,3D scanning, Sensors and its types, Principles and the science behind photogrammetry, LiDAR, RADAR and SONAR. Overview and working of various platforms. Demo of Terrestrial Lidar Equipment, Demo of Bathymetry, Demo of Ground Penetrating RADAR. Application of sensors & platforms. Basics of GIS, vector & raster data models, Types and components of a Map. Hardware for GIS, DEM and TIN Data products and attributes, Basic GIS data conversions, conversions from non-spatial formats to spatial formats. Demo of Conversion of Excel to GIS, Demo of Conversion of CAD TO GIS, Demo of Downloading and Georeferencing Toposheets. GIS database management – RDBMS, SQL, Creation, configuration, and enterprise Geodatabase.

Unit 3
Application of GIS - Spatial Analysis, Catchment Area delineation, Overlay Analysis, Cluster Analysis, Hotspot Analysis, Viewshed Analysis. Future Trends of Geospatial Technologies. Case Study 1 -Benefit Realization - Case Study 2 Advancements in Modern Survey & Mapping Technologies, Advancements in Spatial Analytics – Geo Intelligence, Future Trends, Geospatial

Technology - Way Forward

Textbooks/Reference books:

1. Lillesand, Kiefer and Chipman, “Remote Sensing and Image Interpretation”, Wiley student edition, 2015.
2. A.M.Chandra and S.K. Gosh, “Remote Sensing and GIS”, Alpha Science , 2015.
3. Anji Reddy, “Remote sensing and Geographical systems”, BS Publications, 2012.
4. LRA Narayana, “Remote Sensing and its applications”, Universities Press, 1999
5. Wurbs, R.A., and James, W.P., “Water Resources Engineering”, Pearson Education India, 2015.
6. M G Srinivas (Edited by), “Remote sensing applications”,Narosa Publishing House, 2001.
7. Michael N. Demers, “Fundamentals of geographic information system”, Wiley student edition, 2012.

Evaluation Pattern

Assessment	Internal	End Semester
Mid term	30	
*Continuous Assessment (CA)	30	
End Semester		40

•CA – Can be Quizzes, Assignment, Projects, and Reports

HYDRAULICS & WATER RESOURCES ENGINEERING

23CIE441	GROUND WATER HYDROLOGY	L-T-P-C: 3-0-0-3

Prerequisite(s): 23CIE 213 Hydraulic Engineering

Course Objectives

Introduce to the groundwater system
To explain the basic principles and movement of ground water
To elaborate the use of groundwater flow properties in the well design

Course Outcome

CO1: Understand the basics of groundwater and analyse movement of groundwater in aquifer.
CO2: Estimate the aquifer parameters and groundwater resources for different hydro-geological boundary conditions
CO3: Comprehend the types, design principles and construction of wells.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1										1		
CO2	3	1										1		
CO3	3	1	3									1		

Syllabus

Unit 1
Occurrence of ground water: origin - rock properties affecting ground water vertical distribution - geologic formations as aquifers -types of aquifers - aquifer parameters-ground water basins - springs - Laplace equation - potential flow lines - flownet – flownet for anisotropic soils- seepage under a dam - groundwater contours- determination of flow direction- steady unidirectional flows in aquifers- confined and unconfined - aquifer with percolation- steady radial flow towards a well- well in uniform flow - steady flow with uniform discharge- partially penetrating wells- steady flow in leaky aquifer.

Unit 2
Unsteady flow-general equation- Cartesian and polar coordinate- unsteady radial flow in to a well - confined, unconfined and leaky aquifers -–multiple well system - pumping tests - non equilibrium equation for pumping tests - Thies' method - Jacob method - Chow's method -characteristics well losses –step draw down test- well near aquifer boundaries -determination of boundaries from pumping test. Image wells for various boundary conditions-Cavity well and open well- yield tests-pumping and recuperation test.

Unit 3
Tube wells: design - screened wells - gravel packed wells - well loss-selection of screen size - yield of a well - test holes - well logs - methods of construction - dug wells -shallow tube wells - deep wells - gravity wells - drilling in rocks - screen installation - well completion - well development - testing wells for yield - collector - orradial wells - infiltration galleries - well point system - failure of tube wells
Ground water investigation methods.

Text book(s)

Raghunath, H.M., "Ground Water", New Age International, 2007.
Karanth, K. "Groundwater Assessment, Development and Management", Tata McGraw Hill, 2003.

Reference(s)

Todd, D.K. and Mays.L.W., "Ground Water Hydrology", Wiley India, 2011.
Garg S.P., "Ground Water and Tube wells", Oxford & IBH, 1993.
Raghunath H. M., "Hydrology : Principles, Analysis and Design", New Age International Publishers, 2006.

23CIE442	WATER RESOURCES SYSTEMS PLANNING AND DESIGN	L-T-P-C:3-0-0-3

Prerequisite(s): 23CIE 213 Hydraulic Engineering

Course Objectives

To impart the knowledge about planning, design, and operation of water resources systems using mathematical optimization methods and models.
Exposure to the basic economic analysis and operations research techniques to develop the solutions for various surface and groundwater resources allocation decision making.

Course Outcome

CO1: Understand the water resources systems and express it using mathematical models.
CO2: Formulate and solve various optimization models of water resources planning and management problems.
CO3: Identify the advantages and limitations of various modeling methods and algorithms used in water resources planning and management.
CO4: Use the simulation and optimization models for planning and management decision making

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3										3		
CO2	3	2										3	2	
CO3	2		3									3	2	
CO4	3	3	2	3								3	3	

Syllabus

Unit 1
Water systems engineering –scope and approach.
Issues and the systems planning approach- water system dynamics- water resource development alternatives – Water systems planning objectives- Constraints and Criteria – Economic and Econometric principles
Hydrologic input analysis, Demand analysis, System elements & Subsystem planning - Stochastic planning and management - Design and management issues.

Unit 2
Optimization methods and their application in Water resources systems. Linear programming and Dynamic programming models. Problem formulation for water resources systems – Multi objective planning – Large scale system analysis- Case studies.

Unit 3
Ground water system planning – Conjunctive surface and groundwater development- Hierarchical approach- Water quality management planning- Regional planning- Policy issues.

Reference(s)

Vedula S. and Mujumdar P P, "Water Resources Systems: Modelling techniques and analysis", Tata – McGraw Hill, 2007.
S K Jain, V P Singh, "Water Resources Systems Planning and Management", Elsevier Science, 2003
Maass. A. et.al., "Design of Water Resources Systems", Harvard University Press 2013.
M. C. Chathurvedi , "Water Resources Systems: Planning & Management", Tata McGarw Hill Publications, 1987.
Louks D P et.al, "Water Resources System Planning and Management: An introduction to methods, models and applications", UNESCO, Paris, 2017.
Goodman. A.S. and Major. D.C.,"Principles of Water Resources Planning", Prentice Hall, 1984.

24CIE431 HYDROPOWER AND IRRIGATION ENGINEERING L-T-P-C: 2-1-0-3

Course Objectives
To introduce fundamentals of hydropower and estimation of waterpower potential.
To impart the concepts of irrigation engineering and irrigation system design.

Course outcomes
CO1: Learn the hydrologic analysis relevant for hydropower project planning.
CO2: Estimation of waterpower potential.
CO3: Learn the basics of irrigation engineering.
CO4: Learn the design basics of surface irrigation systems.

CO-PO Mapping

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO														
CO1	2	2										2		
CO2	3	3	2	2								2		
CO3	3	3	2	2								2		
CO4	2	2										2		

Syllabus
Unit 1
Waterpower - Introduction, sources of energy, role of hydropower in a power system.
Estimation of Waterpower Potential - Flow duration curves of gauge and ungauged streams, load curve, load factor, capacity factor, utilization factor, diversity factor, load duration curve, firm power, secondary power, prediction of load.
Types of Hydro-power Plants - Run of river plants, general arrangement of run of river plants, valley dam plants, diversion canal plants, high head diversion plants, storage and pondage, pumped storage power plants.
Penstocks – classification, design criteria, economical diameter. Intakes – losses, power channels. Turbines – types. Water hammer and surges

Unit 2
Introduction - objectives of irrigation, type of irrigation and suitability; selection of irrigation method. Irrigation requirement, water balance, soil water relationships, water storage zone, infiltration. Flow of moisture through root zone, soil physical and chemical properties, crop evaporative and drainage requirements, irrigation efficiency and uniformity.

Unit 3
Surface irrigation systems, types of surface systems, basin irrigation, border irrigation, furrow irrigation, field measurement techniques, flow measurement, flumes, weirs, irrigation events, advance, wetting, depletion and recession phases.
Infiltration, infiltrometer, ponding methods, soil water, tensiometers, neutron probe, time domain reflectometer, evapotranspiration, crop coefficient, leaf area index, FAO guidelines on evapotranspiration estimation.
Fundamentals of surface irrigation hydraulics, continuity equation, momentum equation.

Textbooks
Das, M.M., Saikia, M.D., “Irrigation and Water Power Engineering”, PHI Learning, 2009
Dandekar, M.M., and Sharma, K.H., "Water Power Engineering", Vikas Publishing House Pvt. Ltd., 2000
Majumdar, D.K., “Irrigation Water Management”, PHI Learning, 2009
Michael, A.M., "Irrigation: Theory and Practice", Vikas Publishing House, 1978

Reference Books
Norwegian Institute of Technology: Hydropower Development: Vols. 3, 4, 5 & 6, Division of Hydraulic Engineering, 1992
Walker, W.R., and Skogerboe, G.V., "Surface Irrigation Theory and Practice", Prentice Hall, INC., 1987

Evaluation Pattern

Assessment component	Theory Courses
Continuous Assessment (Quiz,Assignment,Seminar, Project etc)	30
Mid Term Exam	30
End semester/Project	40

PROFESSIONAL ELECTIVE COURSES (Without Prerequisites/open to all)

23CIE451	ENVIRONMENTAL IMPACT ASSESSMENT	L-T-P-C: 3-0-0-3

Prerequisite(s): Nil

Course Objectives

To highlight the evolution of Environmental impact assessment methods
To introduce the Impact assessment methods for various projects
To explain the various components for preparing the EIA document

Course Outcome

CO1: Understand the background of Environmental impact assessment in US and India

CO2: Analyze the factors and perform Impact assessment methods for various projects including water, power related projects

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1				3		2		2		
CO2	3	3	3	1	3	2			2				2	

Syllabus

Unit 1

Concept of environment, Concept of environmental impact, Environmental impact assessment (EIA) – definitions, terminology and overview, Evolution of EIA in the USA, Key features of the National Environmental Policy Act and its implementation and the Council on Environmental Quality (CEQ) guidelines, Role of the USEPA, Evolution of EIA in India, Sustainable development, Generalised EIA process flow chart, Screening, Initial environmental examination (IEE), Scoping, Public participation.

Unit 2

Environmental baseline, Impact assessment methods – checklists – matrices - quantitative methods – networks - overlay mapping. Introduction to impact prediction and evaluation, Factors to be considered while assessing the impacts of water related projects, power projects, waste water treatment facilities etc. Major features of the EIA notification in India, Present status and procedures of EIA in India.

Unit 3

Prediction and assessment of impacts of developmental activities on surface water, land and soil, groundwater, air, biological environment etc.

Prediction and assessment of visual impacts, Socioeconomic impact analysis, Evaluation of alternatives, Preparing the EIA document, Environmental impact statement (EIS), Environmental monitoring, Environmental audit (EA).Case studies.

Reference(s)

Larry W Canter, Environmental Impact Assessment, McGraw Hill, Inc, 1995.
Betty Bowers Marriot, Environmental Impact Assessment: A Practical Guide, McGraw Hill, Inc, 1997.
Barrow, C. J., Environmental and Social Impact Assessment – An Introduction, Edward Arnold, 1997.
Evan. K. Paleologos and Ian Lerche, Environmental Risk Analysis, McGraw Hill Inc, 2001.
Peter Morris (ed.) and Riki Therivel (ed.), Methods of Environmental Impact Assessment, Routledge, 2001.
UNEP, Environmental Impact Assessment Training Resource Manual, 2002.
Website of the Ministry of Environment and Forests, Govt. of India and the USEPA.

23CIE452	REMOTE SENSING & GIS	L-T-P-C: 3-0-0-3

Course Objectives

Explain the basic concepts of Remote Sensing and EM Spectra and the different types of satellite and sensors.
Expose to the concepts of Photogrammetry and its applications
Illustrate Energy interactions (with atmosphere and surface features) and Interpretation of satellite images
Explain different components of GIS and its applications
Develop knowledge on using GIS data and working with GIS software.

Course Outcome

CO1: Understand principles and identify the components of remote sensing and EMR.
CO2: Schematize the process of data acquisition of satellite images and their characteristics
CO3: Understand the principles and identify the components of Photogrammetry and Thematic maps
CO4: Visualize the Remote sensing digitally with digital image processing techniques.
CO5: Apply Remote sensing and GIS in different engineering contexts

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3									1			
CO2	3	3	1		2						1			
CO3	3	3									1			
CO4	3			2							1			
CO5				2	3	2			1		2	2		

Syllabus

Unit 1
Introduction, Basic concepts and principles of remote sensing; Definition components of remote sensing- energy sensor, interacting body – active and passive remote sensing – platforms - EMR interaction with earth surface material, radiance, irradiance, incident, reflected, absorbed and transmitted energy – reflectance – specular and diffused reflection surfaces – spectral signature – spectral signature curves – EMR interaction with water, soil and earth surface. Application; Meteorology, land use, networking, hydrological studies, soil studies and coastal zone analysis.

Unit 2
Photogrammetry; Aerial and Terrestrial; photo interpretation. Sensors; Radar imaging; colour scanners; thematic mapper. Geographic information system – components of GIS – hardware, software and organisational context – data – spatial and non-spatial maps – types of maps – projection- types of projection – data input- digitiser, scanner, editing – raster and vector data structures – comparison of raster and vector data structure.

Unit 3

Analysis using raster and vector data – retrieval, reclassification, overlaying, buffering - data output – printers and plotters. Open source software's.GIS and remote sensing applications – urban applications – water resources – urban analysis – watershed management – resources information system – hazard mitigation.

Text book(s)

Lillesand, Kiefer and Chipman, "Remote Sensing and Image Interpretation", Wiley student edition, 2015.
A.M.Chandra and S.K. Gosh, "Remote Sensing and GIS", Atlantic, 2008.

Reference(s)

Anji Reddy, "Remote sensing and Geographical systems", BS Publications, 2012.
LRA Narayana, "Remote Sensing and its applications", Universities Press, 1999
J.V.S.Murthy, "Watershed management", New Age International, 1998.
Wurbs, R.A., and James, W.P., "Water Resources Engineering", Pearson Education India, 2015.
M G Srinivas (Edited by), "Remote sensing applications",Narosa Publishing House, 2001.
Burrough P A., "Principles of GIS for land resource assessment", Clarendon Press, 1994.
Michael N. Demers, "Fundamentals of geographic information system", Wiley student edition, 2012.

Verticals

Construction Engineering and Management - Vertical

1. Concrete technology
2. Sustainable construction – Materials & Methods*
3. Architectural science
4. Formwork Engineering & practices
5. Construction Equipment and Techniques
6. Construction Economics and finance
7. Quality control and safety management in construction
8. BIM for Construction management

*Course is offered in Sustainability Vertical also

Tentative structure (As per proposed 2023 B. Tech curriculum)

Semester 6	2 electives	Concrete technology (Vertical core) Sustainable construction – Materials & Methods (Vertical core)
Semester 7	3 electives	Architectural science Formwork Engineering & practices (or) Construction Equipment and Techniques Construction Economics and finances (or) Quality control and safety management in construction
Semester 8	1 elective	BIM for Construction management (Project oriented course)

23CIE361	CONCRETE TECHNOLOGY	L-T-P-C: 3-0-0-3

Prerequisite(s): 23CIE204 Construction Engineering Materials & Methods

Course Objectives

To highlight the fundamental concepts and behavioural aspects of various materials in concrete, types of concrete and their manufacture and applications.
To introduce concrete mix proportioning for various conditions using Indian standards and ACI standards

Course Outcome

CO1: Select the suitable ingredients for concrete and suggest suitable laboratory test to check its property.
CO2: Evaluate the properties of ordinary concrete and special concrete based on the destructive and non -destructive tests.
CO3: Evaluate durability related issues in concrete and suggest preventive measures.
CO4: Apply the modern methods in concrete manufacturing
CO5: Proportion the concrete mixtures to meet performance requirements.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	2			2					1			3
CO2	1	1	1			1					1			3
CO3	2	1	2			1					1			3
CO4		1	1			2					1	2		3
CO5	2	2	2			2					2	2		3

Syllabus

Unit 1
Materials: cement - different types - chemical composition and physical properties - tests on cement - I.S. specifications - aggregates - classification - mechanical properties and tests as per I.S. - alkali aggregate reaction - grading requirements - heavy weight - light weight - normal weight - aggregate - sampling of aggregate - water - quality of water - admixtures - accelerators - retarders - water reducing agents – super plasticizers- use of silica fumes
Properties of fresh concrete - workability - factors affecting workability - tests for workability - segregation and bleeding.

Unit 2
Properties of hardened concrete - factors affecting strength of concrete - strength of concrete in compression, tension and flexure - stress- strain characteristics and elastic properties - shrinkage and creep - durability of concrete - permeability - chemical attack - sulphate attack - resistance to abrasion and cavitation - resistance to freezing and thawing - resistance to fire - marine atmosphere - quality control - frequency of sampling - test specimens - statistical analysis of test results - standard deviation - acceptance criteria
Manufacture of concrete - measurement of materials - storage and handling - batching plant and equipment - mixing - types of mixers - transportation of concrete - pumping of concrete - placing of concrete - under water concreting - compaction of concrete - curing of concrete - ready mixed concrete

Unit 3

Mix proportioning - nominal mixes - design mixes - factors influencing mix design - A.C.I method - I.S method - design for high strength mixes.

Special concretes - lightweight concrete - high density concrete - vacuum concrete - shotcrete - Fibre reinforcedconcrete-polymer concrete - ferrocement - high performance concrete - self compacting concrete.

Introduction to Non-destructive test methods.

Text book(s)

Neville.A.M. and Brooks.J.J., "Concrete Technology", Pearson Education, 2006.

Santha Kumar, A. R., "Concrete Technology", Oxford University Press,2018.

Reference(s)

Mehta, P.K. and Monteiro, P.J.M., "Concrete - Microstructure, Properties and Materials", McGraw Hill Education, 2017.

Shetty, M. S, "Concrete Technology-Theory and Practice", S. Chand & Co., New Delhi, 2018.

A.M. Neville, "Properties of Concrete", Pearson Education, 2012.

23CIE371	SUSTAINABLE CONSTRUCTION-MATERIALS & METHODS	L-T-P-C: 3-0-0-3

Prerequisite(s): 23CIE204 Construction Engineering - Materials and Methods

Course Objective

- To expose the students to the concepts of sustainability in the context of building and engineered building materials
- Exposing the student to concepts of embodied and operational energy, minimizing energy consumption

Course Outcome

CO1: Apply the principles of sustainable design for site assessment and development
CO2: Analyze sustainable construction practices related to design decisions
CO3: Assess building energy issues and suggest design options
CO4: Propose strategies for water conservation and ensuring proper indoor air quality

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	1			3						2		3
CO2	2	3	1			3						2		3
CO3	2	3	2		2	3						2	2	3
CO4	2	3				3						2		3

Syllabus

Unit 1
Impacts of built environment on natural environment. Site development- site selection, urban heat island, Public Transport, vegetation, development footprint, storm water runoff, solar reflectance index. Materials and Resources- segregation, recycling, reduction in waste, reuse of materials and building, renewability. Features of sustainable building materials and sustainable alternatives
Cement and carbon emissions, Alternative fuel for cements, alternative cements and cementitious material. Sustainable concrete construction - recycled materials, reducing cement content, improving production processes, designing for longevity, incorporating sustainable additives, water conservation techniques. Smart materials and technologies - Permeable concrete, cool concrete, UHPC, use of PCM

Unit 2
Sustainability of steel reinforcement and structural steel. Building blocks – different types- insulated precast system - Comparative performances. Wood-plastic composites, Engineered lumber, Bio-based products Construction and Demolition – waste management. Design for deconstruction.
Building energy issues - building energy design strategy. Embodied energy, Operational energy in Building and Life cycle energy. Life cycle assessment- LCC, LCIA - Introduction to different Software packages.

Unit 3
Indoor air quality-Paints, Adhesive and sealants for use in building, Volatile organic content (VOC) emission issues and indoor air quality for Sustainability and Health hazard. Construction operations – site planning, air quality during construction
Built environment hydrologic cycle – water resources issues – strategies for conservation and recycling – waste water and storm water handling strategies.
Integrated design approach - Ecological design concepts. Green building evolution and Different phases of Green building project management- Building assessment and eco labels – standards (LEED, GRIHA).

Text Book

"Sustainable Building Design Manual- Volume II", Published by TERI, New Delhi, 2009.

Reference(s)

Kibert, C.J., "Sustainable Construction: Green Building Design and Delivery", John Wiley & Sons, 2016.
Gajanan M. Sabnis "Green Building with Concrete: Sustainable Design and Construction", CRC Press, 2015.
Sandy Halliday, "Sustainable Construction", Routledge, (Taylor & FrancisGroup), 2013.
Dejan Mumovic and Mat Santamouris (Ed), "A Handbook of Sustainable Building Design and Engineering", CRC Press, 2018..
Osman Attmann, "Green Architecture: Advanced Technologies and Materials", Mc-Graw Hill, 2010.

23CIE372	Architectural Science	L-T-P-C: 3-0-0-3

Prerequisite(s): 23CIE204 Construction Materials &

MethodsCourse Objectives

To highlight the basic concepts of architectural composition in the development of built environment.
To expose the students to the concepts of functional design of buildings in tropical climates.
To assess comprehension of the course through case studies

Course Outcome
CO1: Apply knowledge of architectural design principles to critically evaluate building form and space
CO2: Apply knowledge of thermo-physical properties of materials in evaluating heat flow through buildings
CO3: Evaluate quality of indoor climate based on thermal comfort indices and suggest control methods
CO4: Evaluate the natural and artificial lighting of indoor spaces
CO5: Apply knowledge of behavior sound in free field and enclosures to analyze acoustical features.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2						1			1		1
CO2	3	3				2						1	1	2
CO3	3	3	2			1			1			2		2
CO4	3	3	2			1			1			1		2
CO5	3	3	2									1		1

Syllabus

Unit 1

Principles of architectural design: Factors influencing architectural development-examples. Primary elements – Form and Space.
Organizing principles in architecture – symmetry – hierarchy – axis, linear, concentric, radial – asymmetric grouping-Primary and secondary masses. Principles of architectural composition – unity – balance- proportion – scale – rhythm – harmony – contrast.
Role of colour, texture, shapes/forms in architecture. Forms related to materials and structural systems. Architecture as part of the environment.

Unit 2
The Thermal Environment: Climatic elements: classification of climates. Earth'sthermal balance. Thermal balance of human body – thermal comfort indices – comfort zone.
Thermo-physical properties of building materials: resistance and transmittance - solar gainfactor. Heat flow through buildings – thermal transmittance of structural elements - periodic heat flow. Sun-building relationship.
Design criteria for control of climate – passive and active approaches.

Unit 3

The Luminous Environment: Types of visual tasks – principles of day lighting – day light factor - evaluation of lighting by windows, skylights. Artificial lighting – illumination requirements –lamps and luminaries. Design ofartificial lighting – Lumen method – Point by point method.
The Sonic Environment: Physics of sound – airborne and structure borne propagation –behavior of sound in free field and enclosures – design criteria for spaces – acoustical defects – sound reduction,sound insulation and reverberation control – acoustic materials – types and fixtures.

Potential case studies

Critical review based on architectural design principles - ancient/monumental/modern buildings
Case study on thermal or visual comfort audit for a commercial/office building
Exposure to Energy simulation tools

Text book(s)

Francis D.K.Ching, "Architecture-Form, Space and Order", John Wiley NP, 2015
Steven V. Szokolay., "Introduction to Architectural Science - The Basis of Sustainable Design", Routledge,2014.

Reference(s)

Muthu Shobha Mohan, "Principles of Architecture", Oxford University Press, 2006.
Koenigseberger., "Manual of Tropical housing and Building – Climatic Design", Universities Press, 2010.
Bureau of Indian standards, Handbook on Functional Requirement of Buildings – SP:41(S and T) – 1987
Krishnan, "Climate Responsive Architecture", McGraw Hill Education, 2017.

23CIE368	CONSTRUCTION EQUIPMENT AND TECHNIQUES	L-T-P-C: 2-1-0-3

Course Objectives

To provide insight into functions and operations of different construction equipment.
To provide exposure to the maintenance and safety of equipment during construction.

Course Outcome

CO1: Explain the working principles of construction equipment.
CO2: Ability to select appropriate equipment for earth moving, tunneling, concreting, mining and quarrying
CO3: Assess equipment performance and implement maintenance practices.
CO4: Apply safety norms during equipment utilization

CO-PO Mapping

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO														
CO1	3	3										2		
CO2	3	3								1		3		3
CO3	3	3			1					2		1		2
CO4	3	3				2				2		1		1

Syllabus

Unit 1
Basics and Hydraulics of Construction Equipment:
Introduction to Construction Equipment- Functions, Operations of Construction Equipment- Introduction to Four & Two Stroke Engine and their components- Introduction and Components to Automobiles. Introduction to Principles of Hydraulic- Calculation of Pressure, Force & Flow- Components of a Hydraulic System- Basic layout of Hydraulic System- Applications of Hydraulics- Strand Jack Operation

Unit 2
Concreting, Earth Moving, Road Making and Quarry/Mining Equipment:
Operations of a Batching Plant - Introduction and Components of Concrete Pump & Placer- Concrete Pipeline- Laying and Cleaning- Bulldozer- Classification and Components- Classification, Components and Attachments of Excavator- Backhoe Loader- Classification & components- Introduction and classification to Hot mix Plant- Process of Asphalt Paver-PQC Paver- Classification & Components- Motor Grader- Classification & Components- Horizontal Movement Vehicles- Quarry/Mining.
Tunnelling Equipment / Piling Equipment:
Introduction to Tunnel Boring Machines- Details and Operation of a Hard-Rock TBM- Details of Earth Pressure Balance (EPB) TBM- Details and operation of Slurry TBM & Components- Hydraulic Grabs- Piling Rig.

Unit 3
Equipment Life Cycle Management:
Life Cycle of an Equipment- Equipment Performance Parameters - Introduction to Maintenance- Types of Maintenance- Maintenance Practices
Mechanization and Digitalisation in Construction and Safety in Construction Equipment:
Importance of Digital Analytics- Digital Solution in Construction Projects- Importance of Mechanisation - Railway Track Construction- Rebar Processing Machine- Operation of Mechanised Equipment- Introduction to 3D Concrete Printer- Importance of Safety- Various PPE & Purpose- Safety of Men & Machines at Work- Safety During Construction Activities- Safety with Tools & Tackles.

TEXT BOOKS/ REFERENCES

1. R.L.Peurifoy, C.J. Schexnayder, R.L.Schmitt. and A.Shapira, Construction Planning, Equipment, and Methods, McGraw Hill Education, 2018.

2. F. Harris, Modern Construction and Ground Engineering Equipment and Methods, Second Edition, Longman, London, 1994.

3. D.G. Gransberg, C.M. Popescu and R.C. Ryan, Construction Equipment Management for Engineers, Estimators, and Owners, CRC Press, 2006.

4. D.A.Day and N.B.H. Benjamin, Construction Equipment Guide, Second Edition, Wiley, New Jersey, 1991.

5. J.E.Schaufelberger andG.C.Migliaccio, Construction Equipment Management, Routledge, 2019

23CIE369	FORMWORK ENGINEERING PRACTICES	L-T-P-C: 2-1-0-3

Course Objectives

- To give an exposure on the basic concepts, types and parameters to be considered for the selection of formwork
- To give an overview on recent advancements in formwork.
- To explain the special formworks and its selection criteria.

