SYLLABUS

(With effect from 2023 -24)

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕ ವರ್ಷ 2023-24)

Bachelor Degree
In
Civil Engineering

V & VI Semester

Out Come Based Education
With
Choice Based Credit System

[National Education Policy Scheme]

P.E.S. College of Engineering, Mandya - 571 401, Karnataka

[An Autonomous Institution affiliated to VTU, Belagavi,
Grant – in – Aid Institution (Government of Karnataka),
Accredited by NBA (All UG Programs), NAAC and Approved by AICTE, New Delhi]

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ
ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ
(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

Ph : 08232- 220043, Fax : 08232 – 222075,Web : www.pescemandya.org

PES College of Engineering

VISION

PESCE shall be a leading institution imparting quality engineering and management education, developing creative and socially responsible professionals

MISSION

- Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching -learning practices
- Impart engineering and managerial skills through competent and committed faculty using Outcome Based Educational curriculum
- Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs
- Promote research, product development and industry-institution interaction.

QUALITY POLICY

Highly committed in providing quality, concurrent technical education and continuously striving to meet expectations of stake holders.

CORE VALUES

***P**rofessionalism*
***E**mpathy*
***S**ynergy*
***C**ommitment*
***E**thics*

DEPARTMENT OF CIVIL ENGINEERING
(Accredited by National Board of Accreditation)

VISION
To attain Excellence in imparting quality civil engineering education to meet the societal needs.

MISSION
1. Impart civil engineering and managerial skills with state of art infrastructure, competent and committed faculty using outcome based educational curriculum.
2. Promote research, project management and consultancy.
3. Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet• the societal needs.

Programme Education Objectives (PEOs)
Graduates will be able to
1. Apply technical competence in the field of Civil Engineering with a strong background in basic science and mathematics.
2. Analyse and interpret data to design or evaluate civil engineering systems to satisfy societal needs with the use of modern tools including higher education.
3. Function effectively as an individual and or to work in a team on multispecialized Civil Engineering projects with professional ethics and effective communication skills inculcating the habit of life-long learning.

Programme Specific Outcomes (PSOs)

The Program Specific Outcomes have been derived from the PSC's defined by ASCE. By the time of graduation, Civil Engineering students will be able to:

PSO1: Apply knowledge of basic science to analyze and solve problems in the core area of Civil Engineering such as Structural, Geotechnical, Transportation, Environmental, Hydraulics and Water resources engineering.

PSO2: Analyze, Plan, design, quality assessment and cost estimate of Civil Engineering structures with professional ethics.

PSO3: Work in a consulting organization or can be an entrepreneur to investigate and supervise Civil Engineering structures using modern tools and technology to provide sustainable solutions to meet the societal needs.

Bachelor of Engineering (V –Semester)											
Sl. No.	Course Code	Course Title	Teaching Department	Hrs / Week				Credits	Examination Marks		
				L	T*	P	PJ		CIE	SEE	Total
1	P21CV501	Construction Management and Entrepreneurship	Civil	3	-	-	-	3	50	50	100
2	P21CV502	Design of RC Structural Elements	Civil	3	-	-	-	3	50	50	100
3	P21CV503X	Professional Elective -I	Civil	3	-	-	-	3	50	50	100
4	P21CV504	Transportation Engineering (Integrated)	Civil	3	-	2	-	4	50	50	100
5	P21CVO505X	Open Elective- I	Civil	3	-	-	-	3	50	50	100
6	P21CVL506	Skill Lab	Civil	-	-	2	-	1	50	50	100
7	P21INT507	Internship – II / Extensive surveying	Civil	-	-	-	-	2	-	100	100
8	P21HSMC508	Employability Enhancement Skills – V	HSMC	1	-	-	-	1	50	50	100
9.	P21UHV509	Social Connect and Responsibility	Civil	1	-	-	-	1	100	-	100
	Total							**21**			

List of Electives

Professional Elective -I

Sl. No.	Course Code	Course Title
1	P21CV5031	Matrix Method of Structural Analysis
2	P21CV5032	Railway, Airport and Harbour Engineering
3	P21CV5033	Alternative Building Materials and Masonry Structures
4	P21CV5034	Solid Waste Management

Open Elective- I

Sl. No.	Course Code	Course Title
1	P21CVO5051	Building Science and Engineering
2	P21CVO5052	Basic Transportation Engineering
3	P21CVO5053	Geo-Environmental Engineering
4	P21CVO5054	Application of Remote Sensing and GIS in Water Resource Engineering

Bachelor of Engineering (VI –Semester)											
Sl. No.	Course Code	Course Title	Teaching Department	Hrs / Week				Credits	Examination Marks		
				L	T*	P	Pr		CIE	SEE	Total
1	P21CV601	Design of Steel Structure	Civil	3	-	-	-	3	50	50	100
2	P21CV602X	Professional Elective -II	Civil	3	-	-	-	3	50	50	100
3	P21CV603X	Professional Elective -III	Civil	3	-	-	-	3	50	50	100
4	P21CV604	Geo-Technical Engineering (Integrated)	Civil	3	-	2	-	4	50	50	100
5	P21CVO605X	Open Elective – II	Civil	3	-	-	-	3	50	50	100
6	P21CVL606	CAD Laboratory II	Civil	-	-	2	-	1	50	50	100
7	P21CVMP607	Mini – Project	Civil	-	-	2	2	2	50	50	100
8	P21HSMC608	Employability Enhancement Skills - VI	HSMC	1	-	-	-	1	50	50	100
9.	P21UHV609	Universal Human Values and Professional Ethics	Civil	1	-	-	-	1	50	50	100
	Total							**21**			

List of Electives

Professional Elective -II			Professional Elective -III			Open Elective – II		
Sl. No.	Course Code	Course Title	Sl. No.	Course Code	Course Title	Sl. No.	Course Code	Course Title
1	P21CV6021	Advance Design of RC structures	1	P21CV6031	Earthquake Resistant Design of structures	1	P21CVO6051	Building Services
2	P21CV6022	Pavement Materials and Construction	2	P21CV6032	Pavement analysis and Design	2	P21CVO6052	Highway Traffic and Safety Measures
3	P21CV6023	Reinforced Earth Structures	3	P21CV6033	Ground Improvement Techniques	3	P21CVO6053	Sustainability Concepts in Engineering
4	P21CV6024	Design of Hydraulic Structures and Ground Water Hydrology	4	P21CV6034	Occupational Health and Safety	4	P21CVO6054	Municipal Waste Management

CONSTRUCTION MANAGEMENT & ENTREPRENEURSHIP

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21CV501**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand the concept of engineering economics and to study the different comparison methods.
- To understand the concept of construction management and understand the different managements.
- To evaluate various construction equipment.
- Understand and apply the concept of planning, scheduling and the techniques necessary for construction project.
- To evaluate the basic ideas about entrepreneurship and develop skill to work individually as an entrepreneur.

UNIT – I	**Engineering Economics**	**8 Hours**

Demand and supply, break-even analysis, Time value of money, cash flow diagrams, interest rate, simple interest, compound interest, interest formulae, compound interest factors, Equated monthly installment (EMI),Present worth comparisons method, future worth comparison method, annual worth comparison method, Introduction to depreciation causes of depreciation, basic methods of depreciation, Problems on above.

Self-study component:	Concept of rate of return (ROR)

UNIT – II	**Management of Construction**	**8 Hours**

Introduction, classification of construction works, various stages in the construction of a project, the construction team. Definition of an organization management, value engineering and job plan.

Materials Management: Importance, objective, cost, functions and uses of material management.

Safety Management: Importance of safety causes of accidents, safety measures.

Quality Management: Quality control in construction, importance and elements of quality, quality control, quality assurance techniques and documentation.

Self-study component:	Management information system.

UNIT – III	**Management of Construction Equipment**	**8 Hours**

Introduction, need for mechanization, factors affecting selection of construction equipment, factors affecting the cost of owning and operating the construction equipment, planning of infrastructure for mechanization.

Classification of Construction Equipment: Earth moving, hauling, hoisting, conveying, aggregate and concrete production equipment. Problems on cost of owning and operating the construction equipment.

Self-study component:	Pumping and dewatering Equipment

UNIT – IV	Planning for Construction Project	8 Hours

Steps involved in planning, objectives, principles and advantages of planning. Bar charts, milestone charts, job layout, work break down structure.

Program Evaluation and Review Technique (PERT): Introduction to time estimates, earliest expected time (T_E), latest allowable occurrence time (T_L), slack, critical path, and crash time estimate.

Critical Path Method (CPM): Earliest event time, latest event time, combined tabular form, activity time, float and critical activity.

Self-study component:	Line of balance technique

UNIT – V	Entrepreneur and Entrepreneurship	8 Hours

Concept of entrepreneur, characteristics of an entrepreneur, distinguishes between entrepreneur and manager. Functions of entrepreneur, types of entrepreneur.

Institutional finance: KIADB, KSSIDC, DIC, KSFC

Preparation of project report: Meaning of project, project identification, project selection, project report, need and significance of project, guidelines by planning commission for project report.

Self-study component:	SIDO, NSIC

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	***Apply*** the knowledge of engineering fundamentals to calculate present and future worth of money using different interest factors and comparisons. **(PO1, PO2, PSO1, PSO2)**	Applying	L3
CO2	***Summarize*** the concept of construction management. **(PO2, PO4, PSO2)**	Understanding	L2
CO3	***Summarize*** and ***apply*** the concept of project planning and computing CPM and PERT. **(PO3, PSO2)**	Applying	L2,L3
CO4	***Evaluate*** various construction equipments and develop skill to work individually as an entrepreneur. **(PO9, PO11, PSO3)**	Evaluating	L5

Text Book:

1. Construction Engineering and Management by S. Seetharaman, Umesh publications, New Delhi
2. Construction Equipment and its Management- Sharma, S.C.:Khanna Publishers.
3. Engineering Economics by R.K.Hegde, Swapana book house, Banglore
4. Management & Entrepreneurship by K Venkataramana, Seven Hill publications, Banglore.

Reference Book:

1. Construction Planning Equipment's and Methods by Peurifoy,R.L. Mc,Graw Hill publication
2. Entrepreneurship Development by S.S. Khanka, Published by S. Chand & Co. Ltd. New Delhi.
3. Management Science for Civil Engineering by Gururaj, SreehariSatish, Subhash publications, Bangalore.

Web and Video link:

1. Construction Economics & Finance: https://nptel.ac.in/courses/105103023
2. Construction Planning and Management: https://nptel.ac.in/courses/105103093
3. Construction methods and equipment management: https://archive.nptel.ac.in/courses/105/103/105103206/
4. Principles of Construction Management: https://archive.nptel.ac.in/courses/105/104/105104161/
5. Entrepreneurship Essentials: https://nptel.ac.in/courses/127105007

E-Books/Resources:

1. https://www.taylorfrancis.com/books/edit/10.4324/9780203926895/modern-construction-economics-gerard-de-valence
2. https://www.tandfonline.com/doi/full/10.1057/palgrave.jors.2602297
3. https://www.researchgate.net/publication/324274296_Journal_of_Project_Management_2018_-_Journal_of_Project_Management_Using_fuzzy_logic_to_improve_the_project_time_and_cost_estimation_based_on_Project_Evaluation_and_Review_Technique_PERT.

COURSE ARTICULATION MATRIX
(CONSTRUCTION MANAGEMENT & ENTREPRENEURSHIP - P21CV501)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2	1	
CO2		2		2										1	
CO3			2											2	
CO4									2		2				2

3-HIGH, 2-MEDIUM, 1-LOW

DESIGN OF RC STRUCTURAL ELEMENTS [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	**P21CV502**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- To provide basic knowledge of mathematics, science and engineering in the areas of limit state of collapse and serviceability of R C elements.
- To imbibe the culture of professional and ethical responsibilities by following codal provisions in the analysis, design and detailing of R C elements for strength and durability.
- Enable the students to identify, formulate and solve engineering problems of R C elements subjected to flexure, shear and torsion.
- To give procedural knowledge to design a system, component or process as per needs and specifications of R C elements such as beams, slabs, columns and footings subjected to various load combinations with different boundary conditions.
- To show the impact of engineering solutions on the society and also will be aware of contemporary issues regarding failure of structures due to wrong design, use of poor quality of materials and faulty construction methods.

UNIT – I	**Introduction to Limit State Design**	**8 Hours**

Philosophy and principle of limit state design along with the assumptions, Partial safety factors Characteristic Load and Strength. Introduction to stress block parameters, Concept of balanced, under and over reinforced sections. Limit state of collapse in flexure of rectangular sections and flanged sections with examples.

Self-study component:	Philosophy of ultimate load method and working stress method.

UNIT – II	**Limit State of Collapse and Serviceability**	**8 Hours**

Importance of bond, anchorage, lap length. Limit state of collapse in Shear and torsion with examples. Deflection and cracking using IS codal provisions.

Self-study component:	Side face reinforcement, slender limits of beams for stability.

UNIT – III	**Limit State Design of Beams**	**8 Hours**

Design of Singly Reinforced, Doubly Reinforced, Flanged Beams, and Continuous beams.

Self-study component:	Load transfer mechanism in RC Structure.

UNIT – IV	**Limit State Design of Slabs and Stairs**	**8 Hours**

Introduction to slabs-Design of one way and two way slabs with different end conditions. Introduction to stairs-Design of dog legged and folded plate stairs.

Self-study component:	Design concept of open well stairs

UNIT – V	Limit State Design of Columns and Footings	8 Hours

Introduction to columns-Design of short axially loaded RC columns, with uni-axial and bi-axial moments. Footings with axial load and moment – Square and Rectangular types.

Self-study component:	Design of pedestals in footing, introduction to combined footing

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Apply** the knowledge of engineering fundamentals and understand different method of design and terms terminology in design methods.(PO1,PSO1)	**Apply**	**L3**
CO2	Identify**,** Analyze and **Design** using limit state methods for beam elements using relevant codes. (PO2, PO3, PO4, PO6, PO7, PO8, PO9, PO12, PSO2, PSO3)	**Design**	**L6**
CO3	Identify**,** Analyze and **Design** using limit state methods for Slab and stair elements using relevant codes. (PO2, PO3, PO4, PO6, PO7, PO8, PO9, PO12, PSO2, PSO3)	**Design**	**L6**
CO4	Identify, Analyze and **Design** using limit state methods for column and Footing elements using relevant codes. (PO2, PO3, PO4, PO6, PO7, PO8, PO9, PO12, PSO2, PSO3)	**Design**	**L6**

Text Book:

1. SINHA S. N., Reinforced Concrete Design, Tata McGraw Hill Publications.
2. Unnikrishna Pillai and Devdas Menon, Reinforced Concrete Design, TMH, 3rd Edition 2009

Reference Book:

1. Park and Paulay, Reinforced Concrete, John Wiley and Sons
2. Punmia B C, Jain A K and Jain A K, Reinforced Concrete Design, Lakshmi Publications, New Delhi.
3. Jain A K, Limit State Method of Design, Nem Chand and Brothers, Roorkee.
4. Karve S R and Shah V L, Limit State Theory And Design Of Reinforced Concrete – Vidyarthi Prakashan, Pune.
5. N Subramannaya, Design of RC Structures, Oxford IBH

Web and Video link:

1. Different Methods of Design of Reinforced Concrete Structures: https://www.youtube.com/watch?v=ba3mZhOpsTM&list=PL51300B0778FB5784&index=3 –
2. Limit state of collapse in flexure: https://www.youtube.com/watch?v=zVKf6hZfrhA&list=PL51300B0778FB5784&index=6
3. Limit State of Collapse Flexure – II: https://www.youtube.com/watch?v=DjT5G6Klf1M&list=PL51300B0778FB5784&index=8
4. Limit state of collapse in shear:

https://www.youtube.com/watch?v=iT2pjfYbyZg&list=PL51300B0778FB5784&index=11

5. Limit state of collapse in shear: https://www.youtube.com/watch?v=AfHmpWlcqq4&list=PL51300B0778FB5784&index=12
6. Limit state of collapse in torsion: https://www.youtube.com/watch?v=AyRgeA65oI0&list=PL51300B0778FB5784&index=27
7. Design of slab: https://www.youtube.com/watch?v=PDJPcQq3PZE&list=PL51300B0778FB5784&index=14
8. Design of column: https://www.youtube.com/watch?v=wJWt0dcgafs&list=PL51300B0778FB5784&index=19
9. Design of footing: https://www.youtube.com/watch?v=8ATp13mOhvg&list=PL51300B0778FB5784&index=24
10. Design of stair case: https://www.youtube.com/watch?v=hxakW1miEcM&list=PL51300B0778FB5784&index=26 _

E-Books/Resources:

1. https://www.researchgate.net/publication/343649833_DESIGN_OF_REINFORCED_CONCRETE_STRUCTURES
2. https://www.journals.elsevier.com/engineering-structures/most-downloaded-articles
3. https://www.taylorfrancis.com/books/mono/10.1201/9781003208037/design-structural-elements-chanakya-arya

COURSE ARTICULATION MATRIX
(DESIGN OF RC STRUCTURAL ELEMENTS – P21CV502)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2		3	3	2		2	2	3	2			3		3	3
CO3		3	3	2		2	2	3	2			3		3	3
CO4		3	3	2		2	2	3	2			3		3	3

3-HIGH, 2-MEDIUM, 1-LOW

MATRIX METHODS OF STRUCTURAL ANALYSIS

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21CV5031**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Apply knowledge of mathematics and engineering in matrix algebra to solve the problems of structural analysis.
- Apply knowledge of mathematics and engineering in stiffness and flexibility approaches of matrix methods for structural analysis.
- Apply knowledge of mathematics and engineering in flexibility and stiffness methods (element approach) to truss, beam and plane frame problems to evaluate the internal forces and displacement of members.
- Apply knowledge of mathematics and engineering to apply matrix methods for advanced structural analysis and computer applications.

UNIT – I	**Energy Concepts**	**8 Hours**

Structural systems, Geometrical and material nonlinearities. Static and Kinematic indeterminacy. Concepts of stiffness and flexibility. Flexibility and stiffness matrices of truss and beam elements. Energy concepts- Principle of minimum potential energy and minimum complementary energy. (number of indeterminacy ≤ 3)

Self-Study Component:	Maxwell Betti's theorem of reciprocal displacement.

