GMR Institute of Technology
An Autonomous Institute Affiliated to JNTU-GV

GMRIT Training Tomorrow's Engineers Today

1.1.3 (A) Syllabus copy of the courses highlighting Focus on Employability/Entrepreneurship/ Skill development along with their course outcomes

Department of Civil Engineering

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The Vision of GMRIT

- To be among the most preferred institutions for engineering and technological education in the country.
- An institution that will bring out the best from its students, faculty, and staff – to learn, to achieve, to compete and to grow – among the very best.
- An institution where ethics, excellence and excitement will be the work religion, while research, innovation and impact, the work culture.

The Mission of GMRIT

- To turnout disciplined and competent engineers with sound work and life ethics.
- To implement outcome-based education in an IT-enabled environment.
- To encourage all-round rigor and instill a spirit of enquiry and critical thinking among students, faculty, and staff.
- To develop teaching, research, and consulting environment in collaboration with industry and other institutions.

Department Vision

- To be a preferred department of learning for students and teachers alike, with a commitment towards Academics & Research, serving the students in an atmosphere of innovation, critical thinking and making them Industry ready.

Department Mission

M1: To provide adaptable education in a collaborative and innovative environment in skilling the graduates to solve real world problems in the field of Civil Engineering

M2: To prepare the students as critical thinking professionals with multidisciplinary research orientation and Innovation

M3: To instil ethical values and nurture the graduates who will be able to contribute to society.

Program Educational Objectives (PEOs)

PEO 1: Employ logical and analytical skills in solving complex real-world engineering problems in the areas of civil engineering.

PEO 2: Adaptable to emerging technologies with enhanced professional skills and ability towards continuous learning, facilitating higher studies and research.

PEO 3: Demonstrate professional ethics, leadership qualities and promote inclusive and collaborative growth with human values towards societal interest.

Program Outcomes (POs):

Engineering graduate will be able to:

PO 1: Apply the knowledge of basic sciences and fundamental engineering concepts in solving civil engineering problems (**Engineering knowledge**)

PO 2: Identify and define civil engineering problems and investigate to analyze and interpret data to arrive at substantial conclusions. (**Problem analysis**)

PO 3: Propose appropriate solutions for engineering problems complying with functional constraints such as economic, environmental, societal, ethical, safety and sustainability in accordance with Indian standard codes of practices. (**Design/development of solutions**)

PO 4: Perform investigations, design and conduct experiments, analyze and interpret the results to provide valid conclusions. (**Conduct investigations of complex problems**)

PO 5: Select/develop and apply appropriate techniques and IT tools to analyze, design and scheduling of activities with an understanding of the limitations and successfully implement and adopt to technological changes in civil engineering with intervention of IT industries (**Modern tool usage**)

PO 6: Give reasoning and assess societal, health, legal and cultural issues with competency in professional engineering practice. (**The engineer and society**)

PO 7: Demonstrate professional skills and contextual reasoning to assess environmental/societal issues for sustainable development. (**Environment and sustainability**)

PO 8: Demonstrate knowledge of professional and ethical practices. (**Ethics**)

PO 9: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary situations. (**Individual and team work**)

PO 10: Communicate effectively with respect to oral, written and graphical communication (**Communication**)

PO 11: Demonstrate and apply engineering & management principles in their own / team projects in multidisciplinary environment. (**Project management and finance**)

PO 12: Recognize the need for, and have the ability to engage in independent and lifelong learning. (**Life-long learning**)

Program Specific Outcomes (PSOs):

Engineering graduate will be able to:

PSO 1: Demonstrate the quality and suitability of construction materials (**Program Specific**)

PSO 2: Ability to apply the practical aspect of analysis, design and safe construction practices (**Program Specific**)

Department of Civil Engineering

Minimum Credits to be earned: 160 (for Regular students)
123 (for Lateral Entry Students)

No	Course Code	Course	POs	Contact Hours			
				L	T	P	C
First Semester							
1	21HSX01	Communicative English	10, 12	2	-	-	2
2	21MAX01	Engineering Mathematics I	1	3	-	-	3
3	21PYX01 21CYX01	Engineering Physics / Engineering Chemistry	1 / 1	3/3	-	-	3/3
4	21BEX01 21BEX06	Basics of Engineering / IT Workshop	1,12/1,12	3/ -	-	-/ 3	3/1.5
5	21BEX02	Problem Solving and Programming Skills	1, 12	3	-	-	3
6	21BEX03	Problem Solving and Programming Skills Lab	4	-	-	3	1.5
7	21BEX04/ 21BEX05	Engineering Drawing / Engineering Workshop	1,5,10/1, 9,10	-	-	3/3	1.5/1.5
8	21PYX02/ 21CYX02	Engineering Physics Lab /Engineering Chemistry Lab	4/4	-	-	3/3	1.5/1.5
9	21HSX02/-	Communicative English Lab/-	10,12	-	-	3/-	1.5/-
Total				**14/ 11**	**-**	**12/ 12**	**20/17**
Second Semester							
1		Language Elective	10,12	2	-	-	2
2	21MAX02	Engineering Mathematics II	1	3	-	-	3
3	21CYX01/ 21PYX01	Engineering Chemistry /Engineering Physics	1/1	3/3	-	-	3/3
4	21BEX01/ 21BEX06	Basics of Engineering/ IT Workshop	1,12/1,12	-/3	-	3/-	1.5/3
5	21BEX07	Python Programming	1,12	3	-	-	3
6	21BEX08	Python Programming Lab	4	-	-	3	1.5
7	21BEX05/ 21BEX04	Engineering Workshop / Engineering Drawing	1,9,10/ 1,5,10	-	-	3/3	1.5/1.5
8	21CYX02/ 21PYX02	Engineering Chemistry Lab/Engineering Physics Lab	4/4	-	-	3/3	1.5/1.5
9	-/21HSX02	-/Communicative English Lab	-/10,12	-	-	-/3	-/1.5
Total				**11/ 14**	**-**	**12/ 12**	**17/20**
Third Semester							
1	21MA303	Numerical Methods	1, 12	3	-	-	3
2	21CE302	Building Materials and Concrete Technology	2,4,8, 12, PSO1	3	-	2	4
3	21CE303	Building Planning and Drawing	5, 10, 12	3	-	2	4
4	21CE304	Fluid Mechanics	1, 12	3	-	-	3
5	21CE305	Solid Mechanics I	1, 12	3	-	-	3
6	21CE306	Surveying	1, 2, 10, 12	3	-	-	3
7	21CE307	Solid Mechanics Laboratory	1, 4	-	-	3	1.5
8	21CE308	Surveying Laboratory	1, 4	-	-	3	1.5
9	21ESX01	Employability Skills I	1,2,5,8,10, 12	1	-	1	-
10	21HSX11	CC & EC Activities I	6,7,9,10	-	-	1	-
Total				**19**	**-**	**12**	**23**
Fourth Semester							
1	21CE401	Hydraulics and Hydraulic Machinery	1, 12	3	-	-	3
2	21CE402	Soil Mechanics	1, 2, 12, PSO1	3	-	-	3
3	21CE403	Solid Mechanics II	1, 12	3	-	-	3
4	21CE404	Structural Analysis	1, 12	3	-	-	3

5	21CE405	Transportation Engineering	3, 12, PSO2	3	-	2	4
6	21CE406	Fluid Mechanics and Hydraulic Machinery Laboratory	1, 4	-	-	3	1.5
7	21CE407	Soil Mechanics Laboratory	1, 4	-	-	3	1.5
8	21ESX01	Employability Skills I	1,2,5,8,10, 12	1	-	1	2
9	21HSX11	CC & EC Activities I	6,7,9,10	-	-	1	1
Total				**16**	**-**	**10**	**22**
Fifth Semester							
1	21CE501	Design and Detailing of RC Structures	3, 10, 12,PSO2	3	-	2	4
2	21CE502	Environmental Engineering	3, 6, 7, 12	3	-	-	3
3	21CE503	Foundation Engineering	2, 3, 8, 12,PSO2	3	-	-	3
4	21CE504	Hydrology	2, 3, 12	3	-	2	4
5		Elective I (Professional Elective)		3	-	-	3
6		Elective II (Open Elective I)		3	-	-	3
7	21CE505	Environmental Engineering Laboratory	3, 6, 7, 12	-	-	3	1.5
8	21TPX01	Term Paper	1,4,10,12	-	-	3	1.5
9	21ESX02	Employability Skills II	1,2,5,8,10, 12	1	-	1	-
10	21HSX12	CC & EC Activities II	6,7,9,10	-	-	1	-
11	21SIX01	Summer Internship I	1,2,8,10, 12	-	-	-	1
Total				**19**	**-**	**12**	**24**
Sixth Semester							
1	21CE601	Problem solving using OOPS	1, 5, 12	3	-	-	3
2	21CE602	Design of Steel Structures	3, 5, 10, 12,PSO2	3	-	-	3
3	21CE603	Estimation and costing	1,12	3	-	-	3
4		Elective III (Professional Elective)		3	-	2	4
5		Elective IV (Open Elective II)		3	-	-	3
6	21CE604	Programming Language Laboratory	1,2,3,5	-	-	3	1.5
7	21MPX01	Mini Project	1,2,3,4,5,6, 7,8,9,10, 11,12,PSO1 , PSO2	-	-	3	1.5
8	21ESX02	Employability Skills II	1,2,5,8,10, 12	1	-	1	2
9	21HSX12	CC & EC Activities II	6,7,9,10	-	-	1	1
10	21ATX01	Environmental Studies	1,3,6,7	-	-	-	-
11	21ATX02	Professional Ethics and Human Values	---	-	-	-	-
12	21ATX---	Audit Course	---	-	-	-	-
Total				**16**	**-**	**10**	**22**
Seventh Semester							
1		Elective V (Professional Elective)		3	-	-	3
2		Elective VI (Professional Elective)		3	-	-	3
3		Elective VII (Open Elective III)		3	-	-	3
4	21PWX01	Project Work	1,2,3,4,5,6, 7,8,9,10,11 ,12, PSO1, PSO2	-	-	16	8
5	21SIX02	Summer Internship II	1,2,5,6,10, 12	-	-	-	1
Total				**9**	**-**	**16**	**18**
Eighth Semester							
1		Elective VIII (Professional Elective)		-	-	-	3
2		Elective IX (Open Elective IV)		-	-	-	3
3	21FIX01	Full semester Internship (FSI)	1,2,5,8,9, 10,PSO1,	-	-	-	8

			PSO2				
Total				**-**	**-**	**-**	**14**
Language Electives							
No.	**Course Code**	**Course**	**POs**	**Contact Hours**			
				L	**T**	**P**	**C**
1	21HSX03	Advanced Communicative English	10,12	3	-	-	3
2	21HSX04	Communicative German		3	-	-	3
3	21HSX05	Communicative French		3	-	-	3
4	21HSX06	Communicative Japanese		3	-	-	3
5	21HSX07	Communicative Spanish		3	-	-	3
6	21HSX08	Communicative Korean		3	-	-	3
7	21HSX09	Communicative Hindi		3	-	-	3
Elective I							
Career Path I, II, III, IV and Other Core Electives							
1	21CEC11	Principles of Building Architecture	1,3,PSO1, PSO2	3	-	-	3
2	21CEC21	Geometric Design and Highway Materials	1,3,PSO2	3	-	-	3
3	21CEC31	Prefabricated Structures	3, PSO2	3	-	-	3
4	21CEC41	Data Analysis and Visualization Using Python	1,2,5,12	3	-	-	3
5	21CE004	Construction Techniques	4,5,11, PSO2	3	-	-	3
6	21CE005	Airport, Railways and Harbour Engineering	1,3,12	3	-	-	3
7	21CE006	Construction Economics and Finance	3,10,11	3	-	-	3
Elective III							
Career Path I, II, III,IV and Other Core Electives							
1	21CEC12	Building Services	3,7,12 PSO2	3	-	2	4
2	21CEC22	Highway Design and Simulation	1,3,PSO2	3	-	2	4
3	21CEC32	Pre Engineered Buildings	3,11	3	-	2	4
4	21CEC42	ML for Civil Engineering	1,2,4,5,12	3	-	2	4
5	21CE007	Engineering Geology	1,2,4, PSO1	3	-	2	4
6	21CE008	Irrigation and Water Resources Engineering	3, 5, 10, 12	3	-	2	4
Elective V							
Career Path I, II, III,IV and Other Core Electives							
1	21CEC13	Building Information Modeling	3,5,10, PSO2	3	-	-	3
2	21CEC23	Highway Project Formulation and Economics	2,5,10, PSO2	3	-	-	3
3	21CEC33	BIM for Pre-Engineered Building	3,5,10, PSO2	3	-	-	3
4	21CEC43	AI for Civil Engineering	1,2,4,5,12	3	-	-	3
5	21CE010	Ground Improvement Techniques	2, 12, PSO1, PSO2	3	-	-	3
6	21CE011	Advanced Reinforced Concrete Design	2,3,10,12,PSO2	3	-	-	3
7	21CE012	Construction Methods and Equipment	2,7,12	3	-	-	3
Elective VI							
1	21CE013	Basics of Dynamics and Earthquake Engineering	1,2,3,12, PSO2	3	-	-	3
2	21CE014	Pavement Analysis and Design	3,12,PSO2	3	-	-	3
3	21CE015	Prestressed Concrete Structures	3,10,12, PSO2	3	-	-	3
Elective VIII							
1	21CE016	Repair and Rehabilitation of Structures	2,7,12, PSO2	-	-	-	3
2	21CE017	Spatial Analysis Techniques in Remote	1,2,5	-	-	-	3

		Sensing and GIS					
3	21CE018	Pavement Management System	5,12	-	-	-	3
Open Elective I, II, III, and IV (Elective II, IV, VII, and IX)							
1	21CE001	Disaster Management	2,7	3	-	-	3
2	21EE001	Electrical Installation, Safety and Auditing	2,3,6,8	3	-	-	3
3	21ME001	Fundamentals of Optimization Techniques	1,2,3,5	3	-	-	3
4	21EC001	Sensors for Engineering Applications	1	3	-	-	3
5	21CS001	Fundamentals of Artificial Intelligence	1,2,3	3	-	-	3
6	21CH001	Energy Conversion and Storage Devices	1,3,6,7	3	-	-	3
7	21IT001	Fundamentals of Multimedia	3,5,7	3	-	-	3
8	21BS001	Nano Materials and Technology	1,12	3	-	-	3
9	21DS001	Fundamentals of Data Science	1,2	3	-	-	3
10	21CE002	Air Pollution and Environmental Impact Assessment	6,7,12	3	-	-	3
11	21EE002	Renewable Energy Sources	2,7	3	-	-	3
12	21ME002	Principles of Entrepreneurship	1,5,8,11	3	-	-	3
13	21EC002	Electronics for Agriculture	1,2	3	-	-	3
14	21CS002	Fundamentals of Machine Learning	2,5	3	-	-	3
15	21CH002	Industrial Safety and Hazard Management	1,2,3,6,8	3	-	-	3
16	21IT002	Fundamentals of Cloud Computing	2,6,7,8,12	3	-	-	3
17	21BS002	Advanced Numerical Techniques	1,2	3	-	-	3
18	21BS003	Functional Materials and Applications	1,7	3	-	-	3
19	21CE003	Solid Waste Management	3,7,12	3	-	-	3
20	21EE003	Fundamentals of Electrical Vehicle Technology	2,3,12	3	-	-	3
21	21ME003	Industrial Engineering and Management	1,11	3	-	-	3
22	21EC003	Interfacing and Programming with Arduino	1,2	3	-	-	3
21	21CS003	Data Science for Engineering Applications	2,3,4	3	-	-	3
24	21CH003	Industrial Ecology for Sustainable Development	2,6,7	3	-	-	3
25	21IT003	Fundamentals of Mobile Computing	1,7	3	-	-	3
26	21BS004	Advanced Materials of Renewable Energy	1,7	3	-	-	3
27	21BS005	Applied Linear Algebra for Engineers	1,12	3	-	-	3
28	21CE019	Green Buildings	1,7,12	3	-	-	3
29	21EE017	Sustainable Energy	2,3,12	3	-	-	3
30	21ME019	Total Quality Management	1,11	3	-	-	3
31	21EC011	Communication Technologies	1,2	3	-	-	3
32	21CS020	Applications of Artificial Intelligence	2,3,6,7	3	-	-	3
33	21CH016	Green Technologies	2,6,7	3	-	-	3
34	21IT015	Human Computer Interaction	1,7	3	-	-	3
35	21BS006	Handling of Industrial waste and waste water	1,7	3	-	-	3
36	21OE001	Robotics and Automation	5,6,7	3	-	-	3
37	21OE002	Introduction to IoT	1,2	3	-	-	3
38	21OE003	Fundamentals of Image processing	1,2	3	-	-	3
39	21OE004	Fundamentals of Data Acquisition systems	1,2	3	-	-	3
40	21OE005	Airport Operations Management	2,4,11,12	3	-	-	3
41	21OE006	Fundamentals of Embedded Systems	1,2	3	-	-	3
42	21OE007	Remote Sensing and GIS	1,2,5,7,10	3	-	-	3
43	21OE008	Big Data Analytics	1,7	3	-	-	3
44	21OE009	Fundamentals of Cyber Security	3,6,8	3	-	-	3
45	21OE010	Smart Cities	7,12	3	-	-	3
46	21OE011	Nano Materials and Thin Film Technology	1,12	3	-	-	3
47	21CSMC1	Cloud computing	2,3	3	-	-	3
48	21CSMC2	Ethical Hacking	1,2,3	3	-	-	3
49	21CSMC3	Fundamentals of Web Development	2,3,5	4	-	-	4
50	21OE012	Business Intelligence & Analytics	2,3,5	3	-	-	3
51	21OE013	Introduction To Industry 4.0 And Industrial IoT	2,3	3	-	-	3
52	21OE014	Natural Language Processing	2,3	3	-	-	3

Audit Course							
1	21AT001	Communication Etiquette in Workplaces					
2	21AT002	Contemporary India: Economy, Policy and Society					
3	21AT003	Design The Thinking					
4	21AT004	Ethics and Integrity					
5	21AT005	Indian Heritage and Culture					
6	21AT006	Intellectual Property Rights and Patents					
7	21AT007	Introduction to Journalism					
8	21AT008	Mass Media Communication					
9	21AT009	Science, Technology and Development					
10	21AT010	Social Responsibility					
11	21AT011	The Art of Photography and Film Making					
12	21AT012	Gender Equality for Sustainability					
13	21AT013	Women in Leadership					
14	21AT014	Introduction to Research Methodology					
15	21AT015	Climate Change and Circular Economy					
B. Tech. (Honors)							
Domain I: Structural Engineering							
01	21CEH11	Advanced Concrete Technology	1,12	4	-	-	4
02	21CEH12	Advanced Structural Analysis	1,12	4	-	-	4
03	21CEH13	Design of Industrial Structures	3,5,12, PSO2	4	-	-	4
04	21CEH14	Bridge Engineering	1,12,PSO2	4	-	-	4
Domain II: Transportation Engineering							
01	21CEH21	Rural Road Technology	2,3,PSO1	4	-	-	4
02	21CEH22	Evaluation and Strengthening of Pavements	3,12,PSO2	4	-	-	4
03	21CEH23	Traffic Engineering and Management	3,12	4	-	-	4
04	21CEH24	Planning and Design of Airport	3,12,PSO2	4	-	-	4
Domain III: Geotechnical Engineering							
01	21CEH31	Elements of Rock Mechanics	2,12,PSO1	4	-	-	4
02	21CEH32	Construction in Expansive Soils	2,12,PSO2	4	-	-	4
03	21CEH33	Geosynthetics in Soil Structures	2,3,12, PSO1	4	-	-	4
04	21CEH34	Soil dynamics	2,3,12	4	-	-	4
Domain IV: Construction Management							
01	21CEH41	Modern Construction Material	1,7,12	4	-	-	4
02	21CEH42	Construction Planning and Project Management	1,12	4	-	-	4
03	21CEH43	Quality Control and Assurance in Construction	1,3,12, PSO1	4	-	-	4
04	21CEH44	Safety in Construction	2,11, PSO2	4	-	-	4
B. Tech. (Minors)							
Energy Science & Technology							
01	21CHM11	Foundation of Energy Science and Technology	1,2,3,5,7, 12	4	-	-	4
02	21CHM12	Energy Generation from Waste	1,2,3,4,5	4	-	-	4
03	21CHM13	Energy Storage Systems	1,2,3,6,7	4	-	-	4
04	21CHM14	Hydrogen Energy and Fuel Cells	1,2,3,7	4	-	-	4
Nano Science & Technology							
01	21CHM21	Introduction and Characterization of Nano-Materials	1,2,3,7	4	-	-	4
02	21CHM22	Carbon Nano-Structures and Applications	1,3,4,5	4	-	-	4
03	21CHM23	Energy, Environmental and Biomedical Nanotechnology	1,2,3,7	4	-	-	4
04	21CHM24	Industrial Application of Nanotechnology	2,3,5,7	4	-	-	4
Environment Engineering							
01	21CEM11	Watershed Management	6,7	4	-	-	4

02	21CEM12	Industrial Pollution Control and Engineering	3,6,7,12	4	-	-	4
03	21CEM13	Solid and Hazardous Waste Management	1,3,6,7	4	-	-	4
04	21CEM14	Ecology and Environmental Assessment	1,3,6,7	4	-	-	4
05	21CEM15	Environmental Pollution	2,3,6	4	-	-	4
Artificial Intelligence & Machine Leaning							
01	21CSM11	Fundamentals of AI & Machine Learning	1,12	4	-	-	4
02	21CSM12	Feature Engineering for Machine Learning	1,2,3	4	-	-	4
03	21CSM13	Exploratory Data Analytics	1,4	4	-	-	4
04	21CSM14	Deep Learning	1,2,4	4	-	-	4
Cyber Security							
01	21CSM21	Fundamentals of Security	1,2	4	-	-	4
02	21CSM22	Management of Information Security	3,6,7	4	-	-	4
03	21CSM23	Cyber Security	1,3,4	4	-	-	4
04	21CSM24	Cloud Security	2,3	4	-	-	4
Data Science & Analytics							
01	21CSM31	Data Cleaning	2,3,4	4	-	-	4
02	21CSM32	Data Engineering	1,2,3,4	4	-	-	4
03	21CSM33	Text Analytics	1,2,4	4	-	-	4
04	21CSM34	Social Network Semantic Analysis	2,4	4	-	-	4
Computer Systems Programming							
01	21CSM41	Programming Fundamentals	1,2,3	4	-	-	4
02	21CSM42	Data Structures & Algorithms	1,2,3,4	4	-	-	4
03	21CSM43	Fundamentals of Databases	1,4	4	-	-	4
04	21CSM44	Fundamentals of Computer Networks & Operating Systems	1,2,3	4	-	-	4
Digital IC Design							
01	21ECM11	Fundamentals of VLSI Design	1,2,3	4	-	-	4
02	21ECM12	Digital Design using HDL	1,2,3	4	-	-	4
03	21ECM13	FPGA Technology	1,2	4	-	-	4
04	21ECM14	Analog and Mixed Signal Design	1,2	4	-	-	4
Industrial Automation							
01	21ECM21	Microcontrollers and Interfacing	1,2,3	4	-	-	4
02	21ECM22	Sensors and Data Acquisition System	1,2	4	-	-	4
03	21ECM23	Fundamentals of Lab view	1,2	4	-	-	4
04	21ECM24	Medical Robotics	1,2,3	4	-	-	4
Communications and Networking							
01	21ECM31	Principles of Communications	1,2	4	-	-	4
02	21ECM32	Coding Theory and Practice	1,2	4	-	-	4
03	21ECM33	Ad-hoc and Wireless Sensor Networks	1,2,3	4	-	-	4
04	21ECM34	Fundamentals of Multimedia Networking	1,2,3	4	-	-	4
Avionics							
01	21ECM41	Principles of Aerodynamics	1,2	4	-	-	4
02	21ECM42	Aircraft Electrical Systems	1,2	4	-	-	4
03	21ECM43	Aircraft Instrument Systems	1,2	4	-	-	4
04	21ECM44	Aircraft Communication and Navigation Systems	1,2	4	-	-	4
Geographic Information System							
01	21ECM51	Sensors and Sensing Technology	1,2	4	-	-	4
02	21ECM52	Geographic Information Systems	1,2	4	-	-	4
03	21ECM53	Digital Image Processing	1,2	4	-	-	4
04	21ECM54	Lidar Systems	1,2	4	-	-	4
Electric Vehicles Technology							
01	21EEM11	Introduction to Electric Vehicles Technologies	2,3	4	-	-	4
02	21EEM12	Electrical Drives and Controllers for Electric Vehicles	2,3	4	-	-	4
03	21EEM13	Charging Technology in Electric Vehicles	2,3	4	-	-	4
04	21EEM14	Computer Vision in Electric Vehicles	2,3	4	-	-	4
Smart City Management							

01	21EEM21	Fundamentals of Smart City	2,3	4	-	-	4
02	21EEM22	Smart City Infrastructure	2,3,5,6,7, 11	4	-	-	4
03	21EEM23	Computational Methods for Smart City Management	3,5	4	-	-	4
04	21EEM24	Communication Technologies and Mobility for Smart City	2,3	4	-	-	4
Industrial Applications and Control							
01	21EEM31	Modelling and Simulations of Industrial Applications	2,3	4	-	-	4
02	21EEM32	Industrial Sensors and Actuators	2,3	4	-	-	4
03	21EEM33	Programmable Logic Controllers	2,3	4	-	-	4
04	21EEM34	Control Design for Industrial Applications	2,3	4	-	-	4
Cloud Application Development							
01	21ITM11	Introduction to Cloud Computing	6,7,12	4	-	-	4
02	21ITM12	Introduction to Web Development with HTML, CSS, JavaScript	1,2,3,9,12	4	-	-	4
03	21ITM13	Developing Cloud Native Applications	5,8,10	4	-	-	4
04	21ITM14	Developing Cloud Apps with Node.js and React	5,8,10	4	-	-	4
Robotics and Automation							
01	21MEM11	Introduction to Robotics	1,2,3	4	-	-	4
02	21MEM12	Drives and Sensors	1,2,3,4	4	-	-	4
03	21MEM13	Control Systems for Robotics	1,2,3,4	4	-	-	4
04	21MEM14	Machine Learning for Robotics	2,5	4	-	-	4
Industrial Systems Engineering							
01	21MEM21	Industrial Engineering	1,10,11,12	4	-	-	4
02	21MEM22	Fundamentals of Operations Research	1,2,3,5	4	-	-	4
03	21MEM23	Enterprise Resource Planning	1,2,3,5,11, 12	4	-	-	4
04	21MEM24	Production Planning and Control	1,2,3,5,11, 12	4	-	-	4

21CE501 Design and Detailing of RC Structures

3 0 2 4

Course Outcomes

1. Apply the concepts of limit state design philosophy in designing reinforced concrete structural elements
2. Analyze the reinforced concrete rectangular and flanged beam using limit state design for flexure, shear, torsion, and bond
3. Design the reinforced concrete rectangular and flanged beam using limit state design for flexure, shear, torsion, and bond
4. Design the reinforced concrete columns subjected to axial load, uniaxial and biaxial bending
5. Design the reinforced concrete footings subjected to axial load
6. Design the reinforced concrete slabs and check for serviceability.