Course Outcome

CO1: Understand different types of formwork and prepare the configurations.
CO2: Design formwork and do the quantity take off
CO3: Identify special formwork for various applications.
CO4: Understand basics of scaffolding and apply in field conditions

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2										1		2
CO2	3	3	3									1		3
CO3	3	3		1	1							1		3
CO4	3	3										1		3

Syllabus

Unit 1
Introduction and Basics of Formwork - General Objectives, Classification, Benefits, Areas of competitiveness, Selection of Formwork, Selection of Materials, Materials, Accessories and Consumables, Application of Tools.
Types of Formwork – Formwork for Foundation, Wall, Columns, Slab and Beam. Conventional Drawings, Vertical Application of Conventional Foundation Formwork, Formwork System – Components, Assembly, De-shuttering, Flex System, Heavy Duty Tower System, Safety of Work, Formwork for Stairs, Load Bearing Tower.
Formwork Planning and Monitoring- Configuration, Scope, Strategy & Costing of Formwork, Productivity.

Unit 2
Design Concepts in Formwork - Design Loads, Pressures on Concrete, Design Methods & Assumptions.
Formwork Design - Vertical & Horizontal Applications – concepts, Slab Design, wall formwork, Checks. Formwork Drawing Concept and Preparation Guidelines, General Layout and Detailed Drawings, BOQ Calculation and Checklist.
Formwork Quantity take off and Cost Estimation - schedule of formwork, Mobilization distribution, BOQ, Quantity Calculation, Cost optimization. BIM for planning operations.
Modular Formwork – Introduction, Advantages and Limitations, Vertical and Horizontal Application, Shuttering & De-shuttering, Application, Aluminum formwork - Drawings & Components, Activities.

Unit 3
Special Formwork and Various Applications - Tunnel formwork, 3D design Details, High rise construction, Various climbing system, Table lifting system, Bridge construction systems, Project Application.
Building and Erecting Using the Formwork and Formwork Failures - Formwork Assembly for Wall & Column Panels, Stop end & Box outs., Equipment and Layout, Formwork Erection and Safety, Inspection and Corrections, Plant and Machinery, Codal and Contractual Requirements.

Basics of Scaffolding- 'Modular scaffold Installation sequence, Tie and material specification, 'Ladder safety, Loading Classification, application, 'Components of LTMS, 'Access scaffold Do's and Don'ts. Innovation and Global practices.

TEXT BOOKS/ REFERENCES:

1. Kumar NeerajJha, *Formwork for concrete structures*, McGraw Hill Education, 2017.
2. Austin, C.K., *Formwork for Concrete*, Cleaver -Hume Press Ltd., London, 1996.
3. Hurd, M.K., *Formwork for Concrete*, Special Publication No.4, American Concrete Institute, Detroit, 2005
4. Concrete Formwork Systems – Awad. Hanna- University of Wisconsin –Copy right Marcel Dekkel Inc.
5. *Formwork – A guide to Good Practice* –Concrete Society –U.K 2nd Edition 1995
6. Robert L. Peurifoy and Garold D. Oberlender, *Formwork For Concrete Structures*, McGraw -Hill , 2010.
7. Tudor Dinescu and Constantin Radulescu, *Slipform Techniques*, Abacus Press, Turn Bridge Wells, Kent, 1984.

23CIE365	CONSTRUCTION ECONOMICS AND FINANCE	L-T-P-C: 3-0-0-3

Prerequisite(s): 23CIE313 Construction Management

Course Objective

To expose the students to the concepts of construction finance such as comparing alternatives proposals, evaluating alternative investments, cost estimating and management of accounting.

Course Outcome

CO1: Apply time-value of money concept to compare alternatives
CO2: Analyse equipment cost and replacement alternatives.
CO3: Prepare different types of cost estimates
CO4: Understand the financial management procedures and estimate the financial ratios

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3								2				3
CO2	3	3								2				2
CO3	2	3								2				2
CO4	3	3								2				3

Syllabus

Unit 1
Engineering economics : Basic principles – Time value of money, Quantifying alternatives for decision making, Cash flow diagrams, Equivalence- Single payment in the future (P/F, F/P), Present payment compared to uniform series payments (P/A, A/P), Future payment compared to uniform series payments (F/A, A/F), Arithmetic gradient, Geometric gradient. Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value.

Unit 2
Comparison of alternatives: Present, future and annual worth method of comparing alternatives, Rate of return, Incremental rate of return, Break-even comparisons, Capitalized cost analysis, Benefit-cost analysis.
Depreciation, Inflation and Taxes
Equipment economics: Equipment costs, Ownership and operating costs, Buy/Rent/Lease options, Replacementanalysis.

Unit 3
Cost estimating: Types of Estimates, Approximate estimates – Unit estimate, Factor estimate, Cost indexes, Parametric estimate, Life cycle cost.
Financial management: Construction accounting, Chart of Accounts, Financial statements – Profit and loss,Balance sheets, Financial ratios, Working capital management.

Text book(s)
Bose, D. C., "Fundamentals of Financial management", 2nd ed., PHI, New Delhi, 2011.
Prasanna Chandra, "Projects: Planning, Analysis, Selection, Financing, Implementation and Review", McGraw-Hill Education, 2019.

Reference(s)
Gould, F. E., "Managing the Construction Process", 4th ed., Pearson Education, 2012.
Harris, F. , McCaffer, R. and Edum-Fotwe, F., "Modern Construction Management", 6th ed., Wiley India, NewDelhi, 2012.
Jha, K. N., "Construction Project Management, Theory and Practice", Pearson, New Delhi, 2015.
Peurifoy, R. L. and Oberlender, G. D., "Estimating Construction Costs", 6th ed., McGraw-Hill, 2015.

23CIE373	QUALITY CONTROL AND SAFETY IN CONSTRUCTION	L-T-P-C: 3-0-0-3

Course Objective

- To highlight the fundamental concepts of Quality control, Quality assurance, and Total quality management
- To introduce the tools used in Construction Quality management
- To highlight the fundamental concepts of Construction Safety management

Course Outcome

CO1: Recognise and examine the quality control management concepts
CO2: Maintain the records of quality assurance processes and audits
CO3: Recognise and examine the construction safety management.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3								2				3
CO2	3	3								2				2
CO3	2	3								2				2

Syllabus

Unit 1
Introduction to quality; Importance of quality; Quality transition - quality control and inspection, quality assurance, total quality management; Evolution of quality management; Planning and control of quality during design of structures.

Unit 2

Tools and techniques for quality management; Inspection of materials and machinery; Quality assurance in construction; Systems quality management; Quality standards/codes in design and construction; (ISO:9000); Total quality management (TQM) - principles, tools and techniques.

Unit 3

Introduction to safety; Safety and health programs in construction industry; Planning for safety provisions; Analysis of construction hazards and accidents; Construction hazards and safety guidelines; Prevention techniques for construction accidents; Safety requirements for scaffolding; Site management with regard to safety recommendations; Training for safety awareness and implementation; Construction safety and health manual.

TEXT BOOKS/ REFERENCES:

1. Dale B. G, *Managing Quality*,Sixth Edition, John Wiley & sons, Inc., 2016.
2. Reese. C.D and Eidson J.V, *Handbook of OSHA Construction Safety and Health,* Second Edition, CRC Press, Boca Raton, 2006.
3. Reese, Charles D..*Occupational Safety and Health: Fundamental Principles and Philosophies*. United States, CRC Press, 2017.
4. Jimmie W. Hinze "*Construction Safety*", Prentice Hall of India, 1997.
5. Harris .F, McCaffer .R and Edum-Fotwe .F, *Modern Construction Management*, Sixth Edition, Blackwell Publishing, Oxford, 2006.
6. Holt S. J, *Principles of Construction Safety*, Blackwell Publishing, Oxford, 2008.

23CIE374	BIM for Construction Management	L-T-P-C: 2-0-3-3

Course Objectives

- To highlight the use of BIM models based on real-world construction projects
- To explain the modelling and analysis using BIM software.
- To give an overview of clash detection and avoidance using BIM
- To give an exposure on BIM 4D and 5 D models.

Course Outcome

CO1: Create BIM model for effective coordination during planning, design and execution.
CO2: Identify clash and avoid it's occurrence.
CO3: Apply the concept of BIM 4D for project scheduling
CO4: Apply the concept of 5D BIM for quantity takeoff and estimation

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3		3	1				2	2		3	2
CO2	3	2	3		3					3	2		3	3
CO3	3	2	3		3					3	2		3	3
CO4	3	2	3		3					3	3		3	3

Syllabus

Unit 1

Building Information Modeling – Introduction & Process, Evolution of BIM, BIM Model -of various buildings like Commercial & Residential, WTP, Transportation, Airports. Isometric View – Introduction, Examples and Problems. 3D Modeling, Design Authoring – Workflow, Discipline Based Modeling, Architectural, Engineering Analysis, Structural Analysis, HVAC, Electrical, Plumbing, Energy Analysis, Lighting Analysis, Design Review. Views in Model, Visualization Modes, Walkthrough & Fly through the Model, Layers & Properties, AR, VR & MR.

Unit 2

Clash Check, Types of Clashes, Federated Model - Clash avoidance process, Clash Detection Process – Introduction, Clash Detection - Priority Matrix, Clash Detection – Rules, Clash Detection – Report, Clash Detection – Grouping, Clash Detection - Roles & Responsibilities, Clash Detection Process – Demo. CDE, Level of Development (LOD)- Level of Detail & Level of Information, LOD - for all elements- Chart & Matrix

Unit 3

Project Schedule, 4D BIM Modeling, Construction Analysis, 3D Control & Planning, BIM for Safety, Disaster & Risk Analysis, Digital Fabrication, Phase Planning, As-built/Record Models. 5D BIM and Quantity Take off with UOM, Exercise & Demo, Quantity Take Off, 5D – Estimation and Analysis, Cost Control, Asset Information Model, COBie and Deliverables, Space Attributes, Asset Attributes and Asset requirement, Infrastructure System, Information Exchange with Facility Management.
Industrialization of Construction through BIM – DfMA, IoT in BIM, Data analytics using AI and ML, Smart Infrastructure, Digital Twin –Connected Infrastructure.

TEXT BOOKS / REFERENCES:

1. Karen Kensek and Douglas Noble, Building Information Modelling: BIM in Current and Future Practice Wiley; 1st edition (15 August 2014)
2. Andre Borrmann, Markus Konig, Christian Koch, JakobBeetz, Building Information Modelling, Springer 2015
3. Rafael Sacks, Chuck Eastman, Ghang Lee, Paul Teicholz , BIM Handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers, Wiley; 3rd edition (2 October 2018)
4. ISO 19650 – 2018 Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM)

Sustainability - Vertical

1. Introduction to sustainability
2. Sustainable material management
3. Functional efficiency in buildings
4. Water Conservation and Sustainability
5. Sustainable Environmental Management
6. Sustainable Transportation
7. Socio-economic Sustainability
8. Capstone project on sustainable practices

Tentative structure (As per proposed 2023 B.Tech curriculum)

Semester 6	2 electives	Introduction to sustainability (Compulsory) Sustainable material management (Compulsory)
Semester 7	3 electives	Functional efficiency in buildings (Compulsory) Water Conservation and Sustainability (Elective) Sustainable Environmental Management (Compulsory) Sustainable Transportation (Elective) Socio-economic Sustainability (Elective)
Semester 8	1 elective	Capstone project on sustainable practices (Compulsory)

23CIE461	INTRODUCTION TO SUSTAINABILITY	L-T-P-C:3-0-0-3

Course Objectives:

- To build a foundation on the concept of sustainable development and to gain an empirical understanding of the emerging global challenges for sustainable environmental and societal governance systems

Course Outcome

CO1	To build basic understanding of sustainability and its needs
CO2	To understand the global efforts for sustainable development
CO3	To be aware of different laws pertaining to sustainability
CO4	Introduction to building design aspects from sustainability point of view

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1						3	2	1			3			
CO2						3	2	1						
CO3						3	2							
CO4	2					3				3		3		3

Unit 1

Sustainability- Definition- Necessity- Global energy scenario- Indian energy scenario- Three pillars- contribution of each- UNSDGs-17 goals of sustainability – no poverty- zero hunger- good health and well-being- Quality Education- Gender Equality-Clean Water and Sanitation- Affordable and Clean Energy-Decent Work and Economic Growth- Industry, Innovation, and Infrastructure- Reduced Inequalities- Sustainable Cities and Communities- Responsible Consumption and Production- Climate Action-Life Below Water- Life on Land- Peace, Justice and Strong Institutions- Partnerships– Green technologies- Renewable energy- hurdles in implementations

Unit 2

Environmental laws in India- History of environmental laws in India- The Wildlife (Protection) Act, 1972- The Water (Prevention and Control of Pollution) Act, 1974- The Air (prevention and control of pollution) act, 1981- The Environment (Protection) Act, 1986: The ozone-depleting substances (regulation and control) rules, 2000.- Coastal Regulation zone notification 2018- The energy conservation act, 2001- Biological diversity act 2002 - Scheduled Tribes and Other traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (FRA)- The National Green Tribunal Act, 2010- Compensatory Afforestation Fund Act, 2016

Unit 3

Green buildings, Selection of site – preservation and planning Impacts of built environment on natural environment. Site development- site selection, urban heat island, Public Transport, vegetation, development footprint, stormwater runoff, solar reflectance index - Influence of climate on buildings, Basics of climatology, Earth – Sun relationship, Solar angles, and sun path diagram- orientation of buildings- Introducing ECBC-Design of shading systems

Textbooks

Kerr, Julie, "Introduction to energy and climate: Developing a sustainable environment", CRC Press, 2017.
V. R. Krishna Iyer, "Environmental Protection and Legal Defence", Sterling Publishers, 1992
Kibert, C.J., "Sustainable Construction: Green Building Design and Delivery", John Wiley & Sons, 2013.
P. Leelakrishnan, "Environmental Law in India Paperback – 1" LexisNexis, 2010

References

Elliott, Jennifer, "An Introduction to Sustainable Development", 4th Ed. Routledge, London, 2012

23CIE462	SUSTAINABLE MATERIAL MANAGEMENT	L-T-P-C:3-0-0-3

Prerequisite(s): 23CIE204 Construction Engineering - Materials and Methods

Course Objectives:

- To expose the students to the concepts of sustainability in the context of building and conventional engineered building materials, such as Concrete, Bricks, and achieving the same through lower Carbon cements, Superior brick kilns and Recycled aggregate minimizing consumption of natural resources including water. VOC and indoor air quality.

- Exposing the student to concepts of embodied, Operational and Life Cycle Energy, Minimizing Energy consumption by optimal design, use of BIPV. The course also intend to make student aware of ECBC, LEED, GRIHA etc

Course Outcome

CO1	To be able to design by reducing usage of Cement portion in different activities
CO2	To have general understanding of impacts of constructional materials and their energy consumption in production
CO3	To be aware different management perspective for sustainable construction
CO4	To conduct LCA and have knowhow of Green certification

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		2				3						3		
CO2		2		2		3								
CO3						3				3				
CO4		3		3	3	3				3	3	3	3	3

Syllabus

Unit 1

Materials and Resources- segregation, recycling, reduction in waste, reuse of materials and building, renewability- Role of Material: Carbon from Cement, alternative cements and cementitious material, Alternative fuel for cements for reduction in carbon emission. Sustainability issues for concrete- Role of quality, minimization of natural resource utilization, High volume fly ash concrete, geo-polymer concrete etc. concrete with alternative material. Reduction in water consumption in concrete, Recycled aggregate, Energy for grinding and crushing of cement aggregate etc. Smart materials and technologies - Permeable concrete, cool concrete, Ultra-High Performance Concrete, 3D printing, use of PCM

Unit 2

Clay Bricks, Types kilns, Comparative energy performance emission performance and financial performance- Sustainability of steel reinforcement and structural steel. Building blocks – different types- insulated precast system - Comparative performances- Wood-plastic composites, Engineered lumber, Bio-based products Construction and Demolition – waste management. Design for deconstruction. Indoor air quality-Paints, Adhesive and sealants for use in building, Volatile organic content (VOC) emission issues and indoor air quality for Sustainability and Health hazard

Unit 3

Features of sustainable building materials and sustainable alternative- Integrated design approach, Green building evolution and Different phases of Green building project management- Building energy issues - building energy design strategy. Embodied energy, Operational energy in Building and Life cycle energy. Life cycle assessment- LCC, LCEA, LCIA- Introduction to different Software packages. - Certifications – Green Pro-FSC-Eco Mark-EPD-CRI Green Label Plus-Green Seal-BEE Star Label-Water Sense-Green Guard: Rating systems – IGBC, GRIHA, LEED, BREEAM.

Textbooks

Neville.A.M. and Brooks.J.J., "Concrete Technology", Pearson Education, 2006. Santha Kumar, A. R., "Concrete Technology", Oxford University Press, 2018.

Newman, J. and Choo, Ban Sang, Advanced Concrete Technology-Processes, 1 st Edition, Elsevier, 2003

Kubba, S, LEED Practices, Certification, and Accreditation Hand book, 1st ed. Elsevier, 2010.

Minsitry of Power, Energy Conservation Building Code 2018, Revised Version, Bureau of Energy Efficiency, 2018,

Architectural Energy Corporation, Building Envelope Stringency Analysis, International Institute for Energy Conservation, 2004

References

Mehta, P.K. and Monteiro, P.J.M., "Concrete - Microstructure, Properties and Materials", McGraw Hill Education, 2017.

Shetty, M. S, "Concrete Technology-Theory and Practice", S. Chand & Co., New Delhi, 2018.

Chani, P. S., Najamuddin., and Kaushik, S.K. "Comparative Analysis of Embodied Energy Rates for Walling Elements in India". Energy and Buildings., 84, 47- 50. 2003

Andrew, H., Buchanan., and Brian, G. "Energy and carbon dioxide implications of building construction", Energy and Buildings., 20, 205-217. 1994

Sartori, I., and Hestnes, A. G. "Energy use in the life cycle of conventional and low-energy buildings: A review article", Energy and Buildings., 20, 249-257.2007

Green Building Basics, California Integrated Waste Management Board (www.ciwmb.ca.gov/GREENBUILDING/Basics.htm#What)

Huberman, N., Pearlmutter, D. "A life-cycle energy analysis of building materials in the Negev desert".b Energy and Buildings., 40 ,837-848.2007.

Catarina Thormark. "A low energy building in a life cycle—its embodied energy, energy need for operation and recycling potential", Building and Environment., 37, 429-435.2001.

23CIE463	FUNCTIONAL EFFICIENCY IN BUILDINGS	L-T-P-C:3-0-0-3

Prerequisite(s): 23CIE462 Sustainable Materials Management

Course Objectives:

- The course is intended to enhance the students knowledge for designing buildings from perspective of four comforts namely, Thermal, Acoustics, Visual comforts, and Indoor air quality.

Course Outcome

CO1	Understand basics of Thermodynamics and Design for thermal comfort
CO2	Understand basics of Acoustics and Design for Acoustic comfort
CO3	Understand basics of Visual comforts and Design for visual comfort
CO4	To be able to design different buildings with proper ventilations

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2		3		3	3						3		3
CO2	2		3		3	3						3		3
CO3	2		3		3	3						3		3
CO4	2		3		3	3						3		3

Syllabus

Unit 1

Thermal comfort- Basics of Thermodynamics, Conduction, Convection or radiation heat transfer, Heat gain through various elements of a building – Design considerations from IGBC, ECBC & SP41- COMSOL introduction Acoustics – Building acoustics, measures, defects and prevention of sound transmission

Unit 2

Visual comfort -Enhancement strategies for Daylighting and Artificial lighting- Glazing materials- Daylight apertures – Light Shelves. Energy efficiency – Energy efficiency in building envelope, energy simulation,– lighting and renewable energy. Energy Audit. LCEA - Energy performance certification of buildings. Energy management system Energy intelligent building. Design considerations from IGBC, ECBC & SP41

Unit 3

Ventilation and Air Quality – Effects, design consideration- flow rate needed -Design of HVAC systems. Design of Energy Efficient Buildings for Various Zones - Design criteria for control of climate – passive approach. Active systems – Insulation materials - low energy cooling. Design considerations from IGBC, ECBC & SP41

Textbooks

Francis D.K.Ching, "Architecture-Form, Space and Order", John Wiley NP, 2015
Steven V. Szokolay., "Introduction to Architectural Science - The Basis of Sustainable Design", Routledge, 2014.
Author Marshall Long, "Architectural Acoustics-Applications of modern acoustics"Elsevier, 2005

References

Muthu Shobha Mohan, "Principles of Architecture", Oxford University Press, 2006.
Koenigseberger., "Manual of Tropical housing and Building – Climatic Design", Universities Press, 2010.
Bureau of Indian standards, Handbook on Functional Requirement of Buildings – SP:41(S and T) – 1987
Krishnan, "Climate Responsive Architecture", McGraw Hill Education, 2017

23CIE464	WATER CONSERVATION AND SUSTAINABILITY	L-T-P-C:3-0-0-3

Prerequisite(s): 19CIE314 Hydrology and Water Resources Engineering

Course Objectives:

- This course provides ways to manage and sustain water systems for built environment and ecosystems.

Course Outcome

CO1	To manage the water for human and natural uses.
CO2	To design and evaluate sustainable water systems
CO3	To employ modelling, demand-supply management and water accounting to evaluate case studies

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		3	3	1				2					2	
CO2	3	2	3		2				1	1		1		
CO3	3	2	3	1		2							2	

Syllabus

Unit 1: Introduction - Principles of Ecology - Ecosystems - Overview of water resources, concepts and principles of sustainability for freshwater systems, issues and challenges in water resources management, humans and water, sustainable development and water

Unit 2: Balancing the diverse needs for water - Cities and towns, urban environment – water supply, sanitation, sustainable development goals, water-wise cities, sustainable urban water systems- Resource crisis - Water, Energy, Food and other resources - Case studies.

Unit 3:Designing water systems - Sustainable water infrastructure planning, trade-offs, Integrated water resources management, water governance, partnership for sustainable water management - case studies

Textbooks

1. *Daniel P. Loucks, Eelco van Beek, "Water Resources Systems Planning and Management: An introduction to methods, models and applications". Springer Nature jointly published with Deltares and UNESCO-IHE, 2017.*
2. *Ramesha Chandrappa and Diganta B. Das, "Sustainable Water Engineering: Theory and Practice". Wiley, 2014*

References

1. *P D Sharma, "Ecology and Environment", Rastogi Publications, 2011.*
2. *Peter P. Mollinga, Ajaya Dixit, and Kusum Athukorala, "Integrated Water Resources Management: Global Theory, Emerging Practice and Local Needs". Sage India, 2006.*
3. *Meir Russ, "Handbook of knowledge management for sustainable water systems". Wiley_Blackwell, 2018*
4. *X.C.Wang and G. Fu, "Water-wise cities and sustainable water systems: concepts, technologies and applications". IWA Publishing, 2021*

23CIE465	SUSTAINABLE ENVIRONMENTAL MANAGEMENT	L-T-P-C:3-0-0-3

Prerequisite(s): 23CIE302 & 23CIE311 Environmental Engineering I and II

Course Objectives:

- To create general awareness of the current status of Environmental problems.
- Students will be getting broad perspective of the sustainable concepts, technologies and practices related to Environmental problems.
- The students will be capable of understand and conduct Environmental impact assessment (EIA) with case studies

Course Outcome

CO1	Understand the impact of humans on environment and related Environmental problems
CO2	To analyze the sustainable concepts, technologies and practices related to Environmental problems
CO3	To understand and perform the Environmental Impact Assessment (EIA)

CO-PO Mapping

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO														
CO1		3	3	1				2					2	
CO2	3	2	3		2				1	1		1		
CO3	3	2	3	1		2							2	

Syllabus

Unit 1

Introduction to Sustainable Engineering - Ecosystem - Biodiversity – Natural design philosophies. Current environmental problems and practices of pollution abatement Major Environmental Issues - Climate change, Ozone depletion, Resource crisis – case studies

Unit 2

Sustainable resource management - Water and Wastewater treatment and reuse - Emerging contaminants, impact, and adaptation/mitigation solutions • Land contamination and remediation - Resource conservation and recovery Ecological - Carbon and Ecological Footprint analysis- Open loop - closed loop systems - case studies. Sustainable concepts, technologies and practices - Climate mitigation and adaptation strategies - way forward green technologies.

Unit 3

Environmental Regulations- Life cycle analysis (LCA) - Design for Environment - Industrial Ecology - Symbiosis - case studies- Environmental impact assessment (EIA) - Environmental impact assessment (EIA) – Role of the USEPA, Evolution of EIA in India, Sustainable development, Generalised EIA process flow chart, Screening, Initial environmental examination (IEE), Scoping, Public participation. - Environmental baseline, Impact assessment methods- Introduction to impact prediction and evaluation, Major features of the EIA notification in India, Environmental Impact Statement (EIS), Environmental monitoring, Environmental Audit (EA) - LCA -case studies

Textbook:

1. *G.T. Miller Jr., "Environmental Science", 13th Edition, Cenage Learning India Pvt. Ltd., 2010.*

References:

1.Gilbert Masters, "Introduction to Environmental Engineering and Science" Prentice Hall, New Jersey, 3rd Edition.

2.P. Aarne Vesilind, Susan M. Morgan, "Introduction to Environmental Engineering" by, Belmont, CA : Thomson/ Brook/ Cole, c2004, 3rd Edition.

3. Peavy, H.s, Rowe, D.R, Tchobanoglous, G. "Environmental Engineering", Mc-Graw - Hill International Editions, New York, Indian Edition,2017

4. Tchobanoglous, Theissen& Vigil, "Integrated Solid Waste Management". McGraw Hill Publication, Indian edition

5. R. Rajagopalan "Environmental Studies-From Crisis to Cure", Oxford University Press.

6. Benny Joseph "Environmental Studies", Tata McGraw-Hill Publishing Company Limited, 2017

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23CIE466	SUSTAINABLE TRANSPORTATION	L-T-P-C:3-0-0-3

Prerequisite(s): 23CIE462 Sustainable Materials Management

Course Objectives:

- To impart knowledge and skills of environmental issues related to transportation systems, sustainability, and related issues. The course includes the various environmental aspects of mass rapid transportation systems, air quality management through transportation planning in mega cities and current case studies regarding the same.

Course Outcome

CO1	To impart knowledge and skills of environmental issues related to transportation systems, concept of sustainability and related issues
CO2	To understand the mass rapid transportation systems, air quality management through transportation planning
CO3	To gain knowledge on pavement life cycle assessment

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2		3		3						2		3
CO2	1	2		3		3						2	2	3
CO3	1	1		1		3				3		2		2

Syllabus

Unit 1
Land-use plans, zoning schemes and provisions- Urban and regional transport planning- Impacts on humans, flora and fauna, soil, water, air, climate and landscape- Establishment of baseline conditions w.r.t soil, water and air quality

Unit 2
Modelling of impacts and scenario-based analysis - Assessment of potential project impacts including indirect, cumulative and synergistic impacts - Decision support systems for EIA of transport infrastructures - Abatement measures

Unit 3
Sustainable transportation systems - Pavements- Sustainable construction of roads using geotextiles- Design – Construction – Use – Pavement Life Cycle Assessment- Case studies of highway, railway and airport projects, OpenLCA tool for life Cycle Assessment, STAN for material flow analysis Reclaimed asphalt pavements- Pervious pavement

Textbooks
Vanek, Francis M., Largus T. Angenent, James H. Banks, Ricardo A. Daziano, and Mark A. Turnquist, "Sustainable Transportation Systems Engineering" McGraw-Hill, 2014
Preston L Schiller, Jeffrey R Kenworthy, "An Introduction to Sustainable Transportation: Policy, Planning and Implementation", Routledge Publisher, 2010

References
Jeffrey Tumlin,"Sustainable Transportation Planning: Tools for Creating Vibrant, Healthy, and Resilient Communities", Wiley Publication,2012
Fengxiang Qiao, Yong Bai, Pei-Sung Lin, Steven I Jy Chien, Yongping Zhang, Lin Zhu,. "Resilience and Sustainable Transportation Systems", ASCE Book theories,2020

23CIE467	SOCIO-ECONOMIC SUSTAINABILITY	L-T-P-C:3-0-0-3

Course Objectives:

- Two of the three pillars of sustainability are Social and economic prosperity. Sustainable Development Goals (SDGs) highlight the importance of poverty reduction, and call for policy implementation that leads to the socio-economic development of impoverished people. This course provides different aspects for the betterment of society

Course Outcome

CO1	To understand social responsibility for sustainable future
CO2	To understand the public administration policies for susatainability
CO3	To gain knowledge on Sustainable Economic Development

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1				2		3	3				3			
CO2						3	3			3	3			
CO3						3	3			3	3			3

Syllabus

Unit 1

Concepts of Social Entrepreneurship and Creating Shared Value- Strategic corporate social responsibility, double-bottom-line business, social enterprise-social business- Social impact measurement- Partnership management- Open-source model- Social movement strategy- Leadership vs. Management Embedded strategy - Congruence model analysis - Organizational change stages - Focused vs. dispersed scope of social innovation programs - Concepts of business ethics - Ethical principles - Moral relativism - Moral responsibility - Moral development

Unit 2

Introduction to Public Administration and Policy:-The distinctive characteristics of public organizations - The traditional public administration model - The New Public Management model - Public sector reforms - Ethics and accountability in the public sector - Crisis management - The policy cycle - The politics of public policy - Theories of policy learning - Public policy analysis - Comparative public policy

Unit 3

Introduction to Law & Economics; The Big Picture Case for Sustainability- Introduction to Law & Economics; Introduction to US Legal System and Environmental Laws- Introduction to EU Legal System and Environmental Laws- Environmental Crimes and Criminal Enforcement- Economics of Sustainability and Environmental Protection- ASEAN Legal Frameworks, Sustainable Development, and Environmental Protection- Introduction to Corporate Governance and CSR- Sustainability and Sustainable Economic Development; Prosperity within Global and Ecological Limits- Sustainable Cities and Urbanization- Law & Economics Approach to Property Law- Valuation, Environmental Services, and Internalizing All Costs of Pollution- Law & Economics Approach to Tort Law- Law & Economics Approach to Contract Law

Textbooks

Haroon A. Khan, "An Introduction to Public Administration", University Press of America , 2008
Robert Cooter & Thomas Ulen, "Law and Economics", Pearson, 2016
Hal Taback, Ram Ramanan , "Environmental Ethics and Sustainability", CRC Press, 2013
Mark Ryan, "Environmental Ethics and Sustainability: The Precautionary Ecosystem Health Principle (Values and Identities: Crossing Philosophical Borders)", Rowman & Littlefield, 2016

References

Josef Wieland, "Creating Shared Value – Concepts, Experience, Criticism", Springer, 2017

23CIE468	CAPSTONE PROJECT ON SUSTAINABLE PRACTICES	L-T-P-C:0-1-6-3

Prerequisite(s): Minimum of 5 Course from Sustainability

Course Objectives:

- To improve the understanding on the sustainability approach in the selected domain by handling relevant practical problems through proper guidance and make them confident after the completion of the course.