UNIT – II	**Element Flexibility Method**	**8 Hours**

Transformation of system forces to element forces in flexibility method. Assembly of structure flexibility matrix in element flexibility method, Flexibility method applied to trusses, continuous beams.(number of indeterminacy ≤ 3)

Self-Study Component:	Analysis of continuous beam subjected to support settlement.

UNIT – III	**Element Stiffness Method**	**8 Hours**

Transformation from system forces to element forces in stiffness method, Assembly of structure stiffness matrix in element stiffness method. Stiffness method applied to trusses, continuous beams and rigid frames. (number of indeterminacy ≤ 3)

Self-Study Component:	Analysis of continuous beam subjected to support settlement.

UNIT – IV	**Direct Stiffness Method-Trusses and Beams**	**8 Hours**

Local and Global coordinate systems, Stiffness matrices of truss and beam elements in global coordinates, Analysis of trusses and beams by Direct Stiffness method.(number of indeterminacy ≤ 3)

Self-Study Component:	Analysis of continuous beam subjected to support settlement

UNIT – V	**Direct Stiffness Method-Frames and Storage Techniques**	**8 Hours**

Analysis of frames by Direct Stiffness method, (number of indeterminacy ≤ 3). Half band, skyline storage, Equation solvers, Frontal solvers, Band width consideration, Uses of commercial packages.

Self-Study Component:	Algorithms and flowcharts, Solution of equations.

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Define** structural systems and application of the concepts of flexibility and stiffness matrices.**(PO1, PO2, PSO1)**	Remembering	L1
CO2	**Adapt** flexibility matrices to solve problems in trusses, beams and rigid frames. **(PO1, PO2, PSO2)**	Creating	L6
CO3	**Adapt** stiffness matrices to solve problems in trusses, beams, rigid frames.**(PO1, PO2, PSO2)**	Creating	L6
CO4	**Explain** various storage schemes and standard commercial packages.**(PO1, PO5, PSO3)**	Understanding	L2

Text Book:

1. Matrix Analysis of Framed Structures, W.Weaver and J.H.Gere., Van Nastran, 1980.
2. Rajasekaran S, "Computational Structural Mechanics", PHI, New Delhi.

Reference Book:

1. Pundit and Gupta, "Theory of Structures", Vol. II, TMH Publications, New Delhi.
2. Fundamentals of Structural Mechanics, M.L. Gambhir., PHI, New Delhi.
3. A K Jain, "Advanced Structural Analysis", Nemchand Publications, Roorkee.
4. CS Reddy, 'Basic Structural Analysis, "TMH Publications, New Delhi.

Web and Video link:

1. Review of Structural Analysis: https://archive.nptel.ac.in/courses/105/105/105105180/
2. Matrix Method of Structural Analysis: https://www.youtube.com/watch?v=Wa9ZSWlrpnk
3. Displacement Method for beams: https://engineering.purdue.edu/~aprakas/CE474.html.
4. Matrix method of analysis trusses: http://www.nitttrc.edu.in/nptel/courses/video/105105180/L18.html.
5. Introduction to matrix method: https://www.digimat.in/nptel/courses/video/105105180/L01.html.

E-Books/Resources:

1. https://www.elsevier.com/books/matrix-methods-of-structural-analysis/livesley/978-0-08-018888-1
2. https://www.taylorfrancis.com/books/mono/10.1201/9781351210324/matrix-methods-structural-analysis-praveen-nagarajan.
3. https://www.researchgate.net/publication/328123122_Matrix_Methods_of_Structural_Analysis.
4. https://www.taylorfrancis.com/books/mono/10.1201/9781003291305/analysis-structures-matrix-methods-fathi-al-shawi.

COURSE ARTICULATION MATRIX (MATRIX METHODS OF STRUCTURAL ANALYSIS- P21CV5031)															
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1											3		
CO2	3	3												3	
CO3	3	3												3	
CO4	2				2										1
3-HIGH, 2-MEDIUM, 1-LOW															

RAILWAYS, AIRPORTS & HARBOUR ENGINEERING [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	**P21CV5032**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand the history and development, role of railways, railway planning and development based on essential criteria.
- Learn different types of structural components, engineering properties of the materials, to calculate the material quantities required for construction.
- Understand various aspects of geometrical elements, points and crossings, significance of maintenance of tracks.
- Design and plan airport layout, design facilities required for runway, taxiway and impart knowledge about visual aids.

UNIT – I	**Railway Planning**	**8 Hours**

Significance of Road, Rail, Air and Water transports – Coordination of all modes to achieve sustainability

Elements of permanent way: Rails, Sleepers, Ballast, rail fixtures and fastenings, – Track Stress, coning of wheels, creep in rails, defects in rails.

Geometric design of railways: gradient, super elevation, widening of gauge on curves.

Points and Crossings (Explanation & Sketches of Right- and Left-hand turnouts only).

Self-study component:	Route alignment surveys, conventional and modern methods- – Soil suitability analysis

UNIT – II	**Railway Construction and Maintenance**	**8 Hours**

Earthwork – Stabilization of track on poor soil, Calculation of Materials required for track laying – Construction and maintenance of track – Railway stations and yards and passenger amenities- Urban rail – Infrastructure for Metro, Mono and underground railways

Self-study component:	Modern methods of construction, Signaling, Kavach (Indian Railway Safety System) & maintenance

UNIT – III	**Harbour Engineering**	**8 Hours**

Definition of Basic Terms: Planning and Design of Harbours: Requirements, Classification.

Principles – Harbour Layout and Terminal Facilities, Coastal Structures, Inland Water Transport – Wave action on Coastal Structures and Coastal Protection Works.

Self-study component:	Location and Design, Coastal Protection Works

UNIT – IV	**Air Transport**	**8 Hours**

Air transport characteristics, airport classification, and airport planning: objectives, components, layout characteristics, criteria for airport site selection and ICAO stipulations, typical airport layouts,

Parking and circulation area.			
Self-study component:	Socio-economic characteristics of the catchment area		
UNIT – V	**Airport planning & Design**		**8 Hours**
Runway Design: Orientation, Wind Rose Diagram, Runway length, Problems on basic, Geometric design of runways. Configuration and Pavement Design Principles, Elements of Taxiway Design, Airport Zones, Runway and Taxiway Markings and lighting.			
Self-study component:	Passenger Facilities and Services		

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Acquires capability of ***choosing*** alignment and also design geometric aspects of railway system, runway and taxiway. **(PO2, PSO2)**	**Applying**	**L3**
CO2	Suggest and ***estimate*** the material quantity required for laying a railway track and also will be able to determine the hauling capacity of a locomotive. **(PO2, PSO2)**	**Evaluating**	**L5**
CO3	***Develop*** layout plan of airport, harbour, dock and will be able relate the gained knowledge to identify required type of visual and/or navigational aids for the same. **(PO3,PO4, PSO2)**	**Applying**	**L3**
CO4	***Apply*** the knowledge gained to understand the characteristics of Railways and Airways. **(PO1, PSO1)**	**Applying**	**L3**

Text Book:

1. Saxena Subhash C and Satyapal Arora, "A Course in Railway Engineering", Dhanpat Rai and Sons, Delhi
2. Khanna S K, Arora M G and Jain S S, "Airport Planning and Design", Nemch and Brothers, Roorkee.
3. C Venkatramaiah, "Transportation Engineering", Volume II: Railways, Airports, Docks and Harbours, Bridges and Tunnels, Universities Press.

Reference Book:

1. Satish Chandra and Agarwal M. M,"Railway Engineering", 2nd Edition, Oxford University Press ,New Delhi.
2. Bindra S P, "A Course in Docks and Harbour Engineering", Dhanpat Rai and Sons, New Delhi.

Web and Video link:

1. Introduction to Railway Engineering: https://nptel.ac.in/courses/105107123
2. Harbor layout: https://youtu.be/gT0rAkmNuD8
3. Harbor layout: https://nptel.ac.in/courses/114106025
4. Port and harbor structures: https://youtu.be/3YY9FUVtG-4

5. Runway geometrics: https://youtu.be/vtkbeigLTzQ
6. Taxiway design: https://youtu.be/vTi6VtU1TKk

E-Books/Resources:

1. https://www.srividyaengg.ac.in/coursematerial/Civil/103644.pdf
2. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SCIA1701.pdf

COURSE ARTICULATION MATRIX
(RAILWAYS, AIRPORTS & HARBOUR ENGINEERING - P21CV5032)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2												2	
CO2		2												2	
CO3			2	1										2	
CO4	1												2		

3-HIGH, 2-MEDIUM, 1-LOW

ALTERNATE BUILDING MATERIALS AND MASONRY STRUCTURES

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21CV5033**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand environmental issues due to building materials and the energy consumption in manufacturing building materials
- Study the various masonry blocks, masonry mortar and structural behaviour of masonry under compression.
- Study the alternative building materials in the present context.
- Understand the alternative building technologies which are followed in present construction field.

UNIT – I	**Introduction**	**8 Hours**

Introduction: Energy in building materials, Environmental issues concerned to building materials, Global warming and construction industry, Environmental friendly and cost effective building technologies, Requirements for building of different climatic regions, Traditional building methods.

Alternative Building Materials: Characteristics of building blocks for walls, Stones and Laterite blocks and hollow clay blocks, Concrete blocks, Stabilized blocks: mud blocks, Steam cured blocks, Fal-G Blocks stone masonry block. **Energy calculations:** Embodied energy calculation for concrete.

Self-study component:	Autoclave Aerated concrete block, Vernacular architecture

UNIT – II	**Alternative Building Materials**	**8 Hours**

Raw materials, Manufacturing process, Properties and uses, Fiber reinforced concretes , Matrix materials, Fibers: metal and synthetic, Properties and applications, Fiber reinforced plastics, Matrix materials, Fibers: organic and synthetic, Properties and applications, Building materials from agro and industrial wastes , Types of agro wastes, Types of industrial wastes and Properties and applications.

Self-study component:	Field quality control test methods, mine wastes.

UNIT – III	**Alternate Building Technologies**	**8 Hours**

Alternative for wall construction, Types, Construction method, Masonry mortars, Types , Preparation, Properties, Ferro cement and ferroconcrete building components, Materials and specifications, Properties, Construction methods, Applications, Alternative roofing systems, Concepts, Filler slabs, Composite beam panel roofs.

Self-study component:	Masonry vaults and domes.

UNIT – IV	**Structural Masonry**	**8 Hours**

Compressive strength of masonry elements, Factors affecting compressive strength, Strength of units, prisms / wallettes and walls, Bond strength of masonry: Flexure and shear, Elastic properties of masonry materials and masonry. **IS Code provisions**: Design of masonry compression elements, Concepts in lateral load resistance

Self-study component:	Effect of brick work bond on strength.

UNIT – V	Cost Effective Building Design	8 Hours

Cost concepts in buildings, Cost saving techniques in planning, design and construction. Equipment for production of alternative materials: Machines for manufacture of concrete, Equipment's for production of stabilized blocks, Moulds and methods of production of precast elements.

Self-study component: Cost analysis: Case studies using alternatives.

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	***Interpret*** the significance of Energy in building materials, Environmental issues concerned to building materials, Global warming and construction industry. **(PO1,PO2, PO7,PSO1)**	Understanding	L2
CO2	***Select*** appropriate type of masonry unit and mortar for civil engineering constructions. **(PO1,PO2, PO7,PSO1)**	Applying	L3
CO3	***Recommend*** various types of alternative building materials and technologies. **(PO1,PO2, PSO1)**	Evaluating	L5
CO4	***Design*** masonry elements as per IS relevant codes and design of cost effective buildings. **(PO2, PO3,PSO2)**	Creating	L6

Text Book:

1. Alternative Building Materials and Technologies, Jagadish. K. S, Venkatarama Reddy. B. V and Nanjunda Rao. K. S. New Age Int. Pub. New Delhi. (Ch.1 to 8).
2. Structural Masonry, Hendry A.W., 2nd Ed., Palgrave Macmillan Publishers.
3. Brick and Reinforced Brick Structures, Dayaratnam P, Oxford & IBH.

Reference Book:

1. Proceedings of workshop on Alternative Building Material and Technology 19th – 20th Dec 2003 @ BVB College of Engineering & Tech, Hubli.
2. Relevant BIS codes, IS: 2250-1985, IS:3466-1999, IS:4098-1999, IS:2116-1998, IS:1095-1998
3. Design of Reinforced and Prestressed Masonry, Curtin, - Thomas Telford

Web and Video link:

1. Building materials and composites: https://archive.nptel.ac.in/courses/124/105/124105013/
2. Basic construction materials: https://archive.nptel.ac.in/courses/105/106/105106206/
3. Sustainable materials and green buildings: https://archive.nptel.ac.in/courses/105/102/105102195/
4. Design of Masonry Structures: https://www.youtube.com/watch?v=RWck4EnfdSE&list=PLyqSpQzTE6M-81uKP3sjj0lZX_nnrOwpV.
5. Cost Effective Structure and Architecture: https://www.youtube.com/watch?v=PmX0npteV3c&t=95s.

E-Books/Resources:

1. https://books.google.co.in/books/about/Alternative_Building_Materials_Technolog.html?id=hXatSM-_67QC.
2. https://www.pdfdrive.com/building-material-books.html.
3. https://www.intechopen.com/books/8412.

COURSE ARTICULATION MATRIX
(ALTERNATE BUILDING MATERIALS - P21CV5033)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1					2						2		
CO2	1	2					2						2		
CO3	2	1											1		
CO4		2	3											2	
3-HIGH, 2-MEDIUM, 1-LOW															

SOLID WASTE MANAGEMENT

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21CV5034**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- To understand material flow and different elements of solid waste management from generation of solid waste to disposal.
- To study the different methods of solid waste management system in par with statutory rules.
- To analyze different processing technologies of conversion of municipal solid waste to compost or biogas.
- To evaluate landfill site and to study the sanitary landfill reactions.

UNIT – I	**Introduction to Solid Waste Management**	**8 Hours**

Introduction: Definition, scope and importance of solid waste management, material flow and waste generation functional elements of solid waste management. Types of Solid waste and Sources: Classification and characteristics – municipal, commercial & industrial, Factor affecting generation rates.

Self-study component:	Methods of quantification.

UNIT – II	**Collection and Transportation**	**8 Hours**

Collection and Transportation: Systems of collection, collection equipment, transfer stations – bailing and compacting, route optimization techniques and problems on moisture content and Energy content. **Treatment / Processing Techniques:** Components separation, volume reduction, size reduction.

Self-study component:	Chemical reduction and biological processing

UNIT – III	**Incineration and Composting**	**8 Hours**

Incineration: Process – 3 T's, factors affecting incineration process, incinerators – pyrolysis, design criteria for incineration.

Composting: Aerobic and anaerobic composting, factors affecting composting, Indore and Bangalore composting methods, mechanical and semi mechanical composting processes, Vermi-composting.

Self-study component:	Prevention of air pollution due to incinerators

UNIT – IV	**Sanitary Land Filling**	**8 Hours**

Sanitary Land Filling: Different types, trench area, Ramp and pit method, site selection, basic steps involved, cell design, leachate & gas collection and control methods.

Self-study component:	Rock bolts and Thermal methods of stabilization

UNIT – V	**Disposal, Recycle and Reuse**	**8 Hours**

Disposal Methods: Land pollution due to Open dumping – selection of site, ocean disposal, handling of biomedical wastes, E-waste, Hazardous waste, construction and demolition waste.

Recycle and Reuse: Material and energy recovery operations, plastic wastes, environmental significance and reuse.

Self-study component:	Ploughing into fields, feeding to hogs and reuse of material in other industry.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understand** the concepts of importance of solid waste management, source and classification of solid waste. **(PO1, PSO1)**	Understanding	L2
CO2	**Analyze** and **identify** different methods of collection, transportation and management of solid waste. **(PO1, PO2, PSO1)**	Analyzing	L4
CO3	**Explain** the mechanisms of providing Engineering remedies to disposal issues. **(PO1, PO2, PSO1)**	Analyzing	L2
CO4	**Illustrate** the process of safety, legal and societal needs. **(PO5, PO6, PO7, PSO2)**	Analyzing	L3

Text Book:

1. Integrated Solid Waste Management: Tchobanoglous: M/c GrawHill.
2. Solid Waste Management in Developing Countries. Bhide and Sunderashan, Indian National Scientific, Documentation Centre.

Reference Book:

1. Hand book on Solid Waste Disposal.: Pavoni J.L., Published by Van Nost. Reinhold,1975.
2. Environmental Engineering, Howard S. Peavy, George Tchobanoglous and Donald R. Rowe's Environmental Engineering, published by Tata McGraw-Hill Education Donald R. Rowe's Environmental Engineering, published by Tata McGraw-Hill Education.
3. Environmental Engineering – Vol. II: S.K. Garg, Khanna publishers.

Web and Video link:

1. Introduction to solid waste: https://www.youtube.com/watch?v=k0ktJRoRcOA
2. Processing at source: https://www.youtube.com/watch?v=bTgTp70_TtE
3. Sampling and characteristics: https://www.youtube.com/watch?v=at5NuSbIiW8
4. Factors affecting solid waste generation rate: https://www.youtube.com/watch?v=c1t-P8zgmsw
5. Handling, separation and storage at source: https://www.youtube.com/watch?v=Hi4zFTqzf7Q
6. Primary collection: https://www.youtube.com/watch?v=Ac1d2aOw4Qw

E-Books/Resources:

1. https://www.pdfdrive.com/solid-waste-management-engineering-e20164602.html
2. https://www.pdfdrive.com/handbook-of-solid-waste-management-and-waste-minimization-technologies-e184970164.html
3. https://www.pdfdrive.com/solid-urban-waste-management-managing-municipal-waste-

commission-3-e50308040.html

4. https://www.pdfdrive.com/waste-management-practices-municipal-hazardous-and-industrial-e169602210.html
5. https://www.pdfdrive.com/solid-waste-management-principles-and-practice-e164813755.html

COURSE ARTICULATION MATRIX
(SOLID WASTE MANAGEMENT- P21CV5034)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	2	2											2		
CO3	3	3											2		
CO4					2	2	2						2		
3-HIGH, 2-MEDIUM, 1-LOW															

TRANSPORTATION ENGINEERING

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21CV504**	**Credits:**	**04**
Teaching Hours/Week (L:T:P):	**3:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**50**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Gain knowledge of different modes of transportation systems, history, development of highways and the organizations associated with research and development of the same in India.
- Understand Highway planning and development considering the essential criteria's (engineering and financial aspects, regulations and policies, socio economic impact).
- Get insight to different aspects of geometric elements and train them to design geometric elements of a highway network.
- Understand pavement and its components, pavement construction activities and its requirements.
- Gain the skills of evaluating the highway economics by B/C, NPV, IRR methods and also introduce the students to highway financing concepts.