COs–POs Mapping

COs	PO3	PO10	PO12	PSO2
1	2	2	2	2
2	3	3	1	2
3	3	3	1	2
4	3	3	1	2
5	3	3	1	2
6	3	3	1	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Introduction to Reinforced Concrete and Design for Flexure

Introduction to Design Philosophies, Limit State Design: Concepts of limit state design; Characteristic loads; Characteristic strength; Partial load and safety factors; representative stress-strain curves for cold worked deformed bars and mild steel bars; assumptions in limit state design; stress; block parameters; limiting moment of Resistance; analysis and design of singly and doubly reinforced beams.

Practical Components

1. Design and detailing of under reinforced concrete beams (Problem 1).
2. Design and detailing of under-reinforced concrete beams (Problem 2).
3. Design and detailing of doubly reinforced concrete beams (Problem 1).
4. Design and detailing of doubly reinforced concrete beams (Problem 2).

12+8 Hours

Unit II

Flanged Beams and Shear, Torsion & Bond

Flanged Beams: Recommendations of IS 456 – 2000 on flanged sections, limit state analysis and design of singly reinforced flanged (T) beam sections; Shear, Torsion and Bond: Limit state analysis and design of section for shear and torsion; concept of bond

Practical Components

1. Design and detailing of flanged section concrete beams (Problem 1).
2. Design and detailing of flanged section concrete beams (Problem 2).
3. Design and detailing of RC beams for torsional resistance (Problem 1).
4. Design and detailing of RC beams for torsional resistance (Problem 2).

12+8 Hours

Unit III

Columns and Footings

Columns: Short and Long columns – under axial loads, uniaxial bending and biaxial bending – IS Code provisions; Footings: Different types of footings; Design of isolated square and rectangular footing for axial loads

Practical Components

1. Design and detailing of concrete columns for uniaxial bending.
2. Design and detailing of column for biaxial bending.
3. Design and detailing of square footing.
4. Design and detailing of rectangle footing.

12+8 Hours

Unit IV

Slabs and Limit State Design for Serviceability

Slabs: Design of one way slabs, two way slab, and continuous slabs - Limit State Design for Serviceability: Deflection.

Practical Components

1. Design and detailing of one-way concrete slab.
2. Design and detailing of two-way concrete slab.
3. Design and detailing of two-way concrete slab with corners held down
4. Design and detailing of two-way concrete slab with two adjacent edges discontinuous.

12+8 Hours
Total: 48+32 Hours

NOTE

IS 456-2000, Plain and Reinforced Concrete - Code of Practice and SP 16-1982, Design Aids for Reinforced Concrete to IS 456-1978 are permitted to use in classroom and examinations.

Textbook (s)

1. S. Unnikrishna Pillai & Devdas Menon, Reinforced Concrete Design, 3rd Ed., Tata McGraw Hill Publishers, 2010
2. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Limit State Design of Reinforced Concrete, 1st Ed., Laxmi Publications Pvt. Ltd., 2015

Reference (s)

1. N. Subramanian, Design of Reinforced Concrete Structures, 1st Ed., Oxford University Press Publishers, 2014
2. N. Krishna Raju and R.N. Pranesh, Reinforced concrete design, 1st Ed., New age International Publishers, 2018

21CE502 Environmental Engineering

3 0 0 3

Course Outcomes

1. Understand the objective of water supply and the concept of design period in water supply system planning.
2. Classify the various sources and different characteristics of water.
3. Design various primary units of conventional water treatment plant.
4. Explain the construction, operation, and maintenance of various advanced treatment processes wastewater treatment
5. Design various secondary treatment units in sewage treatment plant
6. Comprehend the regulatory standards for effluent disposal and various sludge disposal methods.

COs-POs Mapping

COs	PO3	PO6	PO7	PO12
1	1	2	3	2
2	2	2	3	2
3	3	2	3	2
4	2	2	3	2
5	3	2	3	2
6	2	2	3	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Water Demand and Quality

Water Demand: Public water supply system, Planning, Objectives, Design period, Population forecasting; Water demand.

Water Quality: Development and selection of source, Sources of water, Characteristics of water, Significance, Drinking Water quality standards; intake structures, Functions.

Laying, jointing and testing of pipes; appurtenances

12 Hours

Unit II

Design of Water Treatment Units

Objectives, Unit operations and processes, Principles, functions, design of water treatment plant units; aerators, flash mixers, Coagulation and flocculation, Clariflocculator, Plate and tube settlers; sand filters; Disinfection; Residue Management; Water softening, Construction, Operation and Maintenance aspects.
Desalination Process; Membrane Filtration

12 Hours

Unit III

Sewage Quality and Design of Sewage Treatment Units

Objectives, Unit Operations and Processes, Selection of treatment processes, Onsite sanitation, - Septic tank, - Grey water harvesting,
Primary treatment: Principles, functions and design of sewage treatment units, Screens, Grit Chamber, Primary Sedimentation tanks, Construction, Operation and Maintenance aspects.
Secondary Treatment: Activated Sludge Process and Extended aeration systems, Trickling filters, Sequencing Batch Reactor (SBR), Membrane Bioreactor, UASB, Waste Stabilization Ponds, Other treatment methods, Reclamation and Reuse of sewage, Recent Advances in Sewage Treatment.
Construction, Operation and Maintenance aspects; Sewer Appurtenances

12 Hours

Unit IV

Design of Ponds and Sludge Disposal

Effluent Disposal: Standards for Disposal, Methods, dilution, Self-purification of river, Oxygen sag curve, deoxygenation and reaeration, Streeter–Phelps model, Land disposal of Sewage.
Sludge Disposal: Sludge characterization, Thickening, Sludge digestion, Standard rate and High rate digester design, Biogas recovery, Sludge Conditioning and Dewatering, Sludge drying beds,
Ultimate residue disposal and recent advances; Soil Dispersion System.

12 Hours
Total: 48 Hours

Text Book (s)

1. B.C. Punmia, Ashok Jain &Arun Jain, Water Supply Engineering, Vol. 1, Wastewater Engineering, Vol. II, 2nd Ed., Laxmi Publications Pvt. Ltd, New Delhi, 2016
2. G.S. Birdi, Water supply and Sanitary Engineering, Revised Ed., Dhanpat Rai & Sons Publishers, 2015
3. 3. K.N. Duggal, Elements of Environmental Engineering, 3rd Ed., S. Chand Publishers,2010

Reference Books (s)

1. Manual on Sewerage and Sewage Treatment Systems Part A, B and C, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
2. Metcalf and Eddy- Wastewater Engineering–Treatment and Reuse, Tata Mc.Graw-Hill Company, New Delhi, 2010.
3. Syed R. Qasim "Wastewater Treatment Plants", CRC Press, Washington D.C., 2010
4. Gray N.F, "Water Technology", Elsevier India Pvt. Ltd., New Delhi, 2006.

21CE503 Foundation Engineering

3 0 0 3

Course Outcomes

1. Demonstrate the process of exploration for different type of geotechnical engineering projects
2. Analyze forces, activities, and various slope failures to estimate and ensure slope stability in diverse conditions
3. Apply earth pressure theories to determine lateral earth pressures and ensure the stability of various types of retaining walls
4. Determine allowable bearing pressures and load carrying capabilities of shallow foundations
5. Determine allowable bearing pressures and load carrying capabilities of pile foundation
6. Outline the laterally loaded piles and under reamed piles

COs – POs Mappings

COs	PO2	PO3	PO8	PO12	PSO2

1	2	1	1	1	1
2	2	2	1	1	1
3	3	2	1	1	2
4	3	3	1	1	3
5	3	2	2	1	3
6	3	2	2	1	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Soil Exploration

Methods of soil exploration – Boring and Sampling methods – Field tests – Non – invasive tests-planning of Programme - preparation of soil investigation report.

Slope stability: Infinite and finite earth slopes – types of failures – factor of safety of infinite slopes: stability analysis- Swedish Arc Method – Taylor's Stability Number- Stability of slopes of earth dams under different conditions

Geophysical methods, Stability Analysis by Swedish Arc Method

12 Hours

Unit II

Earth Pressure Theories and Retaining Walls

Earth pressure theories: Rankine's theory of earth pressure – earth pressures in layered soils – Coulomb's earth pressure theory – Culmann's graphical method. Retaining walls: Types of retaining walls – stability of retaining walls

Earth Pressure on inclined back of wall, Modes of Failures of Retaining Walls

12 Hours

Unit III

Shallow Foundations and Settlement Analysis

Shallow foundations: Types - choice of foundation – Location of depth – Safe Bearing Capacity –Terzaghi bearing capacity- IS Methods. Safe bearing pressure based on N- value

Settlement analysis: Allowable bearing pressure; safe bearing capacity and settlement from plate load test – allowable settlements of structures

SBC- Meyerhoff and Skempton Methods

12 Hours

Unit IV

Pile Foundation

Pile foundation: Types of piles – Load carrying capacity of piles based on static pile formulae –Pile load tests. Load carrying capacity of pile groups- settlement of pile groups- Laterally loaded piles- Under reamed piles.

Dynamic pile formulae – Engineering News record formula and Danish Formula

12 Hours

Total: 48 Hours

Textbook (s)

1. Gopal Ranjan & ASR Rao, Basic and Applied Soil Mechanics, 3rd Ed., New Age International Pvt. Ltd, 2016
2. K.R.Arora, Soil Mechanics and Foundation Engineering, 7th Ed., Standard Publishers Distributors, Delhi, 2019

Reference (s)

1. Das, B.M., Principles of Foundation Engineering, 9th Ed., Cengege Learning India Pvt. Ltd., 2018
2. Bowles, J.E., Foundation Analysis and Design, 5th Ed., McGraw-Hill Publishing Company, Newyork, 2017
3. S. K.Gulhati & Manoj Datta, Geotechnical Engineering, 16th Ed., Tata Mc.Graw Hill Publishing Company, New Delhi. 2013
4. B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, Soil Mechanics and Foundations, 17th Ed., Laxmi Publications Pvt. Ltd., New Delhi, 2017

21CE504 Hydrology

3 0 2 4

Course Outcomes

1. Understand the interplay between precipitation, abstractions, and runoff processes, equipping them to analyze and manage water resources effectively.
2. Understand the principles of Unit Hydrograph, including its derivation, limitations, and applications of superposition and S-hydrograph techniques and utilize Unit Hydrograph methods for different durations.
3. Demonstrate proficiency in computing runoff using rational and SCS methods, conducting flood analyses, and employing statistical techniques for flood prediction.
4. Apply flood control measures, conduct flood routing using the Muskingum Method, and perform statistical analyses for accurate flood predictions, contributing to effective water resource management.
5. Understand reservoir management skills, including understanding types, site selection, capacity determination, and applying Mass Curve and Demand Curve concepts for yield analysis.
6. Understand aquifer types, parameters, and flow dynamics, apply steady and unsteady flow concepts, and conduct recuperation tests for sustainable groundwater management.

COs-POs Mappings

COs	PO2	PO3	PO12
1	2	2	3
2	3	3	3
3	2	2	3
4	3	2	3
5	3	3	3
6	3	2	3

3-Strong linked| 2-Moderately linked| 1-Weakly linked

Unit I

Precipitation and Abstractions

Engineering hydrology and its applications, Hydrologic cycle, Types and forms of precipitation, rainfall measurement, types of rain gauges, rain gauge network, average rainfall over a basin, consistency of rainfall data, frequency of rainfall, intensity duration-frequency curves, probable maximum precipitation, evaporation, evapotranspiration, infiltration, infiltration indices.

Practical components

1. Estimation of number rain gauge in a given catchment area.
2. Double Ring Infiltrometer test.
3. Evaporation test using ISI Pan.
4. Lake evaporation using Meyers formula

12+8 Hours

Unit II

Runoff and Hydrograph

Factors affecting runoff, components of runoff, computation of runoff-rational and SCS Methods, separation of base flow, definition of Unit Hydrograph, assumptions, derivation of Unit Hydrograph, unit hydrographs of different durations, principle of superposition and S-hydrograph methods, limitations and applications of UH, Synthetic Unit Hydrograph.

Practical components

1. Design of Unit hydrograph by using Principle of super position
2. Design of Unit hydrograph by using S-hydrograph method
3. Base flow separation.
4. Synthetic unit hydrograph using Snyder's empirical equations

12+ 8 Hours

Unit III

Floods and Reservoir Routing

Flood Control, Flood flows, Statistical analysis for flood prediction, Flood routing, Channel Routing by Muskingum Method, Reservoir planning ,Types of Reservoir, Selection of Site for a Reservoir, Zones of Storage in a Reservoir, Reservoir Regulation, Reservoir Yield, Mass Curve and Demand Curve, Determination of Reservoir Capacity, Yield From a Reservoir of given Capacity.

Practical components

1. Estimation of frequency of flood.
2. Estimation of Reservoir capacity.
3. Seepage from a reservoir using water budget method
4. Flood risk assessment using RS & GIS

12 + 8 Hours

Unit IV

Groundwater Hydrology

Groundwater Occurrence, types of aquifers, aquifer parameters, porosity, specific yield, Permeability, transmissivity and storage coefficients, groundwater Flow lines. Steady flow to a well, steady radial flow to a well in confined aquifer and unconfined aquifer, Unsteady radial flow into a confined aquifer, Non equilibrium Theis equation, Theis method of solution, multiple well system. yield of an open well-recuperation test.

Practical components

1. Estimation of Ground water depth
2. Design of well
3. Ground water potential zones identification using RS & GIS
4. Reservoir site selection using RS & GIS

12 +8 Hours

Total: 48+32 Hours

Textbook (s)

1. K. Subramanya, Engineering Hydrology, 4th Ed., Tata McGraw-Hill Education Private Limited, 2017
2. P.N.Modi, Irrigation Water Resources & Water Power,11th Ed., Standard Book House, 2019.
3. K.R.Arora, Irrigation, Water Power and Water Resources Engineering, 5th Revised Ed., Standard Publishers, New Delhi, 2018

Reference (s)

1. VenTe Chow, Hand Book of Applied Hydrology,4th Ed., Tata-McGraw Hill, 2010 (second reprint)
2. P. Jayarami Reddy, A Text Book of Hydrology, 3rd Ed., Laxmi publications Pvt. Ltd., New Delhi,2016
3. H.M Raghunath, Hydrology: Principles, Analysis & Design,3rd Ed., New Age International Publishers, 2015.
4. David K Todd, Text book on Groundwater hydrology, 3rd edition John Wiley & Sons, Inc.
5. S.K Garg, Irrigation and Hydraulic structures, 36th Ed., Khanna Publishers, 2018
6. B.C. Punmia & Lal, Irrigation and Water Power engineering, Revised 17th Ed., Laxmi publications Pvt. Ltd., New Delhi, 2021.

21CE505 Environmental Engineering Laboratory

0 0 3 1.5

Course Outcomes

1. Demonstrate how to perform relevant tests in the laboratory to determine the major characteristics of water and wastewater
2. Understand the importance of determining the concentration of various parameters in waste water.
3. Make use of various equipment/methods available for examining water and wastewater
4. Apply titration methods to accurately determine the concentrations of various parameters.
5. Identify the practical significance of the characteristics, the relevant codes of practice for examination and permissible limits for the characteristics of water and wastewater
6. Assess the appropriate methods for determining the various parameters in water samples.

COs-POs Mappings

COs	PO3	PO6	PO7	PO12
1	3	3	2	3
2	3	3	2	3
3	3	3	2	3
4	3	3	2	3
5	3	3	2	3
6	3	3	2	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

List of Experiments

1. Determination of pH and Electrical Conductivity
2. Determination and estimation of total Hardness
3. Determination of Calcium and Magnesium hardness
4. Determination of Alkalinity
5. Determination of Acidity
6. Determination of chlorides in water.
7. Determination and estimation of total solids, dissolved solids
8. Determination of Iron
9. Determination of Optimum Coagulant dosage
10. Determination of dissolved oxygen with D.O Meter & Winkler 's Method
11. Determination of B.O.D
12. Determination of COD
13. Determination of chlorine demand
14. Determination of Flourides
15. Determination of Sulphate
16. Determination of Phospate

List of Augmented Experiments

1. pH and Electrical Conductivity value of different samples
2. Estimation of total Hardness of bore water
3. Determination of Calcium and Magnesium hardness of bore water
4. Determination of Alkalinity and Acidity of different samples
5. Determination of chlorides in water.
6. Estimation of total solids, dissolved solids in Surface water and sub-surface water sample
7. Determination of dissolved oxygen of pond water with D.O Meter & Winkler 's Method
8. Physical parameters-Temperature, Turbidity
9. B.O.D/COD of different samples
10. Determination of chlorine demand for municipal water
11. Determine the Sulphate and Phosphate nature of the water and wastewater samples

Total: 48 Hours

Reading Materials (s)

1. Environmental Engineering Lab Manual-Civil Engineering, GMRIT, Rajam
2. Standard Methods for Examination of Water and Waste Water, 23rd Edition, APHA.
3. KVSG Murali Krishna, Chemical Analyses of Water and Soil,3rd Ed., Reem Publications, New Delhi. 2013

21TPX01 Term Paper

0 0 3 1.5

Course Outcomes

1. Interpret the literature to link the earlier research with the contemporary technologies
2. Communicate effectively as an individual to present ideas clearly and coherently
3. Review the research findings and its correlation to the latest applications
4. Prepare documents and present the concepts clearly and coherently
5. Inculcate the spirit of enquiry for self-learning
6. Identify interdisciplinary oriented topics

COs – POs Mapping

COs	PO1	PO4	PO10	PO12
1	-	2	-	-
2	-	-	3	3
3	3	-	-	-
4	-	-	3	-
5	-	-	-	3
6	1	-	-	-

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

21ESX02 Employability Skills II

1 0 1 0

Course Outcomes

1. Demonstrate oral communication and writing skills as an individual to present ideas coherently
2. Develop life skills with behavioral etiquettes and personal grooming
3. Assess analytical and aptitude skills
4. Develop algorithms for engineering applications.
5. Solve engineering problems using software
6. Utilize simulation tools for testing

COs – POs Mapping

COs	PO1	PO2	PO5	PO8	PO10	PO12
1					3	2
2				1	2	2
3	2	1		2		
4	2		2			
5	2		2			
6	2		2			

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

1. Communication Skills, Confidence and Quantitative Aptitude

Introduction to Campus Placements: Stages of Campus Placement, Skills assessed in Campus Placements & How to get ready?

Motivational Talk on Positive Thinking: Beliefs, Thoughts, Actions, Habits & Results (Success)

Resume Preparation: Resume? Templates? Mistakes to be avoided in a Resume, Steps to be followed in preparing it.(with examples)

Group Discussions (Recap): GD? Stages of a GD, Skills assessed in a GD, Blunders to be avoided, How to excel in a GD? (through Practice Sessions)

Psychometric Tests: Definition, Types of Psychometric Tests: Numerical Computation, Data Interpretation, Verbal Comprehension, Verbal Critical Reasoning and Personality Questionnaires

Exercises related to Communication: Story Writing, TAT etc .

16 Hours

2. Quantitative Aptitude

Square &Cube roots, Partnership, Logarithms, Progressions, Mensuration, Data Sufficiency

16 Hours

Unit II

3. Transport Engineering

Airport Engineering: Airport components, classification, site selection, Concept of airport runway length, calculations and corrections; taxiway and exit taxiway design.

Railway Engineering: Rail components and their Functions - Types of Rails, Joints, Rail Fastenings, Gauges, Coning of Wheels, Creep theory- Sleepers functions, requirements, types – Ballast, depth of ballast, Geometric design of railway Track – Speed and Cant.

Dock and Harbour Engineering: Inland water transportation, Ports and harbour: requirements, classification – Harbour components - breakwaters, jetties, fenders, piers, wharves, dolphins- Navigational aids, types, requirements-Docks– dry docks, wet docks, slipways, lock gates, Dredging – classification, dredgers- Port facilities – general layout, development, planning, facilities, terminals.

Highway Pavements: Highway materials - desirable properties and tests; Desirable properties of bituminous paving mixes; Design factors for flexible and rigid pavements; Design of flexible and rigid pavement using IRC codes.

32 Hours

Total 64 Hours

Reference (s)

1. Kadiyali, L. R., Traffic Engineering and Transportation Planning, Khanna Publishers, New Delhi, 2016
2. Simon P. Washington, Matthew G. Karlaftis, Fred L. Mannering, Statistical and Econometric Methods for Transportation Data Analysis, CRC Press, Second Edition, 2010
3. Fundamentals of Mathematical Statistics – Gupta, S.C and Kapoor, K. V. Sultanchand.
4. Multivariate Data Analysis –Cootey W.W & Cohens P. R; John Wiley &Sons.
5. Probability Concepts in Engineering, Planning and Design, Vol. I & II by Alfredo H.S. Wilson H. Tang, Wiley International.

21HSX12 CC & EC Activities II

0 0 1 0

Course Outcomes

1. Interpret and present the abstractive technical information through an activity
2. Think critically in providing solutions to the generic and common problems
3. Demonstrate the creative thinking in dealing with liberal arts
4. Instill team sprit through active engagement with the peer
5. Develop programs of common interest having social impact
6. Empower the under privileged through motivational activities

COs – POs Mapping

COs	PO6	PO7	PO9	PO10
1	-	-	-	3
2	3	2	-	-
3	3	-	-	-
4	-	-	3	-
5	3	-	-	-
6	3		-	-

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

21SIX01 Summer Internship I

0 0 0 1

Course Outcomes

1. Demonstrate the communication skills to meet the requirement of industry
2. Develop logical thinking and analytical skills to thrive in competitive examinations
3. Use mathematical concepts to solve technical quizzes
4. Develop technical skills to work out real time problems
5. Develop algorithms for different applications
6. Solve industry defined problems using appropriate programming skills

COs-POs Mapping

COs	PO1	PO2	PO8	PO10	PO12
1	3				
2	3				
3					3
4				3	
5		2			
6			3		

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

21CEC11 Principles of Building Architecture

3 0 0 3

Course Outcomes

1. Understand the architectural design, layout regulations and site analysis concepts to apply in the real time projects.
2. Classify the different types of buildings and apply the principles of anthropometry and space standards while designing a building.
3. Integrate building services components, interior design concepts and fire safety standards to create efficient and functional spaces in a building.
4. Apply climate and environmental responsive design strategies to create sustainable buildings that take advantage of natural elements while minimizing negative environmental impacts.
5. Apply the concepts of various passive and active energy control systems for the heating and cooling of buildings, along with green building concepts.
6. Utilize knowledge of energy resources for buildings and energy rating systems to design and develop the energy efficient buildings.

COs–POs Mappings

COs	PO1	PO3	PSO1	PSO2
1	3	1	2	1
2	3	1	2	1
3	3	1	2	1
4	3	1	2	1
5	3	1	2	1
6	3	1	2	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Architectural Design and Site planning

Architectural Design - Key aspects and concepts – integration of function and aesthetics – Introduction to basic elements and principles of design. Surveys – Site analysis – Development Control – Layout regulations- Layout design concepts.

Evolution of architectural form and space, Gestalt ideas of visual perception.

12 Hours

Unit II

Building Types

Residential, institutional, commercial and Industrial – Application of anthropometry and space standards- Inter relationships of functions – Safety standards – Building rules and regulations – Integration of building services – Interior design

Configuration of architectural spaces, Built form and open space relationships

12 Hours

Unit III

Climate and Environmental Responsive Design

Man and environment interaction- Factors that determine climate – Characteristics of climate types – Design for various climate types – Passive and active energy controls – Green building concept.

Thermal behavior of the building, global climate and greenhouse effect

12 Hours

Unit IV

Energy resources of the buildings

Energy-Forms of energy, sources, Energy Conservation-Renewable energy-Solar, wind, hydrothermal-Energy use in building-Energy rating of the building-Sustainability issues for the buildings.

Non renewable energy sources, embodied energy

12 Hours

Total: 48 Hours

Textbook (s):

1. Muthu Shoba Mohan.G.," Principles of Architecture"., Oxford University Press., New Delhi, 2006
2. Szokolay, Steven V" Introduction to architectural design",Routledge,Taylor and Francis,2014
3. Arvind Krishnan, Nick Baker, Simos Yannas, Szokolay.S.V., "Climate Responsive Architecture"., A Design Hand Book for Energy Efficient Building, Tata McGraw Hill Publishing Company Ltd., New

Delhi, 2017.
4. Pramar. V.S. "Design fundamental in Architecture", Somaiya Publications Pvt. Ltd., New Delhi, 1997.

Reference (s):

1. Rangwala. S.C. "Town Planning" Charotar Publishing House., Anand, 2005.
2. De Chiara.J., Michael. J. Crosbie.,"Time Saver Standards for Building Types", McGraw Hill Publishing Company, New York, 2001.
3. National Building Code of India., SP7 (Group 1) Bureau of Indian Standards, New Delhi, 2015

21CEC21 Geometric Design and Highway Materials

3 0 0 3

Course outcomes

1. Summarize various considerations for rural and urban arterials
2. Explain the characteristics and considerations for rotary intersections
3. Describe the optimal characteristics of subgrade soil materials
4. Evaluate the characteristics of bitumen and bituminous mixes
5. Explain durability and quality of flexible pavements
6. Explain the components and the construction of cement concrete pavements

COs – POs Mappings

COs	PO1	PO3	PSO2
1	1	3	1
2	1	3	2
3	1	3	1
4	1	3	1
5	2	3	3
6	1	2	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Geometric Design Considerations

Geometric design considerations for urban highways, design speeds, volumes, levels of service and other design considerations.

Design of Intersections: Characteristics and design considerations of at-grade intersections; Design of rotary intersection; Interchanges - different types.

Ribbon development, Ramps

12 Hours

Unit II

Properties of Subgrade Soil and Aggregates

Subgrade soil –Soil classification for engineering purposes, Soil stabilization - Classification, requirements, properties, tests, alternative materials for soil stabilization.

Aggregates: blending and gradation, characteristics, properties and alternatives.

Effective CBR, Light weight deflectometer

12 Hours

Unit III

Characteristic of Bitumen and Bituminous Mixes

Origin, preparation, properties and tests, constituents of bituminous road binders, requirements – Bituminous Emulsions and Cutbacks: Preparation, characteristics, uses and tests. Bituminous Mixes: Mechanical properties – Resilient modulus, dynamic modulus, rutting and fatigue characteristics of bituminous mixes.

Tar, Flow number

12 Hours

Unit IV

Design of bituminous and cement concrete mixes

Weathering and Durability of Bituminous Mixes – Performance based Bitumen mix specifications – Marshall and Super pave mix design method. Cement Concrete for Pavement Construction: Requirements, design of mix for CC pavement, joint filler and sealer materials.

Stresses in CC pavement, Bailey gradation

12 Hours

Total: 48 Hours

Textbook (s)

1. Partha Chakraborty and Animesh Das, Principle of Transportation Engineering, PHI Learning Private Limited, New Delhi, 2012.
2. S K Khanna and C E G Justo. Highway Engineering. Nemchand Bros.,, Roorkee, 2017.

Reference (s)

1. Kadiyali, L.R., Principles and practices of Highway Engineering , Khanna Publishers, New Delhi, 2019
2. Alkins and Harold, "Highway Materials Soils and Concretes", Prentice Hall, Pearson, 4th Edition, 2003.
3. Kerbs and Walkes, "Highway Materials", McGraw Hill Book Co. 2007
4. IRC:37-2018 Guidelines for the design of flexible pavements (fourth revision) Indian Roads Congress.
5. IRC:86-2018 Geometric design standards for urban roads and streets, Indian Roads Congress.