Course Outcome

CO1: Apply the acquired knowledge in sustainability to make preliminary investigations and do functional and/or design of the facility.
CO2: Estimate the material and/or cost requirement involved in a project.
CO3: Address the relevant sustainable goal, environmental / social / economic aspect through the project
CO4: Present the project with clarity, following ethical norms in oral and written mode

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3								3	3	3
CO2										3			3	3
CO3					3	3	3	3			3			3
CO4							3	3	3		3			

Students are required to conceive a problem related to sustainability in their interested domain. At the end of the course, each student should submit a complete report on the selected project consisting of the data given, the design calculations, specifications if any and complete set of drawings, which follow the design.
Project based on all the topics studied in previous subjects

Courses offered under the framework of

Amrita Values Programmes I and II

22AVP201 Message from Amma's Life for the Modern World

Amma's messages can be put to action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enriched by Amma's guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.

22ADM211 Leadership from the Ramayana

Introduction to Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Relevance of Ramayana for modern times.

22ADM201 Strategic Lessons from the Mahabharata

Introduction to Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance - Relevance of Mahabharata for modern times.

22AVP204 Lessons from the Upanishads

Introduction to the Upanishads: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, SatyakamaJabala, Aruni, Shvetaketu.

22AVP205 Message of the Bhagavad Gita

Introduction to Bhagavad Gita – Brief storyline of Mahabharata - Context of Kurukshetra War – The anguish of Arjuna – Counsel by Sri. Krishna – Key teachings of the Bhagavad Gita – Karma Yoga, Jnana Yoga and Bhakti Yoga - Theory of Karma and Reincarnation – Concept of Dharma – Concept of Avatar - Relevance of Mahabharata for modern times.

22AVP206 Life and Message of Swami Vivekananda

Brief Sketch of Swami Vivekananda's Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message from Swamiji's life.

22AVP207 Life and Teachings of Spiritual Masters India

Sri Rama, Sri Krishna, Sri Buddha, AdiShankaracharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri RamanaMaharshi, Mata Amritanandamayi Devi.

22AVP208 Insights into Indian Arts and Literature

The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre.

22AVP209 Yoga and Meditation

The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali's Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

22AVP210 Kerala Mural Art and Painting

Mural painting is an offshoot of the devotional tradition of Kerala. A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

22AVP213 Traditional Fine Arts of India

India is home to one of the most diverse Art forms world over. The underlying philosophy of Indian life is 'Ṹnity in Diversity" and it has led to the most diverse expressions of culture in India. Most art forms of India are an expression of devotion by the devotee towards the Lord and its influence in Indian life is very pervasive. This course will introduce students to the deeper philosophical basis of Indian Art forms and attempt to provide a practical demonstration of the continuing relevance of the Art.

22AVP214 Principles of Worship in India

Indian mode of worship is unique among the world civilizations. Nowhere in the world has the philosophical idea of reverence and worshipfulness for everything in this universe found universal acceptance as it in India. Indian religious life even today is a practical demonstration of the potential for realization of this profound truth. To see the all-pervading consciousness in everything, including animate and inanimate, and constituting society to realise this truth can be seen as the epitome of civilizational excellence. This course will discuss the principles and rationale behind different modes of worship prevalent in India.

22AVP215 Temple Mural Arts in Kerala

The traditional percussion ensembles in the Temples of Kerala have enthralled millions over the years. The splendor of our temples makes art enthusiast spellbound, warmth and grandeur of color combination sumptuousness of the outline, crowding of space by divine or heroic figures often with in vigorous movement are the characteristics of murals.

The mural painting specially area visual counterpart of myth, legend, gods, dirties, and demons of the theatrical world, Identical myths are popular the birth of Rama, the story of Bhīma and Hanuman, Shiva, as Kirata, and the Jealousy of Uma and ganga the mural painting in Kerala appear to be closely related to, and influenced by this theatrical activity the art historians on temple planes, wood carving and painting the architectural plane of the Kerala temples are built largely on the pan-Indians almost universal model of the Vasthupurusha.

22AVP218 Insights into Indian Classical Music

The course introduces the students into the various terminologies used in Indian musicology and their explanations, like Nadam, Sruti, Svaram – svara nomenclature, Stayi, Graha, Nyasa, Amsa, Thala,- Saptatalas and their angas, Shadangas, Vadi, Samavadi, Anuvadi. The course takes the students through Carnatic as well as Hindustani classical styles.

22AVP219 Insights into Traditional Indian Painting

The course introduces traditional Indian paintings in the light of ancient Indian wisdom in the fields of aesthetics, the Shadanga (Sixs limbs of Indian paintings) and the contextual stories from ancient texts from where the paintings originated. The course introduces the painting styles such as Madhubani, Kerala Mural, Pahari, Cheriyal, Rajput, Tanjore etc.

22AVP220 Insights into Indian Classical Dance

The course takes the students through the ancient Indian text on aesthetics the Natyasastra and its commentary the AbhinavaBharati. The course introduces various styles of Indian classical dance such as Bharatanatyan, Mohiniyatton, Kuchipudi, Odissy, Katak etc. The course takes the students through both contextual theory as well as practice time.

22AVP221 Indian Martial Arts and Self Defense

The course introduces the students to the ancient Indian system of self-defense and the combat through various martial art forms and focuses more on traditional Kerala's traditional KalariPayattu. The course introduces the various exercise technique to make the body supple and flexible before going into the steps and techniques of the martial art. The advanced level of this course introduces the technique of weaponry.

PROFESSIONAL ELECTIVES UNDER SCIENCE STREAM

CHEMISTRY

23CHY240	COMPUTATIONAL CHEMISTRY AND MOLECULAR MODELLING	L-T-P-C: 3-0-0-3

Course Outcomes:

CO1: Get to understand the structure of molecules using symmetry.
CO2: Understanding Quantum mechanical approach to calculate the energy of a system.
CO3: Applying mathematical knowledge and quantum mechanical approach in finding out the characteristics-reactivity, stability, etc., of the molecule.
CO4: To get a brief idea about molecular mechanics based chemical calculations.CO5: To get an idea about general methodology of molecular modeling.

Syllabus

Unit 1
Introduction: Stability, symmetry, homogeneity and quantization as the requirements of natural changes - Born - Haber cycle – Energetic – kinetics - Principles of spectra.

Computational techniques: Introduction to molecular descriptors, computational chemistry problems involvingiterative methods, matrix algebra, Curve fitting.

Molecular mechanics: Basic theory - Harmonic oscillator – Parameterization - Energy equations - Principle ofcoupling - Matrix formalism for two masses - Hessian matrix - enthalpy of formation - enthalpy of reactions.

Introduction to Quantum mechanics - Schrodinger equation - Position and momentumMO formation - Operators and the Hamiltonian operator - The quantum oscillator Oscillator Eigen value problems - Quantum numbers - labeling of atomic electrons.

Unit 2
Molecular Symmetry: Elements of symmetry - Point groups - Determination of point groups of molecules.

Huckel's MO theory: Approximate and exact solution of Schrodinger equation - Expectation value of energy - Huckel's theory and the LCAO approximation - Homogeneous simultaneous equations - Secular matrix - Jacobi method - Eigen vectors: Matrix as operator - Huckel's coefficient matrix - Wheeland's method - Hoffmann's EHTmethod - Chemical applications such as bond length, bond energy, charge density, dipole moment, Resonance energy.

Unit 3
Self consistent fields: Elements of secular matrix - Variational calculations - Semi empirical methods - PPP self consistent field calculation - Slater determinants - Hartree equation - Fock equation – Roothaan - Hall equation - Semi empirical models and approximations.

Ab-initio calculations: Gaussian implementations – Gamess - Thermodynamic functions - Koopman's theorem - Isodesmic reactions, DFT for larger molecules - Computer aided assignments/mini projects with softwares - Introduction to HPC in Chemical calculations.

Molecular modelling software engineering - Modeling of molecules and processes
Signals and signal processing in Chemistry - QSAR studies and generation of molecular descriptors - Applications of chemical data mining - Familiarization with open source softwares useful for molecular modeling - Introduction tomolecular simulation - M.D. simulation.

TEXTBOOKS:

1. *K. I. Ramachandran, G Deepa and K Namboori, "Computational Chemistry and Molecular Modeling - Principles and Applications", Springer-Verlag, Berlin, Heidelberg, 2008, ISBN-13 978-3-540-77302-3.*
2. *Donald W Rogers, "Computational Chemistry Using PC", Wiley, (2003).*
3. *Alan Hinchliffe, "Chemical Modeling from atoms to liquids", Wiley, (2005).*

REFERENCES:

1. *James B Forseman and Aeleen Frisch-Gaussian, "Exploring Chemistry with Electronic Structure Method", Inc., Pittsburgh, PA, 2nd edition, (2006).*
2. *A C Philips, "Introduction to Quantum mechanics", Wiley, (2003).*
3. *Wolfram Koch, Max C. Holthausen, "A Chemist's guide to Density Functional Theory", Wiley, VCH, 2nd edition, (2001).*

23CHY241	ELECTROCHEMICAL ENERGY SYSTEMS AND PROCESSES	L-T-P-C: 3-0-0-3

Course Outcomes:

CO1: Understand the fundamental concepts of electrochemistry through electrode potential and reaction kinetics
CO2: Learn the application of the electrochemical principles for the functioning and fabrication of industrial batteries and fuel cells
CO3: Acquire knowledge in solving numerical problems on applied electrochemistry
CO4: Analysis and practical problem solving in fabrication of batteries and fuel cells
CO5: Application of concepts and principle in industrial electrochemical processes
CO6: Evaluation of comprehensive knowledge through problem solving

Syllabus

Unit 1
Background Theory: Origin of potential - electrical double layer - reversible electrode potential - standard hydrogen electrode - emf series - measurement of potential - reference electrodes (calomel and silver/silver chloride) indicatorand ion selective electrodes - Nernst equation - irreversible processes - kinetic treatment - Butler- Volmer equation -Overpotential, activation, concentration and IR overpotential - its practical significance - Tafel equation and Tafelplots - exchange current density and transfer coefficients.

Unit 2
Batteries: Primary batteries: The chemistry, fabrication and performance aspects, packing classification and rating of the following batteries: (The materials taken their function and significance, reactions with equations, their performance in terms of discharge, capacity, and energy density to be dealt with). Zinc-carbon (Leclanche type), zinc alkaline (Duracell), zinc/air, zinc-silver oxide batteries; lithium primary cells - liquid cathode, solid cathode and polymer electrolyte types and lithium-ferrous sulphide cells (comparative account).

Secondary batteries: ARM (alkaline rechargeable manganese) cells, Lead acid and VRLA (valve regulated (sealed)lead acid), nickel-cadmium, nickel-zinc, nickel- metal hydride batteries, lithium ion batteries, ultra thin lithium polymer cells (comparative account). Advanced Batteries for electric vehicles, requirements of the battery - sodium-beta and redox batteries.

Unit 3
Reserve batteries and Fuel cells: Reserve batteries - water activated, electrolyte activated and thermally activated batteries - remote activation - pyrotechnic materials. Fuel Cells: Principle, chemistry and functioning - carbon, hydrogen- oxygen, proton exchange membrane (PEM), direct methanol(DMFC), molten carbonate electrolyte (MCFC) fuel cells and outline of biochemical fuel cells.
Electrochemical Processes: Principle, process description, operating conditions, process sequence and applications of Electroforming – production of waveguide and plated through hole (PTH) printed circuit boards by electrodeposition; Electroless plating of nickel, copper and gold; Electropolishing of metals; Anodizing of aluminium; Electrochemical machining of metals and alloys.

TEXTBOOKS:

1. *Derek Pletcher and Frank C. Walsh, "Industrial Electrochemistry", Blackie Academic and Professional, (1993).*
2. *Dell, Ronald M Rand, David A J, "Understanding Batteries", Royal Society of Chemistry, (2001).*

REFERENCES:

1. *Christopher M A, Brett, "Electrochemistry – Principles, Methods and Applications", Oxford University, (2004).*
2. *Watanabe T, "Nano-plating: microstructure control theory of plated film and data base of plated film microstructure", Elsevier, Oxford, UK (2004).*
3. *Kanani N, "Electroplating and electroless plating of copper and its alloy", ASM International, Metals Park, OH and Metal Finishing Publications, Stevenage, UK (2003).*
4. *Lindon David, "Handbook of Batteries", McGraw Hill, (2002).*
5. *Curtis, "Electroforming", London, (2004).*
6. *Rumyantsev E and Davydov A, "Electrochemical machining of metals", Mir, Moscow, (1989).*

23CHY242	FUELS AND COMBUSTION	L-T-P-C: 3-0-0-3

Course Objectives:

To provide the basic knowledge about fuels, rocket propellants and explosives.

Course Outcomes:

CO1: Understand the types of fuels and variation in their properties
CO2: Able to analyze the fuel content
CO3: Obtain knowledge in identifying a proper fuel as per the requirement
CO4: Ability to know the preparation and working of propellants and explosives

Syllabus

Unit 1
Fuels - Solid fuels - Classification, preparation, cleaning, analysis, ranking and properties - action of heat, oxidation, hydrogenation, carbonization, liquefaction and gasification.

Liquid fuels – Petroleum - origin, production, composition, classification, petroleum processing, properties, testing -flow test, smoke points, storage and handling.

Secondary liquid fuels - Gasoline, diesel, kerosene and lubricating oils. Liquid fuels - refining, cracking, fractional distillation, polymerization. Modified and synthetic liquid fuels. ASTM methods of testing the fuels.

Unit 2
Gaseous fuels - Types, natural gas, methane from coal mine, water gas, carrier gas, producer gas, flue gas, blast furnace gas, biomass gas, refinery gas, LPG - manufacture, cleaning, purification and analysis. Fuels for spark ignition engines, knocking and octane number, anti knock additives, fuels for compression, engines, octane number, fuels forjet engines and rockets.

Flue gas analysis by chromatography and sensor techniques.

Unit 3
Combustion: Stochiometry, thermodynamics. Nature and types of combustion processes - Mechanism - ignition temperature, explosion range, flash and fire points, calorific value, calorific intensity, theoretical flame temperature. Combustion calculations, theatrical air requirements, flue gas analysis, combustion kinetics – hydrogen - oxygen reaction and hydrocarbon - oxygen reactions.

Rocket propellants and Explosives - classification, brief methods of preparation, characteristics; storage and handling.

TEXTBOOK:

1. *Fuels and Combustion, Samir Sarkar, Orient Longman Pvt. Ltd, 3rd edition, 2009.*

REFERENCES:

1. *Fuels - Solids, liquids and gases - Their analysis and valuation, H. Joshua Philips, Biobliolife Publisher, 2008.*
2. *An introduction to combustion: Concept and applications - Stephen R Turns, Tata Mc. Graw Hill, 3rd edition, 2012.*
3. *Fundamentals of Combustion, D P Mishra, 1st edition, University Press, 2010*
4. *Engineering Chemistry - R. Mukhopadhyay and Sriparna Datta, Newage International Pvt. Ltd, 2007.*

23CHY243	GREEN CHEMISTRY AND TECHNOLOGY	L-T-P-C: 3-0-0-3

Course Objectives:

1. Understand the principles of green chemistry and its contribution to the development of sustainable products
2. Possess knowledge of the migration from a hydrocarbon-based economy to carbohydrate-based economy
3. Evaluate the deficiencies of traditional process and acknowledge the invent of new processes
4. Distinctly map the culmination of academic research to industrial chemistry

Course Outcomes:

CO1: Understand the evolving concept of Green Chemistry and its application to the manufacture of sustainable products
CO2: Appreciate the need for Renewable energy and Feed stock along with carbon sequestration through the fundamentals of Green Chemistry Techniques
CO3: Develop a coherence to evaluate systematic deficiencies in traditional Chemical science process and products
CO4: Undertake a purposeful Journey through the microscopic domain of academic research to the macroscopic domain of Industrial chemistry

Syllabus

Unit 1
Our environment and its protection, chemical pollution and environmental regulations, environmental chemistry, pollution prevention strategies, challenges to the sustainability of chemical industry, Pollution Prevention Act 1990,USA, Green Chemistry and its 12 principles, toxicity of chemicals, material safety data sheet (MSDS), concept of zero pollution technologies, atom economy, functional toxicity vs non-functional toxicity, alternative solvents, energy minimization, microwave and sonochemical reactions, renewable feed stock, carbon dioxide as a feed stock.

Unit 2
Greener strategies of the synthesis of ibuprofen synthesis, teriphthalic acid etc. phase behaviour and solvent attributes of supercritical CO2, use of supercritical carbon dioxide as a medium chemical industry, use of ionic liquids as a synthetic medium, gas expanded solvents, superheated water, etc. Synthesis of various chemicals from bio mass, polycarbonate synthesis and CO2 fixation, green plastics, green oxidations, etc.

Unit 3
Processes involving solid catalysts – zeolites, ion exchange resins, Nafion/silica nano composites and enhanced activity. Polymer supported reagents, green oxidations using TAML catalyst, membrane reactors. Green chemistry in material science, synthesis of porous polymers, green nanotechnology.

REFERENCES:

1. *Hand Book of Green Chemistry and Technology; by James Clarke and Duncan Macquarrie; Blakwell Publishing.*
2. *Anastas, P. T., Warner, J. C. Green Chemistry: Theory and Practice, Oxford University Press Inc., New York, 1998.*
3. *Matlack, A. S. Introduction to Green Chemistry Marcel Dekker: New York, NY, 2001.*

23CHY244	INSTRUMENTAL METHODS OF ANALYSIS	L-T-P-C: 3-0-0-3

Course Outcomes:

CO1: To develop an understanding of principle and working of the range of instrumental methods in analytical chemistry
CO2: To provide an understanding and skills in contemporary methods of separation and appropriate selection of instruments for the successful analysis of chemical compounds
CO3: To impart skills in the scientific method of planning, conducting, reviewing, reporting experiments and problem solving in chemical analysis.

Syllabus

Unit 1
Error Analysis and Sampling: Accuracy - Precision - Classification of Errors -Minimization of errors - Standard deviation - Coefficient of variance - F-test - t-test - Significant figures. Sampling - Basis of sampling, Sampling andphysical state - Safety measures of sampling.

Separation Techniques: Brief out line of column, paper and thin layer chromatography - Ion exchange methods - principle and application – HPLC.

Unit 2
Gas chromatography - principle and applications – gel chromatography.

Electroanalytical techniques: Potentiometry - Potentiometric titration - determination of equivalence point - acidbase, complexometric, redox and precipitation titrations - merits and demerits. Voltammetry - Cyclic voltammetry - basic principle and application - Polarography - introduction - theoretical principles - migration current - residual current - half wave potential - instrumentation - analytical applications.

Unit 3
Spectro-chemical techniques: UV-VIS spetrophotometry - principle - Beer's Law application - photometric titration - single and double beam spectrophotometer - instrumentation of IR - sample handling - IR applications - H - NMR - Instrumentation and applications – principle - instrumentation - applications of atomic absorption spectroscopy.

Thermal and Diffraction techniques: Principles and applications of DTG - DTA DSC - X-ray - Electron DiffractionStudies - SEM, TEM.

TEXTBOOKS:

1. *Willard H W, Merritt J R, "Instrumental Methods of Analysis", 6th edition, Prentice Hall, (1986).*
2. *Skoog Douglas A, West Donald, "Fundamentals of Analytical Chemistry", 7th edition, New York Addison, Wesley, (2001).*

REFERENCES:

1. *"Vogel's Textbook of Quantitative Chemical Analysis", 5th edition, ELBS, (1989).*
2. *Kaur. H, "Instrumental Methods of Chemical Analysis", Goel Publisher, (2001).*

23CHY245	BATTERIES AND FUEL CELLS	L-T-P-C: 3-0-0-3

Course Objective:

To provide sound knowledge on the application of electrochemistry in energy storage systems.

Course Outcome

CO1: Understand the fundamental concepts of electrochemistry through electrode potential and reaction kinetics
CO2: Learn the application of the electrochemical principles for the functioning and fabrication industrial batteries and fuel cells
CO3: Analysis of practical problem solving in fabricating batteries and fuel cells
CO4: Evaluation of comprehensive knowledge through problem solving

Syllabus

Unit 1
Background Theory: Origin of potential - electrical double layer - reversible electrode potential - standard hydrogen electrode - emf series - measurement of potential - reference electrodes (calomel and silver/silver chloride) indicatorand ion selective electrodes - Nernst equation - irreversible processes - kinetic treatment - Butler- Volmer equation -Overpotential, activation, concentration and IR overpotential - its practical significance - Tafel equation and Tafelplots - exchange current density and transfer coefficients.

Unit 2
Batteries: Primary batteries: The chemistry, fabrication and performance aspects, packing classification and rating of the following batteries: (The materials taken their function and significance, reactions with equations, their performance in terms of discharge, capacity, and energy density to be dealt with). Zinc-carbon (Leclanche type), zinc alkaline (Duracell), zinc/air batteries; Lithium primary cells - liquid cathode, solid cathode and lithium-ferrous sulphide cells (comparative account).

Secondary batteries: Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultrathin lithium polymer cells (comparative account). Advanced Batteries for electric vehicles, requirements of the battery - sodium-beta and redox batteries.

Unit 3
Fuel Cells: Description, working principle, anodic, cathodic and cell reactions, fabrication of electrodes and other components, applications, advantages, disadvantages and environmental aspects of the following types of fuel cells:Proton Exchange Membrane Fuel Cells, alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells.

Membranes for fuel cells: Nafion – Polymer blends and composite membranes; assessment of performance – recent developments.

Fuels for Fuel Cells: Hydrogen, methane, methanol - Sources and preparation, reformation processes for hydrogen –clean up and storage of the fuels – use in cells, advantages and disadvantages of using hydrogen as fuel.

TEXTBOOKS:

1. *Dell, Ronald M Rand, David A J, 'Understanding Batteries', Royal Society of Chemistry, (2001).*
2. *M. Aulice Scibioh and B. Viswanathan 'Fuel Cells – principles and applications', University Press, India (2006).*

REFERENCES:

1. *Kanani N, 'Electroplating and electroless plating of copper and its alloy', ASM International, Metals Park, OH and Metal Finishing Publications, Stevenage, UK (2003).*
2. *Curtis, 'Electroforming', London, (2004).*
3. *F. Barbir, 'PEM fuel cells: theory and practice', Elsevier, Burlington, MA, (2005).*
4. *G. Hoogers, 'Fuel cell handbook', CRC, Boca Raton, FL, (2003).*

23CHY246	CORROSION SCIENCE	L-T-P-C: 3-0-0-3

Course Outcome:

CO1: Development of skill in identifying the nature and type of corrosion
CO2: Understanding the mechanism of various types of corrosion
CO3: Analysing the problem and find out a solution to combat corrosion in any sort of environment.

CO-PO Mapping

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

Syllabus

Unit 1
Basic principles: Free energy concept of corrosion - different forms of corrosion - Thermodynamic & Kinetic aspects of corrosion: The free energy criterion of corrosion possibility - Mechanism of Electrochemical corrosion - Galvanic and Electrochemical series and their significance.

Corrosion Control: Materials selection - metals and alloys - metal purification - non metallic - changing medium.

Unit 2
Anodic and cathodic protection methods - Coatings - metallic and other inorganic coatings - organic coatings - stray current corrosion - cost of corrosion control methods.

Corrosion protection by surface treatment: CVD and PVD processes - Arc spray - Plasma spray - Flame spray.Corrosion

Inhibitors: Passivators - Vapour phase inhibitor.

Unit 3
Stress and fatigue corrosion at the design and in service condition - control of bacterial corrosion.

Corrosion protection: Automobile bodies – engines – building construction.

TEXTBOOKS:

1. *Fontana and Mars G, "Corrosion Engineering", 3rd edition, McGraw Hill, (1987).*
2. *Uhlig H H and Reviees R W, "Corrosion and its Control", Wiley, (1985).*

REFERENCES:

1. *ASM Metals Handbook, "Surface Engineering", Vol. 5, ASM Metals Park, Ohio, USA, (1994).*
2. *ASM Metals Handbook, "Corrosion", Vol. 13, ASM Metals Park, Ohio, USA, (1994).*
3. *Brain Ralph, "Material Science and Technology", CRC Series, Boston, New York.*

PHYSICS

23PHY240	ADVANCED CLASSICAL DYNAMICS	L-T-P-C: 3-0-0-3

Course Outcomes:

CO1: Able to use the Lagrangian formalism to solve simple dynamical system

CO2: Able to understand Hamiltonian formalism and apply this in solving dynamical systems

CO3: Able to apply Lagrangian formalism in bound and scattered states with specific reference to Kepler's laws and Scattering states

CO4: Able to solve problems in the Centre of Mass frame and connect it to Laboratory Frame of Reference

CO5: Understand and solve problems in rigid body rotations applying of Euler's equations.

CO-PO Mapping

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

Syllabus

Unit 1

Introduction to Lagrangian dynamics

Survey of principles, mechanics of particles, mechanics of system of particles, constraints, D'Alembert's principle and Lagrange's equation, simple applications of the Lagrangian formulation, variational principles and Lagrange's equations, Hamilton's principles, derivation of Lagrange's equations from Hamilton's principle, conservation theorems and symmetry properties.

Unit 2

Central field problem

Two body central force problem, reduction to the equivalent one body problem, Kepler problem, inverse square lawof force, motion in time in Kepler's problem, scattering in central force field, transformation of the scattering to laboratory system, Rutherford scattering, the three body problem.

Rotational kinematics and dynamics

Kinematics of rigid body motion, orthogonal transformation, Euler's theorem on the motion of a rigid body.

Unit 3

Angular momentum and kinetic energy of motion about a point, Euler equations of motion, force free motion of rigid body. Practical rigid body problems. Heavy symmetrical spinning top, satellite dynamics, torque-free motion, stability of torque-free motion - dual-spin spacecraft, satellite maneouvering and attitude control - coning maneuver - Yo-yo despin mechanism - gyroscopicattitude control, gravity- gradient stabilization.