UNIT – I	**Introduction**	**10 Hours**

Principles of Transportation Engineering: Importance of transportation, Different modes of transportation. Characteristics of road transport, Importance of Roads in India.

Highway Development and Planning: Highway Development in India, Highway Planning, Planning Surveys and Interpretation.

Highway Alignment and Project preparation: Highway Alignment, Engineering Surveys for Highway Alignment, Drawings and Reports, Highway Projects, Preparation of Detailed Project Report.

Self-study component:	Current Road Development and Planning Programmes in India.
Practical Topics:	**Tests on Road Aggregates:** a) Aggregate Impact Test b) Los Angeles Abrasion Test c) Aggregate Crushing Value Test

UNIT – II	**Geometric and Pavement Design**	**10 Hours**

Highway Geometric Design of horizontal alignment elements: Cross sectional elements, Sight distance, Design of Horizontal alignment: super elevation, extra widening, transition curve; Gradient and its types.

Pavement Design: Pavement types, component parts of flexible and rigid pavements and their functions, ESWL and its determination (Graphical method only)-Examples.

Self-study component:	Vertical alignment: Design of summit and valley curves, CPWD Handbooks.
Practical Topics:	**Tests on Road Aggregates:**

	d) Specific Gravity and Water Absorption Test e) Shape Tests (IRC and MoRTH guidelines) i. Flakiness Index ii. Elongation Index iii. Angularity Number

UNIT – III	Pavement Materials and Construction	10 Hours

Pavement Materials: Sub grade: desirable properties, HRB soil classification, determination of CBR and modulus of sub grade reaction with Problems. Aggregates: Desirable properties and requirements. Bituminous Binders & Mixes: Types, desirable properties and requirements. Pavement Quality concrete: Materials, Requirements.

Pavement Construction: General features, Embankment and Subgrade, Construction of Flexible pavements: Bituminous concrete, Dense Bituminous Macadam, Construction of CC pavement: Dry Lean Concrete. PQC

Self-study component:	Design of joints in CC pavement.
Practical Topics:	**Tests on Paving Bitumen:** a) Penetration Test b) Ductility Test c) Viscosity Test (Brooke field viscometer) d) Softening Point Test e) Specific Gravity Test f) Flash and Fire Point Test

UNIT – IV	Highway Drainage and Economics	10 Hours

Highway Drainage: Significance and requirements, Surface drainage system and Design-Examples, sub surface drainage system, design of filter materials, Types of cross drainage structures, their choice and location.

Highway Economics: Highway user benefits, VOC using charts only-Examples, Economic analysis: annual cost method, Benefit Cost Ratio method, NPV, IRR methods - Examples, Highway financing-BOT-BOOT concepts.

Self-study component:	Road construction in water-logged areas.
Practical Topics:	**Tests on Paving Bitumen:** a) Bituminous mix design (Marshall method) - Demonstration only b) Flexural strength of PQC - Demonstration only

UNIT – V	Traffic, Railways and Airport Engineering	10 Hours

Elements of Traffic Engineering: Scope and objectives, traffic characteristics, Objectives and methods of traffic engineering studies: volume, O-D, accident surveys, traffic regulation and control.

Elements of Railways: Railways: Introduction, classification of routes; railway gauge, coning of wheels, track components: rails, sleepers, fastenings, ballast and formation.

Airports: Introduction, Layout of an airport with component parts and functions of each, Aircraft Characteristics – Airport Classifications, - Site selection- regional Planning. Orientation of runway by

using wind rose diagram with examples.	
Self-study component:	Track resistance.
Practical Topics:	**Tests on Subgrade Soil:** a) Compaction Test (Standard and Modified) b) California Bearing Ratio Test c) Wet sieve analysis

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	***Develop*** the capability of proposing a new alignment or re-alignment of existing roads, conduct necessary field investigation for generation of required data. **(PO2, PSO1)**	Applying	L3
CO2	***Evaluate*** the engineering properties of the materials and suggest the suitability of the same for pavement construction. **(PO2, PSO2)**	Evaluating	L5
CO3	***Design*** road geometrics, structural components of pavement and drainage. **(PO3, PSO2)**	Creating	L6
CO4	***Evaluate*** the highway economics by few select methods and also will have a basic knowledge of various highway financing concepts. **(PO3,PSO2)**	Evaluating	L5
CO5	***Conduct*** experiments on pavement materials in a team or as an individual having impact for lifelong learning. **(PO9, PO12, PSO3)**	Creating	L6

Text Book:

1. S K Khanna and C E G Justo, "Highway Engineering", Nem Chand Bros, Roorkee.
2. L R Kadiyali, "Highway Engineering", Khanna Publishers, New Delhi.
3. R Srinivasa Kumar, "Highway Engineering", University Press.
4. K. Subramaniam, "Transportation Engineering", SciTech Publications, Chennai.
5. Saxena Subhash C and Satyapal Arora, "A Course in Railway Engineering", Dhanpat Rai and Sons, Delhi.
6. Chandra S. and A garwal M.M. "Railway Engineering", Oxford University Press India.
7. Khanna S K, Arora M G and Jain S S, "Airport Planning and Design", Nem Chand and Bros.
8. Khanna S.K. and Justo C.E.G. Highway Material Testing, Nem Chand & Bros

Reference Book:

1. Relevant IRC codes.
2. Principles of Transportation Engineering- Partha Chakra Borthy, Prentice- Hall.
3. Specifications for Roads and Bridges- MoRT & H, IRC, New Delhi.
4. C. Jotin Khisty, B. Kentlal, "Transportation Engineering", PHI Learning Pvt. Ltd. New Delhi.

Web and Video link:

1. Introduction to Transportation Engineering: https://www.youtube.com/watch?v=5zKC_aq4ypM&list=PLE88643285BC70E0F
2. Geometric Design of Highways: https://www.youtube.com/watch?v=2VehMMP70HE&list=PLLy_2iUCG87C7nApYQjgkDA0p67fMaXnE
3. Bitumen Basics: https://www.youtube.com/watch?v=RVjM79uAyTI&list=PLLy_2iUCG87CHFdFEAVGc2iISoF9DD554&index=22
4. Pavement Materials-1(Part-1): https://www.youtube.com/watch?v=XOyusu4QC8s
5. Introduction to Soil as a Highway Material: https://www.youtube.com/watch?v=959mcz2nX9k&t=10s

E-Books/Resources:

1. https://www.tandfonline.com/doi/full/10.1080/10298436.2020.1821024
2. https://www.tandfonline.com/doi/full/10.1080/10298436.2020.1825711
3. https://www.researchgate.net/publication/344269877_ScienceDirect_Utilization_of_Plastic_waste_in_Bitumen_Mixes_for_Flexible_Pavement_Utilization_of_Plastic_waste_in_Bitumen_Mixes_for_Flexible_Pavement
4. https://www.elsevier.com/books/sustainable-construction-materials/dhir/978-0-08-100985-7
5. https://www.sciencedirect.com/science/article/pii/S2095756422000757

COURSE ARTICULATION MATRIX (TRANSPORTATION ENGINEERING - P21CV504)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2											2		
CO2		2												2	
CO3			2											2	
CO4			1											1	
CO5									2			2			2

3-HIGH, 2-MEDIUM, 1-LOW

BUILDING SCIENCE AND ENGINEERING

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21CVO5051**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand the basic materials in civil engineering.
- Analyze the types of foundation, have an insight to different types of doors, windows.
- Gain the knowledge of bylaws for the planning of a public/private building.
- Understand the different methods and materials of interiors for building.
- Understand the concept of landscaping.

UNIT – I	**Materials for Construction**	**8 Hours**

Cement concrete: introduction, ingredients of cement, grade of concrete, properties. Steel :definition , types of steel, uses of steel, market forms of steel used in construction Doors and windows : location of doors and windows, types of doors, types of windows, Stairs : requirements of good stairs.

Self-study component:	Types of stairs.

UNIT – II	**Foundation and Structural Members**	**8 Hours**

Selection of site, substructure, objectives of foundation, site inspection, soils, loads on foundations, essential requirements of good foundation, types of foundation, failure of foundation and remedial measures. Structural members: columns, lintels, roofing (flat roof and sloped roof), flooring (types of floors and floor covering), damp proofing.

Self-study component:	Painting and Varnish.

UNIT – III	**Building Planning and Maintenance**	**8 Hours**

Plan, section and elevation .Introduction, classification of buildings, components of buildings, building By-Laws, orientation of buildings, ventilation, acoustic requirements, Super structure: introduction, brick masonry, stone masonry and R.C.C. Building maintenance Deterioration of concrete, deterioration of masonry works, prevention of cracks and leaks, cost effective construction

Self-study component:	Anti-termite treatment in building

UNIT – IV	**Interior Design**	**8 Hours**

Functional requirement of interior designer, basic elements of interior design, design problems :Interior design for spacious rooms, comfortable rooms, theme rooms, living area, cooking area, drinking area dining area, home offices, sleeping area.

Self-study component:	Interior design for bathrooms, public/private buildings

UNIT – V	**Landscaping**	**8 Hours**

Elements of Landscape architecture, specialization in landscape, landscape products, landscape

materials, design guidelines for interior landscape.			
Self-study component:	Water efficient landscaping.		
Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Apply** the knowledge of engineering fundamentals to understand, the characteristics of basic civil engineering materials. **(PO1,PSO1)**	Applying	L3
CO2	**Apply** the knowledge of engineering fundamentals and analyze the types of foundation. **(PO2,PSO2)**	Applying	L3
CO3	**Develop** plan, section and apply bylaws and investigate causes and remedies for cracks, have an insight to cost effective construction. **(PO1,PO2,PSO2)**	Applying	L3
CO4	**Develop** the interiors and landscaping for buildings as per design guidelines. **(PO1,PO3)**	Analyzing	L4

Text Book:

1. Basic Civil Engineering: M.s.Palanichamy, 4th Edition, Tata McGraw Hill Education Private Limited, New Delhi.
2. Basic Civil Engineering: Sateesh Gopi, First Edition, Pearson.
3. Building Construction Materials and Techniques: P. Purushothama. Raj, Pearson Education India

Reference Book:

1. Basic Civil Engineering: Dr. B. C. Punmia, Ashok Kumarjain, Arun Kumar Jain Laxmi Publications year of publication.
2. Basic Civil Engineering: S. S. Bhavikatti, New Age International Limited.
3. Interior Landscape: Jialin Tong, Design Media Publishing Limited.

Web and Video link:

1. Materials for Construction: https://www.youtube.com/watch?v=wOyQBVfM1eo&list=PLyqSpQzTE6M_RfjEQMK7_L-UvxAMhplUT
2. Foundation and Structural Members: https://www.youtube.com/watch?v=H6_J8LuTa-M&list=PLA4019BB0B0CF6518
3. Building Planning and Maintenance: https://www.youtube.com/watch?v=mnhmmmHqirM
4. Interior Design: https://www.youtube.com/watch?v=gA_zAbNW5lQ&list=PLLy_2iUCG87CRQBYfawoGzsJ7aoz8SW5V
5. Landscaping: https://www.youtube.com/watch?v=7TXJVv_Wa4&list=PLxHgc0UFNU4vfMkxqBl9ABrZCgwr_Bjby

E-Books/Resources:

1. https://www.google.co.in/books/edition/Building_Construction_Materials_and_Tech/UteXDQAAQBAJ?hl=en&gbpv=0
2. https://www.google.co.in/books/edition/Basic_Civil_Engineering/sWZxu_muxyIC?hl=en&gbpv=0
3. https://www.google.co.in/books/edition/Interior_Landscape/AcfloAEACAAJ?hl=en

COURSE ARTICULATION MATRIX
(BUILDING SCIENCE AND ENGINEERING- P21CVO5051)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												1		
CO2		1												1	
CO3	1	2												1	
CO4	1		2												

3-HIGH, 2-MEDIUM, 1-LOW

BASIC TRANSPORTATION ENGINEERING [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	**21CVO5052**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. Understand the knowledge of different modes of transportation and its importance
2. Understand the importance of Highway cross elements and different types of pavements.
3. Understand the importance of Railway components and its role.
4. Understand the importance of Airport engineering and components of harbor.
5. Understand the basic concept of advance transportation system and role of public transport.

UNIT – I	**INTRODUCTION**	**08 Hours**

Importance of transportation, Different modes of transportation and comparison, Characteristics of road transport, Jayakar committee recommendations and implementation – Central Road Fund, Indian Roads Congress, Central Road Research Institute, Classification of roads as per Nagpur road plan, Scope of highway engineering.

Self-study component:	KSHIP and KRIDL

UNIT – II	**HIGHWAY ENGINEERING**	**08 Hours**

Ideal Alignment, Factors affecting the alignment, obligatory points, Importance of geometric design, design control and criteria, highway cross section elements -cross slope or camber, medians, carriageway, kerbs, road margins, cross section details, Object of highway pavements, requirements of highway pavements, types of pavement structures and comparisons & their limitations, flexible/rigid pavements – components and their functions.

Self-study component:	Road patterns, NHDP & PMGSY

UNIT – III	**RAILWAY ENGINEERING**	**08 Hours**

Permanent Way, Requirements of an ideal permanent way, Gauges in Railway Track, Selection of Gauges, Functions of Rails, Requirements, Types of Rail Sections, Rail Joints, Requirements, types of joints, Welding of Rails, Sleepers-function and requirements, Classification of Sleepers, Spacing of Sleepers and Sleeper Density, Ballast- Functions, requirements and types.

Self-study component:	Comparison of Different types of sleepers, Comparison of Rail sections.

UNIT – IV	**AIRPORT AND HARBOR ENGINEERING**	**08 Hours**

Introduction to airport engineering, Airport site selection Runway Design - Orientation of runway by using wind rose diagram - Basic runway length, Corrections for Elevation, Temperature and Gradient to runway length by ICAO and FAA specification - runway cross sections problems on above.

Introductions, classifications, natural phenomenon affecting the design of harbor viz. wind, wave, tide and currents. Harbor layout with component parts.

Self-study component:	Regional planning, exit taxiway

UNIT – V	ADVANCED TRANSPORTATION SYSTEM	08 Hours

Introduction to ITS- definition, objectives, benefits and historical background, data collection techniques employed in ITS, Promotion and integration of public transportation, Promotion of non-motorized transport, role of metro rail.

Self-study component:	Fly bus technology, MAGLEV Train technology.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	***Apply*** the knowledge of engineering to acquire the fundamentals of basic modes of transportation. **(PO1, PSO1)**	Applying	L3
CO2	***Distinguish*** different cross section elements of highway and different types of pavements. **(PO2, PSO2)**	Analyzing	L4
CO3	***Identify*** different components of railway track, design of airport runway and to understand the components of harbor. **(PO2, PO3, PSO2)**	Applying	L3
CO4	***Discover*** the advanced developments in transportation systems. **(PO4, PSO3)**	Analyzing	L4

Text Book:

1. Highway Engineering, – S.K. Khanna, C.E.G Justo, and A.Veeraragavan, Nem Chand and Bros, Roorkee, Revised 10th Edition.
2. Railway Engineering,- Saxena and Arora, Dhanpat Rai and Sons, New Delhi.
3. Airport Planning and Design, Khanna, Arora and Jain – Nemchand Roorkee.
4. Dock & Tunnel Engineering, Srinivasan R Harbour, Charotar Publishing House.

Reference Book:

1. Highway Engineering, Kadiyali, L.R., Khanna Publishers, New Delhi
2. Railway Engineering, Satish Chandra and Agarwal, M.M., Oxford University Press, New Delhi.

Web and Video link:

1. Introduction to Transportation Engineering: https://nptel.ac.in/courses/105105107
2. Introduction to Geometric Design of Highways: https://archive.nptel.ac.in/courses/105/105/105105107/
3. Introduction to Railway and Airport Engineering: https://archive.nptel.ac.in/courses/105/107/105107123/

E-Books/Resources:

- https://nptel.ac.in/courses/105101087
- https://www.vssut.ac.in/lecture_notes/lecture1428280600.pdf
- https://www.srividyaengg.ac.in/coursematerial/Civil/103644.pdf

COURSE ARTICULATION MATRIX (BASIC TRANSPORTATION ENGINEERING-P21CVO5052)															
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2		2												2	
CO3		2	1											2	
CO4				2											2
3-HIGH, 2-MEDIUM, 1-LOW															

GEO-ENVIRONMENTAL ENGINEERING

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21CVO5053**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- The student acquires the knowledge on the Geotechnical engineering problems associated with soil contamination, safe disposal of waste and remediate the contaminated soils by different techniques thereby protecting environment.
- Identify the contaminated soil and source contamination.
- Study on Ground water contamination.
- Relation between contamination source and the soil & water.

UNIT – I	**Introduction to Geo-Environmental Engineering**	**8 Hours**

Fundamentals: Introduction to Geo environmental engineering, Scope of environmental geotechnical engineering - multiphase behavior of soil – role of soil in geo-environmental and its applications, Sources of subsurface Contamination, Production and classification of ground contamination – Causes of soil pollution – impact of ground contamination on geo-environment - Failures of foundation due to waste movement.

Self-study component:	Environmental cycle - CNS, importance of soil physics, soil chemistry, hydrogeology and biological process

UNIT – II	**Interaction of Soil-water-contaminants**	**8 Hours**

Soil Mineralogy: Clay mineralogy; identification of clay minerals by X-ray diffraction method; Soil-water-contaminant interactions and its implications, concepts of double layer–forces of interaction between soil particles.