21CEC31 Prefabricated Structures

3 0 0 3

Course Outcomes

1. Understand the principles, types, materials, and the concept of modular coordination in prefabricated structures.
2. Describe the concept of standardization along with techniques involved in the production, transportation, and erection of prefabricated structures.
3. Choose the appropriate prefabricated components suitable for various building demands.
4. Discuss the different manufacturing methods of precast elements, including their dimensional tolerances and accelerated concrete hardening techniques.
5. Apply techniques for the safe and efficient erection of various precast members, such as beams, columns, slabs, and wall panels
6. Design and implement various types of prefabricated joints for different prefabricated components.

COs–POs Mappings

COs	PO3	PSO2
1	3	2
2	3	2
3	3	2
4	3	2
5	3	2
6	3	2

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Introduction

Need for prefabrication – Principles –Types of prefabrication- site and plant prefabrication - Materials – Economy of prefabrication– Modular coordination – Standardization – Systems – Production – Transportation – Erection.

Light weight prefabricated components, Scope for prefabrication construction

12 Hours

Unit II

Prefabricated Components

Behaviour of structural components – Large panel constructions – Construction of roof and floor slabs – Wall panels – Columns – Shear walls

Prefabricated chaija, Prefabricated beams

12 Hours

Unit III

Production and Hoisting Technology

Choice of production setup – Manufacturing methods – Stationary and mobile production – Planning of production setup – Storage of precast elements – Dimensional tolerances – Acceleration of concrete hardening. hoisting and erection – Techniques for erection of different types of members like Beams, Slabs, Wall panels and Columns

Vacuum lifting pads, Errors in construction

12 Hours

Unit IV

Structural Joints and Design Principles

Joints for different structural connections – Dimensions and detailing – Design of expansion joints. Disuniting of structures- Design of cross section based on efficiency of material used – Design Principles - Allowance for joint deformation.

Design of abnormal loads, Equivalent load design

12 Hours

Total: 48 Hours

Textbook (s)

1. Pradeep kumar.M" Prefabricated structures" Shanlax Publications,2016
2. CBRI, Building materials and components, India, 1990
3. Gerostiza C.Z., Hendrikson C. and Rehat D.R., "Knowledge based process planning for construction and manufacturing", Academic Press Inc., 1994

Reference (s)

1. Koncz T., "Manual of precast concrete construction", Vol. I, II and III, Bauverlag, GMBH, 1976.
2. "Structural design manual", Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 2009

21CEC41 Data Analysis and Visualization Using Python

3 0 0 3

Course Outcomes

1. Develop a comprehensive understanding of the foundational principles of data science and the role of AI/ML, equipping students to address real-world challenges.
2. Gain proficiency in fundamental statistics, enhancing the ability to analyze data and make predictions within the context of Data Science.
3. Acquire a deep understanding of probability concepts, applying them to hypothesis testing for more informed inferential statistical decisions.
4. Master the fundamentals of Python, enabling the construction and manipulation of Data Frames for various data analysis tasks.
5. Utilize diverse charting methods to visualize data effectively, enhancing comprehension in real-time scenarios.
6. Conduct thorough exploratory data analysis (EDA) to generate high-accuracy, reliable data for both Machine Learning models and real-world applications.

COs-POs Mapping

COs	PO1	PO2	PO5	PO12
1	2	3	2	2
2	2	3	2	2
3	2	3	2	2
4	2	3	2	2
5	2	3	2	2
6	2	3	2	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Introduction to Data Science

Data: Types and Categories - Structured and Un-Structured Data – Data Table **-** Data Science**:** Need for Data Science - Advantages and Disadvantages– Components

Data Analysis: Types –Process – Data cleaning, Mining and Wrangling – Tools for Data Analysis - Machine Learning and Artificial Intelligence – ML for Data Science

Categorical data, Ordinal Data

12 Hours

Unit II

Introduction to Statistics

Basis Statistics: Data Objects, Attributes and Attribute types – Histogram – Descriptive Statistics: Central

Tendency and 3 Ms - Measures of Dispersion, Range and IQR - Standard Deviation - Coefficient of Variation - Boxplot and Five Number Summary - Correlation Analysis
Probability: Meaning and concepts - Rules for Computing Probability - Marginal Probability – Bayes Theorem. Introduction to Inferential Statistics.
Empirical Rule, Chebyshev Rule

12 Hours

Unit III
Python for Data Science
Python Basics: Variables and its types – Looping and Conditional Statements – Functions
Introduction NUMPYs: List, Tuples and Dictionary's – Arrays and Matrices – Arithmetic Operation in Arrays and Matrices – Accessing and Modifying Arrays, Matrices, List and Dictionary's **Introduction to Pandas:** Series and DataFrames – Accessing – loc and iloc method – Modifying DataFrame – Pandas Functions – Date-Time Module
Info(),Groupby

12 Hours

Unit IV
Data Visualization and Exploratory Data Analysis (EDA)
Data Visualization : Introduction Visualization Libraries - Histogram – Skew – Boxplot – Bar Chart – Line, Scatter Plot and LM plot – Joint and Violin plot – Strip and Swam plot – Cat plot – Heat Map – Pair plot – Plotly – Pie chart - Timeline Charts - Concepts of sub plots
EDA: Sanity Check – Univariate Bivariate and Multivariate analysis – Missing Value Treatment – Outliers detection and Treatment.
Count plot , fillna

12 Hours
Total: 48 Hours

Textbook (s)

1. Daniel J. Denis: Univariate, Bivariate, and Multivariate Statistics Using R: Quantitative Tools for Data Analysis and Data Science, Wiley,2020
2. Mukhiya Suresh Kumar Mukhiya, Ahmed Usman Ahmed: Hands-On Exploratory Data Analysis with Python: Perform EDA techniques to understand, summarize, and investigate your data, Packt, 2020
3. Claus Wilke, "Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures", 1st edition, O'Reilly Media Inc, 2019.
4. Downey, Allen. Think stats: exploratory data analysis. " O'Reilly Media, Inc.", 2014.
5. Neil H. Spencer: Essentials of Multivariate Data Analysis, CRC Press,2014

Reference (s)

1. Wes McKinney : Python for Data Analysis 2nd Edition,Wiley,2013
2. Glenn J. Myatt, Wayne P. Johnson: Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining, 2nd Edition,Wiley,2014
3. 1 Tony Fischetti, Brett Lantz, R: Data Analysis and Visualization,O'Reilly ,2016 2 OssamaEmbarak, Data Analysis and Visualization Using Python: Analyze Data to Create Visualizations for BI Systems,Apress, 2018
4. Wendy L. MartinezAngel R. MartinezJeffrey L. Solka: Exploratory Data Analysis with MATLAB, 2nd Edition,CRC Press,2011
5. Radhika Datar, Harish Garg : Hands-On Exploratory Data Analysis with R , Packt,20206.

21CE004 Construction Techniques

3 0 0 3

Course Outcomes

1. Outline the knowledge of construction of substructures and superstructures
2. Analyze the techniques of Erection of Construction units
3. Demonstrate basic knowledge about Construction equipment and machinery
4. Discuss about hauling and conveying equipment
5. Demonstrate the ability to identify and manage with respect to time and their motion with respect to their movements
6. Understand the importance of mechanization of construction

COs–POs Mapping

COs	PO4	PO5	PO11	PSO2
1	2	1	2	3
2	3	2	2	3

3	2	3	2	3
4	3	2	2	3
5	1	3	2	3
6	3	1	2	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Substructure and Superstructure

Digging and excavation of trenches– Grading– Special earth work excavation– Drilling and blasting techniques. Pile driving techniques– sinking wells.

Concrete and reinforced concrete works– form work– reinforcement– concreting– mechanized methods of erection of Buildings and installations. Cast-in-situ and pre-cast concrete, Concreting below G.L. – wall in situ method for cast in situ and precast concrete.

Well Caissons- Pre-Engineered Buildings

12 Hours

Unit II

Erection of Construction Units, Construction Equipment and Machinery

Different types– scaffolding, Erection of steel structures– Tunneling techniques. Precast and prefabricated construction – need and advantages

Earthmoving Equipment Power shovels, Back hoe, Dragline, Clam shell; Tunneling machine – types, hoisting equipment – such as hoist winch, hoisting chains, and hooks and slings, various types of cranes – tower crane, mobile crane and derrick crane. Their characteristics, performance and safety in operation.

Form work- Hauling Equipment

12 Hours

Unit III

Concrete Mixers

Concrete mixers, truck mixers, pneumatic concrete placer, concrete vibrators. Pile Driving Equipment - Tunneling and rock drilling equipment – Pumps and dewatering equipment.

Ready Mix Concrete- Rock Bolting

12 Hours

Unit IV

Time and Motion Studies, Management of Construction Equipment

Process charts – application of queuing or wait line models management of construction equipment

Need for mechanization of construction – planning and financing construction plant and equipment – Owning and operating equipment versus hiring – planning for infrastructure mechanization equipment management – equipment maintenance and repair.

Layouts- Optimization of Machinery Utilization

12 Hours

Total: 48 Hours

Textbook (s)

1. Robert L.P and J.S.Clifford, Construction Planning Equipment Methods. 2nd Ed., Tata Mc Graw Hill, 2003.
2. S.Seetharaman, Construction Engineering and Management, 4th Ed., Umesh publications, New Delhi, 1999.
3. Mahesh varma, Construction Equipment and its Palnning and Applications, 5th Ed., Metroplolitan Book Co. Publishers, 2005.

Reference (s)

1. Sengupta and Guha, Construction Management and Planning, 2nd Ed., Tata Mc Graw Hill, 2002.
2. Rangwala, S.C., Construction of Structures and Management of Works, 5th Ed., (Charotar publishers), 2005.
3. Srivatsava, U.K., Construction Planning and Management, 1st Ed., Galgotia PublicationsPvt. Ltd., 1999.
4. Peurifoy, R.L., Construction Planning, Equipment and Methods, 2nd Ed., Tata McGraw-Hill Education,

21CE005 Airport, Railways and Harbour Engineering

3 0 0 3

Course Outcomes

1. Proficiency in airport planning and design
2. Discuss the components of permanent way and their functions
3. Understand the principles of geometric design of railway track
4. Develop layout plan of harbor, dock and will be able relate the gained knowledge to identify required type of visual and/or navigational aids for the same
5. Understand the components and construction materials of shore structures
6. Understand the various features in Harbours and Ports, their construction, coastal protection works, maintenance and coastal regulations to be adopted

COs–POs Mappings

COs	PO1	PO3	PO12
1	2	3	2
2	2	2	3
3	2	3	3
4	3	3	3
5	3	3	2
6	3	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Airport Planning and Design: Airport site selection, Airport classification-Runway orientation–Wind rose diagram–Runway length – Taxiway design–Terminal area and Airport layout -Visual aids and Air traffic control.

Hanger, Runway marking

12 Hours

Unit II

Introduction to Railway Engineering: Permanent way components -Cross Section of Permanent Way - Functions of various Components like Rails, Sleepers and Ballast -Rail Fastenings -Creep of Rails- Adzing of Sleepers- Sleeper density.

Geometric Design of Railway Track: Gradients- Grade Compensation- Cant and Cant Deficiency -Degree of Curve - Crossings and Turn outs.

Negative Super elevation, Alternative ballast materials

12 Hours

Unit III

Planning of Shore Structures: Definition of Terms - Harbors, Ports, Docks, Tides and Waves, Littoral Drift, Sounding, Locks and lock gates, Site Selection & Considerations- Proximity to Towns/Cities, Utilities, Construction Materials, Coast Lines, Ports-Requirements and Classification of Harbors.

Light house, Dredging

12 Hours

Unit IV

Construction and Maintenance of Docks & Harbours: Coastal Structures- Piers, Breakwaters, Wharves, Quays, Fenders, Inland Water Transport and Container Transportation. Pipe Ways, Rope Ways, Maintenance of Ports and Harbors – Navigational aids.

Jetties, Dolphins

12 Hours

Total: 48 Hours

Textbook (s)

1. Airport Engineering- Khanna & Arora- Nemchand Bros, New Delhi, 1999
2. Airport engineering Virendra kumar , Dhanpathi Rai Publishers, New Delhi, 1999
3. Docks and Harbour Engineering, Bindra S.P- Dhanpathi Rai & Sons, New Delhi, 2012

Reference (s)

1. Ashford, N. J., Mumayiz, S. A., and Wright, P. H. Airport Engineering: Planning, Design and Development of 21st Century Airports, Fourth Edition, John Wiley & Sons, New Jersey, USA, 2011.
2. Kumar, V., and Chandra, S. Air Transportation Planning and Design, Galgotia Publications Pvt. Ltd.,

New Delhi, India, 1999.
3. Seetharaman, S. Dock and Harbour Engineering, Umesh Publications, New Delhi, India, 1999.
4. Srinivasan, R., Harbour, Dock and Tunnel Engineering, Charotar Publishing House, Anand, India, 1209.

21CE006 Construction Economics and Finance

3 0 0 3

Course Outcomes

1. Illustrate the basic principles of engineering economics
2. Describe time value of money and inflation, and its impact on capital budgeting
3. Interpret the cash flow patterns for a construction project
4. Prepare simple financial statements for measuring the financial performance of a firm
5. Evaluate investment proposals through various capital budgeting methods
6. Understand the cost control in construction projects

COs–POs Mapping

COs	PO3	PO10	PO11
1	2	1	3
2	2	1	3
3	2	1	3
4	2	1	3
5	2	1	3
6	2	1	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Introduction to Economics

Concept of Engineering Economics – Equivalence – Cast flow Diagram – Single Payment present worth factor (SPPWF) – Uniform series compound amount factor – Cash flow involving arithmetic gradient payment of receipts – Arithmetic Gradient – Cash flow involving geometric gradient series – Comparison of alternatives – Present worth method - Future worth method – Annual worth method – Rate of return – Incremental rate of return – Net Present Value – Benefit – Cost analysis – Break-even Analysis

Incremental benefit-cost ratio analysis, and breakeven analysis for two and more alternatives

12 Hours

Unit II

Depreciation and Inflation

Classification of Costs – Time value of money – Depreciation and amortization – Capital Budgeting: Meaning, Need and Techniques of Capital Budgeting – Capital Budgeting Methods – Different Depreciation methods – Inflation

Payback period, profitability index

12 Hours

Unit III

Cost Estimating and Finance

Cost Estimating – Types of Estimates – Approximate Estimates – Parametric Estimates – Cost Planning Techniques – Cost Control during Design and Construction stages – Sources of Finance – Infrastructure Financing – Lifecycle costing

Methods of construction costing, Escalation clause

12 Hours

Unit-IV

Financial Statement Analysis

Financial management – Chart of Accounts - Balance sheet and Profit and Loss accounts – Ratios analysis – Fund Flow Statement – Cash Flow Statement – Financial ratios - Working Capital management – Financial Control

Profit-loss account, credit, and debit statements

12 Hours
Total: 48 Hours

Textbook (s)

1. Pravin Kumar, Fundamentals of Engineering Economics, Wiley India Pvt. Ltd. New Delhi, 2015
2. Rajeev M Gupta, Project Management, 2nd Edition, PHI Learning Pvt. Ltd. New Delhi, 2014

Reference (s)

1. Patil, B. S., Civil Engineering Contracts and Estimates, Universities Press (India) Private limited, 2006.
2. Kwaku, A., Tenah, P. E., Jose M. Guevara, P. E., Fundamentals of Construction Management and Organization, Printice Hall, 1985.
3. Peterson, S. J., Construction Accounting and Financial Management, Pearson Education, Upper Saddle River, New Jersey, 2005
4. Panneer Selvam. R, Engineering economics, 2nd Edition, Prentice Hall of India, New Delhi, 2013
5. Gould, F. E., Managing the Construction Process, 2nd Edition, Prentice Hall, Upper Saddle River, New Jersey, 2002.

21CE601 Problem Solving Using OOPS

3 0 0 3

Course Outcomes

1. Implement object oriented concepts to the problems
2. Implement applications using different types of inheritances
3. Develop user defined packages
4. Identify and recover runtime exceptions arise in the applications.
5. Demonstrate parallel processing applications using threads
6. Design interactive applications using Hibernate and spring Framework

COs–POs Mappings

COs	PO1	PO5	PO12
1	1	2	3
2	1	2	3
3	1	2	2
4	1	2	2
5	1	2	3
6	1	2	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Java Fundamentals

Overview of Object Oriented Programming principles, Importance of Java to the Internet, Byte code, Data types, arrays, control statements, Classes and Objects– constructors, methods, call_by_value, call by reference, access control, this keyword, Static keyword, overloading methods and constructors, garbage collection, Strings in java, string tokenizer, string builder.

Features of object oriented programming–Java History–Computer Programming Hierarchy–Role of Java Programmer in Industry

12 Hours

Unit II

Inheritance, Packages & Interface

Inheritance: Hierarchical abstractions, Base class and subclass, Benefits of inheritance, super keyword, final keyword with inheritance, polymorphism, abstract classes Packages: Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages, Member access rules

Interface: Defining an interface, differences between classes and interfaces, implementing interface, variables in interface and extending interfaces, Nested–Inner Class & Anonymous Classes

Generic Class Types

12 Hours

Unit III

Exception Handling & Multithreading

Exception handling: Concepts and benefits of exception handling, exception hierarchy, usage of try, catch, throw, throws and finally, built-in and User Defined Exceptions

Multithreading: Definition thread, thread life cycle, creating threads, synchronizing threads, Demon threads.

Inter Communication of Threads– methods used, Deadlock

12 Hours

Unit IV

Event Handling

The AWT class hierarchy, user interface components labels, buttons, text components.

Event Handling: Events, Delegation event model, handling mouse and keyboard events, Adapter classes, inner classes, compare basic AWT components with swing components, more user interface components – canvas, scroll bars, check box, choice, lists panels – scroll pane, dialogs, menu bar, layout managers.

Java.util package, Anonymous Inner classes a Short-cut to Event Handling.

12 Hours

Total: 48 Hours

Textbook (s)

1. H. Schildt, Java: The complete reference, 7th Ed., TMH, 2016

2. T. A. Budd, An Introduction to Object–Oriented Programming, 3rd Ed., Addison Wesley Longman, 2012

Reference (s)

1. Dietal & Dietal, Java: How to Program, 8th Ed., PHI, 2010
2. E. Balaguruswamy, Programming with Java A Primer, 4th Ed., Tata McGraw Hill Companies, 2009
3. C. S. Horstmann and G. Cornell, Core Java, Vol 1. Fundamentals, 7th Ed., Pearson Education, 2014
4. C. Horstmann, BIG JAVA Compatible with Java 5 & 6, 3rd Ed., Wiley Publishers, 2008

21CE602 Design of Steel Structures

3 0 0 3

Course Outcomes

1. Classify the properties of steel sections and design welded and bolted connections according to IS code specifications
2. Design steel members subjected to tension in accordance with IS code specifications
3. Design steel members subjected to compression following IS code specifications
4. Design steel beams subjected to various loads as per IS code specifications
5. Design column bases subjected to various loads in accordance with IS code specifications
6. Design gantry girders and plate girders subjected to various loads as per IS code specifications

COs–POs Mappings

COs	PO3	PO5	PO10	PO12	PSO2
1	3	1	1	2	2
2	2	2	2	2	2
3	2	2	2	2	2
4	3	2	2	1	3
5	2	2	2	2	2
6	2	2	2	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Design of Welded Connections

Introduction to Structural Steel: Properties of Structural Steel, I. S. Rolled Sections, I. S. Specifications. Welded Connections: Advantages and disadvantages of welding- Strength of welds-Butt and fillet welds: Permissible stresses – IS Code requirements, Lap and Butt Connections, Design of fillet weld subjected to moment acting in the plane and at right angles to the plane of the joints, beam to beam and beam to Column connections only.

Light gauge steel sections, IS code provisions for Bolted connections

12 Hours

Unit II

Design of Tension Members and Compression Members

Tension members: Introduction to different modes of failures – gross section yielding, Net Section rupture and block shear failure, Determines the design strength due to yielding of gross section, rupture of critical section and block shear. Design procedure of tension members.

Compression Members: Effective length of columns, Slenderness ratio, permissible stresses, Design procedure of compression members - Design of built-up sections (Laced and Battened Columns)

Tension Member Splice connection, Tension Member Subjected to UDL along the Longitudinal Axis

12 Hours

Unit III

Beams and Column bases

Beams: Allowable stresses, design requirements as per IS Code-Design of simple and compound beams, check for deflection, shear, buckling, check for bearing, laterally supported beams.

Column bases: Slab base, Gusset base.

Grillage foundation, IS code provisions for laterally unsupported beam,

12 Hours

Unit IV

Plate Girder and Gantry Girder

Introduction: Elements of plate girder, design steps of a plate girder, necessity of stiffeners in plate girder, various types of stiffeners, web and flange splices (only introduction), design of plate girder without stiffeners
Gantry Girders: Introduction, various loads, specifications, design of gantry girder without stiffeners
Stiffener design concepts, Temperature Effect on Plate Girder and Gantry Girder

12 Hours
Total: 48 Hours

Note:
IS 800-2007, General Construction in Steel — Code of Practice and Steel tables are permitted to use in classroom and examinations.

All the designs should be taught in the limit state design method as per IS 800-2007. Welding connections to be used and following drawings are to be practiced by the students.

Drawings:
1. Detailing of welded connection In-plane and Perpendicular to plane.
2. Detailing of built-up columns, laced and battened columns.
3. Detailing of Plate girder including curtailment, splicing and stiffeners.
4. Detailing of Gantry girder including curtailment, splicing and stiffeners.
5. Detailing of Slab Base, Gusseted Base.

Textbook (s)
1. N. Subramanian, Steel Structures (Design & Practice), Oxford University Press, 2011
2. S.K. Duggal, Limit State Design of Steel Structures, 3rd Ed., Tata McGraw Hill, New Delhi, 2019
3. S.S. Bhavikatti, Design of Steel Structures by Limit State Method as per IS: 800- 2007, 4th Ed., IK International Publishing House, Bangalore, 2014

Reference Books (s)

1. V.L.Shah and Veena Gore, Limit State Design of steel structures as per IS: 800-2007, Structures Publications, Pune, 2010
2. Sai Ram, Design of steel Structures, 2nd Ed., Pearson Publications, 2013
3. M.R Shiyekar, Limit State Design in Structural Steel,3rd Ed., PHI learning private limited, New Delhi, 2011

21CE603 Estimation and Costing

3 0 0 3

Course Outcomes

1. Determine the cost of different item of work with including both materials and labours based on the qualities, quantities and methods of execution of works
2. Estimate the quantity of steel reinforcement required for various types of structural element
3. Estimate the current worth of an asset
4. Understand the legal recording of transaction between individual and business entities
5. Identifying clear procurement, market analysis, market sounding and engagement strategies
6. Estimate the quantity of various item of work for the existing infrastructure

COs–POs Mappings

COs	PO1	PO12
1	1	1
2	3	2
3	3	2
4	2	3
5	3	3
6	3	2

3–Strongly linked | 2–Moderately linked 1–Weakly linked

Unit I
Specification and Analysis of Rates
Estimates, types of estimates – approximate and detailed estimate. Specifications – general and detailed specifications. Analysis of rates for various items of works.
Prime cost, Schedule of rates

12 Hours

Unit II

Reinforcement bar Bending Schedules and Valuation of Buildings

Reinforcement bar bending and bar requirement schedules. Valuation of various components of buildings *Scrap value of buildings for different materials, Depreciation*

12 Hours

Unit III

Detailed Estimates of Buildings

Estimation of Buildings by using Separate or individual wall method and center line method. *Standard measurement forms, Revised Estimate*

12 Hours

Unit IV

Contracts and Tenders

Different types of contacts, their relative advantages and disadvantages, Elements of tender operation, Evaluation of tenders and Award of work. Disputes and arbitration. Legal aspects related to land acquisition,
Tender notice, Responsibility of Engineer

12 Hours
Total: 48 Hours

Textbook (s)

1. B.N. Dutta, Estimating and Costing, 28th Revised Edition, UBS Publishers, 2020.
2. M Chakraborti, Estimating, Costing, Specification & Valuation, Chakraborti Publishers,2006

Reference (s)

1. Standard Schedule of Rates and Standard data Book, Public Works Department.
2. IS 1200 (Parts I to XXV - 1992/ method of measurement of building and Civil Engineering works - B.I.S.)
3. National Building Code.

21CE604 Programming Language Laboratory

0 0 3 1.5

Course Outcomes

1. Make use of JAVA SDK environment to create debug and run java programs
2. Create applications based on code reusability
3. Develop programs using threads
4. Develop and debug real time problems using exception handling
5. Using IDE, create interactive application as using event handling mechanisms
6. Design Graphical User Interface using AWT components and Swing

CO–PO Mapping

COs	PO1	PO2	PO3	PO5
1	1	2	2	2
2	1	3	3	2
3	1	2	2	2
4	1	2	2	2
5	1	2	3	2
6	1	3	2	2

3–Strongly linked | 2–Moderately linked 1–Weakly linked

List of Experiments Write Java programs to:

1. Demonstrate the basics of Java using various data types, classes, methods and objects.
2. Demonstrate Call_by_value, Call_by_reference (object reference) methods.
3. Demonstrate overloading methods and constructors methods.
4. Demonstrate Sting handling function in java.
5. Demonstrate the different types of inheritance concept,
6. Demonstrate inheritance concept using method overriding, super & final keywords and runtime polymorphism.
7. Demonstrate the concept of multiple inheritance through interfaces.

8. Implement matrix operations One dimensional, multidimensional arrays.
9. Create a User define package which has classes and methods nad acess the package in another package.
10. Extracting tokens using String Tokenizer, String Bulider.
11. Handle checked and unchecked exceptions using try-catch, finally, throw and throws keywords
12. Handle user-defined Exceptions.
13. Demonstrate the concept of multithreading
14. Design a Job Application/ Student Admission Form using awt and applet.
15. Handle simple event to display cut/copy/paste events using Swings.
16. Evaluate the swing components by creating a registration form.

List of Augmented Experiments

1. New Patient Registry Management System
2. Restaurant Billing Management System
3. Library Management System
4. ATM Management System
5. S. Bus Ticket Booking Management System
6. Movie Ticket Booking Management System
7. Queuing Management System
8. Attendance Management System
9. Medical Store Billing Management System
10. Text Editor Projects in java
11. Google e Search Engine Filter
12. Electronic voting System
13. Day Planner
14. Library management System
15. Personal Finance Management System

Total: 48 Hours

21MPX01 Mini Project

0 0 3 1.5

Course Outcomes

1. Identify a contemporary engineering application to serve the society at large
2. Use engineering concepts and computational tools to get the desired solution
3. Justify the assembled/fabricated/developed products intended
4. Organize documents and present the project report articulating the applications of the concepts and ideas coherently
5. Demonstrate ethical and professional attributes during the project implementation
6. Execute the project in a collaborative environment

COs – POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	-	-	3	2	-	-	-	-	-	3	3
2	3	3	-	-	3	-	-	-	-	-	-	-	3	3
3	3	3	3	2		-	-	-	-	-	2		3	3
4	-	-	-	-	-	-	-	-	-	3	-	2	3	3
5	-	-	-	-	-	-	-	3	-	-	-	-	3	3
6	-	-	-	-	-	-	-	-	3	-	-	-	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

21ESX02 Employability Skills II

1 0 1 2

Course Outcomes

1. Demonstrate oral communication and writing skills as an individual to present ideas coherently
2. Develop life skills with behavioral etiquettes and personal grooming

3. Assess analytical and aptitude skills
4. Develop algorithms for engineering applications.
5. Solve engineering problems using software
6. Utilize simulation tools for testing.

COs POs Mapping

COs	PO1	PO2	PO5	PO8	PO10	PO12
1					3	2
2				1	2	2
3	2	1		2		
4	2		2			
5	2		2			
6	2		2			

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

1. Communication Skills, Confidence and Quantitative Aptitude

Resume (Recap): Resume? Templates? Mistakes to be avoided in a Resume and Steps to be followed in preparing it.