TEXTBOOKS:

1. *H. Goldstein, Classical Mechanics, Narosa Publishing House, New Delhi, 1980, (Second Edition)*
2. *H. Goldstein, Charles Poole, John Safko, Classical Mechanics, Pearson education, 2002 (Third Edition)*
3. *Howard D. Curtis, Orbital Mechanics for Engineering Students, Elsevier, pp.475 - 543*
4. *Anderson John D, Modern Compressible flow, McGraw Hill.*

REFERENCE BOOKS:

1. *D. A. Walls, Lagrangian Mechanics, Schaum Series, McGraw Hill, 1967.*
2. *J. B. Marion and S. T. Thornton, Classical dynamics of particles and systems, Ft. Worth, TX: Saunders, 1995.*

23PHY241	ELECTRICAL ENGINEERING MATERIALS	L-T-P-C: 3-0-0-3

Course Outcomes

CO1: To understand the nature of interaction between atoms in crystalline solid materials that determines their dielectric, magnetic and electrical properties.

CO2: Analyze the relation between the macroscopic dielectric constant and the atomic structure of an insulator.

CO3: Fundamental concepts of magnetic fields required to illustrate the magnetic dipoles. This forms the basis to understand the magnetic properties of dia, para, ferro, antiferro and ferri magnetic materials.

CO4: Fundamentals concerned with conduction mechanism in metals and superconductors.

CO5: Understand the basics for classification of materials based on its conductivity, nature of chemical bonds inSi and Ge, carrier density, energy band structure and conduction mechanism in intrinsic and extrinsic semiconductors.

CO-PO Mapping

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

Syllabus

Unit 1

Conducting materials: The nature of chemical bond, crystal structure Ohm's law and the relaxation time, collision time, electron scattering and resistivity of metals, heat developed in a current carrying conductor, thermal conductivity of metals, superconductivity.

Semiconducting materials: Classifying materials as semiconductors, chemical bonds in Si and Ge and it'sconsequences, density of carriers in intrinsic semiconductors, conductivity of intrinsic semiconductors, carrier densities in n type semiconductors, n type semiconductors, Hall effect and carrier density.

Unit 2

Magnetic materials: Classification of magnetic materials, diamagnetism, origin of permanent, magnetic dipoles in matter, paramagnetic spin systems, spontaneous magnetization and Curie Weiss law, ferromagnetic domains and coercive force, anti ferromagnetic materials, ferrites and it's applications.

Unit 3

Dielectric materials: Static dielectric constant, polarization and dielectric constant, internal field in solids and liquids, spontaneous polarization, piezoelectricity. PN junction: Drift currents and diffusion currents, continuity equation for minority carriers, quantitative treatment of the p-n junction rectifier, the n-p-n transistor.

TEXTBOOK:

1. *A J Decker, "Electrical Engineering materials", PHI, New Delhi, 1957.*

REFERENCES:

1. *A J Decker, "Solid State Physics", Prentice Hall, Englewood Cliffs, N J 1957.*
2. *C Kittel, "Introduction to solid state Physics", Wieley, New York, 1956 (2nd edition).*
3. *Allison, Electronic Engineering materials and Devices, Tata Mc Graw Hill*
4. *F K Richtmyer E H Kennard, John N Copper, "Modern Physics", Tata Mc Graw Hill, 1995 (5th edition).*

23PHY242	PHYSICS OF LASERS AND APPLICATIONS	L-T-P-C: 3-0-0-3

Unit 1

Review of some basic concepts and principle of laser.

Introduction to light and its properties: Reflection, refraction, interference, diffraction and polarization. Photometry – calculation of solid angle. Brewster's law. Snell's law and, its analysis.

Introduction to LASERS: Interaction of radiation with matter - induced absorption, spontaneous emission, stimulated emission. Einstein's co-efficient (derivation). Active material. Population inversion – concept and discussion about different techniques. Resonant cavity.

Unit 2

Properties of LASERS

Gain mechanism, threshold condition for PI (derivation), emission broadening - line width, derivation of FWHM natural emission line width as deduced by quantum mechanics - additional broadening process: collision broadening, broadening due to dephasing collision, amorphous crystal broadening, Doppler broadening in laser and broadeningin gases due to isotope shifts. Saturation intensity of laser, condition to attain saturation intensity.

Properties – coherency, intensity, directionality, monochromaticity and focussibility. LASER transition – role of electrons in LASER transition, levels of LASER action: 2 level, 3 level and 4 level laser system.

Unit 3

Types of LASERS

Solid state LASER: (i) Ruby LASER – principle, construction, working and application. (ii) Neodymium (Nd) LASERS. gas LASER: (i) He-Ne LASER - principle, construction, working and application. (i) CO2 LASER - principle, construction, working and application.

Liquid chemical and dye LASERS. Semiconductor LASER: Principle, characteristics, semiconductor diode LASERS, homo-junction and hetero-junction LASERS, high power semi conductor diode LASERS.

Applications in Communication field:

LASER communications: Principle, construction, types, modes of propagation, degradation of signal, analogue communication system, digital transmission, fiber optic communication.

Applications of LASERS in other fields:

Holography: Principle, types, intensity distribution, applications. laser induced fusion. Harmonic generation. LASER spectroscopy. LASERS in industry: Drilling, cutting and welding. Lasers in medicine: Dermatology, cardiology, dentistry and ophthalmology.

REFERENCES:

1. *William T Silfvast, "Laser Fundamentals", Cambridge University Press, UK (2003).*
2. *B B Laud, "Lasers and Non linear Optics", New Age International (P) Ltd., New Delhi.*
3. *Andrews, "An Introduction to Laser Spectroscopy (2e)", Ane Books India (Distributors).*
4. *K R Nambiar, "Lasers: Principles, Types and Applications", New Age International (P) Ltd., New Delhi.*
5. *T Suhara, "Semiconductor Laser Fundamentals", Marcel Dekker (2004).*

23PHY243	CONCEPTS OF NANOPHYSICS AND NANOTECHNOLOGY	L-T-P-C: 3-0-0-3

Course Outcomes

CO1: Understand, Comprehend and acquaint with concepts of NanoPhysics
CO2: To familiarize the material's property changes with respect to the dimensional confinements.
CO3: Acquire knowledge on the modern preparation process and analysis involved in the nanomaterial's research
CO4: To learn about the technological advancements of the nano-structural materials and devices in the engineering applications

CO-PO Mapping

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

Syllabus

Unit 1 Introduction

Introduction to nanotechnology, comparison of bulk and nanomaterials – change in band gap and large surface to volume ratio, classification of nanostructured materials. Synthesis of nanomaterials - classification of fabrication methods – top down and bottom up methods.

Concept of quantum confinement and phonon confinement

Basic concepts – excitons, effective mass, free electron theory and its features, band structure of solids. Bulk to nano transition – density of states, potential well - quantum confinement effect – weak and strong confinement regime. Electron confinement in infinitely deep square well, confinement in two and three dimension. Blue shift of band gap
- effective mass approximation. Vibrational properties of solids - phonon confinement effect and presence of surfacemodes.

Unit 2

Tools for characterization:

Structural – X-ray diffraction, transmission electron microscope,scanning tunneling microscope, atomic force microscope. Optical - UV – visible absorption and photoluminescence techniques, Raman spectroscopy.

Nanoscale materials – properties and applications:

Carbon nanostructures – structure, electrical, vibration and mechanical properties. Applications of carbon nanotubes

Unit 3

Field emission and shielding – computers – fuel cells – chemical sensors – catalysis – mechanical reinforcement. Quantum dots and Magnetic nanomaterials – applications.

Nanoelectronics and nanodevices:

Impact of nanotechnology on conventional electronics. Nanoelectromechanical systems (NEMSs) – fabrication (lithography) and applications. Nanodevices - resonant tunneling diode, quantum cascade lasers, single electron transistors – operating principles and applications.

TEXTBOOKS:

1. *Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, Nanoscale Science and Technology, John Wiley and Sons Ltd 2004.*
2. *W. R. Fahrner (Ed.), Nanotechnology and Nanoelectronics, Springer 2006.*

23PHY244	PHYSICS OF SEMICONDUCTOR DEVICES	L-T-P-C: 3-0-0-3

Course Outcomes:

CO1: Understand, comprehend and acquaint with the basics working principles and governing equations of electronic devices like diodes, Bipolar junction transistors, Mosfet and heterojunction transistors
CO2: Analyze and Solve physics problems pertaining to various process like charge conduction across semiconductor device.
CO3: Apply the knowledge for the development and design of new methods to determine semiconductor parameters and devices

Syllabus

Unit 1

Introduction: Unit cell, Bravais lattices, crystal systems, crystal planes and Miller indices, symmetry elements. Defects and imperfections – point defects, line defects, surface defects and volume defects

Electrical conductivity: Classical free electron theory – assumptions, drift velocity, mobility and conductivity, drawbacks. quantum free electron theory – Fermi energy, Fermi factor, carrier concentration. Band theory of solids –origin of energy bands, effective mass, distinction between metals, insulators and semiconductors.

Unit 2

Theory of semiconductors: Intrinsic and extrinsic semiconductors, band structure of semiconductors, carrier concentration in intrinsic and extrinsic semiconductors, electrical conductivity and conduction mechanism in semiconductors, Fermi level in intrinsic and extrinsic semiconductors and its dependence on temperature and carrier concentration. Carrier generation - recombination, mobility, drift-diffusion current. Hall effect.

Theory of p-n junctions – diode and transistor:p-n junction under thermal equilibrium, forward bias, reverse bias, carrier density, current, electric field, barrier potential. V-I characteristics, junction capacitance and voltage breakdown.

Unit 3

Bipolar junction transistor, p-n-p and n-p-n transistors: principle and modes of operation, current relations. V-I characteristics. Fundamentals of MOSFET, JFET. Heterojunctions – quantum wells.

Semiconducting devices: Optical devices: optical absorption in a semiconductor, e--hole generation. Solar cells – p-n junction, conversion efficiency, heterojunction solar cells. Photo detectors – photo conductors, photodiode, p-i-n diode. Light emitting diode (LED) – generation of light, internal and external quantum efficiency.

Modern semiconducting devices: CCD - introduction to nano devices, fundamentals of tunneling devices, design considerations, physics of tunneling devices.

TEXTBOOKS:

1. *C Kittel, "Introduction to Solid State Physics", Wiley, 7th Edn., 1995.*
2. *D A Neamen, "Semiconductor Physics and Devices", TMH, 3rd Edn., 2007.*

REFERENCES:

1. *S M Sze, "Physics of Semiconductor Devices", Wiley, 1996.*
2. *P Bhattacharya, "Semiconductor Opto- Electronic Devices", Prentice Hall, 1996.*
3. *M K Achuthan & K N Bhat, "Fundamentals of Semiconductor Devices", TMH, 2007.*
4. *J Allison, "Electronic Engineering Materials and Devices", TMH, 1990.*

23PHY245	ASTROPHYSICS	L-T-P-C: 3-0-0-3

Course Outcomes:

After completion of the course students should be able to
CO1: Get a broad knowledge of scientific and technical methods in astronomy and astrophysics.
CO2: Apply mathematical methods to solve problems in astrophysics.
CO3: Develop critical/logical thinking, scientific reasoning and skills in the area of modern astrophysics.

CO-PO Mapping:

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

Syllabus

Unit 1
Historical introduction: Old Indian and western – astronomy - Aryabhatta, Tycho Brahe, Copernicus, Galileo - Olbers paradox - solar system – satellites, planets, comets, meteorites, asteroids.

Practical astronomy - telescopes and observations & techniques – constellations, celestial coordinates, ephemeris. Celestial

mechanics - Kepler's laws - and derivations from Newton's laws.

Sun: Structure and various layers, sunspots, flares, faculae, granules, limb darkening, solar wind and climate.

Unit 2
Stellar astronomy: H-R diagram, color-magnitude diagram - main sequence - stellar evolution – red giants, white dwarfs, neutron stars, black holes - accretion disc - Schwartzchild radius - stellar masses Saha–Boltzman equation -derivation and interpretation.

Variable stars: Cepheid, RR Lyrae and Mira type variables - Novae and Super novae. Binary and multiple star system - measurement of relative masses and velocities. Interstellar clouds - Nebulae.

Unit 3
Galactic astronomy: Distance measurement - red shifts and Hubble's law – age of the universe, galaxies – morphology - Hubble's classification - gravitational lens, active galactic nuclei (AGNs), pulsars, quasars.

Relativity: Special theory of relativity - super-luminal velocity - Minkowski space - introduction to general theory of relativity – space - time metric, geodesics, space-time curvature. Advance of perihelion of Mercury, gravitational lens.

Cosmology: Comic principles, big bang and big crunch – cosmic background radiation - Nucleo-synthesis - planklength and time, different cosmic models - inflationary, steady state. Variation of G. anthropic principle.

REFERENCES:

1. *"Textbook of Astronomy and Astrophysics with elements of Cosmology", V. B. Bhatia, Narosa publishing 2001.*
2. *William Marshall Smart, Robin Michael Green "On Spherical Astronomy", (Editor) Carroll, Bradley W Cambridge University Press ,1977*
3. *Bradley W. Carroll and Dale A. Ostlie. "Introduction to modern Astrophysics" Addison-Wesley, 1996.*

4. *Bradley W. Carroll and Dale A. Ostlie, "An Introduction to Modern Astrophysics" Addison-Wesley Publishing Company,1996*
5. *'Stellar Astronomy' by K. D Abhayankar.*
6. *'Solar Physics' by K. D Abhayankar.*

MATHEMATICS

23MAT240	STATISTICAL INFERENCE	L-T-P-C: 3-0-0-3

Syllabus

Unit 1
Introduction to Statistics: Data Collection and Descriptive Statistics, Populations and Samples, describing data sets, summarizing data sets, Normal Data Sets, Paired Data Sets and the Sample Correlation Coefficient. Review of Random Variables and Distributions, Distributions of Sampling Statistics, The Sample Mean, The Central Limit Theorem, The Sample Variance, Sampling Distributions from a Normal Population, Distribution of the Sample Mean, Joint Distribution of $\bar{X}$ and S^2, Sampling from a Finite Population.

Unit 2
Parameter Estimation: Introduction, Maximum Likelihood Estimators, Interval Estimates, Estimating the Difference in Means of Two normal populations, Approximate Confidence Interval for the Mean of a Bernoulli random variable, Confidence Interval of the Mean of the Exponential Distribution, Evaluating a Point Estimator, The Bayes Estimator. Hypothesis Testing: Introduction, Significance Levels, Tests Concerning the Mean of a Normal Population, Testing the Equality of Means of Two Normal Populations, Hypothesis Tests Concerning the Variance of a Normal Population, Tests Concerning the Mean of a Poisson Distribution.

Unit 3
Regression: Introduction, Least Squares Estimators of the Regression Parameters, Distribution of the Estimators, Statistical Inferences about the Regression Parameters, the Coefficient of Determination and the Sample Correlation Coefficient, Analysis of Residuals, transforming to Linearity, Weighted Least Squares, Polynomial Regression, Multiple Linear Regression, Predicting Future Responses, Logistic Regression Models for Binary Output Data.

TEXTBOOK:

1. Ross S.M., Introduction to Probability and Statistics for Engineers and Scientists, 3rd edition, Elsevier Academic Press.

REFERENCES:

1. *Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley and Sons Inc., 2005*
2. *Ravichandran, J. Probability and Statistics for engineers, First Reprint Edition, Wiley India, 2012.*
3. *Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability and Statistics for Engineers and Scientists, 8th Edition, Pearson Education Asia, 2007.*
4. *Hogg, R.V., Tanis, E.A. and Rao J.M., Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.*

23MAT241	INTRODUCTION TO GAME THEORY	L-T-P-C: 3-0-0-3

Syllabus

Unit 1
Elements of Game theory, examples, Strategic Games, 2 Player Strategy Games, payoffs, Minimax, Weak and Strong Domination, Saddle Points, Nash Equilibrium, Prisoner's Dilemma, Stag Hunt, Matching pennies, BOS, Multi NE, Cooperative and Competitive Games, Strict and Non Strict NE, Best response functions for NE.

Unit 2
Combinatorial games, Winning and losing positions, Subtraction Game, 3-Pile and K-Pile Games, Proof of Correctness, Variations of K-Pile Games, Graph Games, Construction, Proof of finiteness, SG theorem for sum ofgames.

Unit 3
Cournot's Oligopoly, Bertrand's Oligopoly, Electoral Competition, Median Voter Theorem, Auctions, role of knowledge, Decision making and Utility Theory, Mixed Strategy Equilibrium, Extensive Games with Perfect Information, Stackelberg's model of Duopoly, Buying Votes, Committee Decision making, Repeated Gmes, Prisoner's Dilemma, Supermodular Game and Potential games

TEXTBOOK:

1. *Martin Osborne, An Introduction to Game Theory, Oxford University Press.*

REFERENCES:

1. *Thomas Ferguson, Game Theory, World Scientific, 2018.*
2. *Stef Tijs. Introduction to Game Theory, Hindustan Book Agency.*
3. *Allan MacKenzie, Game Theory for Wireless Engineers, Synthesis Lectures On Communications.*

23MAT242	NUMERICAL METHODS AND OPTIMIZATION	L-T-P-C: 3-0-0-3

Syllabus

09 (a) Roots finding methods:
Roots of Transcendental and Polynomial Equations: Bisection method, Iteration methods based on first degree equation, Rate of convergence, system of nonlinear equations.

09 (b) Interpolations:
Interpolation and Approximation: Lagrange, Newton's Divided Difference, Newton's Forward and Backward interpolations.

07 (b) Multivariable optimization (2 Credits)
Optimality criteria – unidirectional search – direct search methods – gradient based methods. Lagrangian and Kuhn-Tucker conditions.

TEXTBOOK:

1. *Edwin K.P. Chong, Stanislaw H. Zak, "An introduction to Optimization", 2nd edition, Wiley, 2013.*
2. *M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical methods for scientific and Engineering computation, New Age International Publishers, 2007, 5th edition.*

REFERENCES:

1. *Kalyanmoy Deb, "Optimization for Engineering Design: Algorithms and Examples, Prentice Hall, 2002.*
2. *S.S. Rao, "Optimization Theory and Applications", Second Edition, New Age International (P) Limited Publishers, 1995.*

FREE ELECTIVES OFFERED UNDER MANAGEMENT STREAM
COMMON TO ALL PROGRAMS

23MNG331	FINANCIAL MANAGEMENT	L-T-P-C: 3-0-0-3

Course Objectives

- Understand the overview of financial management
- Inculcate methods and concepts on valuation
- Familiarize with working capital management, financial analysis and planning

Course Outcomes

CO1: Understand and apply time value concept of money and use this for investment criteria decisions.
CO2: Evaluate the risk and return for various alternatives of investment.
CO3: Apply the capital budgeting techniques and evaluate the investment decisions.
CO4: Understand working capital management, cash and liquidity management and financial statements**.**

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3				1	1		3	3	1			
CO2	3	3				2	1		3	3	1			
CO3	3	2				1	1		3	3	1			
CO4	3	2			1	2	1	2	3	3	1			

Syllabus

Unit 1
Introduction: Financial Management an overview – Financial Decisions in a firm – Goal of FM – Function of the financial system.

Unit 2
Fundamental Valuation Concepts:Time value of money – Risk and Return. Capital Budgeting: Techniques of capital budgeting investment criteria– NPV – Benefit Cost Ratio – IRR – Payback Period – ARR – Investment appraisal in Practice – Estimation of Project cost flows.

Unit 3
Working Capital Management: Current Assets – Financing Ruling – Profit Criterion. Cash and Liquidity Management. Working Capital Financing.

Financial Analysis and Planning**:** financial instruments, sources of long-term, intermediate term and short term finance. Analyzing Financial Performance – Break – even analysis and Leverages – Financial Planning and Budgeting.Mergers and Takeovers-International trade.

TEXT BOOKS

1. *Chandra, P., 'Financial Management: Theory and Practice', 9e, TMH, 2017.*
2. *Denzil Watson & Antony Head, 'Corporate Finance- Principles and Practice', 2e, Pearson Education Asia,2016.*
3. *R L Varshney& K L. Maheshwari, 'Managerial Economics', S Chand & Sons, 22e, 2014.*

REFERENCE BOOKS

1. *Stephen Blyth, 'An Introduction to Corporate Finance ',McGraw Hill Book Company, 2014.*
2. *Eugene F. Brigham & Louis C.Gapenski, 'Financial Management – Theory and Practice',14e, 2015.*

23MNG332	SUPPLY CHAIN MANAGEMENT	L-T-P-C: 3-0-0-3

Course Objectives

- Understand the complexity and key issues in supply chain management.
- Describe logistics networks, distribution planning, routing design and scheduling models.
- Familiarize dynamics of supply chain and the role of information in supply chain.
- Understand the issues related to strategic alliances, global supply chain management, procurement andoutsourcing strategies.

Course Outcomes

CO1: Analyze the complexity and key issues in supply chain management
CO2: Evaluate single and multiple facility location problems, logistics network configuration, vehicle routing and scheduling models
CO3: Analyze inventory management models and dynamics of the supply chain
CO4: Develop the appropriate supply chain through distribution requirement planning and strategic alliances
CO5: Identify the issues in global supply chain management, procurement and outsourcing strategies

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	1								1	3		
CO2	2	2	3	1					1	1	2	2		
CO3	3	3	3	3	2			3	1	1	3	2		
CO4	2	2	1	1					1	1	2	2		
CO5	3	3	3	1				3	1	1	3	2		

Syllabus

Unit 1
Introduction: Introduction to SCM-the complexity and key issues in SCM – Location strategy – facility location decisions – single facility and multiple location models.
Logistics: Logistics Network Configuration – data collection-model and data validation- solution techniques-network configuration DSS – Transport strategy – Service choices: single service and inter modal services – vehicle routing and scheduling models – traveling salesman problems – exact and heuristic methods.

Unit 2
Inventory: Inventory Management and risk pooling-managing inventory in the SC. Value of Information-bullwhip effect-lead time reduction.
Supply Chain Integration: Supply chain integration-distributed strategies-push versus pull systems. Distribution Requirements Planning – DRP and demand forecasting, DRP and master production scheduling. DRP techniques – time-phased order point – managing variations in DRP – safety stock determination-Strategic alliances-third party logistics-distribution integration.

Unit 3
Issues in SCM**:** Procurement and outsourcing strategies – framework of e-procurement. International issues in SCM-regional differences in logistics. Coordinated product and supply chain design-customer value and SCM.

TEXT BOOK

1. *Simchi-Levi,D.,Kaminsky,P.,Simchi-Levi,E., Shankar,R., 'Designing and Managing the Supply Chain: Concepts,Strategies, and Cases', Tata McGraw Hill, 2008.*

REFERENCE BOOKS

1. *Christopher, M., 'Logistics and Supply Chain Management: Strtegies for reducing Cost and ImprovingService', PH, 1999.*
2. *Ballou, M., 'Business logistics / Supply chain management', Pearson Education, 2003.*
3. *Vollmann, T.E., 'Manufacturing Planning and Control for Supply Chain Management', 5e, McGraw Hill,2005.*

23MNG333	MARKETING MANAGEMENT	L-T-P-C: 3-0-0-3

Course Objective

- To educate the students to apply concepts and techniques in marketing so that they become acquainted with the duties of a marketing manager with an emphasis to make the students exposed to the development, evaluation, and implementation of marketing management in a variety of business environments.

Course Outcomes

On successful completion of the Course students will be able to:

CO1: Illustrate key marketing concepts, theories and techniques for analysing a variety of marketing situations
CO2: Identify and demonstrate the dynamic nature of the environment in which marketing decisions are taken and appreciate the implication for marketing strategy determination and implementation
CO3: Develop the ability to carry out a research project that explores marketing planning and strategies for aspecific marketing situation
CO4: Understand the need and importance of sales promotions and make use of advertising
CO5: Manage a new product development process from concept to commercialization.
CO6: Illustrate the importance of modern trends in retailing and marketing logistics

CO/PO Mapping

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

Syllabus

Unit 1
Marketing Process: Definition, Marketing process, dynamics, needs, wants and demands, value and satisfaction, marketing concepts, environment, mix. Philosophies, selling versus marketing, organizations, industrial versus consumer marketing, consumer goods, industrial goods, product hierarchy.

Buying Behaviour and Market Segmentation: Major factors influencing buying behaviour, buying decision process, businessbuyingbehaviour. Segmenting consumer and business markets, market targeting.

UNIT 2
Product Pricing and Marketing Research: Objectives, pricing, decisions and pricing methods, pricing management. Introduction, uses, process of marketing research.

UNIT 3
Developing New Products - Challenges in new-product Development - Effective organizational arrangements - Managing the development Process: ideas - Concept to strategy - Development to commercialization – The consumer-adoption process.
Advertising Sales Promotion and Distribution: Characteristics, impact, goals, types, and sales promotions- point of purchase-unique selling proposition. Characteristics, wholesaling, retailing, channel design, logistics, and moderntrends in retailing.

TEXT BOOKS

1. *Kolter, P.,'Marketing Management', Pearson Education 2001.*
2. *Ramasamy and Namakumari, 'Marketing Environment: Planning, implementation and control the Indiancontext', 1990.*

REFERENCE BOOKS

1. *Paul, G.E. and Tull, D., 'Research for marketing decisions', Prentice Hall of India, 1975.*
2. *Tull, D.S. and Hawkins, 'Marketing Research', Prentice Hall of Inida-1997.*
3. *Kotler, P. and Armstrong, G., 'Principles of Marketing' Prentice Hall of India, 2000.*
4. *Skinner, S.J., 'Marketing', All India Publishers and Distributes Ltd. 1998.*
5. *Govindarajan, M., 'Industrial marketing management', Vikas Publishing Pvt. Ltd, 2003.*

23MNG334	PROJECT MANAGEMENT	L-T-P-C: 3-0-0-3

Course Objectives

- To discuss the project life cycle and build a successful project from pre-implementation to completion.
- To introduce different project management tools and techniques

Course Outcomes

CO1: Appraise the selection and initiation of individual projects and its portfolios in an enterprise.
CO2: Analyze the project planning activities that will predict project costs, time schedule, and quality.
CO3: Develop processes for successful resource allocation, communication, and risk management.
CO4: Evaluate effective project execution and control techniques that results in successful project completion

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	2	2	1			2		3	1	2	3	2
CO2	2	3	3	2	2			3		3	2	2	3	3
CO3	1	2	3	2	2			2		3	2	1	2	3
CO4	1	1	2		1			2		3	1	1	1	2

Syllabus

Unit 1
Overview of Project Management: Verities of project, Project Features, Project Life Cycle – S-Curve, J-C
Project Selection: Project Identification and Screening – New ideas, Vision, Long-term objectives, SWOT Analysis (Strength, Weakness, Opportunities, Threats).
Project Appraisal – Market Appraisal, Technical Appraisal, Economic Appraisal, Ecological Appraisal, and Financial Appraisal – Payback, Net Present Value (NPV), Internal Rate of Returns (IRR).
Project Selection – Decision Matrix, Technique for Order Preference using Similarity to Ideal Solution (TOPSIS), Simple Additive Weighting (SAW).

Unit 2
Project Presentation: WBS, Project Network – Activity on Arrow (A-O-A), Activity on Node (A-O-N).
Project Scheduling: Gant Chart, Critical Path Method (CPM), Project Evaluation & Review Technique (PERT).**(6hrs)**
Linear time cost trade-offs in project - Direct cost, indirect cost, Project crashing
Resource Consideration - Profiling, Allocation, Levelling.
Introduction to project management software: Primavera/ Microsoft project

Unit 3
Project Execution: Monitoring control cycle, Earned Value Analysis (EVA), Project Control – Physical control, Human control, financial control.
Organizational and Behavioral Issues: Organizational Structure, Selection-Project Manager, Leadership Motivation, Communication, Risk Management.
Project Termination: Extinction, Addition, Integration, Starvation.

TEXT BOOKS

1. *Jack R. Meredith and Samuel J. Mantel, Jr. - 'Project Management- A Managerial Approach' EighthEdition - John Wiley & Sons Inc - 2012.*
2. *Arun Kanda – 'Project Management-A Life Cycle Approach' PHI Learning Private Limited - 2011*

REFERENCE BOOKS

1. *'A Guide to Project Management Body of Knowledge' PMBOK GUIDE, Sixth edition, Project management Institute – 2017*
2. *Ted Klastrorin - 'Project Management, Tools, and Trade-Offs' - John Wiley – 2011*

23MNG335	ENTERPRISE MANAGEMENT	L-T-P-C: 3-0-0-3

Course Objectives

- To impart knowledge on the fundamentals of costing, pricing methods and strategies.
- To give an overview of production operations planning.
- To summarize various quantitative methods of plant location, layout and lean manufacturing.
- To familiarize the concepts of e-commerce, e-purchasing, MRP and ERP in business

Course Outcomes

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

CO1: Understand the concepts of cost and pricing of goods and appraise project proposals
CO2: Design and analyze manufacturing and service processes and to measure the work performed.
CO3: Understand and analyze the key issues of supply chain Management
CO4: Understand the application of lean manufacturing tools and six sigma concepts
CO5: Select appropriate plant location and their layout methods
CO6: Create capacity plan, aggregate plan, schedule, ERP & MRP systems

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	1						2	2			
CO2	2	1							1		2	1		1
CO3	2	1									2	1		1
CO4	2	1	1	1					1		2	1		1
CO5	2	1		1							2			
CO6	2	2	1	1						1	2	1		1

Syllabus

Unit 1
Engineering Economics: cost concepts - types of costs - cost functions. Cost controls: reduction – tools & applications. Pricing policies – methods – problems.Process design and improvement – process capacity – process layout – process reengineering – job design. Work standards – work measurement – work sampling – problems.