Unsaturated Soil: Concepts of unsaturated soil – importance of unsaturated soil in environmental geotechnical engineering problems, Concept of soil suction and measurement of soil suction

Self-study component:	Factors effecting soil-water retention, water flow in saturated and unsaturated zone.

UNIT – III	**Waste Containment System**	**8 Hours**

Waste Containment system: Evolution of waste containment facilities and disposal practices, Site selection based on environmental impact assessment (EIA), Concept and Principles of waste containment, Landfills, Types of landfills, Requirement of barrier materials, Liners for landfills, Landfill Covers, Generation and Control of Leachate and Gas from Landfills, different role of soil in waste containment.

Self-study component:	Stability issues of waste containment component systems and property evaluation for checking soil suitability for waste containment.

UNIT – IV	**Transport of Contaminants**	**8 Hours**

Transport of Contaminants: Contaminant transport in sub surface – Advection, Diffusion,

Dispersion, Governing equations , Contaminant transformation, Sorption, Biodegradation , Ion exchange, Precipitation, Hydrological consideration in land fill design, Ground water pollution.		
Self-study component:	Different method of soil containment waste stabilization	
UNIT – V	**Remediation of Contaminated Soils**	**8 Hours**
Remediation: Need and objectives of site remediation, Site characterization method for remediation and various risk assessment of contaminated site, remediation methods for soil and remediation methods for soil with groundwater- various active and passive methods, selection of suitable remediation method and planning of remediation methods.		
Self-study component:	Various In-situ remediation techniques, its characterizations and application	

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with ***Action verbs*** for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Understand** the concepts of contamination in soils and water**. (PO1, PSO1)**	Understanding	L2
CO2	**Understand** the concept of interaction of soil, water and contaminants**. (PO1, PSO1)**	Understanding	L2
CO3	**Analyze** and **identify** the source for contamination in soils and water and **select** suitable disposal system and transportation methods for particular waste**. (PO2, PO5, PSO2)**	Analyzing	L4
CO4	**Apply** the suitable Remedial measures for contaminated soils**. (PO1, PSO1)**	Applying	L3

Text Book:

1. Geotechnical Practice for Waste Disposal – Daniel D E, Chapman and Hall, London
2. Geo-Environmental Engineering, Hari D. Sharma and Krishna R. Reddy, John Wiley and Sons, INC, USA, 2004.
3. Geo-environmental Engineering – principles and applications, L.N. ReddiandH.F. Inyang, Marcel Dekker, 2000
4. Waste Disposal in Engineered landfills, ManojDatta, Narosa Publishing House, 1997.
5. Hazardous Waste Management – Lagrega M D, Buckingham P L, Evans J C, McGraw Hill Inc, Singapore.

Reference Book:

1. Designing with Geosynthetics - Koerner R M, Prentice Hall, New Jersey
2. Proceedings of International Symposium on Environmental Geotechnology (1986)
3. Industrial Solid Waste Management and Landfilling Practice, ManojDatta, B.P. Parida, B.K, GuhaNarosa Publishing House, 1999.

Web and Video link:

1. Introduction to Geo-environmental Engineering:

https://www.youtube.com/watch?v=FxlHGvCLGug&list=PLJkVJopKoH5SCgWW7OHtgzZ8ES4fTex3R&index=1

2. Sources & Impact of Contamination: https://www.youtube.com/watch?v=jK2gsJIzVmc&list=PLJkVJopKoH5SCgWW7OHtgzZ8ES4fTex3R&index=2
3. Water-Soil Interaction: https://www.youtube.com/watch?v=9XbcaPJm8xU&list=PLJkVJopKoH5SCgWW7OHtgzZ8ES4fTex3R&index=3
4. Solid waste generation and waste disposal: https://www.youtube.com/watch?v=vbj0zfG2mrw&list=PLJkVJopKoH5SCgWW7OHtgzZ8ES4fTex3R&index=4
5. Waste minimization by integrated Solid waste Management: https://www.youtube.com/watch?v=HxXEu9D8YQw&list=PLJkVJopKoH5SCgWW7OHtgzZ8ES4fTex3R&index=5
6. Principles of landfills: https://www.youtube.com/watch?v=rmiD-vzUod0&list=PLJkVJopKoH5SCgWW7OHtgzZ8ES4fTex3R&index=7
7. Planning of landfills Part-1: https://www.youtube.com/watch?v=rHE61AGkHr8&list=PLJkVJopKoH5SCgWW7OHtgzZ8ES4fTex3R&index=8
8. Planning of landfills Part-2: https://www.youtube.com/watch?v=ilhdPsGKp60&list=PLJkVJopKoH5SCgWW7OHtgzZ8ES4fTex3R&index=9
9. Liners for landfills Part-1: https://www.youtube.com/watch?v=8slEPShGgMU&list=PLJkVJopKoH5SCgWW7OHtgzZ8ES4fTex3R&index=10
10. Liners for landfills Part-2: https://www.youtube.com/watch?v=I3NnstHX8JY&list=PLJkVJopKoH5SCgWW7OHtgzZ8ES4fTex3R&index=11
11. Liners for landfills Part-3: https://www.youtube.com/watch?v=0J8sd_KKyao&list=PLJkVJopKoH5SCgWW7OHtgzZ8ES4fTex3R&index=12
12. Liners for landfills Part-4: https://www.youtube.com/watch?v=sjkP8iAEwV0&list=PLJkVJopKoH5SCgWW7OHtgzZ8ES4fTex3R&index=13
13. Covers for landfills Part-1 https://www.youtube.com/watch?v=DaI6qvBMU7g&list=PLJkVJopKoH5SCgWW7OHtgzZ8ES4fTex3R&index=14
14. Covers for landfills Part-2 https://www.youtube.com/watch?v=IkCUlFwqkX0&list=PLJkVJopKoH5SCgWW7OHtgzZ8ES4fTex3R&index=15
15. Generation and control of leachate https://www.youtube.com/watch?v=OX60i3n4xn8&list=PLJkVJopKoH5SCgWW7OHtgzZ8ES4fTex3R&index=16
16. Generation and control of landfill gases: https://www.youtube.com/watch?v=bkXynzS2Emc&list=PLJkVJopKoH5SCgWW7OHtgzZ8ES4fTex3R&index=17
17. Site selection for landfills: https://www.youtube.com/watch?v=tRKWlV4iVzI&list=PLJkVJopKoH5SCgWW7OHtgzZ8ES4fTex3R&index=27
18. Control and Remedial measures at contaminated sites Part-1:

https://www.youtube.com/watch?v=4wEw4QPsOp0&list=PLJkVJopKoH5SCgWW7OHtgzZ8ES4fTex3R&index=29

19. Control and Remedial measures at contaminated sites Part-2: https://www.youtube.com/watch?v=P1kDS_tPTGU&list=PLJkVJopKoH5SCgWW7OHtgzZ8ES4fTex3R&index=30

E-Books/Resources:

1. https://nitsri.ac.in/Department/Civil%20Engineering/CGE-_221_E2-CHAPTER_1_TO_CHAPTER_5.pdf
2. https://www.sciencedirect.com/book/9780128048306/fundamentals-of-geoenvironmental-engineering
3. https://www.elsevier.com/books/geoenvironmental-engineering/mohamed/978-0-444-89847-0
4. https://www.sciencedirect.com/journal/geosystems-and-geoenvironment
5. https://taylorandfrancis.com/knowledge/engineering/environmental-engineering/
6. https://www.tandfonline.com/journals/gcee20
7. https://www.taylorfrancis.com/books/mono/10.1201/9780203913734/geoenvironmental-engineering-lakshmi-reddi-hilary-inyang
8. https://ascelibrary.org/journal/jggefk
9. https://www.scimagojr.com/journalsearch.php?q=16281&tip=sid
10. https://www.icevirtuallibrary.com/isbn/9780727747518
11. https://ascelibrary.org/doi/book/10.1061/9780784411056
12. https://www.scribd.com/book/282503428/Geoenvironmental-Engineering
13. https://www.academia.edu/41438495/GEOENVIRONMENTAL_ENGINEERING

COURSE ARTICULATION MATRIX
(GEO-ENVIRONMENTAL ENGINEERING - P21CV5053)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2												2		
CO3		2			2									2	
CO4	2												2		

3-HIGH, 2-MEDIUM, 1-LOW

APPLICATION OF REMOTE SENSING AND GIS IN WATER RESOURCE ENGINEERING

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21CVO5054**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3: 0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Explain the concepts of Remote Sensing and GIS processes.
- Explain visual image interpretations and to classify different sensors and filters.
- Understand various remote sensing platforms and to represent spatial data, raster and vector data.
- Apply the knowledge of RS and GIS in water resource management.

UNIT – I	**Concepts and Foundations of Remote Sensing**	**8 Hours**

Introduction, definition of remote sensing, remote sensing process, ideal remote sensing system, Principles of electromagnetic remote sensing, electromagnetic spectrum, black body radiation, laws governing electromagnetic radiation, atmospheric effects, scattering and absorption, atmospheric windows, Spectral reflectance of vegetation, soil and water, atmospheric influences on spectral response patterns.

Self-study component:	Characteristics of real remote sensing and data acquisition methods of remote sensing.

UNIT – II	**Visual Image Interpretation**	**8 Hours**

Introduction, Elements of visual image interpretation, image display and band combinations, true and false color composites. Image pre processing, image histogram, radiometric and geometric corrections, image enhancements, image transforms based on arithmetic operations, image filtering, low pass and high pass filters, edge detection, multi-image manipulation, spectral rationing.

Self-study component:	Classification of mixed pixels, fuzzy classification.

UNIT – III	**Remote Sensing Platforms and Fundamentals of Geographic Information System**	**8 Hours**

Introduction, Remote sensing platforms, sensors- active and passive sensors, sensor resolutions (spectral, spatial, radiometric and temporal), panchromatic, multispectral and hyper spectral data. **GIS:** definition of GIS, components of GIS, GIS work flow, representing spatial data and raster and vector data, digital elevation model, geo-referencing, map overlays, surface analysis.

Self-study component:	Characteristics of Indian and other major Earth resource satellites, image processing GIS softwares.

UNIT – IV	**Applications of RS and GIS in Various Field**	**8 Hours**

Applications of Morphometric analysis and Hypsometric analysis of watershed, Applications of remote sensing and GIS in Land use/cover mapping, Urban and regional planning applications, water resources and management, Environmental applications, Disaster management applications.

Self-study component:	Agricultural and forestry applications.

UNIT – V	Water Resource Management	8 Hours

Introduction, definition of WRM, Watershed development programmes developed under different departments, Objectives of water resource management, principles and action plan of watershed management, problem identification and analysis, different case studies.

Self-study component: Land use classification.

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Understand** the importance of remote sensing and GIS. **(PO1, PSO1)**	Understanding	L1
CO2	**Understand** various remote sensing platforms and to **Analyze** the visual image interpretations and to classify different sensors and filters. **(PO1, PO2, PSO1, PSO2)**	Understanding, Analyzing	L1 and L4
CO3	**Analyze** the raster and vector data and to understand the applications of DEM in various fields. **(PO1, PO2, PSO1, PSO2)**	Analyzing	L4
CO4	**Analyze** problems of watershed and find solution for better management. **(PO2, PSO1, PSO2)**	Analyzing	L4

Text Book:

1. Lillesand T.M., and R.W. Kiefer, - "Remote Sensing and Image interpretation", 6th edition, John Wiley & Sons Publications – 2011.
2. G. S Srivastava- "An Introduction to Geoinformatics"- McGraw Hill Educan (India) Priviate Limited- 2014.
3. Sarbhukan M.M - "Integrated Water Resource Management" - CBS Publications-2013.

Reference Book:

1. Manoj K. Arora, R.C. Badjatia, " Geomatics Engineering", Nemichand & Bros. Roorkee - 2011.
2. Jensen J.R., "Introductory digital image processing: A remote sensing perspective", 2nd Edition, Prentice Hall – 1996.
3. Richards J A., X. Jia, "Remote sensing digital image analysis: an introduction", 3rd Edition, Springer - 1999.
4. Peter A. Burrough & Rachel A. McDonnel "Principles of Geographic Information Systems"- (1998), Oxford University press, Great Britain.

Web and Video link:

1. Remote sensing and Components of GIS: https://youtu.be/XcseNgYqXZ4?list=PLLy_2iUCG87CDlroZBlwwBllYwz7KxVtA https://youtu.be/dnfrbhVsy8?list=PL3MO67NH2XxLAFn3jc7gOhXLD9YFx-oew
2. Elements of visual image interpretation: https://youtu.be/p7fU6nfiB5M
3. Different types of raster and vector data: https://youtu.be/4zGbqJNzTqk?list=PLLy_2iUCG87A2ywI6ZFJPmgq0nGwfBt15 and https://youtu.be/bA8UQ9zXue4?list=PLLy_2iUCG87A2ywI6ZFJPmgq0nGwfBt15
4. Applications of RS and GIS in various fields: https://youtu.be/SVa66vO08So.
5. Applications of RS and GIS in water resource management: https://youtu.be/6ueyiwdaLaw.

E-Books/Resources:

1. https://www.wiley.com/enus/Remote+Sensing+and+Image+Interpretation%2C+7th+Edition-p-9781118343289.
2. https://dokumen.pub/introductory-digital-image-processing-a-remote-sensingperspective-9780134058160-013405816x.html.
3. https://www.accessengineeringlibrary.com/content/book/9781259058462.
4. https://www.ircwash.org/sites/default/files/210-96WA-17543.pdf.

COURSE ARTICULATION MATRIX
(APPLICATION OF REMOTE SENSING AND GIS IN WATER RESOURCE ENGINEERING – P21CVO5054)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3											2		
CO2	2	2											2	2	
CO3	2	2											2	2	
CO4	2	3											2	2	
3-HIGH, 2-MEDIUM, 1-LOW															

SKILL LABORATORY

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21CVL506**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**30**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

1. Use FEM packages to solve analysis problems in Civil Engineering.
2. Use Arc GIS software for typical problems in Civil Engineering.
3. Use of Microsoft Project to apply the concept of Planning and Scheduling.

Sl. No.	List of Experiments	
I	**Part – A: STAAD Pro.**	**10 Hours**
	Analysis of two dimensional structural systems using STAAD Pro. : a) Introduction to STAAD Pro. b) Analysis of Beams. c) Analysis of Frames.	
II	**PART- B: Q GIS**	**10 Hours**
	a) Introduction to software, downloading of DEM. b) Mosaicking of DEM. c) Terrain analysis (Development of slope, hill shade map, contour map). d) Catchment delineation using arc hydro tool with calculation of area of catchment, length of river using attribute table.	
III	**PART- C: Project Management**	**10 Hours**
	Exercise on Project planning and scheduling of a building project using Microsoft Project software: a) Understanding basic features of Microsoft Project software. b) Constructing Project: Create WBS, Activities, tasks, computation of time and basic understanding about Resource Creation and allocation. c) Prepare detail project schedule for G+2 Building.	

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	***Analyze*** propped cantilever, Fixed beam and continuous beam, Frames using FEM software. **(PO1, PO2, PO5, PSO1)**	Analyzing	L4
CO2	***Analyze*** the different terrain maps and the characteristics of catchment delineation. **(PO1, PO2, PO3, PSO1)**	Analyzing	L4
CO3	***Apply*** the basic concept of planning and scheduling of a building project using Microsoft Project software. **(PO1, PO2, PO3, PO5, PO12, PSO1, PSO2, PSO3)**	Applying	L3

Text Book:

1. Analysis and Design of Structures - A Practical Guide to Modeling – by D. Trevor Jones, Bentley Publishers.
2. R.W Kiefer- "Remote Sensing and Image Interpretation", 6th Edition, John Wiley & sons Publications, 2011.
3. Construction Engineering and Management - By S. Seetharaman, Umesh Publications, New Delhi.

Reference Book:

1. Referral on CAD Laboratory - By Jayaram & Rajendra Prasad, Sapna Publishers.
2. Microsoft Project Laboratory Manual.

Web and Video link:

1. IIT-STAAD Pro Tutorials: https://www.injntu.com/e-learn/civil-engineering-1/staad-pro-v8i-from-basics-to-advanced-37/iit-staad-pro-tutorials-design-of-rcc-building-part1-day-9-1646.
2. Analysis & Design of Structures: https://www.udemy.com/course/staadpro-cs/
3. Concept of topology: https://youtu.be/Lokif8XXoM0?list=PLLy_2iUCG87A2ywI6ZFJPmgq0nGwfBt15
4. A Complete Beginner's Guide to ArcGIS Desktop: https://youtu.be/BbUctneHfKc.
5. Software Project Management: https://nptel.ac.in/courses/106105218
6. Microsoft Project: https://www.youtube.com/watch?v=eplTOMnmJTQ&list=PLb7eq4kMpMAVAar2hFJoHBF4zJylGnXj7.

E-Books/Resources:

1. https://virtuosity.bentley.com/product/staad-pro/
2. https://www.classcentral.com/course/udemy-staad-pro-v8-industrial-steel-warehouse-des-89259
3. https://www.academia.edu/42688186/MS_PROJECT_EBOOK

COURSE ARTICULATION MATRIX
(SKILL LAB - P21CVL506)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3			2								3		
CO2	3	3	3										2		
CO3	3	3	3		2							2	2	3	2

3-HIGH, 2-MEDIUM, 1-LOW

INTERNSHIP – II / EXTENSIVE SURVEYING

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21INT507**	**Credits:**	**02**
Teaching Hours/Week (L:T:P):	**0:0:0**	**CIE Marks:**	**50**
Internship duration	**2 weeks**	**SEE Marks:**	**50**

Course Objectives: This course will enable students to:

1. Understand the practical applications of Surveying.
2. Use Total station and other Measurement Equipments.
3. Work in teams and learn time management, communication and presentation skills.

1. To be conducted between 4th & 5th Semester for a period of 2 weeks including training on total station.
2. Viva voce conducted along with 5th semester exams.
3. An extensive project preparation training involving investigation, collection of data is to be conducted for 2 weeks. **Use of Total Station is compulsory for minimum of TWO projects.**
4. The student shall submit a project report consisting of designs and drawings.
5. Drawings should be done using CAD and survey work using total station.
6. Students should learn data download from total station, generation of contours, block leveling, longitudinal and cross sectional diagrams, and capacity volume calculation by using relevant softwares.
7. The course coordinators should give exposure and simulate activities to achieve the course outcomes.