Group Discussions (Recap) & Practice: GD? Stages of a GD, Skills assessed in a GD, Blunders to be avoided, How to excel in a GD?

Practice sessions and sharing Feedback. (Screening sample Videos)

Interview Skills: Interview? Types of Interview, Dos & Don'ts, Skills assessed in an Interview, Mistakes to be avoided, How to equip oneself to excel? How to handle the Typical Interview Questions? (with Examples)

Mock Interviews: Practice sessions with Feedback.

Exercises related to Communication: Email Writing, Voice Versant., etc.

16 Hours

2. Quantitative Aptitude

Time and Distance, Problems on Trains, Blood relations, Ratio and Proportions, Calendars, Clocks.

16 Hours

Unit II

3. Structural Modeling and Design Lab

a. Analysis and Design of Simply Supported Beam
b. Analysis and Design of Cantilever Beam
c. Analysis and Design of Continuous beam
d. Analysis and Design of fixed beam
e. Analysis and Design of 2D RCC and Steel Portal Frame

32 Hours

Total 64 Hours

Reference (s)

1. Shellito, Bradley A., Discovering GIS and ArcGIS, New York, NY : W. H. Freeman : Macmillan Learning, 2017.
2. Mesev, Victor, Integration of GIS and remote sensing, Chichester, England; Hoboken, NJ : Wiley, 2007.

21HSX12 CC & EC Activities II

0 0 1 1

Course Outcomes

1. Interpret and present the abstractive technical information through an activity
2. Think critically in providing solutions to the generic and common problems
3. Demonstrate the creative thinking in dealing with liberal arts
4. Instill team sprit through active engagement with the peer
5. Develop programs of common interest having social impact
6. Empower the under privileged through motivational activities

COs – POs Mapping

COs	PO6	PO7	PO9	PO10
1	-	-	-	3
2	3	2	-	-
3	3	-	-	-
4	-	-	3	-
5	3	-	-	-
6	3	-	-	-

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Audit Course

0 0 0 0

Course Outcomes

1. Interpret the meaning of values and select their goals by self- Investigation based on personal values activity
2. Interpret the major events and issues related to a period in Indian history
3. Assess the benefits and limitations of science and its application in technological developments towards human welfare
4. Check the awareness regarding basic human rights and to uphold the dignity of every individual
5. Assess the individual and group behaviour, and understand the implications of organizational behaviour on the process of management
6. Determine the appropriateness of various leadership styles and conflict management strategies used in organizations

COs – POs Mapping

COs	PO12
1	3
2	3
3	3
4	2
5	3
6	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

21CEC12 Building Services

3 0 2 4

Course Outcomes

1. Explain the principles of lighting and design guidelines of natural ventilation.
2. Illustrate the fundamentals of electrical and allied installations.
3. Discuss the HVAC systems and the concepts of sound insulation and noise control.
4. Outline the various plumbing services.
5. Infer the fire safety measures and firefighting systems.
6. Demonstrate the basics of lift, escalators, landscape development and signage structures.

COs–POs Mappings

COs	PO3	PO7	PO12	PSO2
1	3	2	1	1
2	3	2	1	1
3	3	2	1	1
4	3	2	1	1
5	3	2	1	1
6	3	2	1	1

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Lighting, and Natural Ventilation and Electrical Installations

Lighting and Natural ventilation: Principles of lighting - Measurement of light – Daylighting – Types of Lighting - Design considerations for natural ventilation. Electrical Allied Installations: Basic terminologies - Electrical sources - General Requirements - Planning- Single and Three-phase power supply - Distribution of Supply - Cabling - Wiring - Earthing.

Practical Components:

1. Creating structural model including foundation, column, beam and floor
2. Adding rebar to the foundation and column
3. Adding rebar to the beam and slab
4. Material takeoff and Rebar schedule

12+8 Hours

Unit II

HVAC systems, Acoustics, Sound Insulation and Noise Control

HVAC Systems: Heating – Heat transfer mechanism - Types of heating. Mechanical Ventilation – Objectives – Types of mechanical ventilation. Air Conditioning: basic refrigeration cycle and its components –Design considerations - Types of air conditioning systems. Acoustics, Sound Insulation and Noise Control: Definition and terminologies – Planning against outdoor and indoor noise – Sound absorbing materials.

Practical Components:

1. Applying diffuser and VAV system
2. Creating duct work for supply system
3. Applying return diffuser with duct work
4. Applying exhaust and AHU with chiller

12+8 Hours

Unit III

Plumbing Services

Water supply systems: Basic principles – water supply requirements of buildings – water sources and quality - water treatment layout – Water distribution system – Pipe materials. Drainage and Sanitation systems: Different drainage pipe systems – Types of sanitary appliances – Bio-toilet. Solid Waste management: Types of solid waste – SW management systems – Assessment –Treatments. Gas Supply systems, and its regulations.

Practical Components:

1. Applying plumbing fixture
2. Creating water supply systems
3. Creating waste water system
4. Plumbing Schedule

12+8 Hours

Unit IV

Fire safety and miscellaneous services

Fire Safety: Fire Prevention - Grouping of building – Fire Zones – Type of Construction – General requirements. Life Safety: Egress Components. Fire Fighting systems - Installations of Lifts, Escalators and Moving Walks - Information and communication-enabled installations – Landscape planning, Design and development – Signs and outdoor display structures.

Practical Components:

1. Calculating lux value and schedule
2. Applying lighting fixture and switches
3. Creating power system
4. Conduit routing and cable tray designing.

12+ 8 Hours
Total: 48+ 32 Hours

Textbook (s)

1. National Building Code of India 2016-Volume-2, Bureau of Indian Standards.
2. National Building Code of India 2016-Volume-1, Bureau of Indian Standards

Reference (s)

1. Susan Dawson, Architect's Working Details (Volume 1-10), E- Map Construct; 2004.
2. Landscape Construction, Delmar publisher, 2000.
3. Richardson Dietruck, Big Idea and Small Building, Thames and Hudson, 2002.
4. Nelson L Burbank, House Carpentry Simplified, Simmons-Board- McGraw Hill Publishing Corporation, New York, 1986.
5. Francis. D. K. Ching, Building Construction Illustrated, John Wiley & Sons, 2011.

21CEC22 Highway Design and Simulation

3 0 2 4

Course Outcomes

1. Build knowledge on design aspects related to expressways.
2. Understand the parameters involved in the pavements design.
3. Illustrate the design procedure of high low volume flexible pavement as per IRC, and low-volume rigid pavements as per IRC.
4. Design rigid pavement for high volume roads and white topping overlays according to latest codes.
5. Explain different types of special pavements and their applications
6. Design drainage facilities for pavements.

COs – POs Mappings

COs	PO1	PO3	PSO2
1	3	1	1
2	3	1	2
3	3	3	3
4	2	3	3
5	3	2	1
6	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Geometric Design of Expressways: IRC Specification for geometric design of expressways, types and specifications for interchanges , IRC standards and guidelines for design of hill roads.

Practical components

1. Calculation of geometric features of Expressway for 120 kmph design speed.
2. Plotting Marshall curves to find out optimum bitumen content.
3. Calculation of Vehicle Damage Factor for a particular based on traffic load data given.

12+8 Hours

Unit II

Black top pavement design: Road pavements and pavement layers - types, functions, choice, factors affecting design, loads – axle load distribution, ESWL, EWL, VDF due to varying loads. Design of flexible pavements by IRC & AASHTO. Design of flexible pavements for low volume roads.

Practical components

1. To plot the Hand-held GPS coordinates in the Google earth software
2. Plotting gradation curves for single size aggregate gradation for cement concrete pavement according to MoRTH.
3. Plotting gradation curves for single size aggregate gradation for bituminous concrete pavement according to MoRTH.

12+8 Hours

Unit III

White top pavement analysis and design

Types of stresses and causes; Introduction to Westergaard's equation for calculation of stresses in rigid pavements due to wheel loads and temperature; Considerations in rigid pavement analysis, wheel load stresses, warping stresses, frictional stresses, combined stresses. Design of rigid pavements by IRC procedure. Design of rigid pavements for low volume roads

Practical components

1. Design of flexible pavement according to IRC-37-2001.

IRC-58-2015 Design of flexible pavement

2. To estimate the effective subgrade modulus for flexible pavement design.
3. Design Example to check the Adequacy of Granular Sub-base thickness
4. Design of Bituminous concrete Pavement with Granular Base and Sub-base
5. Computation of Cumulative Fatigue Damage in Cement Treated Base(CTB) Layer
6. Design of Bituminous Pavement with Reclaimed Asphalt Pavement (RAP) material treated with Foamed Bitumen/Bitumen Emulsion and Cemented Sub-base
7. Design of Bituminous concrete Long-life Pavement

12+8 Hours

Unit IV

Special Pavements and drainage

Introduction to Concrete block pavements and design, Semi rigid pavements, perpetual pavements, porous pavements. Significant failures in pavements. Design of Pavement Drainage: Detrimental effects of water, methods for controlling water in pavements. Drainage materials: aggregates, geo-textiles, pipes. Estimation of inflow, determination of drainage capacity.

Practical components

1. Back calculation of Resilient modulus of the pavement layers from the FWD deflection data using IITKGPBACK-IRC-115-2014.
2. Design of Rigid pavement according to the code IRC-58-2002.
3. Design of Rigid Pavement according to the code IRC-58-2015.

12+8 Hours
Total: 48+32 Hours

Textbook (s)

1. R. Srinivasa Kumar, Pavement Design, Universities Press, 2013
2. S. K. Khanna, C. E. G. Justo, A. Veeraragavan, Highway Engineering, 10th Edition, Nem Chand & Bros., 2019
3. IRC: SP: 99 (2013), Manual of specifications and standards for expressways.

Reference (s)

1. E. J. Yoder, M. W. Witczak, Principles of Pavement Design, 2nd Edition, Wiley, 2015
2. L. R. Kadiyali, N. B. Lal, Principles of Highway Engineering, 7th Edition, Khanna Publishers, 2018
3. IRC: 58 (2015), Guidelines for the design of plain jointed rigid pavements
4. IRC: 37 (2018), Guidelines for the design of flexible pavements
5. IRC: SP 62 (2014), Guidelines for the design and construction of cement concrete pavement for rural roads
6. IRC: SP 72 (2015), Guidelines for the design of flexible pavements for low volume roads

21CEC32 Pre Engineered Buildings

3 0 2 4

Course Outcomes

1. Choose the materials used for Pre Engineered Building
2. Outline the difference between Conventional steel and Pre Engineered building
3. Discuss the primary and secondary main frame system of building components
4. Explain the design of Pre Engineered frame
5. Discuss the influence of various loads on the Pre-Engineered buildings
6. Explain the PEB components and design methodology

COs – POs Mappings

COs	PO3	PO11
1	3	1
2	3	1
3	3	1
4	3	1
5	3	1
6	3	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Introduction to Pre-Engineered Buildings

Introduction – History - Advantages of PEB - Applications of PEB – Materials used for manufacturing of PEB. Difference between Conventional Steel Buildings and Pre-Engineered buildings.

Practical Components:

1. Modeling steel columns
2. Parametric changes in steel columns
3. Column connections
4. Columns schedules

12+8 Hours

Unit II

Pre-Engineered Building Components

Primary System: Main frames, Gable End Frame - Secondary frame system: Sizes and Properties of Purlins & Girts – Bracing System: Rod, angle, Portal.

Practical Components:

1. Modeling steel beams
2. Parametric changes on steel beams
3. Beam connections
4. Beam schedules

12+8 Hours

Design Loads on Pre-Engineered Buildings

Design of PEB frame under the influence of Dead, Live, Collateral, Wind, Seismic and Other applicable Loads. Serviceability Limits as per code.

Practical Components:

1. Modeling PEB building
2. Applying Loads
3. Analysis of PEB buildings
4. Analysis report generation

12+8 Hours

Unit IV

Additional PEB Components and Design Methodology

Pipe bracing – Sheeting and Cladding: Roof Sheeting and Wall sheeting – Accessories: Turbo Ventilators, Ridge vents, Sky Lights, Louvers, Insulation, Stair cases.

Guidelines for PEB design, Design codes, Structural design Process loop, optimal structural design

Practical Components:

1. Modeling bracings in PEB buildings
2. Modeling sheeting and cladding
3. Modeling Ventilators
4. Modeling staircases

12+8 Hours

Total: 48 + 32 Hours

Textbook (s)

1. L. Mokk, "Prefabricated Concrete for Industrial and Public Structures," Publishing House of the Hungarian Academy of Sciences, Budapest, 2007.
2. T. Koncz, "Manual of Precast Concrete Construction", Vol. I, II, III & IV, Berlin, 1971.

Reference (s)

1. B. Lewicki, "Building with Large Prefabricates", Elsevier Publishing Company, Amsterdam, London, New York, 1998.
2. Structural Design Manual, Precast Concrete Connection Details, Society for the
3. Studies in the use of Precast Concrete, Netherland Betor Verlag, 2009.
4. Hass, A.M. Precast concrete design and Applications, Applied Science Publishers,1983

21CEC42 ML for Civil Engineering

3 0 2 4

Course Outcomes

1. Gain an appreciation for popular ML algorithms and their mathematical foundations, providing a solid understanding of the underlying principles.
2. Develop proficiency in implementing supervised learning algorithms in Python using fundamental machine learning modules.
3. Recognize the significance of ensemble strategies in resolving real-world problems with machine learning algorithms.
4. Appreciate the mathematical basis of unsupervised algorithms, enhancing understanding and application.
5. Acquire practical experience in solving interdisciplinary problems using hands-on applications of unsupervised algorithms.
6. Master the skill of tuning ML model parameters and selecting the most suitable models for challenges across diverse domains.

COs-POs Mapping

COs	PO1	PO2	PO4	PO5	PO12
1	2	3	2	2	2
2	2	3	2	2	2
3	2	3	2	2	2
4	2	3	2	2	2
5	2	3	2	2	2
6	2	3	2	2	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

ML Introduction and Supervised Learning

Introduction to Machine Learning - Supervised and unsupervised learning - Regression and Classification problems - Introduction to Machine Learning - Linear Regression - Multiple Variable Linear Regression - Logistic Regression - Naive Bayes Classifiers - Solving civil Engineering case-studies/problems using Supervised Learning.

Practical Components

1. Take a dataset with missing values or inconsistencies and demonstrate the steps involved in cleaning and integrating the data. Apply techniques such as data imputation, outlier detection, and data standardization to preprocess the dataset
2. Select a dataset with numerical quantities and perform linear regression to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, MSE or RMSE.
3. Select a dataset and perform Logistic Regression to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, Recall, Precision and F1.
4. Select a dataset and perform Naive Bayes Classifiers to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, Recall, Precision and F1.

12+8 Hours

Unit II

Ensemble Techniques

k-NN Classification – Normalization and Standardization - Support Vector Machines - Decision Trees - Bagging - Random Forests - Boosting - Solving civil Engineering case-studies/problems using Ensemble Techniques.

Practical Components

1. Select a dataset and perform k-NN Classification to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, Recall, Precision and F1.
2. Select a dataset and perform Support Vector Machines Classification to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, Recall, Precision and F1.
3. Select a dataset and perform Decision Trees to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, Recall, Precision and F1.
4. Select a dataset and perform Bagging and Boosting to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, Recall, Precision and F1.

12+8 Hours

Unit III

Unsupervised Learning

K-means Clustering - Hierarchical Clustering - Dimension Reduction - PCA - Solving civil Engineering case-studies/problems using Unsupervised Learning

Practical Components

1. Select a dataset and apply the k-means clustering algorithm to perform clustering for classification purposes. Use evaluation metrics such as silhouette coefficient, cohesion, and separation to assess the quality of the clustering results.
2. Select a dataset and apply the Hierarchical Clustering (Agglomerative) algorithm to perform clustering for classification purposes.
3. Select a dataset and apply the Hierarchical Clustering (Divisive) algorithm to perform clustering for classification purposes.
4. Select a dataset and apply the Principal Component Analysis (PCA) is to reduce the dimensionality of a dataset.

12+8 Hours

Unit IV

Featurisation, Model Selection & Tuning

Feature Engineering - Model Selection and Tuning - Model Performance Measures - Regularising Linear Models - Ml Pipeline - Bootstrap Sampling - Grid Search CV - Randomized Search CV - K Fold Cross-validation - Solving civil Engineering case-studies/problems using above method.

Practical Components

1. Select a dataset and perform parameter tuning using Grid Search CV for various ML algorithms.
2. Select a dataset and perform parameter tuning using Randomized Search CV for various ML algorithms.
3. Select a dataset and perform parameter tuning using K Fold Cross-validation for various ML algorithms.
4. Select a data related to Civil Engineering and perform parameter tuning using Grid Search CV and K Fold CV algorithms.

12+8 Hours

Total: 48 + 32 Hours

Textbook (s)

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press (23 April 2020)
2. Tom M. Mitchell- Machine Learning - McGraw Hill Education, International Edition
3. Aurélien Géron Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, Inc. 2nd Edition

Reference Book (s):

1. Ian Goodfellow, Yoshoua Bengio, and Aaron Courville Deep Learning MIT Press Ltd, Illustrated edition.
2. Christopher M. Bishop Pattern Recognition and Machine Learning - Springer, 2nd edition
3. Trevor Hastie, Robert Tibshirani, and Jerome Friedman - The Elements of Statistical Learning: Data Mining, Inference, and Prediction - Springer, 2nd edition.

21CE007 Engineering Geology

3 0 2 4

Course Outcomes

1. Acquire knowledge of the topographical formation, interior earth, earth process, and weathering.
2. Interpret the various types of minerals and assess their physical, mechanical, and engineering properties.
3. Interpret the various types of rocks and assess their physical, mechanical, and engineering properties.
4. Determine geological structures and their relevance to civil engineering projects.
5. Analyze subsurface geological features using geophysical investigation and applications pertinent to civil engineering projects.
6. Application of remote sensing to examine the geological characteristics of a site's viability for civil engineering structures.

CO-PO Mapping:

COs	PO1	PO2	PO4	PSO1
1	2	2	2	1
2	3	2	3	1
3	3	3	3	2
4	1	3	3	1
5	3	2	3	3
6	3	2	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Physical Geology

Geology in civil engineering – branches of geology – structure of earth and its composition - weathering of rocks – scale of weathering – Earth processes – Work of wind, rivers and sea and their engineering importance. Plate tectonics – Earthquakes – Seismic zones in India.

Practical components

1. **Physical Properties of Minerals:** Rock Forming Minerals – Quartz group, Feldspar group, Garnet group, Mica group & Talc, Chlorite, Olivine, Kyanite, Asbestos, Tourmelene, Calcite, Gypsum, etc…
2. **Physical Properties of Minerals:** Ore Forming Minerals – Magnetite, Hematite, Pyrite, Pyralusite, Graphite, Chromite, etc…
3. **Megascopic Identification:** Rock Forming Minerals – Quartz group, Feldspar group, Garnet group, Mica group & Talc, Chlorite, Olivine, Kyanite, Asbestos, Tourmelene, Calcite, Gypsum, etc…
4. **Megascopic Identification:** Ore Forming Minerals – Magnetite, Hematite, Pyrite, Pyralusite, Graphite, Chromite, etc.

12+8 Hours

Unit II

Mineralogy and Petrology

Mineralogy: Definition of mineral, Importance of study of minerals, Physical properties of minerals - Role of study of physical properties in their identification, Study of physical properties of different rock forming mineral groups.

Petrology: Geological classification of rocks - igneous, sedimentary and metamorphic rocks, Different methods of formation of igneous, sedimentary and metamorphic rocks. Description, occurrence, engineering properties, distribution and use of following rocks Granite, Syenite, Diorite, Basalt, Sandstone, Limestone, Conglomerate, shale, Quartizite, Marble, Slate, Gniess.

Practical components

1. **Megascopic Description and Identification of Rocks:** Igneous Rocks: Types of Granite, Pegmatite, Gabbro, Dolerite, Syenite, Granite Poryphery, Basalt, etc…
2. **Megascopic Description and Identification of Rocks:** Sedimentary Rocks: Sandstone, Ferrugineous Sandstone, Limestone, Shale, Laterite, Conglomerate, etc…
3. **Megascopic Description and Identification of Rocks:** Metamorphic Rocks: Biotite, Granite Gneiss, Slate, Muscovite &Biotite Schist, Marble, Khondalite etc…
4. Identification of economic minerals.

12+8 Hours

Unit III

Structural Geology and Geophysical Methods

Attitude of beds – out crop - geological maps – study of structures – folds, faults and joints their bearing on engineering construction. Geophysical methods – Seismic and electrical methods for subsurface investigations

Practical components

1. Interpretation and drawing of sections for geological maps showing tilted beds, faults, unconformities etc.
2. Geological cross sections and study of geological maps.
3. Simple strike and dip problems.
4. Simple Structural Geology problems.

12+8 Hours

Unit IV

Application of Geological Investigations

Remote sensing for civil engineering applications; Geological conditions necessary for design and construction of Dams, Reservoirs, Tunnels, and Road cuttings – Hydrogeological investigations and mining – Coastal protection structures. Investigation of Landslides, causes and mitigation.

Practical components

1. Simple Problems on Electrical Resistivity.
2. Simple Problems on Seismic Refraction Prospecting.
3. Study of models of geological structures.
4. Study of models of out crops patterns of different types of rocks and land forms.

12+8 Hours

Total: 48+32 Hours

Textbook (s)

1. Subinoy Gangopadhyay, Engineering Geology, 1st Edition, Oxford University Press, New Delhi, 2013
2. A.Parthasaradhy, V.Panchapakesan, R.Nagarajan, Engineering Geology, 1st Edition, Wiley Private India Limited, New Delhi, 2013

Reference (s)

1. N Chenna Kesavalu, Text Book of Engineering Geology, 2nd Edition, Trinity Press, Hyderabad, 2014.
2. HalukSucuoglu, SinanAkkar, Basic Earthquake Engineering, 1st Edition, Springer International Publishing, 2014.
3. David George Price, Engineering Geology: Principles and Practice, 2nd Edition, Springer International Publishing, 2009
4. Engineering Geology Lab Manual-Civil Engineering- GMRIT, Rajam

21CE008 Irrigation and Water Resources Engineering

3 0 2 4

Course Outcomes

1. Interpret the various types of irrigational necessities and outline its water quality standards.
2. Acquire knowledge on soil-water-plant relationships and choose the design of lined & unlined Canals
3. Understand the components of diversion head work & its design and describe the types, selections, designs, and failures of earth dams
4. Recognize the various types and design principles of gravity dams and spillways.
5. Understand the different types of canal falls, canal regulators, cross drainage works, and their uses.
6. Develop the design principles of canal regulators and cross-drainage works

COs-POs Mappings

COs	PO3	PO5	PO10	PO12
1	2	3	3	3
2	2	3	3	3
3	2	3	3	3
4	3	3	3	3
5	3	2	3	3
6	3	3	2	3

3-Strong linked| 2-Moderately linked| 1-Weakly linked

Unit I

Soil-Water-Plant Relationship and Design of Canals:

Irrigation: Necessity and Importance of Irrigation, advantages and ill effects of Irrigation, types of

Irrigation, methods of application of Irrigation water, water logging and drainage, standards of quality for Irrigation water, principal crops and crop seasons, crop rotation. Vertical distribution of soil moisture, soil moisture tension, Consumptive use, estimation of consumptive use, factors affecting duty, depth and frequency of Irrigation, irrigation efficiencies. Classification of canals, design of canals by Kennedy's and Lacey's theories, canal lining.

Practical Components

1. Design of canal using Kennedy theory.
2. Design of canal using Lacey's theory.
3. Design of lined canal.
4. Design of canal drop.

12+8 Hours

Unit II

Diversion Head Works and Earth Dams.

Types of Diversion head works-diversion and storage head works, weirs and barrages, layout of diversion head works. Types of dams, merits and demerits, factors affecting selection of type of dam, factors governing selecting site for dam. Types of Earth dams, causes of failure of earth dam, criteria for safe design of earth dam, seepage through earth dam-graphical method, measures for control of seepage.

Practical Components

1. Draw the diversion head works with components parts
2. Design and draw the earth dam with main features.
3. Design of tank surplus weir.
4. Design of Tank sluice with tower head.

12+8 Hours

Unit III

Gravity Dams and Spillways

Forces acting on a gravity dam, causes of failure of a gravity dam, elementary profile and practical profile of a gravity dam, limiting height of a low gravity dam, stability analysis, drainage galleries. Types of spillways, design principles of Ogee spillways, types of spillway gates.

Practical Components

1. Design and draw the gravity dam with all important features
2. Draw the longitude section and cross section of spillway.
3. Draw the ogee spillways
4. Design of canal regulator and river regulator

12+8 Hours

Unit IV

Canal Falls & Regulation Works and Cross-Drainage Works

Types of falls and their location, design principles of Sarda type fall, trapezoidal notch fall and straight glacis fall. Head regulator and cross regulator, design principles of Cross regulator and head regulators, canal outlets, types of canal modules, proportionality, sensitivity and flexibility. Types, selection of site, design principles of aqueduct, siphon aqueduct and super passage.

Practical Components

1. Draw the layout of cross regulator and head regulator with parent channel
2. Design and draw the cross section and longitudinal section of Aqueduct.
3. Draw the cross section and longitudinal section of super passage.
4. Draw the layout of siphon aqueduct.

12+8 Hours

Total: 48+32 Hours

Textbook (s)

1. S.K Garg, Irrigation Engineering and Hydraulic Structures, 36th Ed., Khanna publishers 2018.
2. K.R.Arora, Irrigation,Water Power and Water Resources Engineering, 5th Revised Ed.2018 , Standard Publications, New Delhi
3. R.K. Sharma and T.K. Sharma, Irrigation Engineering, 1st Ed., S. Chand Publishers, 2017.

Reference (s)

1. G.L. Asawa, Irrigation and Water Resources Engineering, 1st Revised Ed., New Age International Publishers, 2017
2. Varshney, Gupta & Gupta, Theory and Design of Hydraulic Structures, 4th Ed., Nem Chand & Bros, 2007.
3. Satyanarayana Murthy. Challa, Water Resources Engineering, 2nd Ed., New Age International Publishers, 2019

21PWX01 Project Work

0 0 16 8

Course Outcomes

1. Identify a contemporary engineering application to serve the society at large
2. Use engineering concepts and computational tools to get the desired solution
3. Justify the assembled/fabricated/developed products intended.
4. Organize documents and present the project report articulating the applications of the concepts and ideas coherently
5. Demonstrate ethical and professional attributes during the project implementation.
6. Execute the project in a collaborative environment.

COs –POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2				3	2						3	3
2	3	3			3								3	3
3	3	3	3	2							2		3	3
4										3		2	3	3
5								3					3	3
6									3				3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

21SIX02 Summer Internship II

0 0 0 1

Course Outcomes

1. Demonstrate communication skills to meet the requirement of industry
2. Develop logical thinking and analytical skills to thrive in competitive examinations
3. Use mathematical concepts to solve technical quizzes
4. Develop technical skills to work out real time problems
5. Develop algorithms for different applications
6. Solve industry defined problems using appropriate programming skills

COs –POs Mapping

COs	PO1	PO2	PO5	PO6	PO10	PO12
1					3	
2	3	1				
3	3					
4	3	1	3			2
5	3	1	3	3		1
6	3	1	3			1

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

21CEC13 Building Information Modeling

3 0 0 3

Course Outcomes

1. Illustrate the AEC business model and the processes of BIM
2. Explain the different dimensions of BIM with various software associated with it
3. Discuss the facility management system for the stakeholders
4. Summarize the applications of BIM in construction management perspective
5. Describe the concept and importance of life cycle assessment
6. Outline the process on the integration of life cycle assessment with BIM

COs–POs Mapping

COs	PO3	PO5	PO10	PSO2
1	2	3	1	3
2	2	3	1	3
3	2	3	1	3
4	2	3	1	3
5	2	3	1	2
6	2	3	1	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Introduction to BIM

The Current AEC Business Model - New Tools and New Processes in BIM - BIM as a Lifecycle Platform - Benefits of BIM - Challenges in BIM – The concept of different dimensions - Core Technologies and Software- Collaboration and Interoperability.