Unit 2
Supply Chain Management – Basic Concepts, SC dynamics, push-pull boundary, integrated supply chain, logistics, customer relationship, supplier relationship – selection, rating and development, procurement, SC metrics and performance measurement - problems. Lean Manufacturing – concepts, wastes – tools viz., pull system, standardized work, takt time, kanban system, JIT, kaizen, SMED, 5S, value stream mapping, benefits of lean and implementation issues. Introduction to Six Sigma. Plant Location – globalization, factors affecting location decisions, facility location- Break-even method, rectilinear, factor-rating and centre of gravity – problems. Plant Layout – types, process layout, product layout, Systematic layout planning (SLP), Line Balancing problems. Capacity Planning – Aggregate Planning – importance, planning process, methods – problems.

Unit 3
Role of IT in business performance improvement – e-commerce – e-purchasing –Master Production Schedule, inventory lot sizing strategies, MRP basics – MRP explosion, Available to Promise(ATP) inventory – MRP calculations – MRP II – Scheduling – Gantt chart – Introduction to ERP – ERP software – ERP modules – ERP implementation.

TEXT BOOKS

1. *L J Krajewski, L.P.RitzmanMalhotra.M and Samir K. Srivastava, 'Operations Management: Processes andValue chains, 11e, Pearson, 2015.*
2. *R L Varshney& K L. Maheshwari, 'Managerial Economics', S Chand & Sons, 22e, 2014.*

REFERENCE BOOKS

1. *Richard B. Chase, Ravi Shankar, F. Robert Jacobs, 'Operations and Supply Chain Management' McGrawHill Education (India) Private Limited.14e, 2017.*
2. *E S Buffa and R K Sariss, 'Modern Production/Operations Management', Wiley India Private Limited, 8e,2007.*
3. *Harrison.B, Smith.C., and Davis.B.,, 'Introductory Economics', 2e Pr Macmillan, 2013.*

23MNG336	OPERATIONS RESEARCH	L-T-P-C: 3-0-0-3

Course Objectives

- Familiarizing the students with quantitative tools and techniques, which are frequently applied in operational decisions

Course Outcomes

CO1: Formulate operations research models to optimize resources.
CO2: Solve transportation and assignment problems using suitable techniques.
CO3: Apply appropriate technique to analyze a project with an objective to optimize resources.
CO4: Solve operational problems using decision theory approaches.
CO5: Select suitable inventory model for effective utilisation of resources.
CO6: Solve Operations Research problems using software package

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2		2					2	2	2		
CO2	3	2	2		2					2	2	2		
CO3	3	2	2		2					2	2	2		
CO4	3	2	2		2					2	2	2		
CO5	3	2	2		2					2	2	2		
CO6	3	2	2		2					2	2	2		

Syllabus

Unit1
Linear Programming: Formulations - graphical solutions - Simplex Method - Duality, Dual simplex method.
Transportation model: Assignment model – Travelling Salesman Problem.

Unit 2
Decision Theory: Decision Trees. Game theory - 2 person zero sum; mixed strategies; 2 x n and m x 2 games.
Network Models- Project Networks- CPM / PERT- Project Scheduling – crashing networks and cost considerations- Resource leveling and smoothing - shortest route problem, minimal spanning tree problem, maximal flow problem.
Unit 3
Sequencing model – 2 machines ‘n’ jobs, ‘m’ machines ‘n’ jobs – n jobs 2 machines.
Inventory models: deterministic & probabilistic models. Quantity discounts. Selective Inventory Management
Queuing models: Poisson arrival and exponential service times. Single server, multi-server. Queues -infinite and finite capacity queues.
Simulation –Monte Carlo simulation: simple problems

Lab session: Practicing case problems with excel solver/MatLab/LINGO package
TEXT BOOK
Hillier, F .S. and Lieberman, G .J, ‘Operations Research’, 9e, McGraw Hill, 2010

REFERENCE BOOKS

1. *Taha,H.A., ‘Operations Research: an Introduction’, 8e, Prentice HalI, New Delhi, 2008.*
2. *Ravindran, A., Phillips, D.J., and Solberg, J.J., ‘Operations Research- Principles and Practice’, John Wiley& Sons, 2005.*
3. *Wagner, H.M., ‘Principles of Operations Research’, Prentice Hall, New Delhi, 1998*

23MEE321	INDUSTRIAL ENGINEERING	L-T-P-C: 3-0-0-3

Course Objectives

- To inculcate the concepts of work study and its application to industrial practice
- Impart skills to design, develop, implement, and improve manufacturing/service systems

Course Outcomes

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

CO1: Create value to organizations through the analysis, evaluation, and improvement of work systems using work study and method study
CO2: Develop work systems through motion economy principles
CO3: Apply work measurement techniques to improve productivity, fix wages and incentives
CO4: Apply systematic layout planning techniques and work station design principles based on ergonomics andmaterial handling.

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	1					1		3	2		
CO2	2	1	2	1	1				1		3	2		
CO3	1	2		1	1					1	3	2		
CO4	2	2		1	2					2	3	2		

Syllabus

Unit 1
Work System: Elements of work, maintenance of machines, interaction, effect of working conditions and environment, physical and mental fatigue.
Productivity: Productivity, factors affecting production, Measurement of productivity.
Work Study: Definition and scope of work study; Areas of application of work study in industry; Human aspects of work study.
Method Study: Information collection, recording techniques, and processing aids; critical examination; development, installation and maintenance of improved methods.

Unit 2
Motion Economy and Analysis: Principles of motion economy; Motion analysis; Micromotion and Memomotion study; Therbligs and SIMO charts; Normal work area and design of work places; Basic parameters and principles of work design.
Work Measurement: Work measurement techniques; Calculation of standard time, work sampling and predetermined Motion time systems.
Wages and Incentive Schemes: Introduction, wage payment of direct and indirect labour, wage payment plans and incentives, various incentive plans, incentives for indirect labour

Unit 3
Plant Layout: Concept of plant layout, types of layout; factors affecting plant layout.
Ergonomics: Ergonomic Design of equipment and work place. work station design, factors considered in designing a work station, ergonomic design standards - Study of development of stress in human body and their consequences. Case Studies.Production planning and scheduling.
Material Handling: Introduction and functions of material handling equipment, selection of material handling equipment for different requirements, safety requirements. Recent advances in Industrial Engineering.

TEXT BOOKS

1. *Barnes, R, "Motion and Time Study" - Design and Measurement of Work . NY: John Wiley and Sons, 8thEdition, 1985.*
2. *"Introduction to Work Study", 4ed, International Labor Office, Geneva, 2006.*

REFERENCE BOOKS

1. *Martand T. Telsang, 'Industrial Engineering and Production Management' S Chand; 2nd Rev Edn 2006.*
2. *Mahajan M., "Industrial Engineering and Production Management" Dhanpat rai and Sons Publishers,2005.*

23MEE323	MANAGERIAL STATISTICS	L-T-P-C: 3-0-0-3

Course Objective

- To impart the knowledge of basic statistical tools for analysis and interpretation of qualitative and quantitativedata for decision making

Course Outcomes

CO1: Apply basic probability and statistics concepts for various business problems
CO2: Perform test of hypothesis
CO3: Compute and interpret the result of regression and correlation analysis for forecasting
CO4: Solve real time problems by applying different decision making methods.

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3		2	2					2	2	3		
CO2	3	3		2	2					2	2	3		
CO3	3	3		2	2					2	2	3		
CO4	3	3		2	2					2	2	3		

Syllabus

Unit 1
Quantitative methods: Basic terminology in probability, probability rules, conditions of statistical dependence and independence, Bayes Theorem, Discrete Random Variables review of probability distributions, measure of central tendency.
Sampling and sampling distributions: Introduction to sampling, random sampling, design of experiments, introduction to sampling distributions
Estimation: point estimates, interval estimates and confidence intervals, calculating interval estimates of mean from large samples, using t test, sample size estimation**.**

Unit 2
Testing hypothesis: Introduction, basic concepts, testing hypothesis, testing when population standard deviation is known and not known, two sample tests.
Chi-square and analysis of variance: introduction, goodness of fit, analysis of variance, inferences about a population variation

Unit 3
Regression and correlation: Estimation using regression line, correlation analysis, finding multiple regression equation, modelling techniques,
Non parametric methods and time series and forecasting: Sign test for paired data, rank sum test, rank correlation, Kolmogrov – smirnov test, variations in time series, trend analysis, cyclic variation, seasonal variation and irregular variation. Decision theory**:** Decision tree analysis

TEXT BOOKS

1. *Levin R. I. and Rubin D. S. - 'Statistics for management' - Pearson Education – 2007 - 5th Edition*
2. *Montgomery D. C. and Runger G. C. - 'Applied Statistics and Probability for Engineers' - John Wiley &Sons - 2002 - 3rd Edition*

REFERENCE BOOKS

1. *Bain.L. J. and Engelhardt M. - 'Introduction to Probability and Mathematical Statistics' - Duxbury Press - March 2000 - 2nd Edition*
2. *Hinkelmann K. and Kempthorne O. - 'Design and Analysis of Experiments : Volume I' - John Wiley & Sons,Inc. - December 2007 - 2nd Edition*
3. *Johnson R. A. and Wichern D. W. - 'Applied Multivariate Statistical Analysis' - Prentice-Hall, Inc. -December 2001 - 5th Edition*
4. *Myers R. H. - 'Classical and Modern Regression with Applications' - PWS-Kent Publishing Company -March 2000 - 2nd Edition*
5. *Devore J. L. - 'Probability and Statistics for Engineering and the Sciences' - Brooks/Cole PublishingCompany - December 1999 - 5th Edition*
6. *Freund J. E. and Walpole R. E. - 'Mathematical Statistics' - Prentice-Hall Inc. - October 1986 - 4th Edition*

23MEE323	TOTAL QUALITY MANAGEMENT	L-T-P-C: 3-0-0-3

Course Objective

- To impart knowledge on quality management principles, tools, techniques and quality standards for real lifeapplications

Course Outcomes

CO1: Evaluate the principles of quality management and to explain how these principles can be applied withinquality management systems.
CO2: Evaluate the performance measures using various quality and management tools
CO3: Apply the Quality Function Deployment, Taguchi principles, Total Productive Maintenance and FailureMode and Effect Analysis concepts to solve industrial problems.
CO4: Practice the various quality system in industry.

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2									2	2		
CO2	1	2									2	2		
CO3	2	2	2								2	2		
CO4	2	2	2	2							2	2		

Syllabus

Unit 1
Definition of quality - dimensions of quality. Quality planning - quality costs. Total Quality Management: historical review and principles –leadership - quality council - quality statements - strategic planning - Deming philosophy. Barriers to TQM implementation

Unit 2
Customer satisfaction – Customer retention - Employee involvement - Performance appraisal - Continuous process improvement - Supplier partnership - Performance measures. Seven tools of quality.Statistical fundamentals - Control Charts for variables and attributes - Process capability - Concept of six sigma - New seven management tools - Benchmarking**.**

Unit 3
Quality function deployment (QFD) - Taguchi quality loss function - Total Productive Maintenance (TPM) - FMEA.Need for quality systems - ISO 9000:2000 – Elements of quality systems (such as ISO 9000:2000). Implementation of quality system – documentation - quality auditing - QS 9000-ISO 14000

TEXT BOOK
Besterfiled D. H. - 'Total Quality Management' - Pearson Education Asia – 2015-4th Edition

REFERENCE BOOKS

1. *Evans J. R, and Lidsay W. M. - 'The Management and Control of Quality' - Southwestern (ThomsonLearning) - 2002 - 5th Edition*
2. *Feigenbaum A. V. - 'Total Quality Management - Vol I &II ' – McGraw Hill - 1991*

23MEE324	LEAN MANUFACTURING	L-T-P-C: 3-0-0-3

Course Objectives

- Understand Lean manufacturing principles and tools
- Inculcate the concepts of value stream mapping
- Familiarize lean implementation practices

Course Outcomes

CO1: Identify key requirements and concepts in lean manufacturing.
CO2: Initiate a continuous improvement change program in a manufacturing organization
CO3: Analyze and improve a manufacturing system by applying lean manufacturing tools
CO4: Build value stream map for improving the productivity
CO5: Improve productivity through lean practices

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2										2	2		
CO2	2	2	2	1				2	1		1	2		1
CO3	2	2	2	2	1			2	1		1	2	1	2
CO4	2	2	2	1	1	1			1		2	2	1	1
CO5	2	2	2	1	1	1			1		2	2	1	1

Syllabus

Unit 1
Introduction to Lean and Factory Simulation: History of Lean and comparison to other methods - The 7 Wastes, their causes and the effects - An overview of Lean Principles / concepts / tools - Stockless Production.
The Tools of Lean Manufacturing: Continuous Flow – Continuous Flow Manufacturing and Standard Work Flow –5S and Pull Systems (Kanban and ConWIP systems) – Error Proofing and Set-up Reduction – Total Productive Maintenance (TPM) – Kaizen Event examples. Toyota production systems.
Ford production systems – FPS gear model

Unit 2
Value Stream Mapping – Current state: Preparation for building a Current State Value Stream Map – Building a Current State Map (principles, concepts, loops, and methodology) – Application to the factory Simulation scenario.

Unit 3
Value Stream Mapping – Future State: Key issues in building the Future State Map – Process tips in building the map and analysis of the customer loop, supplier loop, manufacturing loop and information loop – Example of completed Future State Maps – Application to factory simulation
Implementation of lean practices - Best Practices in Lean Manufacturing.

TEXT BOOKS

1. *Womack, J.P., Jones, D.T., and Roos, D., 'The Machine that Changed the World', Simon & Schuster, NewYork, 2007.*
2. *Liker, J.K., 'Becoming Lean', Industrial Engineering and Management Press, 1997.*

REFERENCES BOOKS

1. *Womack, J.P. and Jones, D.T., 'Lean thinking', Simon & Schuster, USA, 2003.*
2. *Rother, M. and Shook, J., 'Learning to see', The Lean Enterprise Institute, Brookline, USA, 2003.*

23CSE321	SOFTWARE PROJECT MANAGEMENT	L-T-P-C: 3-0-0-3

Course Objectives

- This course describes the key aspects of a software project.
- It introduces the basic principles of Engineering Software Projects. Most, if not all, students' complete projects as part of assignments in various courses undertaken. These projects range in size, subject and complexity but there are basic project essentials that need to be understood and practiced for successful team project outcomes.
- The course provides an understanding of the purpose, methods and benefits of process management by exposing the student to the concepts, practices, processes, tools and techniques used in process managementfor software development.

Course Outcomes

CO 1: To understand the basic concepts, terminologies and issues of software project management.
CO 2: To apply appropriate methods and models for the development of solutions.
CO 3: To analyze the cost-benefits of calculations so as to optimize the selection strategy
CO 4: To evaluate methods, models and technologies towards achieving project success
CO 5: To design and evaluate network planning models with criticality

CO-PO Mapping

PO/PSO CO													
CO1	3	1	1							1		3	2
CO2	3	2	3					3	3		2	3	2
CO3	3	2	2	3	2	2	2	3	3	2	2	3	2
CO4	2	2	2	1	3	2	2	3	3		2	3	2
CO5	3	2	3	3	3	2	2	3	3		2	3	2

Syllabus

Unit 1
Introduction to Software Project Management- Software Projects - ways of categorizing software projects – problems with software projects - Project Life Cycle– Management -Setting objectives –Stakeholders - Project Team- Step-wise : An overview of project planning -project Evaluation –Selection Of Appropriate Project Objectives- Software Effort Estimation Techniques, Function Point Analysis-Object Point-COCOMO.

Unit 2
Activity planning-- project schedules - sequencing and scheduling projects - Network planning model – AON and AOA-identifying critical activities-Crashing And Fast Tracking-,Risk management—Categories , Risk planning, Management and Control - Evaluating risks to the schedule. PERT- Resource Allocation, Monitoring and Tracking - Monitoring and control - allocation - identifying resource requirements - scheduling resources - creating critical paths - publishing schedule - cost schedules- sequence schedule.

Unit 3
Monitoring and control – Visualizing Progress, Earned value analysis, managing people and organizing teams-organizational structures- Planning for small projects. Case Study: PMBOK , Agile Development

TEXT BOOK(S)

1. *Mike Cotterell, Bob Hughes. Software Project Management, Fifth Edition, Tata McGraw-Hill; 2012.*

REFERENCE(S)

1. *Roger S. Pressman. Software Engineering – A Practioner's Approach, Eighth Edition, Tata McGraw-Hill publishers; 2014.*
2. *Jalote P. Software Project Management in practice, Second edition, Person Education; 2003.*

23CSE322	FINANCIAL ENGINEERING	L-T-P-C: 3-0-0-3

Pre-Requisite(s): 23MAT128 Linear Algebra, 23MAT209 Differential Equations and Numerical Methods
Course Objectives

- This course serves as an introduction to financial engineering including cash flows, financial decision making etc
- It gives a thorough yet highly accessible mathematical coverage of standard and recent topics of introductory investments: fixed-income securities, modern portfolio theory, optimal portfolio growth and valuation ofmulti-period risky investments.

Course Outcomes

CO1: Apply basic concepts to understand and evaluate cash flows
CO2: Evaluate and arrive at a financial investment decision employing the underlying knowledge of stocks andderivatives
CO3: Analyse and design Portfolio selection methods
CO4: Understand capital market theory for stock performance evaluation

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1			2							3	2	
CO2	2	3	1									3	2	
CO3	1	3			2							3	2	
CO4	2	1										3	2	

Syllabus

Unit 1
Cash Flows and Fixed income securities: Investments and markets - Principal and interest - Present and future values of streams - IRR. Fixed income securities - Market value for future cash - Bond value - Bond details – Yields – Convexity – Duration - Immunization. Bond portfolio management - Level of market interest rates, Term structure of interest-rate theories.

Unit 2
Stocks and Derivatives: Common stock valuation - Present value of cash dividends - Earnings approach - Value versus price - Efficient markets theory - Technical analysis. Analysis of financial statements. Derivatives - futures and options - Black Scholes formula - Utility functions - Applications in financial decision making.

Unit 3
Portfolio analysis and capital market theory: Covariance of returns – Correlation - Portfolio return - Portfolio standard deviation - Two asset case - Efficient frontier - Optimum portfolio. Capital market theory - Capital market line - Sample diversifications to reduce risk - Characteristic line - Capital asset pricing model. Arbitrage price theory - Stock performance evaluation.

TEXT BOOK(S)

1. *David Luenberger, Investment Science. Second Edition, Oxford University Press; 2013*
2. *Jack Clark Francis, Richard W. Taylor. Investments, Schaum's Outlines, Tata McGraw Hill ;2006.*

REFERENCE(S)

1. *Lyuu YD. Financial Engineering and Computation. Cambridge University Press; 2004.*
2. *Perry H. Beaumont. Financial Engineering Principles. John Wiley and Sons Inc, New Jersey; 2004.*

23CSE323	ENGINEERING ECONOMIC ANALYSIS	L-T-P-C: 3-0-0-3

Course Objectives

- Prepare engineering students to analyze and understand the business, impact of economic environment onbusiness decisions

Course Outcomes

CO1: Understand and evaluate the economic theories, cost concepts and pricing policies and draw inferences forthe investment decisions for appraisal and profitability
CO2: Appraise the dynamics of the market and market structures and portray implication for profit and revenuemaximization
CO3: Employ operations research and allied techniques in managerial economics for an enhanced analysis anddecision making

CO-PO Mapping

PO/ PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO2
CO1	2	3	2	2		2	2			3	2	3	2	
CO2	1	3	2	1		2	2			3	2	3	2	
CO3	2	3	2	2		2	2			3	2	3	2	

Syllabus

Unit 1
Economics: Nature and scope of managerial economics. Economic theory and managerial economics, Cost Concepts: Types of costs - Cost functions. Cost controls: reduction – Tools & Areas. Pricing policies- methods. Capital budgeting - cost of capital. Appraising project profitability

Unit 2
The essentials of demand and supply: The law of demand. Market demand curve. Other determinants of market demand. The law of supply. Determinants of market supply. The market mechanism. Price elasticity of demand, Profit and revenue maximization: Optimal input combination. Total revenue maximization.

Unit 3
Market structure: Perfect competition and monopoly. Characteristics of monopolistic competition. Oligopoly Operations Research techniques in managerial economics: Inventory models. Theory of games. Decision theory, Risk and Uncertainty, Measuring risk, Consumer behavior and risk aversion, Decision making under uncertainty with complete ignorance

TEXT BOOK(S)
1. *Webster, T.J. Managerial Economics- Theory and Practice, Elsevier; 2004.*

REFERENCE(S)

1. *Panneerselvam, R. Engineering Economics, Second Edition, PHI; 2013.*
2. *R L Varshney,K L. Maheshwari. Managerial Economics, S Chand & Sons;2014.*
3. *Harrison.B, Smith.C., and Davis.B. Introductory Economics, Second Edition, Pr Macmillan; 2013.*

23CSE324	INFORMATION SYSTEMS	L-T-P-C: 3-0-0-3

Course Objectives

- This course is to expose the students to the managerial issues relating to information systems and alsounderstand the role of Business Process Reengineering technique in an organization.
- The course also focus on the management of information technology to provide efficiency and effectiveness or strategy decision making.

Course Outcomes

CO1: Understand the fundamental concepts of Information Systems in business.
CO2: Understand and analyse the strategic role played by Information Systems in e-commerce.
CO3: Analyse management challenges in Global Businesses predominantly dependent on IS functions.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3											3	2	
CO2	2	2			2							3	2	
CO3	1	3			2	2				2	1	3	2	

Syllabus

Unit 1
Introduction to IS -Fundamental concepts-IS in Business- Role of IS –Information system and technologies – Components of IS –resources and acivities –Types of IS- E business Applications –Role of BI and Analytics in IS-Functional Business Systems - Marketing Systems, Manufacturing systems, Human Resource Systems, Accounting Systems and Financial Management Systems.-Cross-Functional Enterprise Systems Cross-Functional Enterprise Applications, Enterprise Application Integration, Transaction Processing Systems and Enterprise Collaboration Systems. Enterprice Business Systems CRM, ERP, SCM , Case Studies

Unit 2
Electronic Commerce Systems : Scope of e-Commerce, Essential e-Commerce Processes and Electronic Payment Processes - E-commerce Applications & Issues -Decision Support Systems- Business and Decision Support, Decision Support Trends, Management Information Systems, Online Analytical Processing, Decision Support Systems, Executive Information Systems, Enterprise Portals and Decision Support - Knowledge Management Systems. Artificial Intelligence Technologies and its application in Business- Strategic role of IT- Competing with IT, value chain ,reengineering, virtual organization ,knowledge creation-Organizational Planning, The Scenario Approach, Planning for Competitive Advantage, SWOT Business Models and Planning, Business IT Planning, -Business/ IT Strategies and Business Application Planning- Developing and Implementing Business Systems - Implementation Challenges- barriers - change management-: Case Studies

Unit 3
Management challenges-Security, Ethical and Societal Challenges- Ethical Responsibility of Business Professionals, Computer Crime, Privacy Issues, Health Issues, and Societal Solutions- Security Management of IT- Tools of security Management, Internetworked Security Defenses, other security measures –system controls and audits- Enterprise and Global Management of IT- Managing the IS Function and Failures in IT Management - Global IT Management, Cultural, Political and Geo-economic Challenges, Global Business/IT Strategies, Global Business/IT Applications, Global IT Platforms, Global Data Access Issues and Global Systems Development –Case studies

TEXT BOOK(S)

1. *O'Brien JA, Marakas GM. Management information systems. McGraw-Hill Irwin; 2006.*
2. *Brien,Marakas G M and Behi R , MIS,9th edition, Tata McGraw Hill Special Indian Edition;2010.*

REFERENCE(S)

1. *Laudon K, Laudon JP. Management Information Systems;2010*

FREE ELECTIVES OFFERED UNDER HUMANITIES / SOCIAL SCIENCE STREAMSCOMMON TO ALL PROGRAMS

23CUL230	ACHIEVING EXCELLENCE IN LIFE -AN INDIAN PERSPECTIVE	L-T-P-C: 2-0-0-2

Course Objectives:

- The course offers to explore the seminal thoughts that influenced the Indian Mind on the study of human possibilities for manifesting excellence in life. This course presents to the students, an opportunity to study the Indian perspective of Personality Enrichment through pragmatic approach of self analysis and application.

Syllabus

Unit 1
Goals of Life – Purusharthas
What are Purusharthas (Dharma, Artha, Kama, Moksha); Their relevance to Personal life; Family life; Social life & Professional life; Followed by a Goal setting workshop;
Yogic way of Achieving Life Goals – (Stress Free & Focused Life)
Introduction to Yoga and main schools of Yoga; Yogic style of Life & Time Management (Work Shop);
Experiencing life through its Various Stages
Ashrama Dharma; Attitude towards life through its various stages (Teachings of Amma);

Unit 2
Personality Development
What is Personality – Five Dimensions – Pancha Kosas (Physical / Energy / Mental / Intellectual / Bliss); Stress Management & Personality; Self Control & personality; Fundamental Indian Values & Personality;
Learning Skills (Teachings of Amma)
Art of Relaxed Learning; Art of Listening; Developing 'Shraddha' – a basic qualification for obtaining Knowledge; Communication Skills - An Indian Perspective;

Unit 3
Developing Positive Attitude & Friendliness - (Vedic Perspective);
Achieving Work Excellence (Karma Yoga by Swami Vivekananda & teachings based on Amma);
Leadership Qualities – (A few Indian Role models & Indian Philosophy of Leadership);

REFERENCE BOOKS:

1. *Awaken Children (Dialogues with Sri Mata Amritanandamayi) Volumes 1 to 9*
2. *Complete works of Swami Vivekananda (Volumes 1 to 9)*
3. *Mahabharata by M. N Dutt published by Parimal publications – New Delhi (Volumes 1 to 9)*
4. *Universal message of Bhagavad-Gita (An exposition of Gita in the light of modern thought and Modernneeds) by Swami Ranganathananda. (Vols.1 to 3)*
5. *Message of Upanishads, by Swami Ranaganathananda published by Bharatiya Vidya Bhavan, Bombay.*
6. *Personality Development – Swami Vivekananda published by Advaitha Ashram, Kolkatta.*
7. *Art of Man Making - Swami Chinmayananda published by Chinmaya Mission, Bombay*
8. *Will Power and its Development- Swami Budhananda published by Advaitha Ashram, Kolkatta*
9. *Ultimate Success - Swami Ramakrishnananada Puri published by Mata Amritanandamayi Math, Kollam*
10. *Yoga In Daily Life - Swami Sivananda – published by Divine Life Society*
11. *Hindu Dharma - H. H. Sri Chandrasekharandra Saraswati published by Bharatiya Vidya Bhavan, Bombay*
12. *All about Hinduism – Swami Sivananda - Published by Divine Life Society*
13. *The Mind and its Control by Swami Budhananda published by Advaitha Ashram, Kolkatta*
14. *Krida Yoga - Vivekananda Kendra, Publication.*
15. *Valmiki Ramayana – Four volumes- published by Parimal Publications, Delhi*

16. *New perspectives in Stress Management - Dr H R Nagendra & Dr R Nagaratna published by SwamiVivekananda Yoga Prakashana, Bangalore.*
17. *Mind Sound Resonance Technique (MSRT) Published by Swami Vivekananda Yoga Prakashana,Bangalore.*
18. *Yoga & Memory - Dr H R Nagendra & Dr. Shirley Telles, published by Swami Vivekananda YogaPrakashana, Bangalore.*

23CUL231	EXCELLENCE IN DAILY LIFE	L-T-P-C: 2-0-0-2

Syllabus

Unit 1

1. The anatomy of 'Excellence'. What is 'excellence'? Is it judged by external factors like wealth?
2. The Great Flaw. The subject-object relationship between individual and world. Promote subject enhanceexcellence.
3. To work towards excellence, one must know where he is. Our present state... An introspective analysis.Our faculties within.