Sl. No.	LIST OF PROJECTS
1	**NEW TANK PROJECTS:** The work shall consist of: a. Reconnaissance survey for selection of site and conceptualization of project. b. Alignment of center line of the proposed bund, Longitudinal and cross sections of the center line. c. Detailed survey required for project execution like Capacity surveys, Details at Waste weir and sluice points, Canal alignment etc. as per requirement. d. Design and preparation of drawing with report.
2	**WATER SUPPLY AND SANITARY PROJECT:** The work shall consist of: a. Reconnaissance survey for selection of site and conceptualization of project. b. Examination of sources of water supply, Calculation of quantity of water required based on existing and projected population. c. Preparation of village map by using total station. d. Survey work required for laying of water supply and UGD. e. Location of sites for water tank. Selection of type of water tank to be provided (ground level, overhead and underground). f. Design of all elements and preparation of drawing with report.
3	**HIGHWAY PROJECT:** The work shall consist of: a. Reconnaissance survey for selection of site and conceptualization of project. b. Preliminary and detailed investigations to align a new road (min. 1 to

	1.5 km stretch) between two obligatory points. The investigations shall consist of topographic surveying of strip of land for considering alternate routes and for final alignment. Surveying by using total station. c. Report should justify the selected alignment with details of all geometric designs for traffic and design speed assumed. d. Drawing shall include key plan initial alignment, final alignment, longitudinal section along final alignment, typical cross sections of road.
4	**RESTORATION OF AN EXISTING TANK:** The work shall consist of: a. Reconnaissance survey for selection of site and conceptualization of project. b. Alignment of center line of the existing bund, Longitudinal and cross sectionsof the center line. c. Detailed survey required for project execution like Capacity surveys, Details atWaste weir and sluice points, Canal alignment etc. as per requirement. d. Design of all elements and preparation of drawing with report.

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Apply** the surveying knowledge and modern surveying equipments effectively for the projects **(PO1,PO5,PSO2,PSO3)**	**Applying**	L3
CO2	**Understand** the technical difficulties at site and managerial skills to tackling them in completing the assigned survey work. **(PO9, PO11, PSO1)**	**Understanding**	L2
CO3	**Apply** the individual effectiveness skills in team and organizational context, goal setting, time management, communication and presentation skills. **(PO9,PO10, PO11, PSO1)**	**Applying**	L3
CO4	**Build** as a team member imparting networking, communicating effectively in gaining lifelong learning process. **(PO9, PO10, PO12, PSO2)**	**Applying**	L3

Text Book:

1. Surveying, Vol-1 and Vol-2 - B.C. Punmia ,Laxmi Publications, New Delhi.
2. Plane Surveying, Vol-1 and Vol-2-A.M. Chandra, Newage International ® Ltd.
3. Advanced Surveying: Total Station, GPS, GIS & Remote Sensing by Pearson 2017 by Gopi Satheesh, R.Sathikumar, N. Madhu
4. Text book of highway Engineering, Khanna and Justo, Newchand brothers, Roorke-2011.
5. S.K.Garg, Environmental Engineering vol-I, Water supply Engineering – Khanna Publishers, New Delhi 2010.
6. Environmental Engineering-I – B.C. Punmia & Ashok Jain, Lakshmi Publications (P) Ltd.

Reference Book:

1. Manual on water supply and treatment – CPHEEO, Ministry of Urban Development, New Delhi.
2. Environmental Engineering- Howard S. Peavey, Donald R. Rowe, George.
3. Plane Surveying, Chandra A.M. New age International.
4. Surveying Vol. 1, S.K. Duggal, Tata McGraw Hill Publishing Co. Ltd. New Delhi.

Web and Video link:

1. New tank project :https://www.youtube.com/watch?v=wQBWh75lG1E
2. Restoration Tank Project : https://www.youtube.com/watch?v=Ixvc7NTqrJk
3. Highway Project : https://www.youtube.com/watch?v=HgKYf6TVrNE
4. Water Supply and Sanitary Project : https://www.youtube.com/watch?v=xdZILMrRkzo

E-Books/Resources:

1. https://www.google.co.in/books/edition/Surveying_Vol_I/EMsLyVmMwIC?hl=en&gbpv=1&dq=advanced+SURVEYING&printsec=frontcover
2. https://www.google.co.in/books/edition/Advanced_Surveying/GC6K78Kkou4C?hl=en&gbpv=1&dq=advanced+SURVEYING&printsec=frontcover
3. https://www.google.co.in/books/edition/Water_Supply_Engineering/74HYY31zwhQC?hl=en&gbpv=1&dq=Water+supply+Engineering&printsec=frontcover

COURSE ARTICULATION MATRIX
[INTERNSHIP – II (EXTENSIVE SURVEYING) - P21INT507]

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2				2									2	1
CO2									2		2		2		
CO3									2	2	2		2		
CO4									2	2		1		2	

3-HIGH, 2-MEDIUM, 1-LOW

Employability Enhancement Skills (EES) - V
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – V

Course Code:	**P21HSMC508**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:2:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**28**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable students to:

- Apply programming constructs of C language to solve the real-world problem.
- Explore user-defined data structures like arrays, structures and pointers in implementing solutions to problems.
- Design and Develop solutions to problems using functions.

UNIT – I	**10 Hours**

Problem solving through C -

Flow Control: If…else, for Loop, while Loop, break and continue, switch…case, goto, Control Flow Examples, Simple Programs.

Functions: Functions, User-defined Functions, Function Types, Recursion, Storage Class, Programs

Arrays: Arrays, Multi-dimensional Arrays, Arrays & Functions, Programs.

Self-Study: Variables and constants

UNIT – II	**10 Hours**

Problem solving through C -

Pointers: Pointers, Pointers & Arrays, Pointers and Functions, Memory Allocation, Array & Pointer Examples.

Strings: String Functions, String Examples, Programs.

Self-Study: Evaluation of Expression.

UNIT – III	**08 Hours**

Problem solving through C -

Structure and Union: Structure, Struct & Pointers, Struct & Function, Unions, Programs.

Programming Files: Files Input/output

Self-Study: Error handling during I/O operations.

Course Outcomes: On completion of this course, students are able to:	
CO – 1:	Apply suitable programming constructs of C language to solve the given problem.
CO – 2:	Explore user-defined data structures like arrays in implementing solutions to problems like searching and sorting.
CO – 3:	Design and Develop solutions to problems using functions.

Text Book(s):

1. The C Programming Language (2nd edition) by Brian Kernighan and Dennis Ritchie.
2. C in Depth by S K Srivastava and Deepali Srivastava.
3. Computer fundamentals and programming in c, "Reema Thareja", Oxford University, Second edition, 2017.

Reference Book(s):

1. E. Balaguruswamy, Programming in ANSI C, 7th Edition, Tata McGraw-Hill. Brian W. Kernighan and Dennis M. Ritchie, The 'C' Programming Language, Prentice Hall of India.

Web and Video link(s):

1. Problem Solving through Programming in C - https://archive.nptel.ac.in/courses/106/105/106105171/

COURSE ARTICULATION MATRIX [Employability Enhancement Skills (EES) - V**]**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	2	2	-	-	-	-	-	-	-	-	-
CO-2	2	2	2	-	-	-	-	-	-	-	-	-
CO-3	2	2	1	-	-	-	-	-	-	-	-	-

Social Connect and Responsibility

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – V

Course Code:	**P21UHV509**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**1:0:0**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**25+5**	**SEE Marks:**	**--**

Course Outcomes: This course will enable the students to:

- **Identify** the needs of the community and involve them in problem solving.
- **Demonstrate** the knowledge about the culture and societal realities.
- **Develop** sense of responsibilities and bond with the local community.
- **Make use** of the Knowledge gained towards significant contributions to the local community and the society at large.
- **Develop** among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions for individual and community problems.

PART-I

Plantation and adoption of a tree: Plantation of a tree that will be adopted for four years by a group of BE / B.Tech students. (ONE STUDENT ONE TREE) They will also make an excpert either as a documentary or a photo blog describing the plant's origin, its usage in daily life, its appearance in folklore and literature – Objectives, Visit, case study, report, outcomes.

PART-II

Heritage walk and crafts corner: Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms - – Objectives, Visit, case study, report, outcomes.

PART-III

Organic farming and waste management: Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus.

PART-IV

Water conservation: Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photoblog presenting the current practices – Objectives, Visit, case study, report, outcomes.

PART-V

Food walk: City's culinary practices, food lore, and indigenous materials of the region used in cooking – Objectives, Visit, case study, report, outcomes.

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Identify** the needs of the community and involve them in problem **solving.**	**Knowledge / Apply**	**L1 & L3**
CO2	**Demonstrate** the knowledge about the culture and societal realities.	**Understand**	**L2**
CO3	**Develop** sense of responsibilities and bond with the local community	**Apply**	**L4**
CO4	**Make use** of the Knowledge gained towards significant contributions to the local community and the society at large.	**Apply**	**L4**
CO5	**Develop** among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions for individual and community problems.	**Create**	**L6**

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Identify** the needs of the community and involve them in problem **solving.**	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
2	**Demonstrate** the knowledge about the culture and societal realities.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
3	**Develop** sense of responsibilities and bond with the local community.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
4	**Make use** of the Knowledge gained towards significant contributions to the local community and the society at large.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
5	**Develop** among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-

Guideline for Assessment Process:

Continuous Internal Evaluation (CIE) :

After completion of the social connect and responsibility course, the student shall prepare, with daily diary/ report as reference and a comprehensive report in consultation with the faculty/mentor to indicate what he has observed and learned in the social connect period. The report shall be evaluated on the basis of the following below criteria's or other relevant criteria pertaining to the activity completed.

- Planning and scheduling the social connect.
- Information/Data collected during the social connect.
- Analysis of the information/data and report writing.
- Presentation and interaction.

CIE Rubrics for Evaluation.

Report	Video presentation	Interaction	Total
10	05	05	20

Note:

- Video presentation of **4 to 5 min** in a team to be presented and the same to be uploaded in the department YouTube channel.
- The number of students in each team can be from **4 to 5** members.
- Each activities has to be evaluated on above basis that is [20 * 5 = 100 marks] for final total marks.

Duration : A total of 25 – 30 hours engagement per semester is required for the 5^{th} semester of the B.E./B.Tech. program. The students will be divided into groups and each group will be handled by faculty mentor.

Pedagogy – Guidelines:

Special Note: NO SEE – Semester End Exam – Completely Practical and activities based evaluation

It may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution.

Sl No	Topic	**Group size**	Location	**Activity execution**	**Reporting**	**Evaluation Of the Topic**
1.	**Plantation and adoption of a tree:**	May be individual or team	Farmers land/ parks / Villages / roadside/ community area / College campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
2.	**Heritage walk and crafts corner:**	May be individual or team	Temples / monumental places / Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
3.	**Organic farming and waste management:**	May be individual or team	Farmers land / parks / Villages visits / roadside/ community area / College campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
4.	**Water conservation:** & conservation techniques	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers / campus etc…..	site selection / proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
5.	**Food walk: Practices in society**	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty

DESIGN OF STEEL STRUCTURES

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21CV601**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students:

1. Learn the analysis and design of steel structures.
2. Understand the Codal provisions.
3. Learn different types of connections.
4. Learn the analysis and design of various components of steel structures.
5. Understand the plastic behaviour of steel structures.

UNIT – I	**Introduction to Steel Structures and Connections**	**8 Hours**

Steel Structures and Codal Specification: Advantages and Disadvantages of steel structures, Principles of Limit state method (LSM) of design, Loads and Load combinations, Design considerations, codes, specifications and section classification.

Analysis and Design of Bolted Connection: Introduction to bolted connections, Behavior of Bolted joints, Design strength of ordinary Black Bolts, Design strength of High strength friction Grip bolts (HSFG), simple Bolted connections of tension members. Efficiency of joints. Beam to Beam connections and Beam to Column framed connections.

Self-study component:	Failure criteria for steel, Pin connections

UNIT – II	**Design of Bolted and Welded Connections**	**8 Hours**

Analysis and Design of Bolted Connection: Moment resistant bracket connections, moment acting in the plane of joint, moment acting in the plane perpendicular to the joint.

Welded Connections: Introduction, Advantages and disadvantages of welded connections, types of welds, strength of welds, Design of welded connections for tension members and bracket connections.

Self-study component:	Defects in welds, Weld symbols

UNIT – III	**Design of Tension and Compression Members**	**8 Hours**

Design of Tension Members: Introduction, types of tension members, Slenderness ratio, Behaviour of tension members, Modes of failure, Design strength of tension members, Design of tension members, Lug angles.

Design of Compression Members: Introduction, Failure modes, Strength of compression members, Sections used for compression members, Slenderness ratio, Effective length of compression members, Design of single section compression members.

Self-study component:	Prying forces, Design of Tension splices

UNIT – IV	**Design of Built-Up Compression Members and Bases**	**8 Hours**

Design of Compression Members: Design of compression members- built up compression members. Design of lacing and battening system.

Design of Column Splice and Bases: Design of column splices for columns of same sections only. Design of simple slab base and gusseted base.

Self-study component:	Grillage foundation, Design concepts of column splices for different sections

UNIT – V	**Plastic Analysis and Design of Beams**	**8 Hours**

Introduction to Plastic Behaviour of Structural Steel: Introduction, Plastic theory, Plastic hinge concept and shape factors, Plastic collapse load, conditions of Plastic analysis, Theorem of Plastic analysis, and Plastic analysis of continuous beams.

Design of Beams: Introduction, Beam types and splicing in beams, lateral stability of beams, factors affecting lateral stability. Analysis and design of laterally supported and, Check for deflection.

Self-study component:	Laterally unsupported beams, Design of purlins.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	***Make use of*** the steel structure knowledge through IS codes and ***understand*** the area of applications and design principles. **(PO1, PO3, PO8, PO12, PSO1, PSO2, PSO3)**	Applying	L3
CO2	***Apply*** limit state design method for the ***analysis*** and ***design*** of connection of steel members by bolting and welding. **(PO1, PO2, PO3, PO8, PO12, PSO1, PSO2, PSO3)**	Applying and analyzing	L3 and L4
CO3	***Evaluate*** axial tension, compression, bending moment and shear forces in steel members and also to ***outline*** and ***apply*** the concepts of plastic behavior of steel members for the plastic analysis of structural system. **(PO1, PO2, PO3, PO12, PSO1, PSO2, PSO3)**	Evaluating	L5
CO4	***Apply*** limit state design method for the ***analysis*** and ***design*** of tension members, compression members and flexural members in steel structures. (**PO1, PO2, PO3, PO4, PO8, PO12, PSO1, PSO2, PSO3)**	Applying and analyzing	L3 and L4

Text Book:

1. N. Subramanian, "Design of Steel Structures", Oxford, IBH.
2. Duggal. S.K., "Design of Steel structures", Tata McGraw-Hill Education, 2000.
3. Dr. B.C. Punmia and Jain and Jain ,"Design of Steel Structures", Laxmi Publications.

Reference Book:

1. Dr. Ramchandra & Virendra Gehlot, "Design of Steel Structures", Scientific Publishers.
2. Prof. V. L. Shah and Prof. Veena Gore **"**Design of steel structure", Structure Publication, Standard Publishers and Distributors.
3. Relevant Indian Standard Code books-IS 800-2007: General Construction in Steel Code Practice (Third revision), Bureau of Indian Standards, New Delhi., SP 6(1)-1984 or Steel Table.

Web and Video link(s):

1. Introduction to steel structures by Prof. Damodar Maity, IIT Kharagpur: https://nptel.ac.in/courses/105105162
2. Design of connections by Prof. Damodar Maity, IIT Kharagpur: https://nptel.ac.in/courses/105105162
3. Design of tension members by Prof. Damodar Maity, IIT Kharagpur: https://nptel.ac.in/courses/105105162
4. Design of Compression members by Prof. Damodar Maity, IIT Kharagpur: https://nptel.ac.in/courses/105105162
5. Design of steel beams by Prof. Damodar Maity, IIT Kharagpur: https://nptel.ac.in/courses/105105162

E-Books/Resources:

1. Design of Steel structures by Lingyu Zhou, https://www.elsevier.com/books/design-of-steel-structures/zhou/978-0-323-91682-0
2. Design of Steel structures by Elias G.Abu Saba, https://link.springer.com/book/10.1007/978-1-4615-2079-5
3. The Behaviour and Design of Steel Structures to EC3 By N.S. Trahair, M.A. Bradford, David Nethercot, Leroy Gardner, https://doi.org/10.1201/9781315273518

COURSE ARTICULATION MATRIX
(DESIGN OF STEEL STRUCTURES - P21CV601)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		2					1				2	2	1	1
CO2	2	1	2					1				2	2	2	1
CO3	1	2	2									2	2	2	1
CO4	1	2	2	2				1				2	2	2	1
3-HIGH, 2-MEDIUM, 1-LOW															

ADVANCED DESIGN OF RC STRUCTURES – P21CV6021

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21CV6021**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3: 0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand, analyse and design reinforced concrete grid floors
- Understand, analyse and design reinforced concrete flat slabs
- Understand, analyse and design reinforced circular overhead water tank
- Understand, analyze and design reinforced concrete Silo
- Understand, analyze and design reinforced concrete retaining wall

UNIT – I	**Design of grid floors**	**08 Hours**

Introduction, grid floor systems, analysis of the slabs for moment and shears by Rankine's method and Design of floors using approximate method- Rankine's method.

Self-study component:	Students shall compare the grid floor with conventional beam slab systems, prepare a report, and submit the same.

UNIT – II	**Design of flat slabs**	**08 Hours**

Introduction, Proportioning of flat slab, design strips, analysis of flat slabs-Direct design method-Limitations of Direct design method, Distribution of moments in column strips and middle strip-Shear in Flat slabs. Design of flat slab (interior panel) with and without drop.

Self-study component:	Students shall visit construction sites or buildings providing flat slabs, prepare a report, and submit the same. Detailing of flat slab as per IS: 456-2000.

UNIT – III	**Design of RCC overhead circular water tanks**	**08 Hours**

Introduction, design requirements as per IS: 3370, components of circular elevated water tank, analysis and design of top dome, top ring beam, side walls of water tank and bottom slab.