Benefits of BIM; Impacts of BIM in design; Hardware system requirements.

12 Hours

Unit II

Facility Management System

BIM for owners: owner's role in BIM project – Cost and Time management – BIM implementation on project – Barriers and issues in implementation BIM on projects. BIM for Architects and Engineers: BIM use in design process – Building models and libraries. BIM for contractor, sub-contractors and fabricators.

Facility and Information Asset Management; Visualization and Coordination.

12 Hours

Unit III

BIM for Construction Management

Value – Role – Scheduling and controlling schedules– Logistics – Estimating cost and controlling cost – Constructability – Analyzing data in BIM – Material management- Tracking equipment – Managing facilities – Level of development - Model-based coordination.

BIM 360 document management; Common data environment.

12 Hours

Unit IV

Life Cycle Assessment and BIM

Introduction of LCA – History of LCA – Methodology – life cycle impact assessment – Life cycle interpretation analysis - LCA on construction and demolition waste management – Integrating LCA and BIM – SWOT analysis on integration – The relation between LCA and BIM for sustainable construction.

Embodied energy; the relation between CO_2 emission and LCA

12 Hours

Total: 48 Hours

Textbook (s)

1. Rafael Sacks, Charles Eastman, Ghang Lee, Paul Teicholz (2011). BIM handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers. Third Edison, John Wiley & Sons.
2. Brad Hardin, Dave McCool (2015). BIM and construction management: proven tools, methods, and workflows. Second Edition, John Wiley & Sons.

Reference (s)

1. Paul Teicholz, BIM for Facility Managers, John Wiley & Sons (2013).
2. Raja. R.A. Issa, Svetlana Olbina, Building Information Modeling: Application and Practices, ASCE publications (2015).
3. Laura Alvarez Antón, Joaquín Diaz, Integration of LCA and BIM for Sustainable Construction, World Academy of Science, Engineering and Technology, International Journal of Civil and Environmental Engineering Vol:8, No:5, 2014.
4. Mark Kyeredey Ansah, Xi Chen, Hongxing Yang, Lin Lu a, Patrick T. I. Lam, Developing an automated BIM-based life cycle assessment approach for modularly designed high-rise buildings, Environmental Impact Assessment Review 90 (2021) 106618.
5. Ruben Santos, Antonio Aguiar Costa, Jose D. Silvestre, Thomas Vandenbergh, Lincy Pyl, BIM-based life cycle assessment and life cycle costing of an office building in Western Europe, Building and Environment 169 (2020) 106568.

21CEC23 Highway Project Formulation and Economics

3 0 0 3

Course Outcomes

1. Discuss the concepts of economic evaluation and preparation of a detailed project report.
2. Analyze the computation of road user cost for evaluation of highway projects.
3. Analyze the basic methods of economic analysis carried out for transportation engineering projects
4. Discuss transportation project feasibility using economic, Toll, and financial methods.
5. Describe the importance of EIA for transportation engineering projects.
6. Outline the environmental impact assessment factors for highway projects

COs–POs Mapping

COs	PO2	PO5	PO10	PSO2
1	2	2	2	2
2	3	3	1	2
3	3	3	1	2
4	3	3	1	2
5	3	3	1	2
6	3	3	1	1

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Project Formulation and Preparation of DPR

Requirements in project formulation; Criteria fixation; Components of project; Non-monetary and monetary Criteria in formulation of project; Decision making Criteria input in Project formulation. DPR – Guidelines; Transport Projects and development of cash flow diagrams; Cost and benefit components; Discounting criteria; Preparation of Project; Highway Planning; Traffic infrastructure; Project formulation; Road Network project development; Need for Economic Evaluation; Principles of economic evaluation; Welfare economics; Social costs, Vest change, Rate of return.

Road network in India. EMI, Compound Interest

12 Hours

Unit II

Road user costs

Value of Travel time Savings; Economic concept of evaluation of travel time savings; Issues connected with evaluation of travel time savings. Vehicle operating costs; Components of VOC, Road User Cost study in India; Accident costs; Methodologies for economic evaluation of an accident; Factors involved, Basic methods of economic analysis.

EEE measures to reduce accidents, Travel time reliability.

12 Hours

Unit III

Basic methods of economic and financial analysis

Equivalent Uniform Annual Cost Method; Present worth of cost method; Equivalent uniform annual net return method; Net present value method; Benefit cost ratio method; Rate of Return Method; Applications of these methods to highway projects; Project appraisal by shadow pricing with case studies. Toll system analysis, Financial analysis; Budgeting.

Rate of Interest, Inflation, Salvage value, Monopoly

12 Hours

Unit IV

Environmental impact assessment

Basic Concepts, Objectives, Transportation Related Environmental Impacts; Vehicular Impacts; Safety and Capacity Impacts; Roadway Impacts; Construction Impacts; Environmental Impact Assessment; Environmental Impact Statement, Environment Audit, Typical case studies.

Distinguish EIA and SEA (Strategic Environmental Assessment)

12 Hours

Total: 48 Hours

Textbook (s)

1. Transportation Engineering Economics by Heggie. I. G.; Mc Graw Hill Publishers, 1972.
2. Economic Analysis for Highways by Winfrey. R; International Textbook; 1st edition, 1969

Reference (s)

1. Traffic Engineering and Transport Planning by L.R Kadiyali, Khanna Publishers, 2000
2. Road User Cost Study, CRRI
3. IRC: SP: 30-1993, Manual on Economic Evaluation of Highway Projects in India, IRC Publications, New Delhi.
4. IRC: SP: 19; 2001, Manual for Survey, Investigation & Preparation of Road Projects, IRC Publications, New Delhi.

21CEC33 BIM for Pre-Engineered Building

3 0 0 3

Course Outcomes

1. Explain the concepts of BIM and PEB
2. Illustrate the most practiced PEB workflow
3. Explain the BIM framework development and evaluation for PEB
4. Discuss BIM design workflows and material quantification
5. Outline the reverse modeling approach, customization and generalization
6. Summarize the 5'D BIM concept for PEB automation.

COs–POs Mapping

COs	PO3	PO5	PO10	PSO2
1	2	3	1	3
2	2	3	1	3
3	2	3	1	3
4	2	3	1	2
5	2	3	1	3
6	2	3	1	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

BIM and PEB Introduction

BIM-Introduction- Need –benefits- BIM tools and parametric modeling- Interoperability- BIM for in design and development phase-BIM in Construction Phase- BIM for Operation phase, Level of Development. PEB-Introduction- Advantages- Applications- Difference between Conventional Steel Buildings and Pre-Engineered buildings.

Model-based scheduling, Estimating, and analysis; Importance of BIM for PEB.

12 Hours

Unit II

BIM framework for PEB construction Project

Introduction- PEB industry's most practiced process and workflow-Importance and applications of BIM for PEB industry- Challenges and Obstacles of BIM implementation on PEB- Development of a BIM framework for PEB- Evaluation of the framework for PEB industry.

Risk associated with BIM implementation PEB; PEB industry Vs. Pre-fabrication industry.

12 Hours

Unit III

Automation in BIM process with PEB

Introduction- 3D model creation- 3D Coordination- Design workflows- Material quantification- Project management and reverse modeling- Customization and Generalization-Application based classification – flaw analysis- Evaluation.

LOD Classifications; Optimization in Level of Development.

12 Hours

Unit IV

5'D BIM concept for PEB automation

Introduction- Material quantification (take-off) MTO – 5D BIM vs 5D contribution for MTO and procurement system- Challenges and barriers to BIM-assisted MTO and procurement system- Resolving the 5D BIM challenges- Evaluation process 5'D BIM concepts in PEB projects.

Automation in BIM Process; BIM workflows.

12 Hours

Total: 48 Hours

Textbook (s)

1. Andre Borrmann, Markus Konig, Christian Koch, Jacob Beetz, "Building Information Modeling Technology Foundations and Industry Practice", Springer Publications.
2. Mohammad Delavar, "BIM Assisted Design Process Automation for Pre-Engineered Buildings (PEB)", Electronic Thesis and Dissertation Repository, Western Graduate & Postdoctoral Studies, The University of Western Ontario.

Reference (s)

1. Chuck Eastman, Paul Teicholz, Rafael Sacks, Kathleen Liston, "BIM Handbook, A guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors", Second Edition, John Wiley & Sons, Inc. Publications.
2. Alexander Newman, "Metal Building Systems Design and Specifications", Second Edition, McGraw-Hill Publications.
3. Fabio Roberti, Decio Ferreira, "Increasing Autodesk Revit Productivity for BIM Projects, A Practical guide to using Revit workflows to improve productivity and efficiency in BIM Projects", Packt publishing Ltd.
4. Vivek K S, "Pre-Engineered Steel Building, Limit state Design of Structural Members", Atlantic Publishers

21CEC43 AI for Civil Engineering

3 0 0 3

Course Outcomes

1. Proficient in designing, implementing, and optimizing neural networks using Tensor Flow and Keras for various real time applications.
2. Proficient in fundamentals of Convolutional Neural Networks, implementing key mechanisms like convolution, pooling, and padding for image recognition.
3. Adopt at analyzing and applying major transfer learning architectures, enabling them to make informed decisions for diverse computer vision tasks.
4. Apply cutting-edge computer vision techniques, mastering object detection, instance and semantic segmentation and face recognition for solving diverse and challenging visual perception tasks
5. Proficient in NLP fundamentals, including stop words removal, tokenization, stemming, lemmatization, and the application of Bag of Words model and Word Vectorization for text data.
6. Efficiently navigate sequential data and RNNs, addressing challenges like vanishing and exploding gradients, and applying advanced models like LSTMs for effective processing of sequential data in NLP applications.

COs-POs Mapping

COs	PO1	PO2	PO4	PO5	P012
1	3	3	3	2	1
2	3	3	3	2	1
3	3	3	3	2	1
4	3	3	3	2	1
5	3	3	3	2	1
6	3	3	3	2	1

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Introduction to Neural Networks and Deep Learning

Introduction to Perceptron & Neural Networks - Activation and Loss functions - Gradient Descent - Batch Normalization - TensorFlow & Keras for Neural Networks - Hyper Parameter Tuning.
Loss Function, Normalization

12 Hours

Unit II
Computer Vision I
Introduction to Convolutional Neural Networks - Introduction to Images - Convolution, Pooling, Padding & its Mechanisms - Forward Propagation & Backpropagation for CNNs - CNN architectures like AlexNet, VGGNet, - InceptionNet & ResNet.
Generative Adversarial Networks (GANs) for Image Generation, Transfer Learning and Fine-tuning Pretrained Models

12 Hours

Unit III
Computer Vision II
Transfer Learning - Object Detection - YOLO, R-CNN, SSD - Semantic Segmentation - U-Net - Face Recognition using Siamese Networks - Instance Segmentation.
One-Shot Learning, , Inception.

12 Hours

Unit IV
NLP (Natural Language Processing)
Introduction to NLP - Stop Words - Tokenization - Stemming and Lemmatization - Bag of Words Model - Word Vectorizer - Introduction to Sequential data – RNNs and its Mechanisms - Vanishing & Exploding gradients in RNNs - LSTMs - Long short-term memory
GRUs - Gated Recurrent Unit , LSTMs Applications

12 Hours
Total: 48 Hours

Textbook (s)
1. Nikhil Buduma, “Fundamentals of Deep Learning”, ORELLIY, 1st Edition, 2017.
2. Laurene Fausett, "Fundamentals of Neural Networks" , Pearson Education, 2004.
3. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep Learning." An MIT Press book in preparation,2015

Reference (s)
1. Satish Kumar,”Neural Networks: A Classroom Approach” Tata McGraw Hill Education, 2004.
2. Simon Haykin, " Neural networks and Learning Machines", Prentice Hall, 2008
3. Josh Patterson and Adam Gibson ”Deep Learning A Practitioner’s Approach” O’Reilly Media, Inc. 2017

21CE010 Ground Improvement Techniques

3 0 0 3

Course Outcomes
1. Understand the Principles and suitable techniques of dewatering
2. Understand the Principles and methods of grouting techniques
3. Understand diverse in situ densification methods, encompassing surface and subsurface techniques for ground improvement
4. Understand the principles and suitability of various stabilization techniques
5. Identify and improve the expansive soils
6. Classify different geosynthetics and understand their field applications

COs – POs Mappings

COs	PO2	PO12	PSO1	PSO2
1	2	1	1	3
2	2	2	2	1
3	2	2	3	2
4	3	2	3	2
5	3	3	1	2
6	2	2	3	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Dewatering and Grouting

Methods of de-watering - sumps and interceptor ditches- single, multi stage well points - vacuum well points- Horizontal wells-foundation drains-blanket drains- criteria for selection of fill material around drains - Electro- osmosis.

Grouting: Objectives of grouting- grouts and their properties- grouting methods - ascending, descending and stage grouting- hydraulic fracturing in soils and rocks- post grout test.

Design Steps for Dewatering Systems, Applications of Grouting

12 Hours

Unit II

In Situ Densification Methods in Cohesion less and Cohesive Soils

Vibration at the ground surface, Impact at the Ground Surface, Vibration at depth, Impact at depth. Preloading or dewatering, Vertical drains - Sand Drains, Sand wick geodrains - Stone and lime columns - thermal methods

Compaction Quality Control, Selection of Field Compaction Procedure

12 Hours

Unit III

Stabilization and Expansive Soils

Methods of stabilization mechanical cement lime bituminous - chemical stabilization with calcium chloride sodium silicate and gypsum

Expansive Soils: Problems of expansive soils - tests for identification - methods of determination of swell pressure - Improvement of expansive soils. Foundation techniques in expansive soils - under reamed piles.

Chemical Stabilization Using Natural and Synthetic Polymers

12 Hours

Unit IV

Geosynthetics and Reinforced Earth

Geotextiles- Types, Functions and applications - geogrids and geomembranes - functions and applications.

Reinforced Earth: Principles - Components of reinforced earth - factors governing design of reinforced earth walls - design principles of reinforced earth walls.

Properties of Geosynthetics, purpose of different components of reinforced earth

12 Hours

Total: 48 Hours

Textbook (s)

1. Purushotham Raj, Ground Improvement Techniques, 2st Ed., Laxmi Publications, New Delhi, 2016
2. Hausmann M.R., Engineering Principles of Ground Modification, McGraw-Hill International Edition, 2015

Reference (s)

1. Moseley M.P, Ground Improvement, 2nd Ed., Blackie Academic and Professional, Boca Taton, Florida, USA,2004
2. Xanthakos P.P, Abramson, L.W and Brucwe, D.A , Ground Control and Improvement, John Wiley and Sons, New York, USA, 1994

21CE011 Advanced Reinforced Concrete Design

3 0 0 3

Course Outcomes

1. Design and Detail the components of a retaining wall as per the recommendations of IS Code.
2. Design & Detail the staircase as per the recommendations of IS Code.
3. Design & Detail the flat slab as per the recommendations of IS Code.
4. Design & Detail the combined footing as per the recommendations of IS Code.
5. Design & Detail the pile Foundation as per the recommendations of IS Code.
6. Design & Detail the Rectangular and circular overhead tank as per the recommendations of IS Code.

COs–Pos Mapping

COs	PO2	PO3	PO10	PO12	PSO2
1	2	3	3	3	3
2	2	3	3	3	3
3	2	3	3	3	3
4	2	3	3	3	3
5	2	3	3	2	3

6	1	3	1	2	3

3–Stronglylinked|2–Moderatelylinked|1–Weakly linked

Unit I

Retaining Walls

Introduction – Types of retaining walls –Active and passive earth pressure-Design principles of cantilever retaining walls with horizontal back fill- Design principles of Counter fort retaining walls with horizontal backfill-Reinforcement detailing and bar bending schedule.

The design of the counter-fort retaining walls, detailing of counter-fort retaining walls

12 Hours

Unit II

Staircases and Flat Slabs

Introduction- types- dog-legged staircases – Design of flat slabs – Types – Design methods, IS code recommendations–Reinforcement details.

Exterior panel design, detailing of dog-legged staircases

12 Hours

Unit III

Combined Footings and Pile Foundations

Design of combined footing - rectangular and trapezoidal footing. Types of piles–Load carrying capacity of piles – Group action in piles – Structural design of RC piles – Design of pile cap for 2 or 3 piles – Reinforcement detailing and bar bending schedule.

Trapezoidal footing, detailing of trapezoidal footing

12 Hours

Unit IV

Liquid Retaining Structures

Design of rectangular and circular water tanks- both below and above ground level- Design of overhead water tank (AsperIS3370(Part I-III))

Design of underground rectangular tank, Design of over head rectangular tank

12 Hours

Total: 48 Hours

Text Book(s)

1. N. Krishna Raju, Structural Design and Drawing (Concrete and Steel) 3rd edition, University press publications, 2005.
2. N. Krishna Raju and R.N. Pranesh, Reinforced concrete design, 1stedition, New age International Publishers, 2009.

Reference(s)

1. S.N Sinha, Reinforced concrete Design 2nd edition, Tata Mc.Hill publications, 2002.
2. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Limit State Design of Reinforced concrete design '1stedition, Laxmi publications, 2016.
3. Punmia B.C., Ashok Kumar Jain & Aurn Kumar Jain, Reinforced concrete structures, volume I, 5thEdition, Laxmi publications Pvt. Ltd., 2008.
4. Varghese P.C., Limit State Design of Reinforced Concrete Structures, 3rd Edition, Prentice Hall of India, 2005.

21CE012 Construction Methods and Equipment

3 0 0 3

Course Outcomes

1. Evaluate equipment ownership and operating costs
2. Estimate the earthwork quantity and estimate the equipment requirements
3. Assess the soil stabilization techniques and equipment requirements
4. Select construction equipment appropriate to various construction-related activities
5. Assess the equipment productivity and costs
6. Estimate and schedule activities using equipment productivity and costs

COs–POs Mapping

COs	PO2	PO7	PO12
1	3	3	2
2	3	3	2
3	2	2	2
4	3	3	2
5	3	2	2
6	2	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Equipment Economics and Planning for Earthwork Construction

Equipment records, Cost of Capital, Elements of ownership cost, Operating cost, Replacement Decisions, Rent and Lease Considerations

Earthwork planning, Graphical Presentation of Earthwork, Earthwork Quantity, Mass Diagram

Pricing Earthwork Operations, Reduced levels for earthwork estimation

12 Hours

Unit II

Compaction and Stabilization Equipment

Compaction of Soil and Rock, Types of Compacting Equipment, Dynamic Compaction, Stabilizing Soils with Lime, Cement Soil Stabilization, Mobile Equipment Power Requirements, Required Power, Available Power, Usable Power, Performance Charts

Geotextiles and geogrids for soil stabilization, lime for soil stabilitation

12 Hours

Unit III

Excavating, Hauling, and Finishing Equipment

Introduction, Performance Characteristics of Dozers, Pushing Material, Land Clearing, Scraper types, Operation, Performance Charts, Production Cycle, Hydraulic Excavators, Shovels, Hoes; Trucks, Productivity, Performance Calculations, Graders, Trimmers

Types of cranes and uses, Gradal uses

12 Hours

Unit IV

Asphalt and Concrete Mix Production and Placement

Asphalt Mixing Plant, Hauling, Paving Equipment, Concrete mixers, Types, Agitators, Transit mixers, Placement, Finishing

Placement of dowel bars in concrete pavement construction, Finishing and tining in rigid pavement construction.

12 Hours

Total: 48 Hours

Textbook(s)

1. Peurifoy, R. L., Schexnayder, C. J., Schmitt, R. L., and Shapira, A. Construction Planning, Equipment, and Methods, 9th Edition, McGraw Hill LLC, 2018.
2. Gransberg, D. D., and Rueda-Benavides, J. A., Construction Equipment Management for Engineers, Estimators, and Owners, 2nd Edition, CRC Press, 2020.

Reference (S)

1. Sharma, S. C., Construction Equipment and Management, 1st Edition, Khanna Publishers, New Delhi, India, 2019.
2. Schaufelberger, J. E., and Migliaccio, G. C., Construction Equipment Management, 2nd Edition, Routledge, London, 2019.

21CE013 Basics of Dynamics and Earthquake Engineering

3 0 0 3

Course outcomes

1. Compute the response for single degree of freedom (SDOF) systems and for multi-degree of freedom systems (MDOF) subjected to free vibration for damped and undamped system
2. Evaluate the response of SDOF and MDOF systems subjected to forced vibrations for damped and undamped system
3. Comprehend seismic phenomena, including earthquake causes, plate tectonics, elastic rebound theory, earthquake characteristics, measurement techniques in engineering seismology
4. Identify the possible causes of failure in poorly designed structures subjected to earthquake loading.
5. Evaluate the Earthquake forces as per IS:1893 – 2002
6. Discuss the design methodology for Earthquake resistant structures as per IS codal provisions.

COs–POs Mapping

COs	PO1	PO2	PO3	PO12	PSO2
1	3	3	3	3	3
2	2	3	3	3	3
3	2	3	3	1	3
4	3	3	3	2	3
5	2	3	3	3	3
6	2	3	3	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Theory of vibrations and multiple degree of freedom system

Static loading and dynamic loading – Degree of freedom – idealisation of structure as single degree of freedom system – Formulation of Equations of motion of SDOF system - D'Alemberts principles – effect of damping – free and forced vibration of damped and undamped structures – Two degree of freedom system – formulation of equations of motion of multi degree of freedom (MDOF) system - Eigen values and Eigen vectors – Response to free and forced vibrations - damped and undamped MDOF system – Modal superposition methods.

Consequences of vibration, Vibration control in the design of structures

12 Hours

Unit II

Elements of seismology

Elements of Engineering Seismology - Causes of Earthquake – Plate Tectonic theory – Elastic rebound Theory – Characteristics of Earthquake-Measurement of Earthquake– Estimation of earthquake parameters - Magnitude and intensity of earthquakes – Spectral Acceleration.

Types of Earthquake, Tsunami.

12 Hours

Unit III

Response of structures to earthquake

Effect of earthquake on different type of structures – Behaviour of Reinforced Cement Concrete, Steel and Prestressed Concrete Structure under earthquake loading – Pinching effect – Bouchinger Effects – Evaluation of earthquake forces as per IS:1893 – 2002 - Response Spectra – Lessons learnt from past earthquakes.

Effect of Earthquake on Steel concrete composite structures and Water retaining structures

12 Hours

Unit IV

Design Methodology

Causes of damage – Planning considerations / Architectural concepts as per IS:4326 – 1993 – Guidelines for Earthquake resistant design – Earthquake resistant design for masonry and Reinforced Cement Concrete buildings – Later load analysis – Design and detailing as per IS:13920 – 1993.

Special Construction features of Earthquake resistant structures, Seismic strengthening of RC structures

12 Hours

Total: 48 Hours

Textbook(s)

1. Chopra, A.K., "Dynamics of Structures – Theory and Applications to Earthquake Engineering", 5th Edition, Pearson Education, 2020.
2. Damodarasamy S R, Kavitha S.," Basics of structural Dynamics and Aseismic Design", PHI Learning Private Limited, 2013.

Reference(s)

1. Agarwal. P and Shrikhande. M., "Earthquake Resistant Design of Structures", Prentice Hall of India Pvt. Ltd. 2017.
2. Biggs, J.M., "Introduction to Structural Dynamics", McGraw Hill Book Co., New York, 1964.
3. Dowrick, D.J., "Earthquake Resistant Design", John Wiley & Sons, London, 2019.
4. Paz, M. and Leigh.W. "Structural Dynamics – Theory & Computation", 4th Edition, CBS Publishers & Distributors, Shahdara, Delhi, 2016.

21CE014 Pavement Analysis and Design

3 0 0 3

Course outcomes

1. Foundational understanding of pavement engineering
2. Proficiency in pavement material characterization
3. Evaluate structural and functional stresses in flexible and rigid pavement
4. Synthesize components of flexible pavement design
5. Synthesize components of rigid pavement design
6. Evaluate the distress states of pavement and recommend maintenance measures

COs–POs Mapping

COs	PO3	PO12	PSO2
1	3	2	3
2	3	3	3
3	3	3	3
4	2	2	3
5	2	2	3
6	2	2	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Introduction to Pavement Engineering

Functions of Pavements; Types of Pavements: Flexible, Rigid, Composite Pavements; Variables Considered in Pavement Design: Material Characteristics, Traffic Volume, Factors related to Axle and Wheel Loads, Concept of Equivalent Single Wheel Load (ESWL), Factors related to Climatic and Surrounding Environment; Drainage Considerations.

IRC Traffic Loading Classifications, axle configurations

12 Hours

Unit II

Pavement Materials: Stresses and Strains

Necessity of Pavement Materials Characterization, Soil: Resilient Modulus, Permeability, Shear Test, CBR Test, Plate Load Test; Stone Aggregate: Crushing Test, Impact Test, Abrasion Test, Shape Test, Water Absorption and Specific Gravity; Bituminous Materials: Viscosity, Ductility, Specific Gravity; Bituminous Mixes: Marshall Test; Stresses and Strains in Flexible Pavement using: Single layer and Double layer theory; Stresses and Strains in Rigid Pavement for: Wheel Load, Temperature and Friction.

Marginal Pavement Materials, elastic recovery of bituminous materials

12 Hours

Unit III

Design of Components in Flexible and Rigid Pavement

Overview of IRC design method for Flexible Pavement and Rigid Pavement; Design of Flexible Pavement: Salient features of IRC: 37 (2018), Design of Flexible Pavement using IRC: 37 (2018) guidelines, Design of Rigid Pavement using IRC: 58 (2015) guidelines; Design of Joints in Rigid Pavements: Tie Bars, Dowel Bars, Tie Bars.

Semi-rigid Pavements, IIT Pave

12 Hours

Unit IV

Introduction to Highway Maintenance and Management

Importance of Highway Maintenance Works; Deterioration and Damages in Road Infrastructure; Maintenance requirement for different Road Components; Distresses in Flexible Pavement and Maintenance Measures; Distresses in Rigid Pavement and Maintenance Measures; Structural Evaluation of Flexible Pavement by using Benkelman Beam Deflection Approach.