Unit 2

4. The play of the mind. Emotions – convert weakness into strength.
5. The indispensible role of the intellect. How to achieve and apply clear thinking?
6. The quagmire of thought.The doctrine of Karma – Law of Deservance.
7. Increase Productivity, reduce stress.. work patterning.

Unit 3

8. The art of right contact with the world. assessment, expectations.
9. Myths and Realities on key issues like richness, wisdom, spirituality.
10. Collect yourself, there is no time to waste. The blue-print of perfect action.

REFERENCES:

1. *The Bhaja Govindam and the Bhagavad Gita.*

23CUL232	EXPLORING SCIENCE AND TECHNOLOGY IN ANCIENT INDIA	L-T-P-C: 2-0-0-2

OBJECTIVES:

- This course offers a journey of exploration through the early developments in India of astronomy, mathematics,technologies and perspectives of the physical world. With the help of many case studies, the students will be equipped to understand concepts as well as well as actual techniques.

Syllabus

Unit 1

1. General introduction: principles followed and sources;
2. Astronomy & mathematics from the Neolithic to the Indus civilization;
3. Astronomy & mathematics in Vedic literature;
4. Vedanga Jyotisha and the first Indian calendars;
5. Shulba Sutras and the foundations of Indian geometry;

Unit 2

1. Astronomy & mathematics in Jain and Buddhist literature;
2. The transition to the Siddhantic period; Aryabhata and his time;
3. The Aryabhatiya: concepts, content, commentaries;
4. Brahmagupta and his advances;
5. Other great Siddhantic savants;
6. Bhaskara II and his advances;

Unit 3

1. The Kerala school of mathematics;
2. The Kerala school of astronomy;
3. Did Indian science die out?;
4. Overview of recent Indian scientists, from S. Ramanujan onward;
5. Conclusion: assessment and discussion;

TEXTBOOK:

1. *Indian Mathematics and Astronomy: Some Landmarks, by S. Balachandra Rao*

REFERENCE:

1. *IFIH's interactive multimedia DVD on Science & Technology in Ancient India.*

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23CUL233	YOGA PSYCHOLOGY	L-T-P-C: 2-0-0-2

OBJECTIVES:

- This course offers the foundation necessary to understand Eastern approaches to psychology and spirituality. Thecourse includes experiential components centering on meditation and spiritual practice.

Syllabus

Unit 1
Introduction
Introduction to Modern Psychology
A short history of Modern Psychology - Major Schools of Modern Psychology - The three major forces in Western Psychology - Freudian Psychoanalysis; Behaviourism; Humanistic Psychology.

Introduction to Indian Psychology
What is Yoga? - Rise of Yoga Psychology tradition - Various schools of Yoga Psychology - Universal Goal of all Yoga-schools.

Patanjali Yoga Sutra – 1
Introduction to Rishi Patanjali - Bird view of Yoga-Sutra - Definition of Yoga – Vrittis.

Patanjali Yoga Sutra – 2
Five Kinds of Vrittis - Pramanam - sources of right knowledge - Viparyayah – unfolded belief - Vikalpah – Unfolded belief - Smriti – Memory.

Unit 2
Patanjali Yoga Sutra – 3
Two formulae - Necessity of Abhyasah and Vairagyah - Foundation of Abhyasah - Foundation of Vairagyah.

Patanjali Yoga Sutra – 4
Introduction to Samadhi - Samprajnata-Samadhi - Reasoning in Samprajnata-Samadhi - Reflection in Samprajnata-Samadhi - Bliss in Samprajnata-Samadhi - Sense of Individuality in Samprajnata-Samadhi.

Patanjali Yoga Sutra – 5
Main obstacles in the path of Yoga - other obstructions - removal of obstacles by one – pointedness; by controlling Prana - by observing sense experience - by inner illumination - by detachment from matter - by knowledge of dream and sleep - by meditation as desired.

Patanjali Yoga Sutra – 6
How to make mind peaceful? - Cultivating opposite virtues: happiness – friendliness - misery – compassion - virtue – gladness - vice – indifference.

Patanjali Yoga Sutra – 7
Five causes of Pain - avidya – ignorance (Root Cause) - asmita – ‘I-Feeling’ – raga – attraction - dwesha – repulsion - abhinivesha – clinging to life.

Unit 3
Patanjali Yoga Sutra – 8
Necessity of Yoga practice - eight parts of Yoga practice - five Yamas: ahimsa – satya – asteya – brahmacharyam – aparigraha.

Patanjali Yoga Sutra – 9
Five Niyamas: Soucha – Santhosha – Tapas – Swadyah – Ishwara - Pranidhanam.

Patanjali Yoga Sutra – 10
Asanam – Pranayamah - various kinds of Pranayamah - Pratyaharah - Mastery over the senses.
Report review Conclusion

REFERENCES:

1. *The course book will be "The four chapters of Freedom" written by Swami Satyananda Saraswati of BiharSchool of Yoga, Munger, India.*
2. *"The message of Upanishads" written by Swami Ranganathananda. Published by Bharathiya VidyaBhavan.*
3. *Eight Upanishads with the commentary of Sankaracharya, Translated by Swami Gambhirananda,Published by Advaita Ashram, Uttaranjal.*
4. *'Hatha Yoga Pradipika' Swami Muktibodhananda, Yoga Publications Trust, Munger, Bihar, India*

23ENG230	BUSINESS COMMUNICATION	L-T-P-C: 1-0-3-2

OBJECTIVES:

- To introduce business vocabulary; to introduce business style in writing and speaking; to expose students to the cross-cultural aspects in a globalised world; to introduce the students to the art of persuasion and negotiation inbusiness contexts.

Course Outcomes

CO1: Familiarize and use appropriate business vocabulary and etiquettes in verbal communication in theprofessional context
CO2: Understand organizational structures, pay structures and performance assessments
CO3: Apply language skills in drafting various business documents and other necessary communications in thebusiness context
CO4: Understand and address cross cultural differences in the corporate environmentCO5: Participate in planned and extempore enactments of various business situations

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	
CO1									3		2	
CO2								1		1		
CO3									3			
CO4						2						
CO5								2				

Syllabus

Unit 1
Business Vocabulary - Writing: Drafting Notices, Agenda, and Minutes - Reading: Business news, Business articles.

Unit 2
Writing: Style and vocabulary - Business Memorandum, letters, Press Releases, reports – proposals – Speaking: Conversational practice, telephonic conversations, addressing a gathering, conducting meetings.

Unit 3
Active Listening: Pronunciation – information gathering and reporting - Speaking: Cross-Cultural Issues, Group Dynamics, negotiation& persuasion techniques.

Activities
Case studies & role-plays.

BOOKS RECOMMENDED:

1. *Jones, Leo & Richard Alexander. New International Business English. CUP. 2003.*
2. *Horner, David & Peter Strutt. Words at Work. CUP. 1996.*
3. *Levi, Daniel. Group Dynamics for Teams. 3 ed. Sage Publications India Pvt. Ltd. New Delhi, 2011.*
4. *Owen, Roger. BBC Business English. BBC. 1996.*

5. *Henderson, Greta Lafollette & Price R Voiles. Business English Essentials. 7th Edition. Glencoe / McGrawHill.*
6. *Sweeney, Simon. Communicating in Business. CUP. 2000.*

23ENG231	INDIAN THOUGHT THROUGH ENGLISH	L-T-P-C: 2-0-0-2

OBJECTIVES:

- To expose the students to the greatness of Indian Thought in English; to develop a sense of appreciation for the lofty Indian Thought; to develop an understanding of the eclectic Indian psyche; to develop an understanding about thesocietal changes in the recent past.

Syllabus

Unit 1 Poems
Rabindranath Tagore's Gitanjali (1-10); Nizzim Ezekiel's Enterprise; A.K. Ramanujam's Small-Scale Reflections on a Great House.

Unit 2Prose
Khushwant Singh's The Portrait of a Lady; Jhumpa Lahiri's Short Story - Interpreter of Maladies.

Unit 3

Drama and Speech
Vijay Tendulkar's Silence, the Court is in Session; Motivational speeches by Jawaharlal Nehru/ S. Radhakrishnan / A. P. J. Abdul Kalam's My Vision for India etc. (any speech).

REFERENCES:

1. *Lahiri, Jhumpa. Interpreter of Maladies, Harper Collins Publications, 2000.*
2. *Ramanujan A. K. ed. K. M. George, Modern Indian Literature: An Anthology, Vol. I, Sahitya Akademi,1992.*
3. *Singh, Khushwant. The Portrait of a Lady: Collected Stories, Penguin, 2009.*
4. *Tagore, Rabindranath. Gitanjali, Penguin Books India Pvt. Ltd, 2011.*
5. *Tendulkar, Vijay. Five Plays, Oxford University Press, 1996.*

23ENG232	INSIGHTS INTO LIFE THROUGH ENGLISH LITERATURE	L-T-P-C: 2-0-0-2

OBJECTIVES:

- To expose the students to different genres of Literature; to hone reading skills; to provide deeper critical and literaryinsights; to enhance creative thinking; to promote aesthetic sense.

Syllabus

Unit 1 Poems
1. W. H. Auden: Refugee Blues; 2. A. K. Ramanujan: Obituary; 3. William Blake: The LittleBlack Boy; 4. Gieve Patel: Grandparents at a Family Get–together.

Unit 2

Short Stories
1. Chinua Achebe: Marriage is a Private Affair; 2. Ruskin Bond: The Thief; 3. Isai Tobolsky: Not Just Oranges; 4.K A Abbas: The Refugee

Unit 3

Prose
1. A G Gardiner: On The Philosophy of Hats; 2. Robert Lynd: Mispronunciation

Practicals:

Role plays: The Proposal, Chekov / Remember Ceaser, Gordon Daviot / Final Solutions, Mahesh Dattani, Book reviews, Movie reviews.

SUGGESTED READING:
1. *The Old Man and the Sea, Hemingway / Any one of the novels of R.K. Narayan, etc.*

23ENG233	TECHNICAL COMMUNICATION	L-T-P-C: 2-0-0-2

OBJECTIVES:

- To introduce the students to the elements of technical style; to introduce the basic elements of formal correspondence; to introduce technical paper writing skills and methods of documentation; to improve oral presentation skills in formal contexts.

Course Outcomes:

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

CO1: Understand and use the basic elements of formal correspondence and methods of documentation
CO2: Learn to edit technical content for grammatical accuracy and appropriate tone and style
CO3: Use the library and internet recourses for research purposes
CO4: Demonstrate the ability to communicate effectively through group mock-technical presentations and other activities

Mapping of course outcomes with program outcomes:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1										3				
CO2										3				
CO3				1										
CO4									3	3				

Syllabus:

Unit 1
Mechanics of writing: Grammar rules – punctuation - spelling rules - tone and style - graphical Representation.

Unit 2
Different kinds of written documents: Definitions – descriptions – instructions – recommendations - manuals - reports – proposals; Formal Correspondence: Letter Writing including job applications with Resume.

Unit 3
Technical paper writing: Library research skills - documentation style - document editing – proof reading – formatting.

Practice in oral communication and Technical presentations

REFERENCES:

1. *Hirsh, Herbert. L "Essential Communication Strategies for Scientists, Engineers and TechnologyProfessionals". II Edition. New York: IEEE press, 2002*
2. *Anderson, Paul. V. "Technical Communication: A Reader-Centred Approach". V Edition. Harcourt BraceCollege Publication, 2003*
3. *Strunk, William Jr. and White. E B. "The Elements of Style" New York. Alliyan & Bacon, 1999.*
4. *Riordan, G. Daniel and Pauley E. Steven. "Technical Report Writing Today" VIII Edition (IndianAdaptation). New Delhi: Biztantra, 2004.*

23ENG234	INDIAN SHORT STORIES IN ENGLISH	L-T-P-C: 2-0-0-2

OBJECTIVES:

- To help the students learn the fine art of story writing; to help them learn the techniques of story telling; to helpthem study fiction relating it to the socio- cultural aspects of the age; to familiarize them with different strategies of reading short stories; to make them familiar with the morals and values held in high esteem by the ideals of Indianness.

Syllabus

Unit 1
Introduction: Differences between novel and short stories – origin and development of short stories - Rabindranath Tagore: Kabuliwallah; Mulk Raj Anand: The Gold Watch.

Unit 2
R. K. Narayan: Sweets for Angels; K. A. Abbas: The Refugee; Khushwant Singh: The Mark of Vishnu.

Unit 3
Masti Venkatesha Iyengar: The Curds-Seller; Manohar Malgonkar: Upper Division Love; Romila Thapar: The Spell; Premchand: The Voice of God.

TEXT:

1. *M. G. Narasimha Murthy (ed), Famous Indian Stories. Hyderabad: Orient Black Swan, 2014*

REFERENCE:

1. *Mohan Ramanan (Ed), English and the Indian Short Story: Essays in Criticism, Hyderabad, Orient Black Swan,2000.*

23FRE230	**PROFICIENCY IN FRENCH LANGUAGE (LOWER)**	**L-T-P-C: 2-0-0-2**

Syllabus

Unit 1

Population - Identity
How to introduce yourself (name, age, address, profession, nationality); Numbers; How to ask questions; Grammar – Pronouns - subjects; Regular verbs of 1st group (er) in the present; Être (to be) and avoir (to have) in the present; Interrogative sentence; Gender of adjectives.

Unit 2

The suburbs - At the train station
Introduce someone; Buy a train ticket or a cinema ticket; Ask for information; Official time; Ask for a price; The city (church, town hall, post office…)
Grammar – Pronouns - subjects (continuation); Gender of adjectives (continuation); Plural of nouns and adjectives; Definite and indefinite articles; Interrogative adjectives; I would like (Je voudrais).

Unit 3

Paris and the districts - Looking for a room
Locate a room and indicate the way; Make an appointment; Give a price; Ordinal numbers; Usual time; Ask for the time.
Grammar - Imperative mode; Contracted articles (au, du, des); negation.

TEXTBOOK:

1. *Metro St Michel - Publisher: CLE international*

23FRE231	PROFICIENCY IN FRENCH LANGUAGE (HIGHER)	L-T-P-C: 2-0-0-2

Syllabus

Unit 1

The first room of a student
A party to celebrate the 1st room; Description of a room; furniture; Locate objects: prepositions (devant, derrière, dans…), Read advertisement; Appreciation (I like, I prefer,).

Grammar - Perfect past tense with avoir; Possessive adjectives (mon, ton, son…); Demonstrative adjectives (ce, cet, cette); Yes (oui, si).

Unit 2 Small

jobs
Conversation on the phone; Give Time indications; Answer a job offer; Describe a job; Suggest a meeting time. Grammar - Perfect past tense with être and avoir (continuation); Possessive adjectives (notre, votre, leur); Prepositions (à, pour, avec …); Pronoun as direct object (le, la, l', les).

Unit 3

University Restaurant
Inquiry; Express an opinion; Ask questions (continuation); Food, meals, taste, preferences; Nutrition, diet, choosea menu or diet, Expression of quantities (beaucoup, peu).

Grammar - Partitif (expressing quantity) (du, de la, pas de….); Comparison (plus...que, moins….que, autant …que); Interrogation (continuation), inversion, Est-ce que, qu'est-ce que?.

TEXTBOOK:

1. Metro St Michel - Publisher: CLE International

23GER230	GERMAN FOR BEGINNERS I	L-T-P-C: 2-0-0-2

Syllabus

Unit 1
Greetings; Introducing one-self (formal and informal context), saying their name, origin, living place, occupation. Numbers 1-100; Saying the telephone number. Countries and Languages.
Grammar: Structure – W - Questions and Yes/No questions and statements, personal pronouns, verb conjugations. Articles.
Vocabulary: Professions.

Unit 2
Giving the personal details. Name, age, marital status, year of birth, place of birth, etc.
Numbers till 1000. Saying a year. Alphabets – spelling a word.
Filling up an application form; In the restaurant – making an order.
Grammar: Definite, indefinite and negative article in nominative. Accusative: indefinite and negative Article
Vocabulary: Food items

Unit 3
Numbers above 1000. Orientation in Shopping plazas: asking the price, where do I find what, saying the opinion. Grammar: Accusative – definite article. Adjectives and plural forms. Vocabulary: Furniture and currencies.

23GER231	GERMAN FOR BEGINNERS II	L-T-P-C: 2-0-0-2

Syllabus

Unit 1
Shopping and orientation in supermarket; Conversation between the customer and salesman; Where one finds what in supermarket; Asking for requests and suggestions.

Grammar: Dative of personal pronouns. Imperative form. Vocabulary: Consumables and measurements;

Unit 2
Appointments; Work and leisure time activities; Time, weekdays, months and seasons; saying the date; fixing upan appointment.

Grammar: Model verbs; Prepositions with time and place; Ordinal numbers. Vocabulary: Leisure activities, weekdays, months and seasons.

Unit 3
Family and household; Family and relations; household and daily routine. Grammar: Possessive articles; Divisibleand indivisible verbs.
Vocabulary: Family circle; Household articles.

23GER232	PROFICIENCY IN GERMANLANGUAGE (LOWER)	L-T-P-C: 2-0-0-2

Syllabus

To have an elementary exposure to German language; specifically

1. to have some ability to understand simple spoken German, and to be able to speak it so as to be able tocarry on life in Germany without much difficulty (to be able to do shopping, etc.);
2. to be able to understand simple texts, and simple forms of written communication;
3. to have a basic knowledge of German grammar;
4. to acquire a basic vocabulary of 500 words;
5. to be able to translate simple letters with the use of a dictionary; and
6. to have some familiarity with the German life and culture.

(This will not be covered as part of the regular classroom teaching; this is to be acquired by self-study.)

Some useful websites will be given.

23GER233	PROFICIENCY IN GERMAN LANGUAGE (HIGHER)	L-T-P-C: 2-0-0-2

Syllabus

The basic vocabulary and grammar learned in the earlier course is mostly still passive knowledge. The endeavourof this course is to activate this knowledge and develop the skill of communication.

Topics are: Airport, railway station, travelling; shopping; invitations, meals, meeting people; around the house; the human body; colours; professions.

Past and future tenses will be introduced. Applying genitive, dative and accusative. Some German culture. Films.

23HIN230	HINDI I	L-T-P-C: 2-0-0-2

OBJECTIVES:

- To teach Hindi for effective communication in different spheres of life - Social context, Education, governance,Media, Business, Profession and Mass communication.

Course Outcomes:

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

CO1: Gain knowledge about the nature and culture of Hindi
languageCO2: Understand the structural aspects of Hindi language
CO3: Apply the knowledge of the grammatical structures to communicate in
HindiCO4: Analyse the social significance of modern literature.
CO5: Develop the ability to translate a given text to Hindi

CO-PO Mapping:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1								2	3					
CO2								2	3					
CO3								2	3					
CO4									3					
CO5								2						

Syllabus

Unit 1
Introduction to Hindi Language, National Language, Official Language, link Language etc. Introduction to Hindi language, Devanagari script and Hindi alphabet.

Shabda Bhed, Roopanthar ki Drishti se- Bhasha – Paribhasha aur Bhed – Sangya - Paribhasha Aur Bhed - Sangyake Roopanthar - kriya.

Unit 2
Common errors and error corrections in Parts of Speech with emphasis on use of pronouns, Adjective and verb in different tenses – Special usage of adverbs, changing voice and conjunctions in sentences, gender& number - General vocabulary for conversations in given context –understanding proper pronunciation - Conversations, Interviews, Short speeches.

Unit 3
Poems – Kabir 1st 8 Dohas, Surdas 1st 1 Pada; Tulsidas 1st 1 Pada; Meera 1st 1 Pada

Unit 4
Letter writing – personal and Formal – Translation from English to Hindi.

Unit 5
Kahani – Premchand: Kafan, Abhilasha, Vidroh, Poos ki rath, Juloos.

BOOKS:

1. *Prem Chand Ki Srvashrestha Kahaniyam: Prem Chand; Diamond Pub Ltd. New Delhi*
2. *Vyavaharik Hindi Vyakaran ,Anuvad thaha Rachana : Dr. H. Parameswaran, Radhakrishna publishingHouse, New Delhi*
3. *Kamtha Prasad Guru : Hindi Vyakaran, Best Book pub House, New Delhi*
4. *Poetry : Kavya Ras - Ed: T.V. Basker - Pachouri Press; Mathura*

23HIN231	HINDI II	L-T-P-C: 2-0-0-2

OBJECTIVES:

- Appreciation and assimilation of Hindi Literature both drisya & shravya using the best specimens provided asanthology.

Course Outcomes:

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

CO1: Understand the grammatical structures of HindiCO2: Understand the post modern trends of literature CO3: Enhance critical thinking and writing skills
CO4: Identify and analyse different literary and audio-visual material
CO5: Apply fundamental knowledge of Hindi in formal and informal writing

CO-PO Mapping:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1								**1**	**2**					
CO2								**1**	**2**					
CO3								**1**	**2**					
CO4									**3**					
CO5								**1**	**2**					

Syllabus:

Unit 1
Kavya Tarang; Dhumil ke Anthim Kavitha [Poet-Dhumil]; Dhabba [Poet-Kedarnath Singh]; Proxy [Poet-Venugopal]; Vakth [Poet-Arun Kamal]; Maachis [Poet-Suneeta Jain].

Unit 2
Communicative Hindi - Moukhik Abhivyakthi

Unit 3
Audio-Visual Media in Hindi – Movies like Tare Zameen par, Paa, Black etc., appreciation and evaluation. News reading and presentations in Radio and TV channels in Hindi.

Unit 4
Gadya Manjusha – Budhapa, Kheesa, Sadachar ka Thavis

Unit 5
Translation: Theory and Practice - Letter writing: Formal and Personal – Introduction to Hindi Software.

BOOKS:

1. *Kavay Tarang: Dr. Niranjan, Jawahar Pusthakalay, Mathura.*
2. *Gadya Manjusha: Editor: Govind, Jawahar Pusthakalay, Mathura*

23HUM230	EMOTIONAL INTELLIGENCE	L-T-P-C: 2-0-0-2

Syllabus

Unit 1

Emotional Intelligence: Concept of Emotional Intelligence, Understanding the history and origin of Emotional Intelligence, Contributors to Emotional Intelligence, Science of Emotional Intelligence, EQ and IQ, Scope of Emotional Intelligence.

Unit 2

Components of Emotional Intelligence: Self-awareness, Self-regulation, Motivation, Empathy, Social skills. Emotional Intelligence Competencies, Elements of Emotional Intelligence, Models of Emotional Intelligence: The Ability-based Model, The Trait Model of Emotional Intelligence, Mixed Models of Emotional Intelligence.

Unit 3

Emotional Intelligence at Work place: Importance of Emotional Intelligence at Work place? Cost–savings of Emotional Intelligence, Emotionally Intelligent Leaders, Case Studies Measuring Emotional Intelligence: Emotionally Intelligence Tests, Research on Emotional Intelligence, Developing Emotional Intelligence.

REFERENCES:

1. *Daniel Goleman (1996). Emotional Intelligence- Why it can Matter More than IQ. Bantam Doubleday Dell Publishing Group*
2. *Daniel Goleman (2000). Working with Emotional Intelligence. Bantam Doubleday Dell Publishing Group*
3. *Liz Wilson, Stephen Neale & Lisa Spencer-Arnell (2012). Emotional Intelligence Coaching. Kogan PageIndia Private Limited*

23HUM231	GLIMPSES INTO THE INDAN MIND -THE GROWTH OF MODERN INDIA	L-T-P-C: 2-0-0-2

Syllabus

Unit 1

Introduction General Introduction; 'His + Story' or 'History' ?; The concepts of 'nation', 'national identity' and 'nationalism';Texts and Textualities: Comparative Perspectives.

Unit 2

Selected writings / selections from the complete works of the following authors will be taken up for study in a chronological order:
Raja Ram Mohan Roy; Dayananda Saraswati; Bal Gangadhar Tilak; Rabindranath Tagore;

Unit 3

Selected writings / selections from the complete works of the following authors will be taken up for study in a chronological order:
Swami Vivekananda; Sri Aurobindo; Ananda K. Coomaraswamy; Sister Nivedita; Mahatma Gandhi; Jawaharlal Nehru; B.R. Ambedkar; Sri Chandrasekharendra Saraswati, the Paramacharya of Kanchi; Dharampal; Raja Rao; V.S. Naipaul.

Conclusion.

REFERENCES:

1. *Tilak, Bal Gangadhar. The Orion / Arctic Home in the Vedas.*
2. *Tagore, Rabindranath. The History of Bharatavarsha / On Nationalism / Greater India.*
3. *Vivekananda, Swami. "Address at the Parliament of Religions"/"The Future of India"/"In Defence ofHinduism" from Selections from the Complete Works of Swami Vivekananda.*
4. *Aurobindo, Sri. The Renaissance in India / On Nationalism.*
5. *Coomaraswamy, Ananda K. Essays in Indian Idealism (any one essay) / Dance of Shiva.*
6. *Nivedita, Sister. "Noblesse Oblige: A Study of Indian Caste" / "The Eastern Mother" from The Web ofIndian Life.*
7. *Gandhi, Mahatma. Hind Swaraj.*
8. *Nehru, Jawaharlal. "The Quest" from Discovery of India.*
9. *Ambedkar, B. R. "Buddha and His Dhamma" from Collected Works.*
10. *Saraswati, Chandrasekharendra. "The Sastras and Modern Life" from The Hindu Dharma.*
11. *Dharampal. Bharatiya Chitta, Manas and Kala / Understanding Gandhi.*
12. *Naipaul, V. S. India: A Wounded Civilization / India: A Million Mutinies Now.*

23HUM232	GLIMPSES OF ETERNAL INDIA	L-T-P-C: 2-0-0-2

Syllabus

Unit 1

Introduction

A peep into India's glorious past

Ancient India – the vedas, the vedic society and the Sanatana Dharma – rajamandala and the Cakravartins – Ramarajya – Yudhisthira's ramarajya; Sarasvati - Sindhu Civilization and the myth of the Aryan Invasion; Classical India – Dharma as the bedrock of Indian society – Vaidika Brahmanya Dharma and the rise of Jainism and Buddhism – the sixteen Mahajanapadas and the beginning of Magadhan paramountcy - Kautilya and his Arthasastra – Chandragupta Maurya and the rise of the Mauryan empire – Gupta dynasty Indian art and architecture – classical sanskrit literature – Harsavardhana; Trade and commerce in classical and medieval India and the story of Indian supremacy in the Indian ocean region; The coming of Islam – dismantling of the traditional Indian polity – the Mughal empire – Vijayanagara samrajya and days of Maratha supremacy.

Unit 2

India's contribution to the world: spirituality, philosophy and sciences

Indian Philosophy – the orthodox (Vaidika) and the heterodox (atheistic) schools; Ramayana and Mahabharata; Bhagavad Gita; Saints and sages of India; Ancient Indian medicine: towards an unbiased perspective; Ancient Indian mathematics; Ancient Indian astronomy; Ancient Indian science and technology.

The arrival of Europeans, British paramountcy and colonization

What attracted the rest of the world to India?; India on the eve of the arrival of European merchants; The story of colonization and the havoc it wrecked on Indian culture and civilization; Macaulay and the start of the distortion of Indian education and history; Indian economy – before and after colonization: a brief survey; The emergence of modern India.

Unit 3

Women in Indian society

The role and position of women in Hindu civilization; Gleanings from the Vedas, Brihadarnyaka Upanishad, Saptasati Devi Mahatmyam, Ramayana, Mahabharata, Manusmriti, Kautilya's Arthasastra and Mrichchhakatikamof Sudraka; The role and position of Indian women vis-a-vis Islam and European cultures; The great women of India.

Modern India

The national movement for freedom and social emancipation; Swami Vivekananda, Sri Aurobindo, Rabindranath Tagore; Understanding Mahatma Gandhi; A new nation is born as a republic – the pangs of birth and growth; India since Independence – the saga of socio-political movements; Problems facing the nation today; Globalization and Indian Economy; Bharatavarsha today and the way ahead: Regeneration of Indian National Resources.

Conclusion

The Wonder that was India; The 'politics' and 'purpose' of studying India.