Self-study component:	Analysis of bottom ring beam and Foundations details.

UNIT – IV	**Design of silos**	**08 Hours**

Introduction – storage bins-silos, bin loads, analysis of bins using Janssen's theory and Airy's theory-Design requirements- design of silos with circular cross sections using Janssen's theory.

Self-study component:	Students shall compare the horizontal pressures using Janssen's theory and Airy's theory, prepare a report, and submit the same.

UNIT – V	**Design of Retaining walls**	**08 Hours**

Introduction, types of retaining walls, design principles of cantilever retaining wall, design of Cantilever Retaining Wall

Self-study component:	Design of Counter Fort Retaining Wall.

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Analyze** and **Design** grid floor (PO3, PO6, PO7,PO8, PO12, PSO1,PSO2, PSO3)	Creating	L6
CO2	**Analyze** and **Design** flat slab **(**PO3, PO6, PO7,PO8, PO12, PSO1,PSO2, PSO3)	Creating	L6
CO3	**Analyze** and **Design** water tank components(PO3, PO6, PO7,PO8, PO12, PSO1,PSO2, PSO3)	Creating	L6
CO4	**Analyze** and **Design** silos(PO3, PO6, PO7,PO8, PO12, PSO1,PSO2, PSO3)	Creating	L6
CO5	**Analyze** and **Design** retaining walls(PO3, PO6, PO7,PO8, PO12, PSO1,PSO2, PSO3)	Creating	L6

Text Book(s):

1. Advanced Reinforced Concrete Design, Krishnaraju N., CBI Publishers, New Delhi
2. Advance R.C.C. Design, S.S.Bhavikatti ., NEW AGE Publishers, New Delhi
3. B.C. Punmia, Ashok Kumar Jain & Arun kumar Jain, Limit State Design of Reinforced Concrete, Laxmi Publication, New Delhi, India.

Reference Book(s):

1. Reinforced Concrete Design, Unnikrishna Pillai and Devadas Menon, Tata McGraw Hill Publishing Company Limited, New Delhi.
2. Reinforced Concrete Structures, Shah H.J., Charotar Publishers, Anand.
3. IS: 456 - 2000, "Plain and Reinforced Concrete - Code of Practice", New Delhi 110002.
4. IS: 3370 (Parts I to IV), "Code of Practice for Concrete Structures for the Storage of Liquids, New Delhi 110002.
5. IS: 4995-1974, "Criteria for Design of Reinforced Concrete Bins for Storage of Granular and Powdery Materials", New Delhi.
6. SP16:1980, Design Aids for Reinforced Concrete to IS: 456-1978, Bureau of Indian Standards, New Delhi, 1992

Web and Video link(s):

1. https://www.youtube.com/watch?v=PH0SSG7io3Q
2. https://www.youtube.com/watch?v=t8oI0lKZ7sE
3. https://www.youtube.com/watch?v=CtPeNz2bIGQ

E-Books/Resources:

1. https://www.google.co.in/books/edition/Advance_R_C_C_Design_R_C_C_Volume_Ii/a8bUTe3u-YoC?hl=en&gbpv=1&dq=Advanced+RCC&printsec=frontcover
2. https://www.google.co.in/books/edition/ADVANCED_REINFORCED_CONCRETE_DESIGN/uXqXP6pEEsUC?hl=en&gbpv=1&dq=Advanced+RCC&printsec=frontcover

COURSE ARTICULATION MATRIX (ADVANCED DESIGN OF RC STRUCTURES-P18CV6021)															
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			2			2	2	2				2	1	2	2
CO2			2			2	2	2				2	1	2	2
CO3			2			2	2	2				2	1	2	2
CO4			2			2	2	2				2	1	2	2
3-HIGH, 2-MEDIUM, 1-LOW															

PAVEMENT MATERIALS AND CONSTRUCTION

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21CV6022**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Expose students to different materials which are used in pavement construction, impart knowledge about the engineering properties required.
- To train students to perform various types of bituminous mix designs as per the guidelines (MoRTH).
- Student will get knowledge about different highway construction equipment with their suitability and adaptability in various field scenarios.
- Expose students to construction practice and quality control aspects of embankment, flexible and rigid pavement as per the required specifications (MoRTH).
- To introduce students to possible improvisation in various layers of pavement to increase the structural strength by the use of non-basic materials (DLC, polythene sheets).

UNIT – I	**Pavement Materials**	**8 Hours**

Aggregates: Origin, Classification, Requirements, properties and tests on Road aggregates, Concepts of size and gradation- design gradation, maximum aggregate size, aggregate blending by different methods to meet specification.

Bituminous Binders: Origin, Preparation, Properties and Chemical Constitution of bituminous road binders, Requirements.

Bituminous Emulsion and Cutbacks: Preparation, Characteristics, uses and test. Adhesion of bitumen binders to road aggregates, Adhesion failure, Mechanism of stripping, tests and methods of improving adhesion.

Self-study component:	Aggregate mineralogy and importance, bitumen rheology: DSR parameters for bitumen testing. Crude field test, Anionic (IS: 3117) and Cationic (IS: 8887) emulsion uses.

UNIT – II	**Bituminous Mixes**	**8 Hours**

Mechanical properties, dense and open textured mixes, flexibility and brittleness, (No Hveem stabilometer and Hubbard- field tests) bituminous mixes, Design methods using Rothfutch's method only and specification, Marshall mix design, volumetric properties, Numerical Problems.

Self-study component:	Super pave mix design, cold and warm mix asphalt.

UNIT – III	**Cement concrete, Recycled and Alternate Materials**	**8 Hours**

Cement and Cement concrete: Material requirement for DLC and PQC, Admixtures, Temp Reinforcement, materials for joints construction, Fibers.

Recycled and Alternate Materials: Use of RAP, RCA, Fly ash, Blast furnace Slag, waste plastic, etc. in sustainable pavement construction

Self-study component:	Mineral admixtures and stabilizers

UNIT – IV	Highway Construction	8 Hours

Equipment in highway construction: Various types of equipment for excavation, grading and compaction their working principles, advantages and limitations, Special equipment for bituminous and cement concrete pavement and stabilized soil road construction.

Sub grade: Earthwork grading and Construction of embankments and cuts for roads, Preparation of subgrade, quality control tests**.**

Self-study component:	Components of equipment planning process, Plan for equipment utilization – Equipment loading diagram.

UNIT – V	Flexible and Rigid Pavements	8 Hours

Flexible Pavements: Specifications of materials, Construction method and field control checks for various types of flexible pavement layers.

Cement Concrete Pavements: Specifications and method of cement concrete pavement construction (PQC, DLC, White topping, Quality control tests, Construction of various types of joints.

Self-study component:	Prime coat, Tack coat and Seal coat

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	***Evaluate*** and assess the suitability of any pavement material to be used in various components of pavement by conducting required tests as per IS, IRC specifications. **(PO2, PSO1)**	Evaluating	L5
CO2	***Formulate*** the proportions of different sizes of aggregates to suit gradation criteria for various mixes as per MORTH and also design bituminous mixes. **(PO3, PSO2)**	Creating	L6
CO3	***Discover*** suitable modern technique and equipment for speedy and economic construction. **(PO2, PO5, PSO2)**	Analyzing	L4
CO4	***Execute*** the construction of embankment, flexible, rigid pavement and perform required quality control tests at different stages of pavement construction. **(PO4, PSO2)**	Evaluating	L5

Text Book:

1. Highway Engineering- Khanna, S.K., and Justo, C.E.G.: Nem Chand and Bros. Roorkee.
2. Construction Equipment and its Management- Sharma, S.C.: Khanna Publishers.
3. Hot Mix Asphalt Materials, Mixture Design and Construction- Freddy L. Roberts, Kandhal, P.S: University of Texas Austin, Texas. NAPA Education Foundation Lanham, Maryland.

Reference Book:

1. RRL, DSIR, 'Bituminous Materials in Road Construction', HMSO Publication.
2. RRL, DSIR, 'Soil Mechanics for Road Engineers', HMSO Publication.
3. Relevant IRC codes and MoRT&H specifications.

Web and Video link(s):

1. Introduction to Mineral Aggregates: Origin and Types: https://www.youtube.com/watch?v=eDpZ1qSJgVE&list=PLLy_2iUCG87CHFdFEAVGc2iISoF9DD554&index=12
2. Aggregates Shape and Surface Texture: https://www.youtube.com/watch?v=Qy0Gqnv2T0I&list=PLLy_2iUCG87CHFdFEAVGc2iISoF9DD554&index=17
3. Classification and Gradation of Aggregates (Part 1): https://www.youtube.com/watch?v=1tTD-ZhT9k4&list=PLLy_2iUCG87CHFdFEAVGc2iISoF9DD554&index=14
4. Bitumen Basics: https://www.youtube.com/watch?v=RVjM79uAyTI&list=PLLy_2iUCG87CHFdFEAVGc2iISoF9DD554&index=22
5. Physical Properties of Bitumen (Part 1): https://www.youtube.com/watch?v=_4ud_O-kVTc&list=PLLy_2iUCG87CHFdFEAVGc2iISoF9DD554&index=24
6. Physical Properties of Bitumen (Part-2): https://www.youtube.com/watch?v=BmFnttJPZ6g&list=PLLy_2iUCG87CHFdFEAVGc2iISoF9DD554&index=25
7. Pavement Materials-1(Part-1): https://www.youtube.com/watch?v=XOyusu4QC8s
8. Marshall Method of Bituminous Mix Design, Flow Stability Analysis, Volumetric Analysis: https://www.youtube.com/watch?v=G8hrchzKh3U&t=6s

E-Books/Resources:

1. https://www.tandfonline.com/doi/full/10.1080/10298436.2020.1821024
2. https://www.tandfonline.com/doi/full/10.1080/10298436.2020.1825711
3. https://www.researchgate.net/publication/344269877_ScienceDirect_Utilization_of_Plastic_waste_in_Bitumen_Mixes_for_Flexible_Pavement_Utilization_of_Plastic_waste_in_Bitumen_Mixes_for_Flexible_Pavement
4. https://www.elsevier.com/books/sustainable-construction-materials/dhir/978-0-08-100985-7
5. https://www.sciencedirect.com/science/article/pii/S2095756422000757
6. https://www.sciencedirect.com/science/article/pii/S2095756422000770

COURSE ARTICULATION MATRIX
(PAVEMENT MATERIALS AND CONSTRUCTION- P21CV6022)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2											1		
CO2			2											2	
CO3		2			1									2	
CO4				2										2	

3-HIGH, 2-MEDIUM, 1-LOW

REINFORCED EARTH STRUCTURES [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	**P21CV6023**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Create an understanding of the latest technique such as reinforcing the soil.
- Analyze the concept of RE so as to ascertain stability of RE structures
- Understand the different reinforcing materials that can be used efficiently in soils.
- Understand design concepts of different RE structures including introductory concepts of Foundations resting of RE soil bed

UNIT – I	**Introduction to Reinforced Earth Structures**	**8 Hours**

Basics of Reinforced Earth Construction: Definition, Historical Background, Components, Mechanism-Equal Confining and Psuedo Cohesion Concepts, Advantages and Disadvantages of reinforced earth Construction, Sandwich technique for clayey soil.

Geo-synthetics and their Functions: Manufacturing process woven & non-woven, Raw materials, Classification based on materials type – Metallic and Non-metallic, Natural and Man-made.

Geo-synthetics Material Properties: Physical, Chemical, Mechanical, Hydraulic, Endurance and Degradation requirements

Self-study component:	Historical developments, Recent developments of Geo-synthetic materials, Testing & Evaluation of properties for Geo-synthetics.

UNIT – II	**Reinforced Retaining Wall & Soil Nailing**	**8 Hours**

Design of Reinforced Earth Retaining Walls: Concept of Reinforced earth retaining wall, Components with selection of materials, Construction sequence, General concepts of internal and external stability and simple numerical stability checking problems.

Soil Nailing Techniques: Concept, Methods of soil nailing, Construction sequence, Components of system, Advantages & limitations of soil nailing techniques, Comparison of soil nailing with reinforced soil.

Self-study component:	Design aspects and precautions to be taken for Reinforced earth retaining wall.

UNIT – III	**Reinforced Earth Foundations**	**8 Hours**

Design of Reinforced Earth Foundations: Determination of force induced in reinforcement ties – Location of failure surface, tension failure and pull out resistance, length of tie and its curtailment, Bearing capacity improvement in soft soils, General guidelines on the use of geo-grids in foundations and Numerical problems

Self-study component:	Modes of failures in foundation and Applications of Reinforced Soil Beds.

UNIT – IV	Geo-synthetics for Roads and Slopes	8 Hours

Geo-synthetics for Roads: Applications to Temporary and Permanent roads, Role of Geo-synthetic in enhancing properties of road, Control of mud pumping, Enhancing properties of subgrade.

Geo-synthetics for Slopes: Design requirements for Slopes, Improvement of slope stability with Geo-synthetic, Slope drainage system design and requirements, Construction technique.

Self-study component:	Causes of Slope failures and Analysis of reinforced soil slope stability.

UNIT – V	Filtration and Landfills	8 Hours

Filter & Drain: Conventional granular filter design criteria, Geo-synthetic filter design requirements, Properties, Design criteria – soil retention, Geo-synthetic permeability, Anti-clogging, Survivability and Durability (No Numerical Problems).

Landfills: Typical design of Landfills – Landfill liner & cover, EPA Guidelines, Barrier walls for existing landfills and abandoned dumps (No Numerical Problems)

Self-study component:	Application of Drain and filter, ill-effects of landfills site to environment.

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Understand** the concepts of Geo-synthetic materials used in earth structures and concept Soil Nailing. **(PO1, PSO1)**	Understanding	L2
CO2	**Analyze** and **Identify** the reinforced earth techniques that are suitable for different soils and in different structures. **(PO2, PO5, PSO2)**	Analyzing	L4
CO3	**Apply** the knowledge of geosynthetics in construction of reinforced roads and slopes. (**PO1, PSO1)**	Applying	L3
CO4	**Evaluate** the parameters used in **Design** of Reinforced Earth retaining walls, Reinforced Earth foundations, filter and landfill.**(PO3, PO4, PSO2)**	Evaluating	L5

Text Book:

1. Design with Geo-synthetics, Koerner. R.M, Prince Hall Publications.
2. Construction and Geotechnical Engineering using synthetic fabrics, Koerner. R.M. &Wesh, J.P, Wiley Inter Science, New York.
3. An introduction to Soil Reinforcement and Geo-synthetics, SivakumarBabu G. LUniversities Press, Hyderabad.
4. Reinforced Soil and its Engineering Applications, Swami Saran, I. K. International Pvt. Ltd, New Delhi.
5. Engineering with Geo-synthetics, Venkattappa Rao, G., & Suryanarayana Raju., G. V.S, Tata McGraw Hill publishing Company Limited., New Delhi.
6. Construction and Geotechnical Engineering using synthetic fabrics, Koerner. R.M. & Wesh, J.P, Wiley Inter Science, New York.

Reference Book:

1. Earth reinforcement and Soil structure, Jones, CJEP Butterworths, London.
2. Geotextile Hand Book, Ingold, T.S. & Millar, K.S, Thomas, Telford, London.
3. Earth Reinforcement Practices, Hidetoshi Octial, Shigenori Hayshi & Jen Otani, Vol. I, A.A. Balkema, Rotterdam.
4. Ground Engineer's reference Book, Bell F.G, Butterworths, London.
5. Geosynthetics in Civil Engineering, Sarsby R W- Editor, Woodhead Publishing Ltd & CRC Press, 2007

Web and Video link(s)

1. Civil-Geosynthetic Engineering: In theory and Practice(Playlist): https://www.youtube.com/watch?v=4TM7NZsChMk&list=PLbMVogVj5nJS1KOuK7lTZBg48hBFcLmaY
2. Introduction to Reinforced Earth: https://www.youtube.com/watch?v=ijwi_gzcESM&list=PLbMVogVj5nJS1KOuK7lTZBg48hBFcLmaY&index=2
3. An Overview of Geosynthetics: https://www.youtube.com/watch?v=0KGDf1-lf10&list=PLbMVogVj5nJS1KOuK7lTZBg48hBFcLmaY&index=6
4. Geosynthetic properties and test methods: https://www.youtube.com/watch?v=skQMuCNJxNQ&list=PLbMVogVj5nJS1KOuK7lTZBg48hBFcLmaY&index=10
5. Geosynthetics in Filteration, drainage and erosion control: https://www.youtube.com/watch?v=ssska2Tl11o&list=PLbMVogVj5nJS1KOuK7lTZBg48hBFcLmaY&index=15
6. Geosynthetic in Pavements: https://www.youtube.com/watch?v=2ImpEVHGU1k&list=PLbMVogVj5nJS1KOuK7lTZBg48hBFcLmaY&index=20
7. Geosynthetic for Reinforced Soil retaining walls: https://www.youtube.com/watch?v=jT5C-6rNZIA&list=PLbMVogVj5nJS1KOuK7lTZBg48hBFcLmaY&index=26
8. Geosynthetic for steep slopes: https://www.youtube.com/watch?v=SUiTcHV2paQ&list=PLbMVogVj5nJS1KOuK7lTZBg48hBFcLmaY&index=36
9. Geosynthetic for embankments on soft foundations: https://www.youtube.com/watch?v=eyCR8kZ7grw&list=PLbMVogVj5nJS1KOuK7lTZBg48hBFcLmaY&index=40
10. Geosynthetic for ground improvements: https://www.youtube.com/watch?v=-mQlyTomB3c&list=PLbMVogVj5nJS1KOuK7lTZBg48hBFcLmaY&index=43
11. Geosynthetic for improvement in Bearing Capacity: https://www.youtube.com/watch?v=CIqOsuOtq1o&list=PLbMVogVj5nJS1KOuK7lTZBg48hBFcLmaY&index=50
12. Design of geosynthetic for landfills: https://www.youtube.com/watch?v=XxKW7kbhW5I&list=PLbMVogVj5nJS1KOuK7lTZBg48hBFcLmaY&index=53

E-Books/Resources:

1. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/reinforced-soil
2. https://www.sciencedirect.com/science/article/pii/S003808062031475X
3. https://www.sciencedirect.com/science/article/pii/0266352X9599214C
4. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/soil-reinforcement
5. https://www.elsevier.com/books/earth-reinforcement-and-soil-structures/jones/978-0-408-03549-1
6. https://www.taylorfrancis.com/chapters/edit/10.1201/9780203739600-69/design-method-steel-grid-reinforced-earth-structure-considering-bearing-resistance-matsui-nabeshima-zhou-ogawa
7. https://www.springer.com/journal/40891
8. https://www.sciencedirect.com/science/article/pii/S0038080621001773
9. https://www.researchgate.net/publication/37408178_Earth_Reinforcement_and_Soil_Structures
10. https://www.academia.edu/40325571/Earth_Reinforcement_and_Soil_Structures
11. https://trid.trb.org/view/190611.
12. https://www.pdfdrive.com/reinforced-soil-retaining-walls-design-and-construction-e62255074.html
13. https://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_290.pdf

COURSE ARTICULATION MATRIX
(REINFORCED EARTH STRUCTURES - P21CV6023)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2		2			1									2	
CO3		2											2		
CO4			2	1										2	
3-HIGH, 2-MEDIUM, 1-LOW															

DESIGN OF HYDRAULIC STRUCTURES AND GROUND WATER HYDROLOGY

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21CV6024**	**Credits:**	**03**
Teaching Hours/Week (L:T:P)	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand the various types of dams, its uses, suitability and functions.
- Evaluate the stresses generated in gravity dams and design of apron on impervious floor on pervious foundation.
- Explain the occurrence and aquifer parameters pertaining to groundwater.
- Analyze the steady radial flow in confined / unconfined aquifers and to select a particular type of well and augment the ground water storage.