Pavement Overlay, Falling Weight Deflectometer

12 Hours

Total: 48 Hours

Textbook(s)

1. R. Srinivasa Kumar, Pavement Design, Universities Press, 2013
2. S. K. Khanna, C. E. G. Justo, A. Veeraragavan, Highway Engineering, 10th Edition, Nem Chand & Bros., 2019

Reference(s)

1. Yang H. Huang, Pavement Analysis and Design, 2nd Edition, Pearson, 2004
2. E. J. Yoder, M. W. Witczak, Principles of Pavement Design, 2nd Edition, Wiley, 2015
3. L. R. Kadiyali, N. B. Lal, Principles of Highway Engineering, 7th Edition, Khanna Publishers, 2018
4. IRC: 58 Guidelines for the design of rigid pavements (2015)
5. IRC: 37 Guidelines for the design of flexible pavements (2018)

21CE015 Prestressed Concrete Structures

3 0 0 3

Course Outcomes

1. Explain the concepts of pre-stressing in concrete structures and identify the materials for pre-stressing
2. Evaluate the short-term and long-term losses in prestressing and design prestressed structures considering these losses
3. Analyse the stresses in a prestressed concrete member
4. Analyse the flexural behaviour and effect of shear in a prestressed concrete member
5. Design the prestressed concrete members for flexure and shear
6. Calculate the short term and long-term deflection in prestressed members

COs–POs Mapping

COs	PO3	PO10	PO12	PSO2
1	3	3	2	2
2	3	3	1	2
3	3	2	1	2
4	3	2	1	2
5	3	2	1	2
6	2	3	2	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Introduction to Prestressed Concrete

Historic development – General principles of prestressing, pretensioning and post tensioning – Advantages and limitations of prestressed concrete – Materials – High strength concrete and high tensile steel their characteristics. I.S. Code provisions, Methods and Systems of Prestressing; Pre-tensioning and post tensioning methods – Analysis of post tensioning - Different systems of prestressing like Hoyer System, Magnel System Freyssinet system and Gifford – Udall System.

Properties of Strands, Properties of Tendon

12 Hours

Unit II

Losses and Analysis of Prestress

Loss of prestress in pre-tensioned and post-tensioned members due to various causes like elastic shortage of concrete, shrinkage of concrete, creep of concrete, Relaxation of steel and frictional losses. Load Balancing Concept. Elastic analysis of concrete beams prestressed with straight, concentric, eccentric, and parabolic tendons.

Cracking moment, Anchorage Slip

12 Hours

Unit III

Design of Sections for Flexure and Shear

Allowable stress, Design criteria as per IS Code – Elastic design of simple rectangular and I-section for flexure, shear, and principal stresses – design for shear in beams – cable profile, Detailing requirements for shear and flexure. Transmission of Prestress – Transmission length – End zone reinforcement.

Kern Lines, Flexural strength for T-section

12 Hours

Unit IV

Deflections of Prestressed Concrete Beams

Importance of control of deflections – factors influencing deflections – short term deflections of uncracked members, stage wise prestressing. Limits of span-to-effective depth ratio Calculation of Crack Width – Method of calculation – Limits of crack width

Prediction of long-term deflection, short term deflection of cracked members

12 Hours

Total: 48 Hours

Textbook (s)

1. N. Krishna Raju, Prestressed Concrete, 4th Ed., Tata Mc. Graw Hill Publications,2006
2. N. Rajasekharan, Prestressed Concrete, 2nd Ed., Narosa Publications, 2014

Reference (s)

1. S. Ramamrutham, Prestressed Concrete,5th Ed., Dhanpatrai Publications, 2013
2. T.Y. Lin & Ned H. Burns, Design of Prestressed concrete structures, 3rd Ed., John Wiley & Sons,1981
3. BIS code on prestressed concrete, IS 1343.

21FIX01 Full Semester Internship (FSI)

0 0 0 8

Course Outcomes

1. Use the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
3. Select appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
4. Use ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
5. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
6. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

Cos – POs Mapping

COs	PO1	PO2	PO5	PO8	PO9	PO10	PSO1	PSO2
1	3							3
2		3						3
3			3					
4				3				
5					3		1	1
6						3	3	

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

21CE016 Repair and Rehabilitation of Structures

0 0 0 3

Course Outcomes

1. Understand structural distress and deterioration in various types of structures, including the causes, mechanisms, and preventative measures to mitigate deterioration
2. Understand structural deterioration due to corrosion of steel reinforcement, exploring its causes, effects, mechanisms, and prevention strategies.
3. Acquire knowledge on damage assessment methodologies, including non-destructive testing (NDT), semi-destructive tests to assess structural integrity
4. Identify the appropriate method for strengthening of existing members
5. Understand levels and components of structural health monitoring system, recognizing its necessity for continuous monitoring of structures
6. Gain knowledge of smart materials and their applications in SHM, understanding their role and significance in enhancing structural monitoring and ensuring structural health.

Cos – POs Mapping

COs	PO2	PO7	PO12	PSO2
1	3	3	2	3
2	3	3	2	3
3	2	2	2	3
4	3	3	2	3
5	3	2	2	3
6	2	2	2	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Structural Distress and Structural Damage

Introduction to Structural Distress – Deterioration of Structures – Causes and prevention of Deterioration.

Introduction to Structural Damage– Types of causes of Damage-Mechanism of Damage.
Importance of Maintenance – Facets of Maintenance – Need for Rehabilitation

12 Hours

Unit II

Corrosion and Damage Assessment

Introduction to Corrosion of Steel Reinforcement – Causes and Effects – Mechanism and Prevention of Corrosion. Damage of Structures due to Fire – Fire Rating of Structures – Phenomena of Desiccation Introduction to Damage assessment, Inspection and Testing – Symptoms and Diagnosis of Distress – Damage assessment – NDT – Mechanical and Chemical Properties – Semi destructive Tests
Ground Penetrating Radar (GPR) – NDT Methods for Corrosion Monitoring

12 Hours

Unit III

Damage Repairs and Retrofitting

Introduction to Repair of Structure – Common Types of Repairs – Material selection for Repair – Repair in Concrete Structures – Repairs in Under Water Structures – Repair Techniques – Guniting – Shotcrete – Underpinning. Introduction to Retrofitting – Strengthening of Structures – Strengthening Methods – Retrofitting techniques – Jacketing
Rust Eliminators – Seismic Retrofitting of Beams and Columns

12 Hours

Unit IV

Structural Health Monitoring

Introduction – Need for continuous monitoring – Levels of system Identification – Components of SHM system –Techniques of SHM – Sensors, actuators and its role in SHM – Principle and organization of a SHM system – Smart materials in SHM
Non-Invasive techniques for SHM – Case study using SHM and Building Instrumentation in SHM

12 Hours
Total:48 Hours

Text Book(s)

1. Poonam I. Modi, Chirag N. Patel, Repair and Rehabilitation of Concrete Structures, PHI Learning Pvt. Ltd.,
2. E F & N Spon, Defects and Deterioration in Buildings, 2nd Ed., Spon press London

Reference(s)

1. W. H. Ranso, Concrete Repair and Maintenance Illustrated, RS Means Company Inc, 1993
2. B. A. Richardson, Building Failures: Diagnosis and Avoidance, EF & N Spon, London, 1991
3. Bungey, Non-Destructive Evaluation of Concrete Structures, Surrey University Press, 1982
4. B.L. Gupta and Amit Gupta, Maintenance and Repair of Civil Structures, 1st Ed., Standard Publications, 2009

21CE017 Spatial Analysis Techniques in Remote Sensing and GIS

0 0 0 3

Course Outcomes

1. Understand the basic concepts, platforms, and sensors involved in remote sensing.
2. Understand GIS, its fundamental operations, and its applications in different fields
3. Explain the geographic information system and its related concepts like database management and metadata.
4. Illustrate foundational understanding of spatial data models.
5. Understand the fundamentals of geospatial data analysis.
6. Apply GIS and remote sensing techniques in engineering geology, water resources engineering, and transportation engineering.

COs–POs Mapping

COs	PO1	PO2	PO5
1	3	1	2

2	3	2	2
3	3	1	3
4	3	2	3
5	3	3	3
6	3	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Basic Concepts, Platforms and Sensors

Remote Sensing Concepts: Basic Concepts and Foundation of remote sensing, Elements involved in Remote Sensing, Electromagnetic Spectrum, Remote Sensing Terminology and Units, Energy Resources, Energy Interactions with Earth Surface features and Atmosphere, Spectral properties of Vegetation, Soil and Water bodies. Remote Sensing Platforms & Sensors: Introduction, Characteristics of Imaging Remote Sensing Instruments, Satellite Remote Sensing System - A Brief Overview, other Remote Sensing Satellites, Concept of Resolution in Remote Sensing.

Indian Remote Sensing Satellites and their features-Indian Space Program

12 Hours

Unit II

Geographic Information System

Geographic Information System: Introduction, GIS definition and terminology, GIS categories, components of GIS, fundamental operations of GIS, A theoretical framework for GIS, Applications and Advantages of GIS, Layer based GIS, Feature based GIS mapping, Functions of GIS, Process of GIS. Data Management and Metadata Concept: Introduction, Concept of Database and DBMS, Advantages of DBMS, Functions of DBMS, File and Data Access, Data Models, Database Models, Data Models in GIS.

Concept of Meta Data

12 Hours

Unit III

Spatial Data Model and Geospatial Analysis

Spatial Data Model: Introduction, Different dimensions of Geographic Data, Spatial Entity and Object, Spatial Data Model, Raster Data Model, Vector Data Model, Raster versus Vector, Object Oriented Data Model, File Formats of Spatial Data.

Geospatial Analysis: Introduction, Geospatial Data Analysis, Integration and Modelling of Spatial Data, Geospatial Data Analysis Methods, Database Query, Geospatial Measurements, Overlay Operations, Network Analysis, Surface Analysis.

Raster Data Spatial Analysis-Introduction to Web GIS

12 Hours

Unit IV

Applications of GIS and Remote sensing

Applications in Engineering Geology and Water Resources Engineering: LULC, Agriculture, Forestry, Geology, Geomorphology, Urban Development, Flood Zone Delineation and Mapping, Ground Water Prospects and Recharge. Applications in Transportation Engineering: GIS database design for Physical Facility Planning, Decision Support Systems for Land Use Planning. GIS based Highway Alignment, GIS based Road Network Planning and GIS based Traffic Congestion Analysis, Accident investigation.

Irrigation Management-Rainfall-Runoff Modelling

12 Hours

Total: 48 Hours

Textbook (s)

1. Thomas M Lillesand, Ralfh W Kiefer, Jonathan.W. Chipman, Remote Sensing and Image Interpretation, 5th Ed., Wiley India Pvt. Ltd, 2014.
2. Basudeb Batta, Remote Sensing and GIS, 2nd Ed., Oxford University Press, New Delhi, 2011.

Reference (s)

1. Floyd F. Sabins, Remote Sensing: Principles and Interpretation, 3rd Ed., W.H.Freeman and Company, New York, 1997.
2. James B. Cambell, Rondolph H. Wynne, Introduction to Remote Sensing, 5th Ed., Guilford Press, London and Newyork, 2011.
3. A.M.Chandra and S.K.Ghosh, Remote Sensing and Geographical Information System, 1st Ed., Narosa Publishing House, New Delhi, 2007.
4. M.Anji Reddy, Text Book of Remote Sensing and Geographical Infromation Systems, 4th Ed., BS Publications, 2012.

21CE018 Pavement Management System

0 0 0 3

Course Outcomes

1. Expand knowledge on fundamental aspects of Pavement Management System (PMS).
2. Demonstrate structural and functional evaluation techniques for pavements.
3. Differentiate distress and surveys conducted on pavements.
4. Analyze design strategies and conduct economic evaluations.
5. Apply expert systems in pavement management systems.
6. Develop knowledge on project appraisal and its components.

Cos – POs Mapping

COs	PO5	PO12
1	1	1
2	2	1
3	3	2
4	2	1
5	1	3
6	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Pavement Management Components Levels and functions

Definition - Components of pavement management systems, essential features. ideal PMS - network and project levels of PMS - influence levels - PMS functions – function of pavement evaluation

Major Phases and Components of the Pavement System Methods - Various Tools and Usage in Pavement Management Systems

12 Hours

Unit II

Pavement Performance and Evaluation of Pavement Structural capacity

Serviceability concepts – roughness - roughness components – equipment – IRI - modelling techniques, structural condition deterioration models, mechanistic and empirical models, HDM and other models, comparison of different deterioration models, basics - Non-Distractive Testing (NDT) and Analysis — Condition Surveys – Distress - Destructive Structural Analysis - Application in Network and Project Levels

User Related Evaluation Vs. Engineering Evaluation of Pavements - Pavement Evaluation with respect to User Cost and Benefits

12 Hours

Unit III

Pavement Design Selection and Alternatives

Design objectives and constraints, basic structural response models, physical design inputs, Alternate pavement design strategies and economic evaluation, life cycle costing, analysis of alternate pavement strategies based on distress and performance, case studies. Equipment.

General Response of Pavement Subjected to Traffic Loads and Temperature Induced Stresses

12 Hours

Unit IV

Expert Systems and Pavement Management, Project Appraisal decision support system

Role of computers in pavement management, applications of expert systems for managing pavements, expert system for pavement evaluation and rehabilitation, knowledge - based expert systems, case studies. Project appraisal: private sector participation - Environmental impact assessment – Total Quality Management (TQM) in highway projects

Rehabilitation and Maintenance Policies - Methods for Economic Evaluation of Pavement

12 Hours

Total: 48 Hours

Textbook(s)

1. Ralph Haas, W. Ronald Hudson, Pavement Management Systems, McGraw Publishers, 2015
2. S. K. Khanna & C. E. G Justo, Highway Engineering, 10th Ed., Nem Chand & Bros., Publisher, 2018

Reference(s)

1. AASHTO Guidelines on Pavement Management, American Association of State Highway and Transportation Officials, Washington D.C., 9p. 1985.
2. National Cooperative Highway Research Program Synthesis of Highway Practice 135: Pavement Management Practices. NCHRP, TRB, National Research Council. Washington, D.C. 1987
3. National Cooperative Highway Research Program Synthesis 222: Pavement Management Methodologies to Select Projects and Recommend Preservation Treatments. Transportation Research Board, National Research Council. Washington, D.C. 1995.
4. International Roughness Index. Web page from the Road Roughness Home Page: http://www.umtri.umich.edu/erd/roughness/iri.html).
5. Pavement Performance, Lijun Sun, in Structural Behaviour of Asphalt Pavements, ScienceDirect, 2016.
6. IRC 115. (2014). Guidelines for Structural Evaluation and Strengthening of Flexible Road Pavements Using Falling Weight Deflectometer (FWD) Technique. New Delhi.

The Vision of GMRIT

- To be among the most preferred institutions for engineering and technological education in the country.
- An institution that will bring out the best from its students, faculty, and staff – to learn, to achieve, to compete and to grow – among the very best.
- An institution where ethics, excellence and excitement will be the work religion, while research, innovation and impact, the work culture.

The Mission of GMRIT

- To turnout disciplined and competent engineers with sound work and life ethics.
- To implement outcome-based education in an IT-enabled environment.
- To encourage all-round rigor and instill a spirit of enquiry and critical thinking among students, faculty, and staff.
- To develop teaching, research, and consulting environment in collaboration with industry and other institutions.

Department Vision

- To be a preferred department of learning for students and teachers alike, with a commitment towards Academics & Research, serving the students in an atmosphere of innovation, critical thinking and making them Industry ready.

Department Mission

M1: To provide adaptable education in a collaborative and innovative environment in skilling the graduates to solve real world problems in the field of Civil Engineering

M2: To prepare the students as critical thinking professionals with multidisciplinary research orientation and Innovation

M3: To instil ethical values and nurture the graduates who will be able to contribute to society.

Program Educational Objectives (PEOs)

PEO 1: Employ logical and analytical skills in solving complex real-world engineering problems in the areas of civil engineering.

PEO 2: Adaptable to emerging technologies with enhanced professional skills and ability towards continuous learning, facilitating higher studies and research.

PEO 3: Demonstrate professional ethics, leadership qualities and promote inclusive and collaborative growth with human values towards societal interest.

Program Outcomes (POs):

Engineering graduate will be able to:

PO 1: Apply the knowledge of basic sciences and fundamental engineering concepts in solving civil engineering problems (**Engineering knowledge**)

PO 2: Identify and define civil engineering problems and investigate to analyze and interpret data to arrive at substantial conclusions. (**Problem analysis**)

PO 3: Propose appropriate solutions for engineering problems complying with functional constraints such as economic, environmental, societal, ethical, safety and sustainability in accordance with Indian standard codes of practices. (**Design/development of solutions**)

PO 4: Perform investigations, design and conduct experiments, analyze and interpret the results to provide valid conclusions. (**Conduct investigations of complex problems**)

PO 5: Select/develop and apply appropriate techniques and IT tools to analyze, design and scheduling of activities with an understanding of the limitations and successfully implement and adopt to technological changes in civil engineering with intervention of IT industries (**Modern tool usage**)

PO 6: Give reasoning and assess societal, health, legal and cultural issues with competency in professional engineering practice. (**The engineer and society**)

PO 7: Demonstrate professional skills and contextual reasoning to assess environmental/societal issues for sustainable development. (**Environment and sustainability**)

PO 8: Demonstrate knowledge of professional and ethical practices. (**Ethics**)

PO 9: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary situations. (**Individual and team work**)

PO 10: Communicate effectively with respect to oral, written and graphical communication (**Communication**)

PO 11: Demonstrate and apply engineering & management principles in their own / team projects in multidisciplinary environment. (**Project management and finance**)

PO 12: Recognize the need for, and have the ability to engage in independent and lifelong learning. (**Life-long learning**)

Program Specific Outcomes (PSOs):

Engineering graduate will be able to:

PSO 1: Demonstrate the quality and suitability of construction materials (**Program Specific**)

PSO 2: Ability to apply the practical aspect of analysis, design and safe construction practices (**Program Specific**)

Department of Civil Engineering

Minimum Credits to be earned: 160 (for Regular students)
120 (for Lateral Entry Students)

No	Course Code	Course	POs	Contact Hours			
				L	T	P	C
First Semester							
1	23PYX01 23CYX02	Engineering Physics/ Engineering Chemistry	1,2,7,10,12/1,2,6,7, 12	3/3	0	0	3/3
2	23MAX01 23MAX02	Linear Algebra& Calculus/ Differential Equations and Vector calculus	1,2,3,4,12/1,2,3,4,12	3/3	0	0	3/3
3	23BEX01/ 23BEX02	Basic Electrical and Electronics Engineering/ Basic Civil & Mechanical Engineering	1,3,6,7,9,12/1,2,3,6,7, 8,12	3/3	0	0	3/3
4	23BEX03	Introduction to Programming	1,2,3,12	3	0	0	3
5	23BEX04/ 23HSX01	Engineering Graphics/ Communicative English	1,5,10,12/1,9,10, 11,12	2/2	0	2/0	3/2
6	23PYX02/ 23CYX04	Engineering Physics Lab/ Engineering Chemistry Lab	4,6,9,11,12/1,6,7,9, 12	0	0	2/2	1/1
7	23BEX05/ 23BEX06	Electrical & Electronics Engineering workshop/Engineering Workshop	4,5,6,9,12/1,9,12	0	0	3/3	1.5/1.5
8	23BEX07	Computer Programming Lab	2,3,4,12	0	0	3	1.5
9	23HSX11	-/ECA (Yoga / Sports)	-	-	-	-/1	-/0.5
10	23HSX12	-/CCA (NSS/NCC/Community Service)	-	-	-	-/1	-/0.5-
11	23BEX08	IT Workshop/-	1,2,3,4,9,12	0	0	2/-	1/-
12	23HSX02	/Communicative English Lab	1,9,10,11,12	0	0	0/2	-/1
Total				**14/14**	**0**	**12/12**	**20/20**
Second Semester							
1	23HSX01/ 23BEX04	Communicative English/ Engineering Graphics	10,12/1, 5,10	2/2	0	0/2	2/3
2	23MAX02/ 23MAX01	Differential Equations and Vector calculus/Linear Algebra& Calculus	1,2,3,4,12/1,2,3,4,12	3/3	0	0	3/3
3	23CYX01/, 23PYX01	Engineering Chemistry/ Engineering Physics	1,2,6,7,12/1,2,7,10,12	3/3	0	0	3/3
4	23BEX02/ 23BEX01	Basic Civil & Mechanical Engineering/ Basic Electrical and Electronics Engineering	1,2,3,6,7,8,12/1,3,6,7, 9,12	3/3	0	0	3/3
5	23ME201	Engineering Mechanics	1,2,3,12, PSO1	3/3	0	0	3/3
6	23CYX04/ 23PYX02	Engineering Chemistry Lab/ Engineering Physics Lab	1,6,7,9,12/4,6,9,11,12	0	0	2/2	1/1
7	23BEX06/ 23BEX05	Engineering Workshop/Electrical & Electronics Engineering workshop	1,9,12/ 1,4,5	0	0	3/3	1.5/1.5
8		IT Workshop/-	1,2,3,4,9,12	0	0	2/-	1/-
9	23HSX02	Communicative English Lab/-	1,9,10,11,12	0	0	2/-	1/-
10	23CE201	Engineering Mechanics and Building Practices Lab	2,3,4,12, PSO1	0	0	3/3	1.5/1.5
11	23HSX11	-/ECA (Yoga/ Sports)	-	-	-	-/1	-/0.5
12	23HSX12	-/CCA (NSS/NCC/Community Service)	-	-	-	-/1	-/0.5
Total				**14/14**	**0**	**12/12**	**20/20**
Third Semester							
1	23MA303	Numerical Methods	1,2,3,4,12	3	-	-	3
2	23CE302	Building Materials and Concrete Technology	2,4,8,12, PSO1	3	-	2	4
3	23CE303	Building Planning and Drawing	1,5,10,12,PSO2	3	-	2	4
4	23CE304	Fluid Mechanics	1,2,3,4, PSO1	3	-	-	3
5	23CE305	Solid Mechanics I	1,2,3,12, PSO1	3	-	-	3
6	23CE306	Surveying	1,2,3,4, PSO1	3	-	-	3

7	23CE307	Solid Mechanics Laboratory	1,4,5,9, PSO1	-	-	3	1.5
8	23CE308	Surveying Laboratory	1,4,5,9, PSO1	-	-	3	1.5
9	23ESX01	Employability Skills I	1,2,5,8, 10,12	1	-	1	-
Total				**19**	-	**11**	**23**
Fourth Semester							
1	23CE401	Hydraulics and Hydraulic Machinery	1,2,3,4,5,6,7	3	-	-	3
2	23CE402	Soil Mechanics	1,2,3,12,PSO1	3	-	-	3
3	23CE403	Solid Mechanics II	1,2,3,12, PSO2	3	-	-	3
4	23CE404	Structural Analysis	1,2,3,12, PSO2	3	-	-	3
5	23CE405	Transportation Engineering	1,2,3,12, PSO2	3	-	2	4
6	23CE406	Fluid Mechanics and Hydraulic Machinery Laboratory	1,2,5,9, PSO2	-	-	3	1.5
7	23CE407	Soil Mechanics Laboratory	1,4,5,10, PSO1	-	-	3	1.5
8	23ESX01	Employability Skills I	1,2,5,8,10,12	1	-	1	2
Total				**16**	**-**	**9**	**21**
Fifth Semester							
1	23CE501	Design and Detailing of RC Structures	2,3, 10, 12,PSO2	3	-	2	4
2	23CE502	Environmental Engineering	2,3,6,7,12	3	-	-	3
3	23CE503	Foundation Engineering	1,2,3,7, PSO2	3	-	-	3
4	23CE504	Hydrology	1,2,3,4, 7,PSO2	3	-	2	4
5		Elective I (Professional Elective)		3	-	-	3
6		Elective II (Sequential Open Elective I)		3	-	-	3
7	23CE505	Environmental Engineering Laboratory	3,6,7,9, 12,PSO2	-	-	3	1.5
8	23TPX01	Term Paper	1,4,10,12	-	-	3	1.5
9	23ESX02	Employability Skills II	1,2,5,8, 10,12	1	-	1	-
10	23SIX01	Summer Internship I	1,2,8,10, 12	-	-	-	1
Total				**19**	**-**	**11**	**24**
Sixth Semester							
1	23CE601	Problem solving using OOPS	1, 2,3,5, 12	3	-	-	3
2	23CE602	Design of Steel Structures	1,2,3,4,12,PSO2	3	-	-	3
3	23CE603	Estimation and costing	1,2,3, 11,PSO2	3	-	-	3
4		Elective III (Professional Elective)		3	-	2	4
5		Elective IV (Sequential Open Elective II)		3	-	-	3
6	23CE604	Programming Language Laboratory	1,2,3,5,12	-	-	3	1.5
7	23MPX01	Mini Project	1,2,3,4,5,6,7,8,9,10, 11,12, PSO1, PSO2	-	-	3	1.5
8	23ESX02	Employability Skills II	1,2,5,8, 10,12	1	-	1	2
10	23ATX01	Environmental Studies	12	-	-	-	-
11	23ATX02	Professional Ethics and Human Values	12	-	-	-	-
12	23ATX03	Indian Knowledge Systems	12	-	-	-	-
Total				**16**	**-**	**9**	**21**
Seventh Semester							
1		Elective V (Professional Elective)		3	-	-	3
2		Elective VI (Professional Elective)		3	-	-	3
3		Elective VII (Sequential Open Elective III)		3	-	-	3
4	23PWX01	Project Work	1,2,3,4,5,6,7,8,9, 10,11,12, PSO1, PSO2	-	-	16	8
5	23SIX02	Summer Internship II	1,2,5,6, 10,12	-	-	-	1
Total				**9**	**-**	**16**	**18**
Eighth Semester							
1		Elective VIII (Professional Elective)		-	-	-	3
2		Elective IX (Sequential Open Elective IV)		-	-	-	2
3	23FIX01	Full semester Internship (FSI)	1,2,5,8,9,10,PSO1, PSO2	-	-	-	8

Total				**-**	**-**	**-**	**13**
Elective I							
Career Path I, II, III, IV and Other Core Electives							
1	23CEC11	Principles of Building Architecture	1,2,6,7, PSO2	3	-	-	3
2	23CEC21	Geometric Design and Highway Materials	1,2,3,4, PSO1,PSO2	3	-	-	3
3	23CEC31	Environmental Sustainability and Climate Resilience	1,2,3,6,7,8,12	3	-	-	3
4	23CEC41	Data Analysis and Visualization Using Python	1,2,3,4,5,10,12	3	-	-	3
5	23CE001	Prefabricated Structures	1,2,3,12, PSO2				
6	23CE002	Construction Techniques	1,2,7,11, 12,PSO2	3	-	-	3
7	23CE003	Airport, Railways and Harbour Engineering	1,2,3,12, PSO2	3	-	-	3
8	23CE004	Construction Economics and Finance	2,3,10,11,12	3	-	-	3
		MOOCs		-	-	-	3
Elective III							
Career Path I, II, III,IV and Other Core Electives							
1	23CEC12	Building Services	1,5,8,12, PSO2	3	-	2	4
2	23CEC22	Highway Design and Simulation	1,2,3,4, PSO1, PSO2	3	-	2	4
3	23CEC32	Environmental Data Analytics and IoT for Smart Monitoring	1,2,3,4,7,8,11	3	-	2	4
4	23CEC42	ML for Civil Engineering	1,2,3,4,5,10,12	3	-	2	4
5	23CE005	Pre Engineered Buildings	1,3,4,12, PSO2	3	-	2	4
6	23CE006	Engineering Geology	1,2,6,7, PSO1	3	-	2	4
7	23CE007	Irrigation and Water Resources Engineering	1,2,3,7, PSO1	3	-	2	4
Elective V							
Career Path I, II, III,IV and Other Core Electives							
1	23CEC13	Building Information Modeling	1,2,5,12, PSO1	3	-	-	3
2	23CEC23	Highway Project Formulation and Economics	1,2,6,12, PSO1	3	-	-	3
3	23CEC33	Pollution Control and Waste Management	3,6,7,8,12	3	-	-	3
4	23CEC43	AI for Civil Engineering	1,2,3,4,5,10,12	3	-	-	3
5	23CE008	Ground Improvement Techniques	1,2,3,12, PSO2	3	-	-	3
6	23CE009	Advanced Reinforced Concrete Design	1,2,3,4, 12,PSO2	3	-	-	3
7	23CE010	Construction Methods and Equipment	1,2,5,11, PSO2	3	-	-	3
		MOOCs		-	-	-	3
Elective VI							
1	23CE011	Basics of Dynamics and Earthquake Engineering	1,2,3,12, PSO2	3	-	-	3
2	23CE012	Pavement Analysis and Design	1,2,3,4,5,12,PSO1	3	-	-	3
3	23CE013	Prestressed Concrete Structures	1,2,3,12, PSO2	3	-	-	3
		MOOCs		-	-	-	3
Elective VIII							
1	23CE014	Repair and Rehabilitation of Structures	1,2,3,12,PSO2	-	-	-	3
2	23CE015	Remote Sensing and GIS	1,2,5,12, PSO1, PSO2	-	-	-	3
3	23CE016	Pavement Management System	1,2,3,12, PSO2	-	-	-	3
		MOOCs		-	-	-	3
B. Tech. (Honors)							
Domain I: Structural Engineering							
01	23CEH11	Advanced Concrete Technology	1,2,12,PSO1,PSO2	4	-	-	4

02	23CEH12	Advanced Structural Analysis	1,2,3,12, PSO2	4	-	-	4
03	23CEH13	Design of Industrial Structures	1,2,3,4, PSO1,PSO2	4	-	-	4
04	23CEH14	Bridge Engineering	1,2,3,12, PSO2	4	-	-	4
Domain II: Transportation Engineering							
01	23CEH21	Rural Road Technology	1,2,3,4, PSO1, PSO2	4	-	-	4
02	23CEH22	Evaluation and Strengthening of Pavements	1,2,3,4,5,PSO1, PSO2	4	-	-	4
03	23CEH23	Traffic Engineering and Management	1,3,7,12, PSO2	4	-	-	4
04	23CEH24	Planning and Design of Airport	1,3,7,12, PSO2	4	-	-	4
Domain III: Geotechnical Engineering							
01	23CEH31	Elements of Rock Mechanics	1,2,7, PSO1,PSO2	4	-	-	4
02	23CEH32	Construction in Expansive Soils	1,2,3,7, PSO2	4	-	-	4
03	23CEH33	Geosynthetics in Soil Structures	1,2,3,7, PSO1	4	-	-	4
04	23CEH34	Soil dynamics	1,2,3,7, PSO1	4	-	-	4
Domain IV: Construction Management							
01	23CEH41	Modern Construction Material	1,2,4,7,12,PSO2	4	-	-	4
02	23CEH42	Construction Planning and Project Management	1,2,7,10, 11,12, PSO2	4	-	-	4
03	23CEH43	Quality Control and Assurance in Construction	1,2,3,4,6,PSO1	4	-	-	4
04	23CEH44	Safety in Construction	1,2,3,4,6,PSO1	4	-	-	4

23MA303 Numerical Methods

3 0 0 3

Course Outcomes

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

1. Apply numerical techniques to find approximate solutions of Algebraic and Transcendental Equations.
2. Apply the methods of least squares to fit a best curve for the given data.
3. Apply concepts of interpolation to estimate the unknown functional values.
4. Examine the technique of numerical methods to find the derivative of a function.
5. Evaluate the definite integrals using numerical methods.
6. Solve ordinary differential equations using numerical methods.