REFERENCES:

1. *Parameswaran, S. The Golden Age of Indian Mathematics. Kochi: Swadeshi Science Movement.*
2. *Somayaji, D. A. A Critical Study of Ancient Hindu Astronomy. Dharwar: 1972.*
3. *Sen, S. N. & K. V. Sarma eds. A History of Indian Astronomy. New Delhi, 1985.*
4. *Rao, S. Balachandra. Indian Astronomy: An Introduction. Hyderabad: Universities Press, 2000.*
5. *Bose, D. M. et. al. A Concise History of Science in India. New Delhi: 1971.*
6. *Bajaj, Jitendra & M. D. Srinivas. Indian Economy and Polity. Chennai: Centre for Policy Studies.*
7. *Bajaj, Jitendra & M. D. Srinivas.Timeless India, Resurgent India. Chennai: Centre for Policy Studies.*
8. *Joshi, Murli Manohar. Science, Sustainability and Indian National Resurgence. Chennai: Centre forPolicy Studies, 2008.*
9. *The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.*

10. *Vivekananda, Swami. Selections from the Complete Works of Swami Vivekananda. Kolkata: AdvaitaAshrama.*
11. *Mahadevan, T. M. P. Invitations to Indian Philosophy. Madras: University of Madras.*
12. *Hiriyanna, M. Outlines of Indian Philosophy. Motilal Banarsidass.*
13. *Tagore, Rabindranath. The History of Bharatavarsha / On Nationalism / Greater India.*
14. *Majumdar, R. C. et. al. An Advanced History of India. Macmillan.*
15. *Mahajan, V. D. India Since 1526. New Delhi: S. Chand & Company.*
16. *Durant, Will. The Case for India. Bangalore: Strand Book Stall, 2008.*
17. *Aurobindo, Sri. The Indian Renaissance / India's Rebirth / On Nationalism.*
18. *Nivedita, Sister. The Web of Indian Life. Kolkata: Advaita Ashrama.*
19. *Durant, Will. The Story of Civilization. Volume 1 – Our Oriental Heritage. New York: Simon & Schuster.*
20. *Ranganathananda, Swami. Eternal Values for A Changing Society. Bombay: Bharatiya Vidya Bhavan.*
21. *Ranganathananda, Swami. Universal Message of the Bhagavad Gita. Kolkata: Advaita Ashrama.*
22. *Seturaman, V. S. Indian Aesthetics. Macmillan.*
23. *Coomaraswamy, Ananda K. The Dance of Shiva. New Delhi: Sagar Publications.*
24. *Coomaraswamy, Ananda K. Essays on Indian Idealism. New Delhi: Munshiram Manoharlal.*
25. *Danino, Michel. The Invasion That Never Was.*
26. *Kautilya. Arthasastra.*
27. *Altekar, A. S. State and Government in Ancient India. New Delhi: Motilal Banarsidass.*
28. *Altekar, A. S. The Position of Women in Hindu Civilization. New Delhi: Motilal Banarsidass.*
29. *Sircar, D. C. Studies in the Religious Life of Ancient and Medieval India. New Delhi: Motilal Banarsidass.*
30. *Sircar, D. C. Studies in the Political and Administrative Systems in Ancient and Medieval Times.NewDelhi: Motilal Banarsidass.*
31. *Madhavananda, Swami & R. C. Majumdar eds. The Great Women of India. Kolkata: Advaita Ashrama.*
32. *Dutt, R. C. The Economic History of India. London, 1902.*
33. *Dharampal. Collected Works.*
34. *Dharampal. Archival Compilations (unpublished)*

23HUM233	GLIMPSES OF INDIAN ECONOMY AND POLITY	L-T-P-C: 2-0-0-2

Syllabus

Unit 1
Introduction
General Introduction; Primitive man and his modes of exchange – barter system; Prehistoric and proto-historic polity and social organization.
Ancient India – up to 600 B.C.
Early India – the vedic society – the varnashramadharma – socio-political structure of the various institutions based on the four purusarthas; The structure of ancient Indian polity – Rajamandala and Cakravartins – Prajamandala;Socio-economic elements from the two great Epics – Ramayana and Mahabharata – the concept of the ideal King(Sri Rama) and the ideal state (Ramarajya) – Yudhisthira's ramarajya; Sarasvati - Sindhu civilization and India'strade links with other ancient civilizations; Towards chiefdoms and kingdoms – transformation of the polity: kingship – from gopati to bhupati; The mahajanapadas and the emergence of the srenis – states and cities of theIndo-Gangetic plain.

Unit 2
Classical India: 600B.C. – 1200 A.D.
The rise of Magadha, emergence of new religions – Buddhism and Jainism – and the resultant socio-economic impact; The emergence of the empire – the Mauryan Economy and Kautilya's Arthasastra; of Politics and trade – the rise of the Mercantile Community; Elements from the age of the Kushanas and the Great Guptas; India's maritime trade; Dharma at the bedrock of Indian polity – the concept of Digvijaya: dharma-vijaya, lobha-vijaya and asura-vijaya; Glimpses into the south Indian economies: political economies of the peninsula – Chalukyas, Rashtrakutas and Cholas

Medieval India: 1200 A.D. – 1720 A.D.
Advent of Islam – changes in the social institutions; Medieval India – agrarian economy, non-agricultural production and urban economy, currency system; Vijayanagara samrajya and maritime trade – the story of Indian supremacyin the Indian Ocean region; Aspects of Mughal administration and economy; The Maratha and other provincial economies.

Unit 3
Modern India: 1720 - 1947
the Indian market and economy before the arrival of the European traders; Colonisation and British supremacy (dismantling of everything that was 'traditional' or 'Indian') – British attitude towards Indian trade, commerce and economy and the resultant ruining of Indian economy and business – man-made famines – the signs of renaissance: banking and other business undertakings by the natives (the members of the early Tagore family, the merchants of Surat and Porbander, businessmen of Bombay, etc. may be referred to here) – the evolution of the modern banking system; Glimpses into British administration of India and administrative models; The National movement and nationalist undertakings in business and industry: the Tatas and the Birlas; Modern India: the growth of large- scale industry – irrigation and railways – money and credit – foreign trade; Towards partition – birth of two new nations – division of property; The writing of the Indian Constitution – India becomes a democratic republic – a new polity is in place.

Independent India – from 1947
India since Independence – the saga of socio-political movements; Indian economy since Independence – the fiscal system – the five year plans – liberalisation – the GATT and after; Globalisation and Indian economy; Impact of science and (new/ emerging) technology on Indian economy; Histories of select Indian business houses and business entrepreneurship.
Conclusion

REFERENCES:

1. *The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.Kautilya. Arthasastra.*

2. *Altekar, A. S. State and Government in Ancient India. New Delhi: Motilal Banarsidass.*
3. *Sircar, D. C. Studies in the Political and Administrative Systems in Ancient and Medieval Times. NewDelhi: Motilal Banarsidass.*
4. *Dutt, R. C. The Economic History of India. London, 1902.*
5. *Dharampal. Collected Works (Volumes IV & V).*
6. *Dharampal. Archival Compilations (unpublished).*
7. *Bajaj, Jitendra & M. D. Srinivas. Indian Economy and Polity. Chennai: Centre for Policy Studies.*
8. *Bajaj, Jitendra & M. D. Srinivas. Timeless India, Resurgent India. Chennai: Centre for Policy Studies.*
9. *Joshi, Murli Manohar. Science, Sustainability and Indian National Resurgence. Chennai: Centre forPolicy Studies, 2008.*
10. *Tripathi, Dwijendra. The Oxford History of Indian Business. New Delhi: Oxford University Press, 2004.*
11. *McGuire, John, et al, eds. Evolution of World Economy, Precious Metals and India. New Delhi: OxfordUniversity Press, 2001.*
12. *Tripathi, Dwijendra and Jyoti Jumani. The Concise Oxford History of Indian Business. New Delhi: Oxford University Press, 2007.*
13. *Kudaisya, Medha M. The Life and Times of G. D. Birla. New Delhi: Oxford University Press, 2003.*
14. *Raychaudhuri, Tapan and Irfan Haib, eds. The Cambridge Economic History of India. Volume*
15. *New Delhi: Orient Longman, 2004.*
16. *Kumar, Dharma, ed. The Cambridge Economic History of India. Volume 2. New Delhi: Orient Longman,2005.*
17. *Sabavala, S. A. and R. M. Lala, eds. J. R. D. Tata: Keynote. New Delhi: Rupa & Co., 2004.*
18. *Mambro, Arvind ed. J. R. D. Tata: Letters. New Delhi: Rupa & Co., 2004.*
19. *Lala, R. M., For the Love of India: The Life and Times of Jamsetji Tata. New Delhi: Penguin, 2006.*
20. *Thapar, Romila. The Penguin History of Early India: From the Origins to AD 1300. New Delhi Penguin,2002.*
21. *Majumdar, R. C., et. al. An Advanced History of India. Macmillan.*

23HUM234	HEALTH AND LIFESTYLE	L-T-P-C: 2-0-0-2

Syllabus

Unit 1

Introduction to Health
Health is wealth; Role of lifestyle habits on health; Importance of adolescence; Stages, Characteristics and changes during adolescence; Nutritional needs during adolescence why healthy lifestyle is important for adolescence. Eating Habits - eating disorders, skipping breakfast, junk food consumption.

Practicals - Therapeutic Diets

Unit 2

Food and Nutritional Requirements during Adolescence
Fluid intake; nutrition related problems; lifestyle related problems, Role of physical activity; resting pattern and postures, Personal habits – alcoholism, and other tobacco products, electronic addiction etc

Practicals - Ethnic Foods

Unit 3

Need for a Positive Life Style Change
Peer pressure & procrastination, Stress, depression, suicidal tendency, Mini project review and viva, Whole portions revision.

Practical - Cooking without Fire or Wire-healthy Snacks

TEXTBOOKS:

1. *B. Srilakshmi, "Dietetics", New age international (P) ltd, publishers, 2010.*
2. *"Nutrient requirement and Recommended Dietary Allowances for Indians", published by Indian Councilof Medical Research, ICMR, 2010.*

REFERENCE BOOKS:

1. *K Park "Textbook of preventive and social medicine", 2010.*
2. *WHO Report on Adolescent Health: 2010*

23HUM235	INDIAN CLASSICS FOR THE TWENTY-FIRST CENTURY	L-T-P-C: 2-0-0-2

Syllabus

Unit 1
Introductory study of the Bhagavad Gita and the Upanishads.

Unit 2
The relevance of these classics in a modern age.

Unit 3
Goals of human life - existential problems and their solutions in the light of these classics etc.

REFERENCE:

1. *The Bhagavad Gita, Commentary by Swami Chinmayananda*

23HUM236	INTRODUCTION TO INDIA STUDIES	L-T-P-C: 2-0-0-2

PREAMBLE:

This paper will introduce the students to the multiple dimensions of the contribution of India to the fields of philosophy, art, literature, physical and social sciences. The paper intends to give an insight to the students about the far-reaching contributions of India to world culture and thought during the course of its long journey from the hoary antiquity to the present times. Every nation takes pride in its achievements and it is this sense of pride and reverence towards the achievements that lays the foundation for its all-round progress.

Syllabus

Unit 1
A brief outline of Indian history from prehistoric times to the present times.
Contributions of India to world culture and civilization: Indian Philosophy and Religion; Art and Literature; Physical and Social Sciences.
Unit 2
Modern India: Challenges and Possibilities.
Scientific and technological progress in post-independence era; Socio-cultural and political movements after independence; Challenges before the nation today - unemployment – corruption – degradation of cultural and moral values - creation of a new system of education; Creation of a modern and vibrant society rooted in traditional values.
Unit 3
Modern Indian Writing in English: Trends in Contemporary Indian Literature in English.

TEXTBOOK:
Material given by the Faculty

BACKGROUND LITERATURE:

1. *Selections from The Cultural Heritage of India, 6 volumes, Ramakrishna Mission Institute of Culture(Kolkata) publication.*
2. *Selections from the Complete Works of Swami Vivekananda, Advaita Ashrama publication.*
3. *Invitations to Indian Philosophy, T. M. P. Mahadevan, University of Madras, Chennai.*
4. *Outlines of Indian Philosophy, M. Hiriyanna, MLBD.*
5. *An Advanced History of India, R. C. Majumdar et al, Macmillan.*
6. *India Since 1526, V. D. Mahajan, S. Chand & Company*
7. *The Indian Renaissance, Sri Aurobindo.*
8. *India's Rebirth, Sri Aurobindo.*
9. *On Nationalism, Sri Aurobindo.*
10. *The Story of Civilization, Volume I: Our Oriental Heritage, Will Durant, Simonand Schuster, New York.*
11. *Eternal Values for a Changing Society, Swami Ranganathananda, Bharatiya Vidya Bhavan.*
12. *Universal Message of the Bhagavad Gita, Swami Ranganathananda, Advaita Ashrama.*
13. *Awaken Children: Conversations with Mata Amritanandamayi*
14. *Indian Aesthetics, V. S. Seturaman, Macmillan.*
15. *Indian Philosophy of Beauty, T. P. Ramachandran, University of Madras, Chennai.*
16. *Web of Indian Thought, Sister Nivedita*
17. *Essays on Indian Nationalism, Anand Kumaraswamy*
18. *Comparative Aesthetics, Volume 2, Kanti Chandra Pandey, Chowkhamba, Varanasi*
19. *The Invasion That Never Was, Michel Danino*
20. *Samskara, U. R. Ananthamurthy, OUP.*
21. *Hayavadana, Girish Karnard, OUP.*
22. *Naga-Mandala, Girish Karnard, OUP.*

23HUM237	INTRODUCTION TO SANSKRIT LANGUAGE AND LITERATURE	L-T-P-C: 2-0-0-2

OBJECTIVES:

- To familiarize students with Sanskrit language; to introduce students to various knowledge traditions in Sanskrit;to help students appreciate and imbibe India’s ancient culture and values.

Syllabus

Unit 1
Sanskrit Language – Vakya Vyavahara (प्रथमादीक्षा) - Introduction to Sanskrit language - Devanagari script and Sanskrit alphabet - Vowels and Consonants – Pronunciation - Classification of Consonants – Samyukthakshara Words – Nouns and Verbs - Cases – Introduction to Numbers and Time – Verbs: Singular, Dual and Plural – SarvaNamas: First Person, Second Person, Third Person – Tenses: Past, Present and Future -Words for Communication – Selected Slokas – MoralStories – Subhashithas – Riddles.

Unit 2
Language Studies - Role of Sanskrit in Indian & World Languages.

Unit 3
Introduction to Sanskrit Classical Literature – KavyaTradition – Drama Tradition - Stotra Tradition – Panchatantra Stories.

Unit 4
Introduction to Sanskrit Technical Literature – Astronomy – Physics – Chemistry – Botany – Engineering – Aeronautics – Ayurveda – Mathematics – Medicine – Architecture - Tradition of Indian Art – Administration – Agriculture.

Unit 5
Indology Studies – Perspectives and Innovations.

TEXTBOOKS AND REFERENCE BOOKS:

1. *Vakya Vyavahara- Prof. Vempaty Kutumba Sastri, Rashtriya Sanskrit Sansthan, New Delhi*
2. *The Wonder that is Sanskrit - Dr.Sampadananda Mishra, New Delhi*
3. *Science in Sanskrit – Samskritha Bharathi, NewDelhi*

23HUM238	NATIONAL SERVICE SCHEME	L-T-P-C: 2-0-0-2

Syllabus

Unit 1
Introduction to Basic Concepts of NSS: History, philosophy, aims and objectives of NSS, Emblem, flag, motto, song, badge etc., Organisational structure, roles and responsibilities of various NSS functionaries.
NSS Programmes and Activities: Concept of regular activities, special campaigning, Day Camps, Basis of adoption of village / slums, methodology of conducting survey, financial pattern of the scheme, other youth programme/schemes of GOI, Coordination with different agencies, Maintenance of the Diary.

Unit 2
Volunteerism and Shramdan: Indian Tradition of volunteerism, Needs and importance of volunteerism, Motivation and Constraints of volunteerism, Shramdan as part of volunteerism, Amalabharatam Campaign, Swatch Bharath.

Unit 3
Understanding youth: Definition, profile and categories of youth, Issues, challenges and opportunities for youth, Youth as an agent of social change.
Youth and Yoga: History, philosophy and concept of Yoga, Myths and misconceptions about Yoga, Different Yoga traditions and their impacts, Yoga as a preventive and curative method, Yoga as a tool for healthy life style

Unit 4
Youth Development Programmes in India: National Youth Policy, Youth development programmes at the national level, state level and voluntary sector, youth-focused and youth-led organizations.
Youth and Crime: Sociological and psychological factors influencing youth crime, Peer mentoring in preventing crimes, Awareness about Anti-Ragging, Cyber Crime and its prevention, Juvenile Justice.

Unit 5
Environmental Issues: Environment conservation, enrichment and sustainability, climate change, waste management, rain water harvesting, energy conservation, waste land development.

Project Work / Practical

23HUM239	PSYCHOLOGY FOR EFFECTIVE LIVING	L-T-P-C: 2-0-0-2

Course Objectives

- To help students acquire the basic knowledge of behavior and effective living
- To create an awareness of the hazards of health compromising behaviours
- To develop and strengthen the tools required to handle the adversities of life

Course Outcome

CO 1: Understand the basic concepts of Behavioral PsychologyCO
2: Demonstrate self reflective skills through activities
CO 3: Apply the knowledge of psychology to relieve stress
CO 4: Analyse the adverse effects of health compromising behaviours.
CO 5: Evaluate and use guided techniques to overcome and cope with stress related problems.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1						1					1
CO2						3		3	3		
CO3						3	2	1		3	2
CO4						2	3				1
CO5						2				1	1

Syllabus

Unit 1

Self-Awareness & Self-Motivation
Self analysis through SWOT, Johari Window, Maslow's hierarchy of motivation, importance of self esteem and enhancement of self esteem.

Unit 2

The Nature and Coping of Stress
Conflict, Relationship issues, PTSD. Stress – stressors – eustress - distress, coping with stress, stress management techniques.

Unit 3

Application of Health Psychology
Health compromising behaviours, substance abuse and addiction.

TEXTBOOKS:

1. *V. D. Swaminathan & K. V. Kaliappan "Psychology for effective living - An introduction to Health*
2. *Psychology. 2nd edition Robert J. Gatchel, Andrew Baum & David S. Krantz, McGraw Hill.*

REFERENCE BOOKS:

1. *S. Sunder, 'Textbook of Rehabilitation', 2nd edition, Jaypee Brothers, New Delhi. 2002.*
2. *Weiben & Lloyd, 'Psychology applied to Modern Life', Thompson Learning, Asia Ltd.2004.*

23HUM240	PSYCHOLOGY FOR ENGINEERS	L-T-P-C: 2-0-0-2

Course Objectives:

- To strengthen the fundamental knowledge of human behavior
- To strengthen the ability to understand the basic nature and behavior of humans in organizations as a whole
- To connect the concepts of psychology to personal and professional life

Course Outcome

CO 1: Understand the fundamental processes underlying human behavior such as learning, motivation,individual differences, intelligence and personality.
CO 2: Apply the principles of psychology in day- to- day life for a better understanding of oneself and others.
CO 3: Apply the knowledge of Psychology to improve study skills and learning methods
CO 4: Apply the concepts of defense mechanisms to safeguard against abusive relationships and to nurturehealthy relationships.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PsO1
CO1						3		3	2		1	
CO2						3	2	3	3	1	2	
CO3									2	1		
CO4						3		2	2		2	

Syllabus

Unit 1
Psychology of Adolescents: Adolescence and its characteristics.

Unit 2
Learning, Memory & Study Skills: Definitions, types, principles of reinforcement, techniques for improving study skills, Mnemonics.

Unit 3
Attention & Perception: Definition, types of attention, perception.

TEXTBOOKS:

1. *S. K. Mangal, "General Psychology", Sterling Publishers Pvt. Ltd.2007*
2. *Baron A. Robert, "Psychology", Prentice Hall of India. New Delhi 2001*

REFERENCE BOOKS:

1. *Elizabeth B. Hurlock, Developmental Psychology - A life span approach, 6th edition.*
2. *Feldman, Understanding Psychology, McGraw Hill, 2000.*
3. *Clifford Morgan, Richard King, John Scholper, "Introduction to Psychology", Tata Mcgraw Hill, PvtLtd 2004.*

23HUM241	SCIENCE AND SOCIETY - AN INDIAN PERSPECTIVE	L-T-P-C: 2-0-0-2

Syllabus

Unit 1
Introduction
Western and Indian views of science and technology
Introduction; Francis Bacon: the first philosopher of modern science; The Indian tradition in science andtechnology: an overview.

Unit 2
Indian sciences
Introduction; Ancient Indian medicine: towards an unbiased perspective; Indian approach to logic; The methodology of Indian mathematics; Revision of the traditional Indian planetary model by Nilakantha Somasutvan in circa 1500 AD

Science and technology under the British rule
Introduction; Indian agriculture before modernization; The story of modern forestry in India; The building of New Delhi

Unit 3
Science and technology in Independent India
Introduction; An assessment of traditional and modern energy resources; Green revolution: a historical perspective; Impact of modernisation on milk and oilseeds economy; Planning without the spirit and the determination.

Building upon the Indian tradition
Introduction; Regeneration of Indian national resources; Annamahatmyam and Annam Bahu Kurvita: recollecting the classical Indian discipline of growing and sharing food in plenty and regeneration of Indian agriculture to ensure food for all in plenty.

Conclusion

REFERENCES:

1. *Joseph, George Gheverghese. The Crest of the Peacock: Non-European Roots of Mathematics. London:Penguin (UK), 2003.*
2. *Iyengar, C. N. Srinivasa. History of Hindu Mathematics. Lahore: 1935, 1938 (2 Parts).*
3. *Amma, T. A. Saraswati. Geometry in Ancient and Medieval India. Varanasi: Motilal Banarsidass, 1979.*
4. *Bag, A. K. Mathematics in Ancient and Medieval India. Varanasi: Motilal Banarsidass, 1979.*
5. *Sarma K. V. & B. V. Subbarayappa. Indian Astronomy: A Source-Book. Bombay: Nehru Centre, 1985.*
6. *Sriram, M. S. et. al. eds. 500 Years of Tantrasangraha: A Landmark in the History of Astronomy. Shimla:Indian Institute of Advanced Study, 2002.*
7. *Bajaj, Jitendra & M. D. Srinivas. Restoring the Abundance: Regeneration of Indian Agriculture toEnsure Food for All in Plenty.Shimla: Indian Institute of Advanced Study, 2001.*
8. *Bajaj, Jitendra ed. Report of the Seminar on Food for All: The Classical Indian Discipline of Growingand Sharing Food in Plenty. Chennai: Centre for Policy Studies, 2001.*
9. *Bajaj, Jitendra & M. D. Srinivas. Annam Bahu Kurvita: Recollecting the Indian Discipline of Growingand Sharing Food in Plenty. Madras: Centre for Policy Studies, 1996.*
10. *Parameswaran, S. The Golden Age of Indian Mathematics. Kochi: Swadeshi Science Movement.*
11. *Somayaji, D. A. A Critical Study of Ancient Hindu Astronomy. Dharwar: 1972.*
12. *Sen, S. N. & K. V. Sarma eds. A History of Indian Astronomy. New Delhi, 1985.*
13. *Rao, S. Balachandra. Indian Astronomy: An Introduction. Hyderabad: Universities Press, 2000.*
14. *Bose, D. M. et. al. A Concise History of Science in India. New Delhi: 1971.*
15. *Bajaj, Jitendra & M. D. Srinivas. Indian Economy and Polity. Chennai: Centre for Policy Studies.*

16. *Bajaj, Jitendra & M. D. Srinivas. Timeless India, Resurgent India. Chennai: Centre for Policy Studies.*
17. *Joshi, Murli Manohar. Science, Sustainability and Indian National Resurgence. Chennai: Centre for Policy Studies, 2008.*
18. *The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.*

** The syllabus and the study material in use herein has been developed out of a 'summer programme' offered by the Centre for Policy Studies (CPS), Chennai at the Indian Institute of Advanced Study (IIAS), Rashtrapati Nivas,Shimla, sometime ago. The same has been very kindly made available to us by Professors Dr M.D. Srinivas (Chairman) and Dr J.K. Bajaj (Director) of the CPS.*

23HUM242	THE MESSAGE OF BHAGWAD GITA	L-T-P-C: 2-0-0-2

Syllabus

Unit 1
Introduction: Relevance of Bhagavad Gita today – Background of Mahabharatha.

ArjunaVishada Yoga: Arjuna's Anguish and Confusion – Symbolism of Arjuna's Chariot.

Sankhya Yoga: Importance of Self-knowledge – Deathlessness: Indestructibility of Consciousness – Being Established in Wisdom – Qualities of a Sthita-prajna.

Unit 2
Karma Yoga: Yoga of Action – Living in the Present – Dedicated Action without Anxiety over Results - Conceptof Swadharma.

Dhyana Yoga: Tuning the Mind – Quantity, Quality and Direction of Thoughts – Reaching Inner Silence.

Unit 3
Bhakti Yoga: Yoga of Devotion – Form and Formless Aspects of the Divine – Inner Qualities of a True Devotee.

GunatrayaVibhaga Yoga: Dynamics of the Three Gunas: Tamas, Rajas, Sattva – Going Beyond the Three Gunas – Description of a Gunatheetha.

TEXTBOOKS / REFERENCES:

1. *Swami Chinmayananda, "The Holy Geeta", Central Chinmaya Mission Trust, 2002.*
2. *Swami Chinmayananda, "A Manual of Self Unfoldment", Central Chinmaya Mission Trust, 2001.*

23HUM243	THE MESSAGE OF THE UPANISHADS	L-T-P-C: 2-0-0-2

OBJECTIVES:

- To give students an introduction to the basic ideas contained in the Upanishads; and explores how their messagecan be applied in daily life for achieving excellence.

Syllabus

Unit 1
An Introduction to the Principal Upanishads and the Bhagavad Gita - Inquiry into the mystery of nature - Sruti versus Smrti - Sanatana Dharma: its uniqueness - The Upanishads and Indian Culture - Upanishads and Modern Science.

Unit 2
The challenge of human experience & problems discussed in the Upanishads – the True nature of Man – the Moving power of the Spirit – The Message of Fearlessness – Universal Man - The central problems of the Upanishads – Ultimate reality – the nature of Atman - the different manifestations of consciousness.

Unit 3
Upanishad Personalities - episodes from their lives and essential teachings: Yajnavalkya, Aruni, Uddalaka, Pippalada,Satyakama Jabala, Svetaketu, Nachiketas, Upakosala, Chakrayana Ushasti, Raikva, Kapila and Janaka. Important verses from Upanishads - Discussion of Sage Pippalada's answers to the six questions in Prasnopanishad.

REFERENCES:

1. *The Message of the Upanishads by Swami Ranganathananda, Bharatiya Vidya Bhavan*
2. *Eight Upanishads with the commentary of Sankaracharya, Advaita Ashrama*
3. *Indian Philosophy by Dr. S. Radhakrishnan, Oxford University Press*
4. *Essentials of Upanishads by R L Kashyap, SAKSI, Bangalore*
5. *Upanishads in Daily Life, Sri Ramakrishna Math, Mylapore.*
6. *Eternal stories of the Upanishads by Thomas Egenes and Kumuda Reddy*
7. *Upanishad Ganga series – Chinmaya Creations*

23HUM244	UNDERSTANDING SCIENCE OF FOOD AND NUTRITION	L-T-P-C: 2-0-0-2

Course Objectives:

- To introduce the significance of food, nutrients, locally available food resources, synergic foodcombinations, good cooking methods and importance of diversity in foods
- To understand nutritional imbalances and chronic diseases associated with the quality of food.
- To gain awareness about the quality of food - Organic food, genetically modified food, adulterated food,allergic food, , food poisoning and food safety.
- To understand food preservation processing, packaging and the use of additives.

Course Outcome:

CO1: Acquire knowledge about the various food and food groups
CO2: Understand nutritional imbalances and chronic diseases prevailing among different age groups.
CO3: Understand the significance of safe food and apply the food safety standards
CO4: Demonstrate skills of food processing, preservation and packaging methods with or without additives
CO5: Evaluate the quality of food based on the theoretical knowledge of Food and Nutrition

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1		1	1			2	1	1	1	1	3
CO 2		1	1			1	1	1	1	1	3
CO 3		1	1			1	1	1	1	1	3
CO 4		1	1			1	1	1	1	1	3
CO 5		1	1			2	1	2	1	1	3

Syllabus

Unit 1

Food and Food Groups
Introduction to foods, food groups, locally available foods, Nutrients, Cooking methods, Synergy between foods, Science behind foods, Food allergies, food poisoning, food safety standards.