UNIT – I	**Reservoir Planning**	**08 Hours**

Reservoirs: Introduction, types, Investigations, Storage zones of a reservoir, Mass Inflow and Mass Demand curves. Capacity of reservoir. Reservoir sedimentation.

Dams: Introduction, types, Selection of type of dam, Economical height of dam. Situation of Dams in Indian context.

Self-study component:	Rehabilitation of dams. Geophysical methods to assess dam health.

UNIT – II	**Gravity Dams and Earthen Dams**	**08 Hours**

Gravity Dams: Introduction, forces acting on the gravity dam, causes of failure, design principles, principal and shear stresses. Elementary profile and practical profile of a gravity dam. Simple problems on stresses. Galleries in dam.

Earthen Dams: Introduction, types, Design principles, causes of failure of earthen dams.

Self-study component:	Joints and seals in gravity dams. Stability analysis of Earthen dams.

UNIT – III	**Diversion Head Works and Impervious floor**	**08 Hours**

Diversion Head Works: Weirs and Barrages, Layout of a typical drainage head works and its components. Design of impervious floor on pervious foundation. Bligh's creep theory and Lane's weighted creep theory. Khosla's theory.

Self-study component:	Listing down the various drainage head works in and around with their uses.

UNIT – IV	**Occurrence and Movement of Ground Water**	**08 Hours**

Ground Water: Importance, vertical distribution of subsurface water, definitions- aquifers, aquifuge aquitard, aquiclude, confined and Unconfined aquifers.

Aquifer Parameters: Specific yield and specific retention, porosity, storage coefficient, derivation of the expression, Darcy's law, hydraulic conductivity, coefficient of permeability and intrinsic permeability, transmissibility, Numerical problems.

Self-study component:	Groundwater occurrence in different types of rocks and soils.	
UNIT – V	**Well Hydraulics**	**08 Hours**
Steady-radial flow into confined and unconfined aquifers. Numericals. Types of wells, methods of construction, Yield of an open well. Pumping test. Numerical Problems.		
Self-study component:	Ground Water Exploration: Seismic method, electrical resistively method.	

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	***Apply*** the concepts of water resources and hydrology in **understanding** Design of Hydraulic structures and ground water. **(PO1, PSO1)**	Applying	L3
CO2	***Evaluating*** the various stresses developed in gravity dam and ***assessing*** the method in designing the apron on pervious foundation. **(PO2, PSO2)**	Evaluating	L5
CO3	***Analyze*** the groundwater movement in steady radial flow conditions. **(PO2, PSO2)**	Analyzing	L4
CO4	***Apply*** the concepts of groundwater in ***choosing*** the types of well adopted and their test in augmenting the groundwater draft. **(PO1, PSO1)**	Applying	L3

Text Book:

1. Santosh Kumar Garg – Irrigation Engineering and Hydraulic Structures, Khanna Publications, Vol. 2, New Delhi.
2. Dr. P N Modi – Irrigation Water Resources and Water Power Engineering, Standard Book House, 11th Edition, New Delhi.
3. H.M. Raghunath, "Ground Water", Wiley Eastern Publication, New Delhi.
4. K. Todd, "Ground Water Hydrology", Wiley and Sons, New Delhi.

Reference Book:

1. R S Varshney – Concrete Dams, Oxford & IBH Publications, 1978.
2. Creager, Justin, Hinds. - Engineering for Dams (Volume-I, II and III) – Wiley India Publications.
3. Satyanarayana Murthy, C, "Design of Minor Irrigation and Canal Structure", Wiley Eastern, 1990.
4. W. C. Walton, "Ground Water Resources and Evaluation" McGraw Hill, Delhi.
5. K. Subramanya – Engineering Hydrology. McGraw Hill Education, 4th Edition, New Delhi.
6. P. Jaya Rami Reddy - A Textbook of Hydrology, Lakshmi Publications, 3rd Edition, New Delhi.

Web and Video link(s):

1. Dams: https://www.youtube.com/watch?v=T3vBYTuAXtI
2. Diversion head works: https://www.youtube.com/watch?v=9Y74s2a8GKo
3. Occurrence and Movement of Ground Water : Origin and Age of Ground Water : https://www.youtube.com/watch?v=IkzyeE035M4&list=PLQ4eLmRBCHoxGQ5Sx_pc08_rhbyxSP3Zr&index=5
4. Steady Radial flow into wells: https://www.youtube.com/watch?v=AOWjiXXkUcc&list=PLQ4eLmRBCHoxGQ5Sx_pc08_rhbyxSP3Zr&index=37
5. Surface Investigation of ground water: https://www.youtube.com/watch?v=rDQcGWbS3Ro&list=PLbMVogVj5nJQrSFlE4ZUl-Uu1NQJIDTvm&index=17

E-Books/Resources:

1. https://link.springer.com/book/10.1007/978-3-662-47331-3

2. http://www.freeengineeringbooks.com/Civil/Design-Of-Hydraulic-Structure-Books.php

COURSE ARTICULATION MATRIX
(DESIGN OF HYDRAULIC STRUCTURES AND GROUND WATER HYDROLOGY-P21CV6024)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2		2												2	
CO3		2												2	
CO4	2												2		

3 – HIGH, 2 – MEDIUM, 1 - LOW

EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21CV6031**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3: 0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Fundamentals of engineering seismology.
- Irregularities in building which are detrimental to its earthquake performance.
- Different methods of computation of seismic lateral forces for framed and masonry structures.
- Earthquake resistant design requirements for RCC and Masonry structures
- Relevant clauses of IS codes of practice pertinent to earthquake resistant design of structures.

UNIT – I	**Seismology**	**8 Hours**

Seismic Hazard Assessment - Engineering Seismology: Definitions, Classification of Earthquakes, Causes of Earthquakes, Internal structure of earth, Seismic waves, Theory of plate tectonics and seismic zoning of India, Intensity of earthquake and Magnitude of earth quake, Seismographs. **Effect of structural irregularities** - Lessons Learnt from Past Earthquakes on the Performance of the Buildings, Effect of Structural Irregularities on seismic performance of RC buildings-Vertical irregularity and plan configuration problems.

Self-study component:	Local site effects, Torsional response of buildings.

UNIT – II	**Seismo-Resistant Buildings and Detailing of Masonry structures**	**8 Hours**

Seismo-resistant buildings – Different types of lateral load resistant systems, building configuration, Building characteristics, quality of construction and materials-quality of concrete, construction joints as per IS codes.

Earthquake Resistant Detailing of Masonry Structures - Elastic Properties of Structural Masonry – Materials for masonry construction, Elastic properties of masonry assemblage – compressive strength, flexural tensile strength, shear strength, lateral load analysis.

Self-study component:	IITK- BMTPC Earthquake Tips

UNIT – III	**Seismic Analysis of RC Building**	**8 Hours**

Seismic analysis of RC building: Philosophy and principle of Earthquakes Resistant Design, Guidelines for Earthquakes Resistant Design, Structural system, types of buildings for seismic resistance, Equivalent lateral force procedure and dynamic analysis procedure, Evaluation of Earthquake forces as per IS: 1893:(part-I)-2016.

Self-study component:	Time history analysis

UNIT – IV	**Earthquake Resistant Design of RC Structures**	**8 Hours**

Earthquake Resistant Design of RC Buildings – Ductility Considerations Introduction, Impact of ductility, requirement for ductility, Assessment of ductility, factors affecting ductility, Ductile detailing of RC structures.

Self-study component:	Confinement of concrete, special confining reinforcement, damages and non damages to masonry building from past earthquakes.	
UNIT – V	**Seismic Base Isolation and Retrofitting**	**8 Hours**

Seismic Base Isolation and Retrofitting: Basic concept of seismic base isolation, Active and passive control methods, Seismic retrofitting strategies of RC and Masonry buildings.

Self-study component:	Necessity of seismic evaluation, Methods of seismic evaluation.

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Understand** the basic knowledge of earth quakes and it's relation to structural systems. **(PO1, PO2, PSO1, PSO2)**	**Understanding**	L2
CO2	**Apply** the knowledge of engineering to conceptually design of structural systems against earthquakes. **(PO1, PO3, PSO1, PSO2)**	**Apply**	L3
CO3	**Analyze** RC frame structures for seismic loads by Equivalent lateral force method using IS-1893 procedures. **(PO2, PO3, PSO1, PSO2)**	**Analyze**	L4
CO4	**Understand** the ductile detailing of RC building, concept of base isolation and retrofitting strategies of RCC and Masonry structure. **(PO1, PO4, PSO1, PSO3)**	**Understanding**	L2

Text Book:

1. Pankaj Agarwal and Manish Shrikhande, Earthquake resistant design of structures, PHI, India.
2. S.K.Duggal, Earthquake resistant design of structures, Oxford university press, 2007.
3. S. R. Damodaraswamy and S. Kavitha, Basics of Structural Dynamics and Aseismic design, PHI Learning Private Limited, New Delhi.
4. T. K. Datta, "Seismic Analysis of Structures", John Wiley & Sons (Asia) Ltd.

Reference Book:

1. Anil K. Chopra, "Dynamics of Structures: Theory and Applications to Earthquake Engineering", Pearson Education, Inc.
2. David Dowrick, "Earthquake resistant design and risk reduction", John Wiley and Sons Ltd.
3. C. V. R. Murty, Rupen Goswami, A. R. Vijaya Narayanan & Vipul V. Mehta, "Some Concepts in Earthquake Behaviour of Buildings", Published by Gujarat State Disaster Management Authority, Government of Gujarat.
4. IS: 1893- 2016, Indian Standard Criteria for Earthquake Resistant Design of Structures, Part-1, BIS, New Delhi.
5. IS: 13920 - 2016, Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces, BIS, New Delhi.
6. IS: 4326 - 2013, Earthquake Resistant Design and Construction of Buildings, BIS, New Delhi.
7. IS: 13828 - 1993, Indian Standard Guidelines for Improving Earthquake Resistance of Low Strength Masonry Buildings, BIS, New Delhi.
8. IS: 3935- 1993, Repair and Seismic Strengthening of Buildings-Guidelines, BIS, New Delhi.

Web and Video link(s):

1. www.nicee.org
2. www.eeri.org
3. www.gsdma.org
4. www.ndma.gov.in
5. www.nptel.iitm.ac.in/courses/
6. www.nisee.berkeley.edu/elibrary/getpkg?id=NONLIN
7. Introduction to Earthquake Engineering: https://www.youtube.com/watch?v=J1aW2VImhcQ
8. 8. Building Construction Design Principles **:** https://www.youtube.com/watch?v=5yWFortTL3o

E-Books/Resources:

1. https://www.google.co.in/books/edition/EARTHQUAKE_RESISTANT_DESIGN_OF_STRUCTURE/2_7PzFQVmV0C?hl=en&gbpv=1&dq=EARTHQUAKE+RESISTANT+DESIGN+OF+STRUCTURES&printsec=frontcover
2. https://www.google.co.in/books/edition/Earthquake_Resistant_Design_of_Structure/oB2xmgEACAAJ?hl=en
3. https://www.sciencedirect.com/science/article/pii/S0267726120301834
4. https://www.sciencedirect.com/science/article/pii/S2214785322070638

COURSE ARTICULATION MATRIX
(EARTHQUAKE RESISTANT DESIGN OF STRUCTURES – P21CV6031)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2	2	
CO2	2		2										2	2	
CO3		2	2										2	2	
CO4	2			2									2		2
3-HIGH, 2-MEDIUM, 1-LOW															

PAVEMENT ANALYSIS AND DESIGN [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	**P21CV6032**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Gain knowledge of science and engineering to acquire the fundamentals of various factorsaffecting design and performance of pavements.
- Calculate the stresses and deflection in flexible pavements and rigid pavements.
- Design of flexible and rigid pavements by IRC method.

UNIT – I	**Introduction**	**8 Hours**
Types of pavements, component parts and functions of individual layers of flexible pavement and rigid pavement. Factors affecting pavement design, variables considered in pavement design, classification of axle types, tire pressure, contact pressure, ESWL concept, lane distributions & vehicle damage factors.		
Self-study component:	Effect of moving loads.	
UNIT – II	**Stresses and Deflections in Flexible Pavements**	**8 Hours**
Stresses and deflections in homogenous mass (single layer system), two-layer theory, three layer and application of two layer theory in flexible pavement design. Numerical problems.		
Self-study component:	Multilayer theories concept.	
UNIT – III	**Flexible Pavement Design**	**8 Hours**
Design approach of empirical, semi - empirical and theoretical design method, design steps, advantages and applications of different pavement design methods - CBR, McLeod, and IRC. Numerical problems.		
Self-study component:	Group index method.	
UNIT – IV	**Stresses in Rigid Pavements**	**8 Hours**
Factors affecting design and performance of cc pavements. Stresses in rigid pavement: types of stresses and causes, Westergaard's analysis, wheel load stresses, warping stresses, frictional stresses, and combined stresses. Numerical problems.		
Self-study component:	Modified equation for wheel load stresses	
UNIT – V	**Rigid Pavement Design**	**8 Hours**
Types of joints in cement concrete pavements and their functions, longitudinal joints, transverse joints, joint spacing, design of CC pavement as per IRC guidelines, dowel bars: function and design, tie bars: function and design. Numerical problems.		
Self-study component:	Sustainability concepts in pavement design, Design of Concrete overlay (white topping)	

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	Understand the basic terminology and various factors affecting design and performance of pavements	Understanding	L2
CO2	Illustrate stresses and strains in flexible pavements & rigid pavements	Understanding	L2
CO3	Design flexible pavement and rigid pavement	Creating	L6
CO4	Analyze the stresses in rigid pavements and design of joints.	Analyzing	L4

Text Book(s):

1. Khanna and Justo, 'Test Book of Highway Engineering' Nemchand brothers, Roorke - 2004
2. Yoder, E.J., and Witczak, `Principles of Pavement Design', 2nd ed. John Wiley and Sons.
3. Yang, `Design of Functional Pavements', McGraw Hill Book Co.

Reference Book(s):

1. Relevant IRC codes
2. Principles of Transportation Engineering - Partha Chakra Borthy, Prentice- Hall.
3. SubhaRao, "Principles of Pavement Design".
4. R Srinivasa Kumar, "Pavement Design", University Press.

Web and Video link(s):

Introduction: http://nptel.iitm.ac.in

Stresses and Deflections in Flexible Pavements: https://www.youtube.com/watch?v=a-2XUcbdJiw

Flexible Pavement Design: https://www.youtube.com/watch?v=uJntLOgEHD4

Stresses in Rigid Pavements: https://www.youtube.com/watch?v=UcVGsxyQlTE

Rigid Pavement Design: https://www.youtube.com/watch?v=GxXONAINMBE

E-Books/Resources:

https://nptel.ac.in/courses/105104098

https://www.sciencedirect.com/science/article/pii/S1877705815034281

https://www.sciencedirect.com/science/article/pii/S0266352X19303027

https://www.sciencedirect.com/science/article/pii/S2214391222000137

COURSE ARTICULATION MATRIX
(PAVEMENT ANALYSIS AND DESIGN- P21CV6032)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2	2											2		
CO3		2	2										2	2	
CO4	2	2	1										2	2	

3-HIGH, 2-MEDIUM, 1-LOW

GROUND IMPROVEMENT TECHNIQUES

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21CV6033**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand the concepts of ground improvement techniques, mechanical modification and chemical modification for different types of soil.
- Apply knowledge of mathematics, Science and Geotechnical Engineering to solve problems in the field of modification of ground required for construction of civil engineering structures.
- Understand the concepts of chemical compaction, grouting and other miscellaneous methods.
- Impart the knowledge of geo-synthetics, vibration, grouting and Injection.

UNIT – I	**Engineered Ground Improvement**	**8 Hours**

Ground Improvement: Definition, Objectives of soil improvement, Classification of ground improvement techniques, Factors to be considered in the selection of the best soil improvement technique.

Mechanical modification: Type of mechanical modification, Aim of modification, compaction, Principle of modification for various types of soils.

Compaction: Effect of compaction on engineering behavior like compressibility, swelling and shrinkage, permeability, relative density, liquefaction potential, Field compaction – static, dynamic, impact and vibratory type, Specification of compaction, tolerance of compaction, Shallow and Deep Compaction.

Self-study component:	Effect of grain size distribution on compaction for various soil types like BC soil, lateritic soil, coarse-grained soil.

UNIT – II	**Hydraulic Modification**	**8 Hours**

Hydraulic Modification: Definition, Aim, Principle Techniques, Gravity drain, lowering of water table, multistage well point, Vacuum dewatering and Discharge equations.