COs – POs Mappings

COs	PO1	PO2	PO3	PO4	PO12
1	3	2	2	3	1
2	3	2	2	3	1
3	3	2	3	3	1
4	3	1	2	2	1
5	3	3	2	2	1
6	3	3	2	3	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Solution of Algebraic and Transcendental Equations, Curve fitting

Introduction, Bisection method, Regula-Falsi method, Newton-Raphson method, Iterative method, Curve fitting- Fitting a straight line, Second degree curve, Exponential curve, Power curve by method of least squares

Geometrical interpretation - Bisection Method, Regula- Falsi method, Newton-Raphson Method

12 Hours

Unit II

Interpolation

Introduction, Finite differences, Symbolic relations, Newton's- forward and backward differences, Gauss's forward and backward differences, Lagrange's interpolation method

Newton's divided differences

12 Hours

Unit III

Numerical differentiation and Integration

Numerical differentiation- First and Second order derivatives using forward, backward and Stirling's difference formulas

Numerical Integration-Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Weddle's rule

Boole's rule of integration

12 Hours

Unit IV

Numerical solutions of Ordinary Differential Equations

Taylor's series Method, Euler's and Modified Euler's Methods, Runge-Kutta Methods, Milne's Predictor-Corrector Method

Adams Bashforth Predictor-Corrector Method

12 Hours

Total: 48 Hours

Textbook (s)

1. B. S. Grewal, Higher Engineering Mathematics, 42nd Ed., Khanna Publishers, New Delhi, 2012
2. B. V. Ramana, Engineering Mathematics, 4th Ed., Tata Mc Graw Hill, 2009

Reference (s)

1. T.KV.Iyengar, S.Ranganatham, B.Krishna Gandhi, Mathematical Methods, 2nd Ed., S.Chand Co., New Delhi,

2006.
2. Ervin Kreyszig, Advanced Engineering Mathematics, 9th Ed., Wiley India Pvt. Ltd., 2012
3. S. S. Sastry, Introductory methods of Numerical Analysis, 4th Ed., Prentice Hall of India Pvt. Ltd., 2006

23CE302 Building Materials and Concrete Technology

3 0 2 4

Course Outcomes

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

1. Utilize the characteristics of building materials to determine their suitability for various construction applications.
2. Implement standardized testing procedures to assess the quality and performance of construction materials.
3. Select and apply appropriate finishing materials to enhance the durability and aesthetics of building elements.
4. Prepare and proportion concrete mix designs as per IS code to achieve desired strength and workability.
5. Conduct and analyze tests on fresh concrete to ensure its workability and compliance with standards.
6. Assess and interpret the properties of hardened concrete to evaluate its structural performance.

COs-POs Mapping

COs	PO2	PO4	PO8	PO12	PSO1
1	3	1	1	2	3
2	3	1	1	2	3
3	3	1	1	2	3
4	3	1	1	2	3
5	3	1	1	2	3
6	3	3	3	2	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Building Materials

Stones- Tests on stones; Bricks – Classification, Manufacturing of clay bricks, Tests on bricks, Bricks for special use - Refractory bricks, Cement Concrete blocks, Lightweight concrete blocks; Timber - Classification of timber, structure of timber, seasoning of timber, Defects on timber. Modern materials: Glass, Aluminum, Ceramics, Sealants for joints, Geosynthetics.

Practical Components

1. Determination of water absorption of clay bricks
2. Determination of compressive strength of clay bricks

12+4 Hours

Unit II

Construction Materials and Building Finishes

Construction Materials: Constituents of cement and their significance, Manufacturing of Cement, Heat of hydration, types of cement. Aggregates- size and shape, gradation, fineness modulus, bulking of sand. Mortar - mix proportions and compressive strength of mortars for masonry.

Building Finishes: Plastering –Types; Painting –constituents- Types– characteristics, Varnish, Damp proofing - causes and effects of dampness, methods of damp proofing.

Practical Components

1. Determination of fineness and consistency of cement
2. Determination of Initial and Final setting time of cement
3. Determination of compressive strength of mortar
4. Determination of specific gravity of fine aggregate
5. Determination of specific gravity of coarse aggregate
6. Determination of bulking of sand

12 + 12 Hours

Unit III

Concrete Mix Design and Fresh Concrete

Ingredients, Manufacturing process, Properties of fresh concrete –Workability- slump test, compaction factor, Vee Bee Consistometer, segregation, bleeding; Mix Design - Concrete mix design by I.S. method.

Practical Components

1. Develop a Python programme to design concrete mix as per IS 10269 2019
2. Determine the workability of concrete using slump cone
3. Determine the workability of concrete using compaction factor
4. Determine the workability of concrete using Vee Bee Consistometer

12 +8 Hours

Unit IV

Hardened Concrete

Hardened Concrete: Water / Cement ratio – Abram's Law –Gel space ratio. Properties of hardened concrete- Factors affecting strength of concrete– Strength in compression, tension and flexure. Relation between compression, tensile, flexural strength and modulus of elasticity of concrete .Shrinkage and creep of concrete.

Practical Components

1. Determine the compressive strength of concrete
2. Determine the Split tensile strength of concrete
3. Determine the flexural strength of concrete
4. Determine the modulus of elasticity of concrete

12 +8 Hours

Total: 48 + 32 Hours

Textbook (s)

1. S. K. Duggal, Building Material, 5th Ed, New Age International Publishers, 2019
2. Rangwala "Engineering Materials (Material science)" Charotar Publishing House Pvt. ltd., Edition-2017
3. M.S. Shetty, "Concrete Technology" S. Chand & Co., Ltd., Revised Edition - New Delhi, 2018
4. A.M. Neville, Properties of Concrete, 5th Ed., Low Priced Edition, Prentice Hall Publishers, 2012

Reference (s)

1. P.C. Varghese, Building materials, 2nd Ed., Prentice-Hall of India private Ltd, New Delhi. 2015
2. R.K. Rajput "Engineering Materials (Including construction materials)", 4th Ed., S. Chand Publications. 2014
3. Rofat Siddique "Special structural Concrete" Galgotia Publishing Pvt. Ltd., New Delhi, 2000
4. Code book: IS 10262-2019 "Concrete Mix Proportioning-Guidelines", Second Revision.

23CE303 Building Planning and Drawing

3 0 2 4

Course Outcomes

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

1. Describe building byelaws in diverse building scenarios with regulatory standards and legal requirements.
2. Apply the concepts of FAR and FSI in different building types.
3. Evaluate and analyze the preliminary prerequisites for residential buildings.
4. Examine and elucidate the specific planning requisites applicable to different types of buildings.
5. Determine the minimum project duration by applying the principles of critical path methods.
6. Analyze the project durations and examine the probability of project completion using the PERT technique.

COs – POs Mapping

COs	PO1	PO5	PO10	PO12	PSO2
1	3	1	2	3	2
2	3	3	2	2	3
3	3	1	2	3	3
4	3	3	2	3	3
5	2	3	2	3	2
6	3	1	3	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Building Byelaws and Regulations

Introduction – Terminology – Objectives of building byelaws. Principles underlying building byelaws. Classification of buildings. Floor Area Ratio (FAR). Floor Space Index (FSI). Open space requirements. Built up area limitations. Height of Buildings. Wall thickness and masonry- Lighting and ventilation requirement.

Practical components

1. Conventional signs and symbols used in civil Engineering
2. English bond and Flemish bonds
3. Panelled Doors
4. Panelled Windows

12+8 Hours

Unit II

Components of Residential Buildings

Minimum standards for various parts of buildings. Requirements of different rooms and their grouping. Characteristics of various types of residential buildings.

Practical components

1. King Post Truss
2. Queen Post Truss
3. Dog Legged Stairs
4. Load Bearing wall

12+8 Hours

Unit III

Planning of Residential and Public Buildings

Planning of Educational institutions, hospitals, dispensaries, office buildings, banks, industrial buildings, hotels and motels, buildings for recreation.

Practical components

1. Plan and section of a residential building
2. Plan and Section of office building
3. Plan, elevation and section of a two storied residential building
4. Plan, elevation and section of a secondary school

12+8 Hours

Unit IV

Planning and scheduling of Construction Projects

Planning scheduling and monitoring of building construction projects, Bar chart, CPM and PERT Network planning. Computation of times and floats – their significance.

Practical components

1. Constructing a Network Diagram and Identifying Critical Path
2. CPM Network Scheduling
3. PERT Analysis for Project Duration
4. Resource-Constrained PERT Analysis

12+8 Hours

Total: 48+32 Hours

Textbook (s)

1. N.Kumaraswamy, A.Kameswara Rao, building planning and drawing, 7th Ed, Charotar Publishing House, 2019
2. R.L. Peurifoyetal, Construction Planning, Equipment and Methods, 7th Ed., Tata Mc. Graw Hill Publications, 2010.
3. B.C.Punmia&Khandelwal, Project Planning and Control with PERT and CPM, 4th Ed., Laxmi publications, 2009.
4. 'A' Series & 'B' Series of JNTU Engineering College, Anantapur.

Reference (s)

1. Building Byelaws by State and Central Governments and Municipal Corporations.

23CE304 Fluid Mechanics

3 0 0 3

Course Outcomes

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

1. Outline the importance of fluid properties and their influence on fluid motion.
2. Apply the principles of total pressure, center of pressure and buoyancy in the design of different components in hydraulic structures
3. Explain the principles of fluid kinematics and dynamics in different fluid flow problem.
4. Interpret the concepts of laminar flow, turbulent flow and boundary layer theory.
5. Solve various problems related to fluid flow through pipes.
6. Explain the fundamental principles of fluid motion in the measurement of flow.

COs–POs Mapping

COs	PO1	PO2	PO3	PO4	PSO1
1	3	2	1	2	3
2	3	3	3	2	3
3	3	3	2	2	3
4	3	3	2	2	3
5	3	3	3	2	3
6	3	3	2	2	3

3–Strongly linked |2–Moderately linked|1–Weakly linked

Unit I

Fluid Properties - Hydro Static Forces on Surfaces – Buoyancy and Floatation

Fluid Properties: Mass Density, Specific Weight, Specific Volume, Specific Gravity, Viscosity, Surface Tension and Capillarity, Vapour Pressure and Cavitations, Pressure at a point, Pascal's law, Hydrostatic law, Atmospheric, Gauge and Vacuum pressure; Measurement of Pressure, Manometers.

Hydrostatic forces on Surfaces: Derivations of Total and Centre of Pressure for Horizontal, Vertical, Inclined and Curved surfaces.

Buoyancy and Floatation: Centre of Buoyancy, Meta Centre and Metacentric Height, Stability of Submerged and Floating bodies, Determination of Metacentric Height.

Metacentric Height for Floating bodies containing liquid, Time period of transverse oscillation of a floating body

12 Hours

Unit II

Fluid Kinematics and Fluid Dynamics

Fluid Kinematics: Velocity of Fluid Particles, Types of Fluid Flow, Description of the Flow Pattern, Basic Principles of Fluid Flow, Equation of Continuity, Acceleration of Fluid Particle, Stream Function and Velocity Potential functions, Flow Net Analysis.

Fluid Dynamics: Forces acting on Fluid in Motion, Euler's Equation of Motion and Bernoulli's Equation, Impulse Momentum Equation and its Application in forces on pipe bend. Angular Momentum Principle – Moment of Momentum Equation

Kinetic Energy Correction Factor

12 Hours

Unit III

Laminar and Turbulent Flows and Boundary Layer Flow

Boundary layer – definition- boundary layer on a flat plate – laminar and turbulent boundary layer- displacement, energy and momentum thickness – Momentum integral equation-Boundary layer separation , velocity distribution for both laminar and turbulent flow.

Methods of Controlling Boundary Layer, Friction in Non -Circular Conduits

12 Hours

Unit IV

Flow through Pipes and Measurement of Flow

Flow through Pipes: Reynolds's Experiment, Laws of Fluid friction, Froud's Experiments, Darcy – Weisbach equation, Chezy's Formula, Mannin's Formula, Hazen William's Formula, Minor losses, Pipes in Series, Pipes in Parallel, Total Energy Line and Hydraulic Gradient Line, Flow through long pipes , Compound Pipe, Equivalent Pipe.

Measurement of Flow: Pitot-tube, Venturi Meter, Flow through Orifices and Mouthpieces, Flow over Notches and Weirs.

Water Hammer in Pipes-Submerged Weirs

12 Hours

Total: 48 Hours

Textbook (s)

1. R.K.Bansal, A Fluid Mechanics and Hydraulic Machines, 9th Ed., Laxmi Publications(P) Ltd.,NewDelhi,2017

2. Modiand Seth, Hydraulics & Fluid Mechanics, 20th Ed., Standard Book House, New Delhi, 2014
3. S.K.Som & G.Biswas, Introduction to Fluid Machines, 3rd Ed., Tata McGraw-Hill Publishers Pvt.Ltd., 2013.

Refernce (s)

1. J.F.Douglas, J.M.Gaserek and J.A.Swaffirld, Fluid Mechanics, 6th Ed., Longman Scientific & Technical, New York,2011
2. Frank.M.White, FluidMechanics, 5th Ed., Tata Mc.Grawhill Pvt.Ltd, 2003
3. A.K.Mohanty, Fluid Mehanics,2nd Ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2006
4. Edward J. Shaughnessy, Jr, Ira M.Katzand James, Introduction to Fluid Machines, P.Schaffer, Oxford University Press, New Delhi, 2005

23CE305 Solid Mechanics I

3 0 0 3

Course Outcomes

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

1. Apply the concepts of normal and shear stresses along with various elastic constants to analyze material behavior.
2. Calculate bending moment and shear force at different cross-sections of a beam under various practical loading conditions.
3. Determine flexural stress for different beam cross-sections subjected to practical loading cases.
4. Construct shear stress distribution diagrams for various beam sections.
5. Analyze the power transmission capacity and required diameter of a shaft subjected to pure torsion.
6. Compute slope and deflection in simply supported and cantilever beams for different loading conditions.

COs–POs Mapping

COs	PO1	PO2	PO3	PO12	PSO1
1	3	3	2	3	3
2	3	3	2	3	2
3	3	3	2	3	2
4	3	3	2	3	3
5	3	3	2	3	3
6	3	3	2	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Simple Stresses, Strains and Strain Energy

Elasticity and plasticity – Types of stresses and strains – Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic modulus and the relationship between them – Bars of varying section – composite bars – Temperature stresses. Resilience – Gradual, sudden, impact loadings – simple applications

Principle of superposition, Resilience

12 Hours

Unit II

Shear Force, Bending Moment and Flexural Stresses

Definition of beam – Types of beams – Concept of shear force and bending moment – Relation between S.F., B.M and rate of loading at a section of a beam, S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads and combination of these loads – Point of contra flexure. Theory of simple bending – Assumptions – Derivation of bending equation-Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections

S.F and B.M diagrams for simply supported beam subjected to couple

12 Hours

Unit III

Shear Stresses and Torsion of Circular shaft

Shear Stresses: Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T, angle sections.

Torsion of Circular Shaft: Theory of pure torsion – Derivation of Torsion equations – Assumptions made in the theory of pure torsion – Torsional moment of resistance – Polar section modulus – Power transmitted by shafts
Combined bending and torsion and end thrust

12 Hours

Unit IV

Deflection of beams

Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration, Moment area method – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, - U.D.L– application to simple cases including overhanging beams.
Conjugate Beam Method-application to cantilever beam

12 Hours

Total: 48 Hours

Textbook (s)

1. S. S. Bhavikatti, Engineering Mechanics,6th Ed New Age International, 2018
2. S. Timoshenko & D. H. Young, and JV Rao, Engineering Mechanics, 4th Ed., TMH Education, 2006
3. R. Subramanian, Strength of Materials, 2nd Ed., Oxford University Press, New Delhi, 2010
4. Ferdinand P Beer, E. Russell, Johnston, Jr, John T Dewolf, Mechanics of Materials, 6th Ed., Tata McGraw-Hill Publications, 2012

Reference (s)

1. R. K. Bansal, Engineering Mechanics, Laxmi Publications, 3rd Ed, 2004
2. R.K.Rajput, Strength of Materials, 4th Ed, S.Chand & Co, New Delhi, 2007
3. U.C. Jindal, Introduction to Strength of Materials, 5th Ed, Galgotia Publications, 2001

23CE306 Surveying

3 0 0 3

Course Outcome

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

1. Explain the chain and compass surveying principles to measure distances and bearings for mapping and layout in civil engineering
2. Utilize the principles of leveling to find the reduced levels of a terrain to draw contour maps
3. Determine the horizontal and vertical angles using theodolite and trigonometric principles
4. Assess areas of irregular boundaries, volumes of barrow pits, embankments and capacity of reservoirs
5. Explain the concept of tachometer in angular measurement to determine the distance and elevation
6. Learn the various curve-setting techniques for roads and railways and make use of advanced techniques to carry out survey work

COs–POs Mapping

COs	PO1	PO2	PO3	PO4	PSO1
1	3	2	2	1	3
2	3	2	3	1	3
3	3	2	3	2	3
4	3	3	3	2	3
5	3	2	2	2	3
6	3	3	3	2	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Basic Surveying: Chain and Compass

Chain Surveying: Principles, Conversions, Basics, Linear Measurement, Ranging, Chain and Tape Corrections.

Compass Surveying: Compass Surveying-Type-Computation of angles from bearings, Local attraction corrections-problems.

Scale usage in plotting Errors in compass survey.

12 Hours

Unit II

Levelling and Contouring, Theodolite Survey, Trigonometric levelling

Levelling and Contouring: Basic Definitions, Types and Methods - Height of Instrument and Rise and Fall methods, Characteristics and uses of contours.

Theodolite Survey: Theodolite- description, uses and adjustments – temporary and permanent, measurement of horizontal and vertical angles.

Trigonometric levelling: Definition, Base is accessible, and Base is inaccessible.

Reciprocal levelling, Fundamental Lines & Desired Relations of Theodolite

12 Hours

Unit III

Computation of Areas and Volumes, Tacheometric Surveying

Computation of areas and volumes: Area from field notes, computation of areas along irregular boundaries and area consisting of regular boundaries. Embankments and cutting for a level section and two-level sections, determination of the capacity of reservoir, volume of barrow pits.

Tacheometric surveying: Stadia and tangential methods of Tachometry. Distance and Elevation formulae for Staff vertical position

Distance and Elevation formulae for Staff Normal Position, Triangulation systems

12 Hours

Unit IV

Curves and Advanced Surveying

Curves: Elements of Simple curve and Compound curve; Methods of setting out of simple curves.

Total Station: Principle of Electronic distance measurement (EDM), Accessories of a Total station, Advantages and Applications.

Geo-informatics: Fundamentals of Remote Sensing - Electromagnetic Spectrum, Active and Passive Remote Sensing, Stages, Photogrammetry – Types, Scale and Flying Height.

GIS Definition, Components, GPS – Segments.

12 Hours
Total: 48 Hours

Textbook (s)

1. B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, Surveying (Vol–1), 18th Ed., Laxmi Publications (P) Ltd., New Delhi, 2016
2. S. K. Duggal, (Vol–I & II), 5th Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2019.

Reference (s)

1. Chandra A M, Higher Surveying, 3rd Ed., New age International Pvt. Ltd., Publishers, New Delhi, 2015
2. Dr. K. R. Arora, Surveying (Vol-1), 11th Ed, Rajsons Publications Pvt. Ltd., 2010
3. Arthur R Benton and Philip J Taety, Elements of Plane Surveying, 8th Ed., McGraw Hill, 2000

23CE307 Solid Mechanics Laboratory

0 0 3 1.5

Course Outcomes

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

1. Apply knowledge of the mechanical properties of materials to select suitable materials for various construction applications based on performance requirements.
2. Apply appropriate testing methods to estimate the compressive strength of wood, concrete, and brick and analyze their suitability for specific construction purposes.
3. Apply tensile strength evaluation techniques to analyze and recommend appropriate materials for use in reinforced concrete structures.
4. Apply standardized procedures to determine the impact resistance of steel and assess its performance for structural applications in construction projects.
5. Apply experimental methods to determine the Young's modulus of wood and steel and interpret results to inform material selection decisions.
6. Apply practical techniques to determine the shear modulus of rigidity for helical springs and evaluate their performance in structural and mechanical systems.

COs – POs Mapping

COs	PO1	PO4	PO5	PO9	PSO1
1	3	2	3	2	3
2	2	2	3	3	3
3	3	3	3	2	3
4	3	3	3	2	2
5	2	3	3	3	3
6	2	2	3	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

List of Experiments

1. Determine the tensile strength of Mild steel rod
2. Determine the young's modulus of elasticity for wooden cantilever beam
3. Determine the young's modulus of elasticity for wooden simple supported beam
4. Determine the young's modulus of elasticity for a mild steel continuous beam
5. Determine the Rockwell's Hardness number for the specimen
6. Determine the shear modulus of rigidity for helical spring
7. Determine the Compression strength of concrete cube
8. Determine the energy absorption of given specimen by using Izod
9. Determine the energy absorption of given specimen by using charpy
10. Determine the Shear strength of given specimen
11. Verification of Maxwell's Reciprocal theorem for beams
12. Determine the Compression strength of wood (along and across the grains)
13. Bend/Rebend Test on steel specimens
14. Determine the stress strain curve for HYSD bars
15. Determine the strain by use of electrical resistance strain gauge
16. Determine the torsional resistance of a given specimen

List of Augmented Experiments[1]

1. Determination of compressive strength of different wood and brick specimens which are locally available

2. Determination of tensile strength on different grades of steel
3. Determination of hardness of different metals
4. Verify Maxwell's Reciprocal theorem on a straight beam.
5. Impact resistance of aluminum and wood
6. Determine the rigidity modulus of open coil helical spring

Text Book(s)

1. U.C. Jindal, Introduction to Strength of Materials, Golgotha publications, 2010
2. R. Subramanian, Strength of Materials, 2nd Ed. Oxford university press, New Delhi, 2011

23CE308 Surveying Laboratory

0 0 3 1.5

Course Outcomes

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

1. Utilize conventional survey equipment to measure distance and bearings.
2. Utilize theodolite to find horizontal angles, vertical angles, heights and distances using trigonometric levelling.
3. Utilize theodolite to find vertical angle and find distance and elevation using tacheometric surveying.
4. Evaluate differences in elevation, draw profiles & sections further to draw contour plots using levelling instrument.
5. Take part in calculation of area, missing measurements and elevation using Total station
6. Plot the hand-held Global Positioning System global coordinate in google earth software

COs – POs Mapping

COs	PO1	PO4	PO5	PO9	PSO1
1	3	2	3	2	3
2	2	2	3	3	3
3	3	3	3	2	3
4	3	3	3	2	2
5	2	3	3	3	3
6	2	2	3	3	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

List of Experiments

1. Survey of an area by chain survey (Closed traverse) & Plotting.
2. Surveying past obstacles using Chain and Prismatic Compass.
3. Distance between inaccessible points using a compass survey.
4. Surveying of a given area by Prismatic compass (closed traverse) and plotting after adjustment.
5. Horizontal angle measurement between two points using Theodolite.
6. Vertical angle measurement using two points using Theodolite.
7. Trigonometric Levelling-When the base is accessible.
8. Trigonometric Levelling- When the base is inaccessible.
9. Fly leveling (differential leveling).
10. Plotting of the Longitudinal section of a given road.
11. Plotting of Cross-sections of a given road.
12. Distance and elevation computations from tacheometric surveying principles.
13. Determination of the area of the ground using a total station.
14. Determination of remote height using a total station.
15. Determination of the Gradient of the line between two inaccessible points using a total station.
16. Exercise on plotting ground points in Google Earth using Hand Held G.P.S

List of Augmented Experiments[1]

1. Determination of the horizontal distance between two inaccessible points using a theodolite.
2. Plot the contour map of a given area using the Grid method.
3. Plotting of existing road details using Total Station traverse.
4. Draw the layout plan of the existing campus.

Text Book (s)

1. B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, Surveying (Vol–1),18th Ed., Laxmi Publications (P) ltd.,

23ESX01 Employability Skills I

1 0 1 0

Course Outcomes

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

1. Demonstrate oral communication and writing skills as an individual to present ideas coherently
2. Develop life skills with behavioral etiquettes and personal grooming
3. Assess analytical and aptitude skills
4. Develop algorithms for engineering applications.
5. Solve engineering problems using software
6. Utilize simulation tools for testing.