Cookery Practicals - Balanced Diet

Unit 2

Nutrients and Nutrition
Nutrition through life cycle, RDA, Nutrition in disease, Adulteration of foods & Food additives, Packaging and labeling of foods.

Practicals - Traditional Foods

Unit 3

Introduction to Food Biotechnology
Future foods - Organic foods and genetically modified foods, Fortification of foodsvalue addition of foods, functional foods, Nutraceuticals, supplementary foods, Processing and preservation of foods, applications of food

technology in daily life, and your prospects associated with food industry – Nanoparticles, biosensors, advanced research.

Practicals - Value added foods

TEXTBOOKS:

1. *N. Shakuntalamanay, M. Shadaksharaswamy, "Food Facts and principles", New age international (P)ltd, publishers, 2005.*
2. *B. Srilakshmi, "Dietetics", New age international (P) ltd, publishers, 2010.*

REFERENCE BOOKS:

1. *B. Srilakshmi, "Food Science", New age international (P) ltd, publishers, 2008.*
2. *"Nutrient requirement and Recommended Dietary Allowances for Indians", published by Indian Councilof Medical Research, ICMR, 2010.*

23JAP230	PROFICIENCY IN JAPANESE LANGUAGE (LOWER)	L-T-P-C: 2-0-0-2

Syllabus

This paper will introduce the basics of Japanese language. Students will be taught the language through various activities like writing, reading, singing songs, showing Japanese movies etc. Moreover, this paper intends to give a thorough knowledge on Japanese scripts that is Hiragana and Katakana. Classes will be conducted throughout in Japanese class only. Students will be able to make conversations with each other in Japanese. Students can make self-introduction and will be able to write letters in Japanese. All the students will be given a text on Japanese verbs and tenses.

Students can know about the Japanese culture and the lifestyle. Calligraphy is also a part of this paper. Informal sessions will be conducted occasionally, in which students can sing Japanese songs, watch Japanese movies, do Origami – pattern making using paper.

23JAP231	PROFICIENCY IN JAPANESE LANGUAGE (HIGHER)	L-T-P-C: 2-0-0-2

Syllabus

Students will be taught the third and the most commonly used Japanese script, Kanji. Students will be taught to write as well as speak.

Students will be given detailed lectures on Calligraphy.

This version of the course includes a new project where the students should make a short movie in Japanese language selecting their own topics.

By the end of the semester they the students will master the subject in all means. They will be able to speak Japanese as fluently as they speak English. Students will be encouraged to write stories and songs in Japanese language themselves.

23KAN230	KANNADA I	L-T-P-C: 2-0-0-2

OBJECTIVES:

- To enable the students to acquire basic skills in functional language; to develop independent reading skills andreading for appreciating literary works; to analyse language in context to gain an understanding of vocabulary,spelling, punctuation and speech.

Syllabus

Unit 1
Adalitha Kannada: bhashe, swaroopa, belavanigeya kiru parichaya Paaribhaashika padagalu
Vocabulary Building

Unit 2
Prabhandha – Vyaaghra Geethe - A. N. Murthy Rao
Prabhandha – Barededi…barededi, Baduku mugiyuvudilla allige…- Nemi Chandra Paragraph writing –Development: comparison, definition, cause & effect Essay – Descriptive & Narrative

Unit 3
Mochi – Bharateepriya
Mosarina Mangamma – Maasti Venkatesh Iyengar Kamalaapurada Hotelnalli – Panje Mangesh Rao Kaanike – B. M. Shree
Geleyanobbanige bareda Kaagada – Dr. G. S. Shivarudrappa Moodala Mane – Da. Ra. Bendre
Swathantryada Hanate – K. S. Nissaar Ahmed

Unit 4
Letter W riting - Personal: Congratulation, thanks giving, invitation, condolence

Unit 5
Reading Comprehension; nudigattu, gaadegalu Speaking Skills: Prepared speech, pick and speak

REFERENCES:

1. *H. S. Krishna Swami Iyangar – Adalitha Kannada – Chetana Publication, Mysuru*
2. *N. Murthy Rao – Aleyuva Mana – Kuvempu Kannada Adyayana Samste*
3. *Nemi Chandra – Badhuku Badalisabahudu – Navakarnataka Publication*
4. *Sanna Kathegalu - Prasaranga, Mysuru University , Mysuru*
5. *B. M. Shree – Kannadada Bavuta – Kannada Sahitya Parishattu*
6. *K. S. Nissar Ahmed – 75 Bhaavageetegalu – Sapna Book House (P) Ltd.*
7. *Dr. G. S. Shivarudrappa – Samagra Kavya – Kamadhenu Pustaka Bhavana*

23KAN231	KANNADA II	L-T-P-C: 2-0-0-2

OBJECTIVES:

- To enable the students to acquire basic skills in functional language; to develop independent reading skills andreading for appreciating literary works; to develop functional and creative skills in language; to enable the students to plan, draft, edit & present a piece of writing.

Syllabus

Unit 1
Official Correspondence: Adhikrutha patra, prakatane, manavi patra, vanijya patra

Unit 2
Nanna Hanate - Dr. G. S. Shivarudrappa
Mankuthimmana Kaggada Ayda bhagagalu – D. V. Gundappa (Padya Sankhye 5, 20, 22, 23, 25, 44, 344, 345, 346, 601)
Ella Marethiruvaga - K. S. Nissaar Ahmed Saviraru Nadigalu – S Siddalingayya

Unit 3
Sayo Aata – Da. Ra. Bendre

Unit 4
Sarva Sollegala turtu Maha Samelana - Beechi Swarthakkaagi Tyaga - Beechi

Unit 5
Essay writing: Argumentative & Analytical Précis writing

REFERENCES:

1. *H. S. Krishnaswami Iyangar – Adalitha Kannada – Chetan Publication, Mysuru*
2. *Dr. G. S. Shivarudrappa – Samagra Kavya. - Kamadhenu Pustaka Bhavana*
3. *Shrikanth - Mankuthimmana Kagga – Taatparya – Sri Ranga Printers & Binders*
4. *K. S. Nissar Ahmed – 75 Bhaavageetegalu – Sapna book house*
5. *Dr. Da. Ra. Bendre – Saayo Aata – Shri Maata Publication*
6. *Beechi – Sahukara Subbamma – Sahitya Prakashana*

23MAL230	MALAYALAM I	L-T-P-C: 2-0-0-2

Course Objectives:

- To appreciate the aesthetics & cultural implications; to enhance creative thinking in mother0-tongue; to learn ourculture & values; to equip students read & write correct Malayalam; to correct the mistakes in pronunciation; to create awareness that good language is the sign of complete personality

Course Outcome:

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

CO1: Understand and inculcate philosophical thoughts and practices CO2: Understand and appreciate the post modern trends of literature.
CO3: Analyse the literary texts and comprehend the cultural diversity of KeralaCO4: Distinguish the different genres in Malayalam literature
CO5: Demonstrate the ability to effectively communicate in Malayalam

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	-	-	2	3	-	-
CO2	-	-	-	-	-	-	-	2	3	-	-
CO3	-	-	-	-	-	-	-	2	3	-	-
CO4	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	-	1	1	-	-

Syllabus

Unit 1
Ancient poet trio: Adhyatmaramayanam,
Lakshmana Swanthanam (valsa soumitre… mungikidakayal), Ezhuthachan - Medieval period classics –Jnanappana (kalaminnu… vilasangalingane), Poonthanam

Unit 2
Modern Poet trio: Ente Gurunathan, Vallathol Narayana Menon - Critical analysis of the poem.

Unit 3
Short stories from period 1/2/3, Poovanpazham - Vaikaom Muhammed Basheer - Literary & Cultural figures of Kerala and about their literary contributions.

Unit 4
Literary Criticism: Ithihasa studies - Bharatha Paryadanam - Vyasante Chiri - Kuttikrishna Mararu - Outline of literary Criticism in Malayalam Literature - Introduction to Kutti Krishna Mararu & his outlook towards literature & life.

Unit 5
Error-free Malayalam: 1. Language; 2. Clarity of expression; 3. Punctuation – Thettillatha Malayalam

Writing - a. Expansion of ideas; b .Precis Writing; c. Essay Writing; d. Letter writing; e. Radio Speech; f. Script / Feature / Script Writing; g. News Editing; h. Advertising; i. Editing; j. Editorial Writing; k. Critical appreciation of literary works (Any one or two as an assignment).

REFERENCES:

1. *P. K. Balakrishnanan, Thunjan padhanangal, D. C. Books, 2007.*
2. *G. Balakrishnan Nair, Jnanappanayum Harinama Keerthanavum, N. B. S, 2005.*
3. *M. N. Karasseri, Basheerinte Poonkavanam, D. C. Books, 2008.*
4. *4 M. N. Vijayan, Marubhoomikal Pookkumbol, D. C. Books, 2010.*
5. *M. Thomas Mathew, Lavanyanubhavathinte Yukthisasthram, National Book Stall, 2009.*
6. *M. Leelavathy, Kavitha Sahityacharitram, National Book Stall, 1998.*
7. *Thayattu Sankaran, Vallathol Kavithapadhanam, D. C. Books, 2004.*

23MAL231	MALAYALAM II	L-T-P-C: 2-0-0-2

OBJECTIVES:

- To appreciate the aesthetics & cultural implications; to enhance creative thinking in mother-tongue;
- To learn ourculture & values; to equip students read & write correct Malayalam;
- To correct the mistakes in pronunciation; tocreate awareness that good language is the sign of complete personality.

Course Outcome:

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

CO1: Understand the different cultural influences in linguistic translation
CO2: Identify and appreciate the Romantic elements of modern literature
CO3: Analyze the genre of autobiographical writing
CO4: Critically evaluate the significance of historical, political and socio cultural aspects in literature
CO5: Demonstrate good writing skills in Malayalam

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1
CO1	-	-	-	-	-	-	-	2	3	-	-	-
CO2	-	-	-	-	-	-	-	2	3	-	-	-
CO3	-	-	-	-	-	-	-	2	3	-	-	-
CO4	-	-	-	-	-	-	-	-	3	-	-	-
CO5	-	-	-	-	-	-	-	1	1	-	-	-

Syllabus

Unit 1
Ancient poet trio: Kalayanasougandhikam, (kallum marangalun… namukkennarika vrikodara) Kunjan Nambiar - Critical analysis of his poetry - Ancient Drama: Kerala Sakunthalam (Act 1), Kalidasan (Translated by Attor Krishna Pisharody).

Unit 2
Modern / romantic / contemporary poetry: Manaswini, Changampuzha Krishna Pillai – Romanticism – modernism.

Unit 3
Anthology of short stories from period 3/4/5: Ninte Ormmayku, M. T. Vasudevan Nair - literary contributions of his time

Unit 4
Part of an autobiography / travelogue: Kannerum Kinavum, V. T. Bhattathirippadu - Socio-cultural literature - historical importance.

Unit 5
Error-free Malayalam - 1. Language; 2. Clarity of expression; 3. Punctuation - Thettillatha Malayalam

Writing - a. Expansion of ideas; b. Précis Writing ; c. Essay Writing; d. Letter writing; e. Radio Speech; f. Script / Feature / Script Writing; g. News Editing; h. Advertising; i. Editing; j. Editorial Writing; k. Critical appreciation of literary works (Any one or two as an assignment).

REFERENCES:

1. *Narayana Pillai. P. K, Sahitya Panchanan. Vimarsanathrayam, Kerala Sahitya Academy, 2000*
2. *Sankunni Nair. M. P, Chathravum Chamaravum, D. C. Books, 2010.*
3. *Gupthan Nair. S, Asthiyude Pookkal, D. C Books. 2005*
4. *Panmana Ramachandran Nair, Thettillatha Malayalam, Sariyum thettum etc., D. C. Book, 2006.*
5. *M. Achuthan, Cherukatha-Innale, innu, National Book Stall, 1998.*
6. *N. Krishna Pillai, Kairaliyude Katha, National Book Stall, 2001.*

23SAN230	SANSKRIT I	L-T-P-C: 2-0-0-2

OBJECTIVES:

- To familiarize students with Sanskrit language and literature
- To enable them to read and understand Sanskritverses and sentences
- To help them acquire expertise for self- study of Sanskrit texts and communication in Sanskrit
- To help the students imbibe values of life and Indian culture as propounded in scriptures.

Syllabus

Unit 1
Introduction to Sanskrit language, Devanagari script - Vowels and consonants, pronunciation, classification of consonants, conjunct consonants, words – nouns and verbs, cases – introduction, numbers, Pronouns,communicating time in Sanskrit. Practical classes in spoken Sanskrit

Unit 2
Verbs- Singular, Dual and plural – First person, Second person, Third person. Tenses – Past, Present and Future – Atmanepadi and Parasmaipadi-karthariprayoga

Unit 3
Words for communication, slokas, moral stories, subhashithas, riddles (from the books prescribed)

Unit 4
Selected slokas from Valmiki Ramayana, Kalidasa's works and Bhagavad Gita. Ramayana – chapter VIII - verse5, Mahabharata - chapter 174, verse -16, Bhagavad Gita – chapter - IV verse 8, Kalidasa's Sakuntalam Act IV – verse 4

Unit 5
Translation of simple sentences from Sanskrit to English and vice versa.

ESSENTIAL READING:

1. *Praveshaha; Publisher: Samskrita bharati, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore - 560085*
2. *Sanskrit Reader I, II and III, R. S. Vadhyar and Sons, Kalpathi, Palakkad*
3. *Prakriya Bhashyam written and published by Fr. John Kunnappally*
4. *Sanskrit Primer by Edward Delavan Perry, published by Ginn and Company Boston*
5. *Sabdamanjari, R. S. Vadyar and Sons, Kalpathi, Palakkad*
6. *Namalinganusasanam by Amarasimha published by Travancore Sanskrit series*
7. *Subhashita Ratna Bhandakara by Kashinath Sharma, published by Nirnayasagar press*

23SAN231	SANSKRIT II	L-T-P-C: 2-0-0-2

OBJECTIVES:

- To familiarize students with Sanskrit language and literature
- To enable them to read and understand Sanskritverses and sentences
- To help them acquire expertise for self- study of Sanskrit texts and communication in Sanskrit
- To help the students imbibe values of life and Indian culture as propounded in scriptures.

Syllabus

Unit 1
Seven cases, indeclinables, sentence making with indeclinables, Saptha karakas.

Unit 2
Ktavatu Pratyaya, Upasargas, Ktvanta, Tumunnanta, Lyabanta. Three Lakaras – brief introduction, Lot lakara.

Unit 3
W ords and sentences for advanced communication. Slokas, moral stories (Pancatantra) Subhashitas, riddles.

Unit 4
Introduction to classical literature, classification of Kavyas, classification of Dramas - The five Mahakavyas, selected slokas from devotional kavyas- Bhagavad Gita – chapter - II verse 47, chapter - IV verse 7, chapter -VI verse 5, chapter - VIII verse 6, chapter - XVI verse 21, Kalidasa's Sakuntala act IV – verse 4, Isavasyopanishat 1st Mantra, Mahabharata chapter 149 verses 14 - 120, Neetisara chapter - III

Unit 5
Translation of paragraphs from Sanskrit to English and vice versa.

ESSENTIAL READING:

1. *Praveshaha; Publisher: Samskrita bharati, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore -560085*
2. *Sanskrit Reader I, II and III, R.S. Vadhyar and Sons, Kalpathi, Palakkad*
3. *Prakriya Bhashyam written and published by Fr. John Kunnappally*
4. *Sanskrit Primer by Edward Delavan Perry, published by Ginn and Company Boston*
5. *Sabdamanjari, R. S. Vadyar and Sons, Kalpathi, Palakkad*
6. *Namalinganusasanam by Amarasimha published by Travancore Sanskrit series*
7. *Subhashita Ratna Bhandakara by Kashinath Sharma, published by Nirnayasagar Press.*

23SWK230	CORPORATE SOCIAL RESPONSIBILITY	L-T-P-C: 2-0-0-2

Syllabus

Unit 1

Understanding CSR - Evolution, importance, relevance and justification. CSR in the Indian context, corporate strategy. CSR and Indian corporate. Structure of CSR - In the Companies Act 2013 (Section 135); Rules underSection 13; CSR activities, CSR committees, CSR policy, CSR expenditure CSR reporting.

Unit 2

CSR Practices & Policies - CSR practices in domestic and international area; Role and contributions of voluntary organizations to CSR initiatives. Policies; Preparation of CSR policy and process of policy formulation; Government expectations, roles and responsibilities. Role of implementation agency in Section 135 of the Companies Act, 2013. Effective CSR implementation.

Unit 3

Project Management in CSR initiatives - Project and programme; Monitoring and evaluation of CSR Interventions. Reporting - CSR Documentation and report writing. Reporting framework, format and procedure.

REFERENCES:

1. *Corporate Governance, Ethics and Social Responsibility, V Bala Chandran and V Chandrasekaran, PHIlearning Private Limited, New Delhi 2011.*
2. *White H. (2005) Challenges in evaluating development effectiveness: Working paper 242, Institute of Development Studies, Brighton.*
3. *UNDP (nd) Governance indicators: A users guide. Oslo: UNDP*
4. *Rao, Subbha (1996) Essentials of Human Resource Management and Industrial Relations, Mumbai,Himalaya*
5. *Rao, V. S. L. (2009) Human Resource Management, New Delhi, Excel Books,*

23SWK231	WORKPLACE MENTAL HEALTH	L-T-P-C: 2-0-0-2

Syllabus

Unit 1

Mental Health – concepts, definition, Bio-psycho-social model of mental health. Mental health and mental illness, characteristics of a mentally healthy individual, Signs and symptoms of mental health issues, presentation of a mentally ill person. Work place – definition, concept, prevalence of mental health issues in the work place, why invest in workplace mental health, relationship between mental health and productivity, organizational culture and mental health. Case Study, Activity.

Unit 2

Mental Health Issues in the Workplace: Emotions, Common emotions at the workplace, Mental Health issues - Anger, Anxiety, Stress & Burnout, Depression, Addictions – Substance and Behavioural, Psychotic Disorders - Schizophrenia, Bipolar Disorder, Personality disorders. Crisis Situations - Suicidal behavior, panic attacks, reactions to traumatic events. Stigma and exclusion of affected employees. Other issues –work-life balance, Presenteeism, Harassment, Bullying, Mobbing. Mental Health First Aid - Meaning. Case Study, Activity.

Unit 3

Strategies of Help and Care: Positive impact of work on health, Characteristics of mentally healthy workplace, Employee and employer obligations, Promoting mental health and well being- corporate social responsibility (CSR), an inclusive work environment, Training and awareness raising, managing performance, inclusive recruitment, Supporting individuals-talking about mental health, making reasonable adjustments, Resources and support for employees - Employee Assistance Programme / Provider (EAP), in house counsellor, medical practitioners, online resources and telephone support, 24 hour crisis support, assistance for colleagues and care givers, Legislations. Case Study, Activity.

REFERENCES:

1. *American Psychiatric Association. "Diagnostic and statistical manual of mental disorders: DSM-IV 4th ed." www.terapiacognitiva.eu/dwl/dsm5/DSM-IV.pdf*
2. *American Psychiatric Association. (2000) www.ccsa.ca/Eng/KnowledgeCentre/OurDatabases/ Glossary/Pages/index.aspx.*
3. *Canadian Mental Health Association, Ontario "Workplace mental health promotion, A how toguide"wmhp.cmhaontario.ca/*
4. *Alberta Health Services Mental Health Promotion. (2012). Minding the Workplace: Tips for employees and managers together. Calgary: Alberta Health Services.http:// www.mentalhealthpromotion.net/resources/minding-the-workplace-tips-for-employees-and-managers- together.pdf*
5. *Government of Western Australia, Mental Health Commission. (2014) "Supporting good mental health in the work place." http://www.mentalhealth.wa.gov.au/Libraries/pdf_docs/ supporting_good_mental_health_in_the_workplace_1.sflb.ashx*
6. *Mental Health Act 1987 (India) www.tnhealth.org/mha.htm*
7. *Persons with disabilities Act 1995 (India) socialjustice.nic.in*
8. *The Factories Act 1948 (India) www.caaa.in/Image/19ulabourlawshb.pdf*

23TAM230	TAMIL I	L-T-P-C: 2-0-0-2

Course Objectives:

- To introduce the students to different literature- Sangam literature, Epics, Bhakthi literatureandmodern literature.
- To improve their ability tocommunicate with creative concepts, and also to introduce them to theusefulness of basicgrammaticalcomponents in Tamil.

Course Outcomes

CO 1: To understand the Sangam literature
CO 2: To understand the creative literature
CO 3: To understand the literary work on religious scriptures
CO 4: To improve the communication and memory skills
CO 5: To understand the basic grammar components of Tamil language and their usage and applications
CO 6: Understand creative writing aspects and apply them.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1
CO1			-	-	-	-	-	2	2	2	-	-
CO2			-	-	-	-	-	2	2	2	-	-
CO3			-	-	-	-	-	2	2	2	-	-
CO4			-	-	-	-	-	2	2	2	-	-
CO5			-	-	-	-	-	2	2	2	-	-
CO6			-	-	-	-	-	2	2	2	-	-

Syllabus

Unit1

The history ofTamilliterature: Nāṭṭupuṟap pāṭalkaḷ, kataikkaḷ, paḻamoḻikaḷ - ciṟukataikaḷ tōṟṟamum vaḷarcciyum, ciṟṟilakkiyaṅkaḷ: Kaliṅkattup paraṇi (pōrpāṭiyatu) - mukkūṭaṟ paḷḷu 35.
Kāppiyaṅkaḷ: Cilappatikāram – maṇimēkalai naṭaiyiyal āyvu maṟṟum aimperum – aiñciṟuṅ kāppiyaṅkaḷ toṭarpāṉa ceytikaḷ.

Unit 2

tiṇai ilakkiyamum nītiyilakkiyamum - patiṉeṇkīḻkkaṇakku nūlkaḷ toṭarpāṉa piṟa ceytikaḷ - tirukkuṟaḷ (aṉpu, paṇpu, kalvi, oḻukkam, naṭpu, vāymai, kēḷvi, ceynaṉṟi, periyāraittuṇakkōṭal, viḻippuṇarvu pēṉṟa atikārattil uḷḷa ceytikaḷ.
Aṟanūlkaḷ: Ulakanīti (1-5) – ēlāti (1,3,6). - Cittarkaḷ: Kaṭuveḷi cittar pāṭalkaḷ (āṉantak kaḷippu –1, 4, 6, 7, 8), maṟṟum akappēy cittar pāṭalkaḷ (1-5).

Unit 3

tamiḻ ilakkaṇam: Vākkiya vakaikaḷ – taṉviṉai piṟaviṉai – nērkkūṟṟu ayaṟkūṟṟu

Unit 4

tamiḻaka aṟiñarkaḷiṉ tamiḻ toṇṭum camutāya toṇṭum: Pāratiyār, pāratitācaṉ, paṭṭukkōṭṭai kalyāṇacuntaram, curatā, cujātā, ciṟpi, mēttā, aptul rakumāṉ, na.Piccaimūrtti, akilaṉ, kalki, jī.Yū.Pōp, vīramāmuṉivar, aṇṇā, paritimāṟ kalaiñar, maṟaimalaiyaṭikaḷ.

Unit 5

tamiḻ moḻi āyvil kaṇiṉi payaṉpāṭu. - Karuttu parimāṟṟam - viḷampara moḻiyamaippu – pēccu - nāṭakam paṭaippu - ciṟukatai, katai, putiṉam paṭaippu.

Textbooks:

1. http:/Www.tamilvu.trg/libirary/libindex.htm.
2. http:/Www.tunathamizh.tom/2013/07/blog0post_24.html
3. Mu.Varatarācaṉ “tamiḻ ilakkiya varalāṟu” cāhitya akaṭemi papḷikēṣaṉs, 2012
4. nā.Vāṉamāmalai “paḻaṅkataikaḷum, paḻamoḻikaḷum” niyū ceñcuri puttaka veḷiyīṭṭakam,1980,2008
5. nā.Vāṉamāmalai, “tamiḻar nāṭṭuppāṭalkaḷ” niyū ceñcuri puttaka veḷiyīṭṭakam 1964,2006
6. poṉ maṇimāṟaṉ “aṭōṉ tamiḻ ilakkaṇam “aṭōṉ papḷiṣiṅ kurūp, vañciyūr, tiruvaṉantapuram, 2007.

23TAM231	**TAMIL II**	**L-T-P-C: 2-0-0-2**

Course Objectives

- To learn the history ofTamilliterature.
- To analyze different styles of Tamil Language.
- To strengthen thecreativity in communication, Tamilbasicgrammar and use of computer on TamilLanguage.

Course Outcomes

CO 1: Understand the history of Tamil literature.
CO 2: Apply practical and comparative analyses on literature.
CO 3: Understand thinai literature, literature on justice, Pathinenkeelkanaku literature.
CO 4: Understand the tamil scholars' service to Tamil language and society.
CO 5: Understand components of Tamil grammar and its usage
CO 6: Understand creative writing aspects and apply them

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1
CO1			-	-	-	-	-	2	2	-	-	-
CO2			-	-	-	-	-	2	2	-	-	-
CO3			-	-	-	-	-	2	2	-	-	-
CO4			-	-	-	-	-	2	2	-	-	-
CO5			-	-	-	-	-	2	2	-	-	-
CO6			-	-	-	-	-	2	2	-	-	-

Syllabus

Unit 1
The history ofTamilliterature: Nāṭṭupuṟap pāṭalkaḷ, kataikkaḷ, paḻamoḻikaḷ - ciṟukataikaḷ tōṟṟamum vaḷarcciyum, ciṟṟilakkiyaṅkaḷ: Kaliṅkattup paraṇi (pōrpāṭiyatu) - mukkūṭaṟ paḷḷu 35.
Kāppiyaṅkaḷ: Cilappatikāram – maṇimēkalai naṭaiyiyal āyvu maṟṟum aimperum – aiñciṟuṅ kāppiyaṅkaḷ toṭarpāṉa ceytikaḷ.

Unit 2
tiṇai ilakkiyamum nītiyilakkiyamum - patiṉeṇkīḻkkaṇakku nūlkaḷ toṭarpāṉa piṟa ceytikaḷ - tirukkuṟaḷ (aṉpu, paṇpu, kalvi, oḻukkam, naṭpu, vāymai, kēḷvi, ceynaṉṟi, periyāraittuṇakkōṭal, viḻippuṇarvu pēṉṟa atikārattil uḷḷa ceytikaḷ.
Aṟanūlkaḷ: Ulakanīti (1-5) – ēlāti (1,3,6). - Cittarkaḷ: Kaṭuveḷi cittar pāṭalkaḷ (āṉantak kaḷippu –1, 4, 6, 7, 8), maṟṟum akappēy cittar pāṭalkaḷ (1-5).

Unit 3
tamiḻ ilakkaṇam: Vākkiya vakaikaḷ – taṉviṉai piṟaviṉai – nērkkūṟṟu ayaṟkūṟṟu

Unit 4
tamiḻaka aṟiñarkaḷiṉ tamiḻ toṇṭum camutāya toṇṭum: Pāratiyār, pāratitācaṉ, paṭṭukkōṭṭai kalyāṇacuntaram, curatā, cujātā, ciṟpi, mēttā, aptul rakumāṉ, na.Piccaimūrtti, akilaṉ, kalki, jī.Yū.Pōp, vīramāmuṉivar, aṇṇā, paritimāṟ kalaiñar, maṟaimalaiyaṭikaḷ.

Unit 5
tamiḻ moḻi āyvil kaṇiṉi payaṉpāṭu. - Karuttu parimāṟṟam - viḷampara moḻiyamaippu – pēccu - nāṭakam paṭaippu - ciṟukatai, katai, putiṉam paṭaippu.

Text Books / References

1. http:/Www.tamilvu.trg/libirary/libindex.htm. http:/Www.tunathamizh.tom/2013/07/blog0post_24.html Mu.Varatarācaṉ “tamiḻ ilakkiya varalāṟu” cāhitya akaṭemi papḷikēṣaṉs, 2012

2. nā.Vāṉamāmalai “paḻaṅkataikaḷum, paḻamoḻikaḷum” niyū ceñcuri puttaka veḷiyīṭṭakam, 1980,2008

3. nā.Vāṉamāmalai, “tamiḻar nāṭṭuppāṭalkaḷ” niyū ceñcuri puttaka veḷiyīṭṭakam 1964,2006 poṉ maṇimāṟaṉ “aṭōṉ tamiḻ ilakkaṇam “aṭōṉ papḷiṣiṅ kurūp, vañciyū