COs –POs Mapping

COs	PO1	PO2	PO5	PO8	PO10	PO12
1					3	2
2				1	2	2
3	2	1		2		
4	2		2			
5	2		2			
6	2		2			

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

1. Communication Skills, Confidence and Quantitative Aptitude

How Communication Skills affect Confidence? How to communicate effectively.(with Examples)

Listening: Listening?, Listening Vs Hearing, Possible reasons for why people do not Listen at times, Active Listening Vs Passive Listening, How Listening can affect our relationships? How Listening helps in Campus Placements also? (with Examples)

Goal Setting: Vision Vs Mission Vs Goals, Why Goal Setting? SMART Technique to Goal Setting, Putting First things First, SWOT Analysis and Time Management

Attitude & Gratitude: Attitude Vs Skills Vs Knowledge, Attitude Vs Behaviour, How to develop Positive Attitude? Developing the attitude of Gratitude.

Public Speaking: JAM, J2M, Presentations by Students on General Topics.

16 Hours

2. Quantitative Aptitude

Number system, L.C.M and H.C.F, Problems on Ages, Averages, Time and work, Pipes and cisterns

16 Hours

Unit II

3. Basics of Python Programming

a. Write a python program to display " HELLO WORLD " .
b. Write a python program to display different data types.
c. Write a python program to add two numbers.
d. Write a python program for checking whether the given number is an even number or not.
e. Write a python program to find the maximum of three numbers.
f. Print the characters in the string "STARSTAR' one by one using for loop.
g. Write a python program that reverses a given string using slicing.
h. Write a python program find the factorial of given number using any loop.
i. Write a python program that prints all prime numbers between 1 and 100 using for loop.
j. Write a program that reverses the digits of a given integer using a while loop.
k. Write a python program to create a list of numbers and get the squares of the numbers.
l. Write a Python program to add an item and create a tuple with different data types
m. Write a python program to demonstrate working such as to access elements, slice, concatenate, repeat, count and find index with tuples in Python.
n. Write a python program to demonstrate working with dictionaries in Python.
o. Write a Python script to sort (ascending and descending) a dictionary by value.
p. Write a python program to that adds two matrices of the same size.

32 Hours
Total: 64 Hours

23CE401 Hydraulics and Hydraulic Machinery

3 0 0 3

Course Outcomes

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

1. Demonstrate the behavior of flow in open channels under various flow conditions.
2. Develop empirical relationships among the physical variables associated with the flow phenomenon in both model and prototype scenarios
3. Determine the hydrodynamic forces exerted by the fluid jet on flat, inclined, and curved vanes.
4. Develop velocity triangles to enhance the understanding of the operations of various turbines and pumps.
5. Design turbines considering diverse hydraulic conditions.
6. Evaluate the performance characteristics of turbines and pumps operating under various conditions.

COs–POs Mapping

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7
1	3	2	1	2	1	1	1
2	3	3	2	3	2	1	1
3	3	3	2	3	2	1	1
4	3	2	3	3	3	1	2
5	3	2	3	3	3	1	2
6	3	2	3	3	3	1	2

3–Strongly linked |2–Moderately linked|1–Weakly linked

Unit I

Open Channel Flow and Critical Flow

Uniform flow: Types of flows-Type of channels– Velocity distribution –Energy and momentum correction factors– Chezy's, Manning's; and Bazin formulae for uniform flow– Most Economical sections. Criticalflow: Specific energy-critical depth–computation of critical depth–critical sub-critical and supercritical flows.

Non-uniform flow: Dynamic equation for G.V.F., Rapidly varied flow, hydraulic jump, energy dissipation. Condition for Max Discharge for a given value of Specific Energy

Minimum Specific Energy in Terms of Critical Depth

12 Hours

Unit II

Hydraulic Similitude and Impact of Jets

Dimensional analysis-Rayleigh's method and Buckingham's pi theorem, study of Hydraulic models – Geometric, kinematic and dynamic similarities-dimensionless numbers – model and prototype relations Impact of jets: Hydrodynamic force of jets on stationary and moving flat, inclined and curved vanes, jet striking centrally and at tip, velocity triangles at inlet and outlet, expressions for work done and efficiency-Angular momentum principle, Applications to radial flow turbines.

Model Testing of Partially Submerged Bodies

12 Hours

Unit III

Hydraulic Turbines

Layout of a typical Hydropower installation – Heads and efficiencies classification of turbines-pelton wheel-Francis turbine-Kaplan turbine-working, working proportions, velocity diagram, work done and efficiency, hydraulic design, draft tube – theory and function efficiency Governing Equations of turbines-surge tanks-unit and specific turbines-unit speed unit quantity-unit power- specific speed performance characteristics-geometric similarity-Cavitation. Outward Radial Flow Reaction Turbines.

The Hydraulic Lift

12 Hours

Unit IV

Centrifugal-Pumps

Pump installation details-classification-work done- Manometric head minimum starting speed-losses and efficiencies-specific speed multistage pumps-pumps in parallel performance of pumps-characteristic curves-NPSH-cavitations., Maximum Suction Lift-Model Testing of Centrifugal Pumps characteristic curves.

The Hydraulic Rams

12 Hours

Total: 48 Hours

Textbook (s)

1. K. Subramanya, Open Channel Flow, 5th Ed., Tata Mc.Grawhill Publishers, New Delhi, 019
2. P.N Modi and S.M Seth, Hydraulics & Fluid Mechanics, 20th Ed., Standard Book House, New Delhi, 2013
3. R.K. Bansal, A Text of Fluid Mechanics and Hydraulic Machines, 9th Ed., Laxmi Publications (P) Ltd., New Delhi, 2015

Reference (s)

1. R.K. Rajput, Fluid Mechanics and Fluid Machines, Revised 9th Ed., S. Chand &Co, 2015
2. V.T. Chow, Open Channel Flow, 7th Ed., McGraw Hill Book Company, 2009
3. S.C Sharma, Fluid Mechanics & Hydraulic Machines, 8th Ed., Khanna Publishers, New Delhi, 2009
4. D.S. Kumar, Fluid Mechanics & Fluid Power Engineering, 8th Ed., Kataria& Sons, 2013

23CE402 Soil Mechanics

3 0 0 3

Course Outcomes

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

1. Explain the significance of geotechnical engineering.
2. Illustrate the physical properties of soil and their importance in geotechnical applications.
3. Utilize appropriate methods to compute the hydraulic conductivity in soils due to seepage.
4. Experiment with laboratory compaction tests and solve for stress distribution under different types of loading.
5. Utilize one-dimensional consolidation tests to determine the characteristics of fine-grained soils under vertical load.
6. Apply laboratory tests to evaluate the shear strength of soils and differentiate between drained and undrained shear strength.

COs-POs Mapping

COs	PO1	PO2	PO3	PO12	PSO1
1	2	2	1	2	1
2	2	2	1	1	3
3	3	3	2	1	2
4	3	3	1	1	2
5	3	2	2	2	2
6	3	3	1	2	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Soil Properties: Soil Structure, Basic definitions; Phase relations

Soil Classification: Index properties; Grain size distribution; Soil aggregate properties. Indian standard soil classification system

Clay Mineralogy: Introduction, Classification of Clay Minerals, Clay Mineral Groups, Crystal Structure of Clay Minerals, Clay Mineral Properties, Thermal Methods, Base Exchange Capacity, Industrial Applications, Origin of Clay, Clay Mineral Equilibrium

Soil Formation - Unified Classification

12 Hours

Unit II

Principle of effective stress and related phenomena: Principle of effective stress; Capillarity; Seepage force and quicksand condition; Total, effective and neutral pressures

Permeability and seepage through soils: One-dimensional flow; Darcy's law; Laboratory methods for permeability determination; Field pumping tests for permeability determination; Permeability as a function of soil type, permanent, void ratio, soil fabric, and effective stress; Two-dimensional flow; Flow nets and their characteristics; Uplift pressure, exit gradient, and piping; Criteria for filters

Coefficient of Permeability by Indirect Tests

12 Hours

Unit III

Compaction & Stress Distribution in Soils

Compaction: Laboratory compaction tests; Factors affecting compaction; Structure and engineering behavior of compacted cohesive soils; Field compaction; Compaction specifications and field control.

Stress distribution in Soils: Two to one method, Boussinesq's theory for point, circular loads and Newmark's chart

Stress Distribution for Rectangular Line and Strip Loads

12 Hours

Unit IV

Compressibility, Consolidation Behavior and Shear Strength

Compressibility and consolidation behavior: Components of total settlement; Effects of soil type, stress history, and effective stress on compressibility; Normally consolidated and over-consolidated soils; Terzaghi's theory of one dimensional consolidation; Time-rate of consolidation; Evaluation of compressibility and consolidation parameters from consolidometer data.

Shear strength: Mohr's stress circle; Mohr Coulomb failure criterion; Laboratory tests for shear strength determination; Effective and total stress shear strength parameters; Shear strength characteristics of clays and sands

3D Consolidation

12 Hours

Total: 48 Hours

Textbooks (s)

1. B.C.Punmia, Soil Mechanics and Foundation Engineering, 17th Ed, Laxmi Publications, 2017.
2. C.V.Ramaiah, A Text Book of Geotechnical Engineering, 3rd Ed, New Age International Publishers, 2006

Reference (s)

1. Gopal Ranjan & ASR Rao, Basic and Applied Soil Mechanics, 3rd Ed., New Age International Pvt. Ltd, 2016.
2. S. K.Gulhati & Manoj Datta, Geotechnical Engineering, 4th Ed, Tata Mc.Graw Hill Publishing Company, New Delhi. 2005.

23CE403 Solid Mechanics II

3 0 0 3

Course Outcomes

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

1. Calculate the principal stresses and strains in materials using analytical and graphical methods.
2. Utilize theories of failure to assess material safety under specified stress conditions.
3. Determine the deflection and stiffness of various types of springs and compute the buckling loads of columns.
4. Compute stresses in thin and thick cylindrical and spherical shells subjected to internal pressure.
5. Examine stresses in structural elements under combined direct loading and bending moments.
6. Assess the resultant stresses and evaluate the stability of dams, retaining walls, and chimneys.

COs – POs Mapping

COs	PO1	PO2	PO3	PO12	PSO2

1	3	2	1	1	2
2	3	2	2	1	3
3	3	3	2	2	3
4	3	3	2	1	2
5	3	3	2	2	2
6	3	3	2	2	3

3– Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Principal Stresses and Strains - Theories of Failures

Principal Stresses and Strains: Introduction – Stresses on an inclined section of a bar under axial loading – compound stresses – Normal and tangential stresses on an inclined plane for bi-axial stresses -bi-axial stresses accompanied by a state of simple shear (Analytical solutions) – Mohr's circle of stresses (graphical solutions)
Theories of Failures: Introduction –Theories of failures like Maximum Principal Stress theory – Maximum Principal Strain theory – Maximum shear stress theory – Maximum strain energy theory – Maximum shear strain energy theory
Strain Rosette, Failure theories using graphical method

12 Hours

Unit II

Springs - Columns and Struts

Springs: Introduction – Types of springs – deflection of close and open coiled helical springs under axial pull and axial couple – springs in series and parallel – Carriage or leaf springs
Columns and Struts: Introduction – Types of columns – Short, medium and long columns – Axially loaded compression members – Crushing load – Euler's theorem for long columns- assumptions- derivation of Euler's critical load formulae for various end conditions – Equivalent length of a column – slenderness ratio – Euler's critical stress – Limitations of Euler's theory – Rankine – Gordon formula – Long columns subjected to eccentric loading – Secant formula, Empirical formulae
Straight line formula, Prof. Perry's formula

12 Hours

Unit III

Thin and Thick Cylinders,

Thin and Thick Cylinders: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in diameter, and volume of thin cylinders – Thin spherical shells. Introduction Lame's theory for thick cylinders – Derivation of Lame's formulae – distribution of hoop and radial stresses across thickness – design of thick cylinders – compound cylinders.
Necessary difference of radii for shrinkage – Thick spherical shells

12 Hours

Unit IV

Direct and Bending Stresses: Introduction - Stresses under the combined action of direct loading and B.M, – determination of stresses in the case of dams, retaining walls and chimneys – conditions for stability – stresses due to direct loading and B.M. about both axis
Unsymmetrical bending

12 Hours
Total: 48 Hours

Textbook (s)

1. R.K.Bansal, Strength of Materials, 4thEd., Laxmi Publications (P) Ltd., 2009
2. R. Subramanian, Strength of Materials, 3rd Ed., Oxford University Press, NewDelhi,2016
3. Ferdinand P Beer, E. Russell, Johnston, Jr, John T dewolf, Mechanics of Materials, 7th Ed., Tata McGraw-Hill Publications,2014

Reference (s)

1. R.K.Rajput, Strength of Materials, 4th Ed., S.Chand& Co, New Delhi,2007
2. U.C. Jindal, Introduction to Strength of Materials, 5th Ed., Galgotia Publications,200
3. Schaum's Outline Series, Strength of Materials, 6th Ed., McGraw-Hill Professional Publications,2013

23CE404 Structural Analysis

3 0 0 3

Course Outcomes

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

1. Apply strain energy and Castigliano's theorem to calculate deflections of statically indeterminate beams.
2. Use analytical methods to determine reactions, shear forces, and bending moments in propped cantilevers under various loading conditions, and sketch the corresponding diagrams.
3. Implement structural analysis techniques to evaluate fixed and continuous beams subjected to different load configurations.
4. Analyze the two hinged and three hinged arches for various load conditions
5. Use the Slope Deflection Method to calculate structural responses of continuous beams.
6. Implement the Moment Distribution Method to analyze continuous beams and frames for various loading scenarios.

COs–POs Mapping

Cos	PO1	PO2	PO3	PO12	PSO2
1	3	3	1	2	2
2	2	3	1	1	2
3	2	3	2	2	3
4	3	3	2	1	3
5	3	3	1	2	3
6	2	3	1	2	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Indeterminate Structural Analysis & Energy theorems

Determination of static indeterminacy, kinematic indeterminacy of beams, frames and trusses. Energy Theorems: Introduction-Strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear forces - Castigliano 's theorem-Deflections of statically indeterminate beams. Analysis of truss using method of joint.

Propped Cantilevers: Analysis of propped cantilevers-simple loading-shear force and bending moment diagrams-Deflection of propped cantilevers.

Static indeterminacy, kinematic indeterminacy of truss

12 Hours

Unit II

Fixed beams and Continuous Beams

Fixed beams: Introduction to statically indeterminate beams with uniformly distributed load, central point load and eccentric point load- shear force and bending moment diagrams - Deflection of fixed beams,

Continuous Beams: Introduction-Clapeyron 's theorem of three moments- Analysis of continuous beams with and without sinking support -shear force and Bending moment diagrams.

Effect of rotation of a support

12 Hours

Unit III

Three Hinged Arches and Two Hinged Arches

Three Hinged Arches: Elastic theory of arches – Determination of horizontal thrust, bending moment, normal thrust and radial shear – effect of temperature.

Two Hinged Arches: Determination of horizontal thrust bending moment, normal thrust and radial shear – Rib shortening.

Eddy's theorem , Temperature Stresses

12 Hours

Unit IV

Slope Deflection Method: Derivation of slope deflection equation of supports application to continuous beams including settlement of supports.

Moment Distribution Method: Stiffness and carry over factors – Distribution factors – Analysis of continuous beams with and without sinking of supports – storey portal frames – including Sway.

Slope Deflection method for frames, Moment Distribution method for frame without sway

12 Hours

Total: 48 Hours

Textbook (s)

1. V.N. Vazirani, M.M Ratwani and S.K. Duggal, _Analysis of Structures-Vol I', 17th Ed.,, Khanna Publishers, New Delhi,2015
2. V.N. Vazirani, M.M Ratwani and S.K. Duggal, _Analysis of Structures-Vol II', 16th Ed., Khanna Publishers, New Delhi,2015
3. S.S. Bhavikatti, Structural Analysis II, 5th Ed.,Vikas Publishing House Pvt Ltd, 2013

Reference (s)

1. S.B.Junnarkar, Mechanics of Structures Vol.I, 31st Ed., Charotar Publishing House, 2015.
2. S.B.Junnarkar, Mechanics of Structures Vol.II, 24th Ed., Charotar Publishing House, 2015
3. T.S. Thandavamoorthy, Analysis of Structures, 1st Ed., Oxford University Press, New Delhi, 2011.
4. B.C. Punmia, Strength of Materials and Mechanics of Solids,5th Ed., Vol-2Laxmi Publications, New Delhi, 2010
5. C.S. Reddy, Structural Analysis, 11th Ed.,Tata McGhill Publications, New Delhi, 2013

23CE405 Transportation Engineering

3 0 2 4

Course Outcomes

At the end of the course**,** students will be able to

1. Explain the necessity of highway planning, road classifications, and alignment factors to develop efficient road networks.
2. Apply geometric design principles, including sight distances, super elevation, and vertical alignment, to enhance road safety and functionality.
3. Analyze the influence of highway alignment and geometric elements on road performance to optimize design efficiency.
4. Analyze the relationship between traffic characteristics, conduct traffic studies, and interpret accident data to enhance road safety and traffic management.
5. Apply traffic control measures such as traffic signals, signs, and road markings to improve traffic flow and minimize conflicts at intersections.
6. Evaluate different intersection types, including at-grade and grade-separated intersections, and apply design principles for effective intersection management.

COs-POs Mapping

COs	PO1	PO2	PO3	PO12	PSO2
1	3	2	1	1	2
2	3	3	2	1	3
3	3	2	3	2	3
4	2	2	3	2	3
5	2	3	3	2	3
6	2	2	3	1	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Highway Development and Planning

Highway Development in India – Necessity for Highway Planning – Different Road Development Plans; Classification of Roads-Road Network Patterns–Highway Alignment-Factors affecting Alignment-Drawing Reports- Highway Project.

Practical Components:

1. Aggregate Crushing Value,
2. Deval's Attrition,
3. Aggregate Impact Test,
4. Los Angeles Abrasion,
5. Aggregate shape tests,

6. Specific gravity and water absorption test.

12+ 8 Hours

Unit II

Highway Geometric Design

Importance of Geometric Design- Design controls and Criteria- Highway Cross Section Elements- Sight Distance Elements: Stopping sight Distance- Overtaking Sight Distance and Intermediate Sight Distance - Design of Horizontal Alignment: Super Elevation-Extra widening -Design of Transition Curves; Design of Vertical Alignment: Gradients-vertical curves, Curve Resistance.

Practical Components:

1. Gradation of aggregates for bituminous concrete and dense bituminous macadam.
2. Ductility Test
3. Flash and Fire Point
4. Softening Point
5. Penetration Test

12+ 8 Hours

Unit III

Traffic Engineering

Relation between basic traffic characteristics, Traffic Volume and Speed Studies-Data Collection and Presentation, Origin and Destination study, Parking studies - On street& off street, Road Accidents – Causes and Preventive Measures – Accident Data Recording – Condition and Collision Diagram, Traffic Signs – Types and specifications, Road Markings, Design of Traffic Signals-Webster Method.

Practical Components:

1. Parking Studies
2. Spot Speed Studies
3. Traffic Volume Studies.

12 + 8 Hours

Unit IV

Intersection Design

Types of Intersection- At grade and grade separated-Conflicts at Intersection–Requirements of at grade intersections– Channelized and non-Channelized Intersection, Traffic Islands-Need of Roundabout – Design Factors of Rotary.

Practical Components:

1. Merlin Cycle
2. Visual distress survey
3. Pavement condition rating.

12+8 Hours

Total: 48+32 Hours

Textbooks (s)

1. Highway Engineering – S. K. Khanna, C.E.G. Justo & A. Veeraragavan, Nem Chand & Sons, 10th Ed, 2018.
2. Transportation Engineering – L. R. Kadiyali, Khanna Book Publishing Co. (P) LTD, 3rd Ed, 2016.

Reference (s)

1. Principles of Transportation Engineering– Partha Chakraborty, Animesh Das, PHI Learning, 2nd Ed, 2017.
2. Transportation Engineering –C. Jotin Khisty, B. Kent Lall, Pearson Education, 3rd Edition, 2007.

23CE406 Fluid Mechanics and Hydraulic Machinery Laboratory

0 0 3 1.5

Course Outcomes

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

1. Determine the coefficient of discharge for different flow conditions
2. Demonstrate the calibration of different flow meters
3. Develop the energy equation for various pipe flow problems
4. Apply Bernoulli's equation and Momentum equation for real fluid flow problems
5. Analyse the formation of hydraulic jumps and impact of jet on vanes.
6. Analyze a variety of practical fluid flow devices and utilize fluid mechanics principles in design

COs–POs Mapping

COs	PO1	PO2	PO5	P09	PSO2
1	3	2	3	3	2
2	3	2	3	3	2
3	3	3	3	3	2
4	3	2	3	3	2
5	3	2	3	3	2
6	3	2	3	3	3

3–Strongly linked |2–Moderately linked|1–Weaklylinked

List of Experiments

1. Calibration of Venturi meter
2. Calibration of Orifice meter
3. Calibration of Rotameter
4. Determination of Coefficient of discharge for a small orifice by a constant head method.
5. Determination of Coefficient of discharge for an external mouth piece by variable head method.
6. Calibration of contracted Rectangular Notch and/or Triangular Notch.
7. Determination of Coefficient of loss of head in a sudden contraction and friction factor.
8. Determination of Coefficient of loss of head in a sudden contraction and friction factor for non-Circular pipe.
9. Verification of Bernoulli's equation.
10. Verification of Reynold's Experiment.
11. Impact of Jet on Vanes
12. Study of Hydraulic jump.
13. Performance test on Pelton wheel turbine
14. Performance test on Francis turbine.
15. Performance test on Kaplan turbine.
16. Efficiency test on Centrifugal Pump.

List of Augmented Experiments[1]

1. Determination of co-efficient of discharge for venture flume
2. Determination of minor losses
3. Determination of Coefficient of discharge for an external mouthpiece by variable head method
4. Determination of hydraulic coefficients of orifice
5. Performance test on Pelton Wheel Turbine
6. Performance test on Single Stage Centrifugal Pump
7. Determination of coefficient of loss of head due to pipe fittings
8. Determination of Coefficient of loss of head in a sudden contraction

Text Book (s)

1. D.S.Kumar, Fluid Mechanics & Fluid Power Engineering ,9th Ed .,Kataria & Sons, Publisher. 2 0 1 8
2. Bangaand Sharma, Hydraulic Machines,8th Ed., Khanna Publishers, NewDelhi,2003

Reading Material(s)

1. Fluid Mechanics & Hydraulic Machinery Lab Manual–Civil Engineering-GMR Institute of Technology Rajam

23CE407 Soil Mechanics Laboratory

0 0 3 1.5

Course Outcomes

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

1. Explain the basic properties of soil, such as moisture content and specific gravity.
2. Explain the process of field investigations, including soil sample collection and observation of soil properties.
3. Apply laboratory tests to classify soil based on standard geotechnical engineering practices.
4. Experiment with permeability tests using constant head and falling head methods to evaluate soil permeability.
5. Construct compaction curves and determine the California Bearing Ratio (CBR) of soil samples through laboratory testing.
6. Utilize soil test results to assess and interpret the engineering properties of soil samples for practical applications.

COs – POs Mapping

COs	PO1	PO4	PO5	PO10	PSO1
1	3	2	2	2	3
2	3	3	1	2	2
3	3	3	1	2	3
4	3	3	2	2	2
5	3	3	2	2	3
6	3	3	1	2	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

List of Experiments

1. Determination of water content of the soil.
2. Determination of Specific Gravity of the coarse garined soil.
3. Determination of Specific Gravity of the clayey soil.
4. Determination of Field density using Core cutter method.
5. Determination of Field density using Sand replacement method.
6. Determination of Particle Size Distribution through mechanical analysis.
7. Determination of Liquid limit of the soil.
8. Determination of Plastic limit of the soil.
9. Determination of Optimum Moisture Content and Maximum Dry Density for given soil with Proctor Compaction Test.
10. Determination of Coefficient of Permeability of soil using Constant head method.
11. Determination of Coefficient of Permeability of soil using Variable head method.
12. Determination of strength parameters of given soil using Unconfined Compression strength (UCS) test.
13. Determination of strength parameter of given cohesion-less soil by performing Direct Shear Test.
14. Determination of strength parameter of given C-ϕ soil by performing Direct Shear Test.
15. Determination of C.B.R Value of given soil using Laboratory CBR Test.
16. Determination of Free swell index for soil.

List of Augmented Experiments

1. Prepare a remoulded cohesive soil sample with given field conditions (bulk density is 2.0g/cc; water content is 20%) collected at a depth of 10m and determine the strength properties.
2. Determine the OMC and MDD for given soil and draw the Zero air void line and 95% air void line.
3. Prepare a remoulded sample with given field conditions for a cohesionless soils (bulk density is1.95g/cc; water content is 16%) and determine the strength properties.
4. Prepare a remoulded cohesive soil sample with given field conditions (bulk density is 2.0g/cc; water content is 18%) collected at a depth of 1.0m and determine the strength properties.
5. Classify the given fine grained soils by using suitable tests.
6. Find out the field density and dry density of the given soil using suitable test and classify the soil.

Textbook (s)

1. Gopal Ranjan and ASR Rao, Basic and Applied Soil Mechanics, 3rd Ed., New Age International Pvt. Ltd, 2016.
2. C.V.Ramaiah, A Text Book of Geotechnical Engineering, 3rd Ed., New Age International Publishers, 2006
3. B.C.Punmia, Soil Mechanics and Foundation Engineering, 16th Ed., Laxmi Publications, 2005
4. S.K.Gulhati&ManojDatta, Geotechnical Engineering, 4th Ed., Tata McGraw Hill Publishing Company, New Delhi, 2005

Reading Material (s)

1. Soil Mechanics Lab Manual-Civil Engineering- GMR Institute of Technology, Rajam

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[1]Students shall opt any one of the Augmented Experiments in addition to the regular experiments

23ESX01 Employability Skills I

1 0 1 2

Course Outcomes

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

1. Demonstrate oral communication and writing skills as an individual to present ideas coherently
2. Develop life skills with behavioral etiquettes and personal grooming
3. Assess analytical and aptitude skills
4. Develop algorithms for engineering applications.
5. Solve engineering problems using software
6. Utilize simulation tools for testing.

COs –POs Mapping

COs	PO1	PO2	PO5	PO8	PO10	PO12
1					3	2
2				1	2	2
3	2	1		2		
4	2		2			
5	2		2			
6	2		2			

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

1. Building Confidence

Fear? Steps to Overcoming the Fear of Public Speaking?

Self Esteem: Definition? Types of Self Esteem, Causes of Low Self Esteem, Merits of Positive Self Esteem and Steps to build a positive Self Esteem.

Group Discussions (Practice): GD? GD Vs Debate, Overview of a GD , Skills assessed in a GD, Dos & Don'ts, & Conducting practice sessions (Simple Topics).

Motivational Talk: Team Work: Team Vs Group? Stages in Team Building, Mistakes to avoid and Lessons to Learn (Through Stories or Can be a Case Specific)

16 Hours

2. Quantitative Aptitude

Percentages, Profit and loss, Mixtures and Allegations, Simple Interest, Compound Interest

16 Hours

Unit II

3. Revit Architecture

a. Basic Drawing and editing tools
b. Setting Up Levels And Grids
c. Modeling Walls in 2D and 3D
d. Working With Doors & Windows in 2D and 3D
e. Modeling floors
f. Modeling Ceiling and Roofs
g. Modeling Stairs
h. Modeling Ramp and Railing

i. Modeling Curtain System
j. Adding Components
k. Working with Quantity
l. Working with Schedules

32Hours
Total: 64 Hours