Drainage & Preloading: Drainage of slopes, preloading, vertical drains, sand drains, Assessment of ground condition for preloading and Electro kinetic dewatering.

Self-study component:	Design of dewatering system including pipe line effects of dewatering and pre-fabricated vertical drain.

UNIT – III	**Chemical Modification**	**8 Hours**

Chemical Modification-I: Definition, Aim, Special effects and methods, Techniques – sandwich technique, Admixtures, Cement stabilization, Hydration – effect of cement stabilization on permeability, Swelling and shrinkage and Criteria for cement stabilization.

Chemical Modification-II: Lime stabilization – suitability, process, special effects, Criteria for lime stabilization, Stabilization of soil using Bitumen. Other chemicals, chlorides and lignin, Field Control of stabilization and Construction methods.

Self-study component:	Stabilization using fly ash and asphalt, Other chemicals - hydroxides, hydrofluoric acid, Properties of chemical components-its reaction with soil and effects.

UNIT – IV	**Modification by Grouting**	**8 Hours**

Grouting: Introduction, Effect of grouting, Chemicals and materials used, Types of grouting, Grouting procedure and Applications of grouting.

Additional methods: Introduction & general concepts of Soil reinforcement, soil confinement methods - Crib walls, Gabions and Mattresses, Anchors, Rock bolts and soil nailing, Thermal methods of stabilization – Ground Heating and Ground Freezing

Self-study component:	Stone column, micro piles, microbial induced calcite precipitation (MICP).

UNIT – V	**Modification by Inclusions and Confinement**	**8 Hours**

Geo-synthetics: Introduction to Soil reinforced structures, Geo-synthetics types-raw materials, woven, non-woven and knitted, Mechanism, Types of geo-synthetics, Properties of geo-synthetic-material and fiber properties, geometrical aspects, mechanical properties, hydraulic properties, durability, applications of geo-synthetics- separation, filtration and fluid transmission, reinforcement, containment and barriers, Advantages and Disadvantages, Applications.

Self-study component:	Bio-degradable nets and grids, three-dimensional mats, composites, membranes and Natural fibers.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Apply** the knowledge of Geology & Geotechnical Engineering in Ground improvement techniques**. (PO1, PSO1)**	Applying	L3
CO2	**Understand** the concepts of different Modification Techniques for ground improvement**. (PO1, PSO1)**	Understanding	L2
CO3	**Analyze** and **identify** different Modification Techniques for ground improvement**. (PO2, PO4, PSO2)**	Analyzing	L4
CO4	**Analyze** and **Select** appropriate geo-synthetics and grouting methods for ground Improvements for sustainability**. (PO2, PSO2)**	Analyzing	L4

Text Book:

1. Ground Improvement Techniques, Purushothama Raj P. (1999), Laxmi Publications, New Delhi.
2. Engineering Principles of Ground Modification, Hausmann, MR, McGraw-Hill International Editions, 1990
3. Construction and Geotechnical Method in Foundation Engineering, Koerner R.M. (1985) - McGraw Hill Pub. Co., New York.

Reference Book:

1. Methods of treatment of unstable ground- Bell, F. G. (1975) Butterworths, London.
2. Ground Control and Improvement Techniques, B.C.Chattopadhyay and JMaity, PEEDOT, Howrah, 2011.

3. Designing with Geosynthetics, Koener, R.M. Prentice Hall, New Jersey, 1994.
4. Earth Reinforcement and soil structures, Jones C.J.P, Butterworths, London, 1985.

Web and Video link(s):

1. Civil-Ground Improvement Techniques: https://youtube.com/playlist?list=PLbMVogVj5nJRb_yA6oMKfoT89hyUcuHIA
2. Need for Ground Improvements: https://www.youtube.com/watch?v=6yhW3CbArQc&list=PLbMVogVj5nJRb_yA6oMKfoT89hyUcuHIA&index=2
3. Classification of Ground modification Techniques: https://www.youtube.com/watch?v=56uqge3OAs&list=PLbMVogVj5nJRb_yA6oMKfoT89hyUcuHIA&index=3
4. Mechanical Modification: https://www.youtube.com/watch?v=47TNhLl0owg&list=PLbMVogVj5nJRb_yA6oMKfoT89hyUcuHIA&index=5
5. Compaction Control: https://www.youtube.com/watch?v=GsUB0fktcmk&list=PLbMVogVj5nJRb_yA6oMKfoT89hyUcuHIA&index=6
6. Vibro-compaction methods: https://www.youtube.com/watch?v=Nkn5Fih0HUc&list=PLbMVogVj5nJRb_yA6oMKfoT89hyUcuHIA&index=9
7. Pre-fabricated vertical drains: https://www.youtube.com/watch?v=S9UxvTtEvYw&list=PLbMVogVj5nJRb_yA6oMKfoT89hyUcuHIA&index=11
8. Dewatering: https://www.youtube.com/watch?v=S9UxvTtEvYw&list=PLbMVogVj5nJRb_yA6oMKfoT89hyUcuHIA&index=11
9. Ground treatment with Lime: https://www.youtube.com/watch?v=2hHxF2fK50&list=PLbMVogVj5nJRb_yA6oMKfoT89hyUcuHIA&index=18
10. Ground treatment with Cement: https://www.youtube.com/watch?v=qf7bIkxuCJA&list=PLbMVogVj5nJRb_yA6oMKfoT89hyUcuHIA&index=20
11. Grouting Procedures: https://www.youtube.com/watch?v=ErbyBNy2mEY&list=PLbMVogVj5nJRb_yA6oMKfoT89hyUcuHIA&index=21
12. Introduction to Geo-synthetics: https://www.youtube.com/watch?v=UveFyGKwayE&list=PLbMVogVj5nJRb_yA6oMKfoT89hyUcuHIA&index=24
13. Reinforced soil principles and mechanism: https://www.youtube.com/watch?v=9DONT0E-

puQ&list=PLbMVogVj5nJRb_yA6oMKfoT89hyUcuHIA&index=26

14. Geo-synthetic material properties: https://www.youtube.com/watch?v=9mXMRv7cycs&list=PLbMVogVj5nJRb_yA6oMKfoT89hyUcuHIA&index=27
15. Soil Nailing Techniques: https://www.youtube.com/watch?v=DqjOXLKz1Vg&list=PLbMVogVj5nJRb_yA6oMKfoT89hyUcuHIA&index=34
16. Nano technologies in Ground improvement and site remediation: https://www.youtube.com/watch?v=9snKx048fA0&list=PLbMVogVj5nJRb_yA6oMKfoT89hyUcuHIA&index=40

E-Books/Resources:

1. http://www.sciencedirect.com/science/book/9780124080768
2. https://www.icevirtuallibrary.com/toc/jgrim/current
3. https://www.sciencedirect.com/science/article/pii/S2405844021017813
4. https://www.sciencedirect.com/topics/engineering/ground-improvement-method
5. https://www.sciencedirect.com/science/article/pii/S0038080620302092
6. https://www.sciencedirect.com/science/article/pii/S095965262201085X
7. https://www.taylorfrancis.com/books/mono/10.1201/9780429507656/ground-improvement-techniques-bujang-huat-arun-prasad-sina-kazemian-vivi-anggraini
8. https://www.taylorfrancis.com/chapters/mono/10.1201/9780367816995-1/introduction-ground-improvement-engineering-jeffrey-evans-daniel-ruffing-david-elton?context=ubx&refId=fc89e4c3-7cb0-4909-ac66-5526a72dc6bc
9. https://istasazeh-co.com/pdf/Ground-Improvement-Techniques.pdf
10. https://www.icevirtuallibrary.com/page/ice-news/142-top-geotech-books
11. https://www.shortform.com/best-books/genre/best-geotechnical-engineering-books-of-all-time
12. https://www.pdfdrive.com/ground-improvement-techniques-by-purushothama-raj-e28595423.html
13. https://www.vikaspublishing.com/books/engineering/civil-engineering/ground-improvement-techniques/9789325960015/

COURSE ARTICULATION MATRIX
(GROUND IMPROVEMENT TECHNIQUES - P21CV6033)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2												2		
CO3		2		1										2	
CO4		2					1							2	

3-HIGH, 2-MEDIUM, 1-LOW

OCCUPATIONAL HEALTH AND SAFETY [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	**P21CV6034**	**Credits:**	**03**
Teaching Hours/Week (L:T:P)	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Gain an historical, economic, and organizational perspective of occupational safety and health.
- Investigate current occupational safety and health problems and solutions.
- Identify the forces that influence occupational safety and health.
- Demonstrate the knowledge and skills needed to identify workplace problems and safe work practice.

UNIT – I	**Occupational Hazard and Control Principles**	**08 Hours**

Safety, History and development, National Safety Policy. Occupational safety and Health Act (OSHA), Occupational Health and Safety administration - Laws governing OSHA and right to know. Accident – causation, investigation, investigation plan.

Self-study component:	Methods of acquiring accident facts, Supervisory role in accident investigation.

UNIT – II	**Ergonomics at Work Place**	**08 Hours**

Ergonomics Task analysis, Preventing Ergonomic Hazards, Work space Envelops, Visual Ergonomics, Ergonomic Standards, Ergonomic Programs. Hazard cognition and Analysis.

Self-study component:	Emergency Response-Decision for action-purpose and considerations.

UNIT – III	**Fire Prevention and Protection**	**08 Hours**

Fire Triangle, Fire Development and its severity, Effect of Enclosures, early detection of Fire, Classification of fire and Fire Extinguishers.

Self-study component:	Technical Requirements of Product safety.

UNIT – IV	**Health Considerations at Work Place**	**08 Hours**

Types of diseases and their spread, Health Emergency. Personal Protective Equipment (PPE) – types and advantages, effects of exposure and treatment for engineering industries, municipal solid waste.

Self-study component:	Environment management plans (EMP) for safety and sustainability.

UNIT – V	Occupational Health and Safety Considerations	08 Hours

Water and wastewater treatment plants, Handling of chemical and safety measures in water and wastewater treatment plants and labs, Construction material manufacturing industries like cement plants, RMC Plants, precast plants and construction sites.

Self-study component:	Policies, roles and responsibilities of workers, managers and supervisors.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	***Apply*** the concepts of safety and environmental engineering in **understanding** occupational health and safety aspects. **(PO1, PSO1)**	Applying	L3
CO2	***Identify*** the various hazards in the workplace that pose a danger or threat to their safety or health, or that of others. **(PO2, PSO2)**	Analyzing	L4
CO3	***Examine*** the Occupational Health and Safety Regulations and relevant legislation when presenting a cogent analysis of a potential safety or health issue. **(PO2, PO6, PO7, PSO2)**	Analyzing	L4
CO4	***Illustrate*** the role of health and safety in the workplace pertaining to the responsibilities of workers, managers, supervisors. **(PO3, PO7, PO8, PSO2)**	Understanding	L2

Text Book:

1. Goetsch D.L., (1999), "Occupational Safety and Health for Technologists, Engineers and Managers", Prentice Hall.
2. Heinrich H.W., (2007), "Industrial Accident Prevent ion - A Scientific Approach", McGraw-Hill Book Company National Safety Council and Associate (Data) Publishers Pvt. Ltd.
3. "Industrial Safety and Pollution Control" Handbook.

Reference Book:

1. Colling D.A., (1990), "Industrial Safety Management and Technology", Prentice Hall, New Delhi.
2. Della D.E., and Giustina, (1996), "Safety and Environmental Management", Van Nostrand Reinhold International Thomson Publishing Inc.

Web and Video link(s):

1. Ergonomics Workplace Analysis [Introduction Video]: https://www.youtube.com/watch?v=cTBA5SC6HsQ
2. Occupational Health & Safety Management Systems(OH&SMS) and OHSAS 18001-Part I : https://www.youtube.com/watch?v=Rr-xFmErOTk

3. Occupational Health & Safety Management Systems(OH&SMS) and OHSAS 18001-Part II: https://www.youtube.com/watch?v=n7oUOUCIblg
4. ISO 45001:2018 Occupational Health and Safety Management System: https://www.youtube.com/watch?v=SHUgun56UqE.
5. Safety in Industries (Part 1): https://www.youtube.com/watch?v=3VReVbsmjKI&t=33s

E-Books/Resources:

1. https://www.sciencedirect.com/science/article/abs/pii/S1074909899000131
2. https://www.sciencedirect.com/science/article/abs/pii/S0304389422024372
3. https://www.sciencedirect.com/journal/safety-and-health-at-work/vol/13/issue/4

COURSE ARTICULATION MATRIX
(OCCUPATIONAL HEALTH AND SAFETY – P21CV6034)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2		2												2	
CO3		2				2	2							2	
CO4			2				2	2						2	

3 – HIGH, 2 – MEDIUM, 1 - LOW

GEO-TECHNICAL ENGINEERING [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	**P21CV604**	**Credits:**	**04**
Teaching Hours/Week (L:T:P):	**3:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**50**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Gain knowledge on History of soil mechanics, origin and formation of soil, Clay mineralogy Soil as three phase system and inter relationship.
- Understand basic definitions of Soil as three phase system and inter relationship.
- Establish various Index properties of soil and classification of soil
- Evaluate Flow of water through soils, compaction of soil
- Establish different parameters of Consolidation and shear strength of soil.

UNIT – I	**Introduction, Clay Mineralogy and Soil Structure, Soil as a Three–Phase System**	**10 Hours**

Introduction: History of soil mechanics, origin and formation of soil.

Clay Mineralogy and Soil Structure- common clay minerals in soils – Kaolinite, Illite and Montmorillonite, clay mineral structure, soil water interaction – diffuse double layer, structure of coarse grained soils – single grained structure, structure of fine grained soil – flocculent and dispersed structure and honeycomb structure.

Soil as a Three–Phase System- Phase Diagram, Basic definitions and inter relationship.

Self-study component:	Primary and Secondary valence forces, diffuse double layer - repulsion.
Practical Topics:	1. Determination of field moisture content of soil by Oven-drying method. 2. Determination of Specific gravity of coarse and Fine grained soil.

UNIT – II	**Index Properties of Soils and their Determination, Classification of Soils**	**10 Hours**

Index Properties of Soils and their Determination: Water content, specific gravity of soils and their determination, Particle size distribution, (Sieve analysis) Consistency limits- liquid limit by Casagrande's' method, plastic limit, Shrinkage limit and indices, Insitu density-Core cutter and Sand replacement method, Activity of clay, sensitivity, thixotrophy of clay

Classification of Soils: Purpose of soil classification, Particle size classification–IS classification, unified soil classification, Plasticity chart and its importance, Field identification of soils.

Self-study component:	Particle size distribution by Hydrometer analysis. Determination of liquid limit by fall cone method.
Practical Topics:	1. Determination of Consistency Limits of soil (Liquid, Plastic and Shrinkage Limits). 2. Particle Size Distribution-Sieve analysis (Dry and Wet).

UNIT – III	Flow of Water through Soils and Compaction of Soils	10 Hours

Flow of Water through soils: Darcy's law- assumption and validity, coefficient of permeability and its determination (laboratory tests), factors affecting permeability, permeability of stratified soils, Seepage velocity, superficial velocity and coefficient of percolation.

Compaction of Soils: Definition, Principle of compaction, Standard and Modified proctor's compaction, factors affecting compaction, Effect of compaction on soil properties Field compaction control, and Proctor needle.

Self-study component:	Determination of coefficient of permeability by field method, Compacting equipment's.
Practical Topics:	1. Determination of Coefficient of Permeability and Percolation by Constant head and Falling head method. 2. Determination of MDD and OMC of soil sample by Light and heavy compaction method. 3. Demonstration on standard penetration test (SPT).

UNIT – IV	Consolidation of Soils and Foundation Settlement	10 Hours

Consolidation of Soils : Definition, spring analogy for normally consolidated, under consolidated and over consolidated soils, pre-consolidation pressure and its determination by- Casagrande's method, Consolidation characteristics of soil (Cc, av, mv and Cv), Terzaghi's one-Dimensional consolidation theory (Assumptions and limitations only) Laboratory 1-D consolidation test to determine the consolidation characteristics of soil, determination of coefficient of consolidation by square root of time fitting method, logarithmic time fitting method.

Foundation Settlement: Settlement Analysis, Data for settlement analysis, computation of settlement, Concept, immediate, consolidation and secondary settlements (no derivations).

Self-study component:	Determination of pre consolidation pressure by Log- log method, BIS specifications for total and differential settlements for footings.
Practical Topics:	1. Determination of free swell index of clayey soil. 2. Determination of Field density of soil by Core cutter and Sand Replacement method. 3. Demonstration of Consolidometer.

UNIT – V	Shear Strength and Safe Bearing Capacity of Soils	10 Hours

Shear Strength of Soils: Concept of shear strength, Mohr's-coulomb theory, conventional and modified failure envelopes, Total and effective shear strength parameters, Laboratory determination of shear strength of soils – Direct shear test, Tri-axial compression test, Unconfined compression test and vane shear test, Test under different drainage conditions.

Safe Bearing Capacity of Soils: Definitions of ultimate, net and safe bearing capacities, Allowable bearing pressure. Terzaghi's bearing capacity equation.

Self-study component:	Concept of pore pressure, factors affecting shear strength of soils**.**
Practical Topics:	1. Determination of Shear strength parameters of soil by Direct shear test. 2. Determination of Shear strength parameters of soil by UCS Test. 3. Determination of Shear strength parameters of soil by vane shear Test

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Apply** the knowledge of chemistry & Geology to distinguish structural Arrangements of soils and **Understand** the soil phase system. **(PO1, PO2, PSO1).**	Applying	L3
CO2	**Evaluate** various index properties and engineering properties of soil for sustainable developments. **(PO2, PSO2)**	Evaluating	L5
CO3	**Analyze** and **identification** of coarse grained and fine grained soil. **(PO2, PSO2)**	Analyzing	L4
CO4	**Investigate** the various index and engineering properties of soil by **conducting** experiments in laboratory. **(PO4, PSO3)**	Analyzing / Evaluating	L5
CO5	Conduct experiments in a **team or as an individual** having impact for **lifelong learning**. **(PO9, PO12, PSO3)**	Creating	L6

Text Book:

1. Soil Mechanics and Foundation Engg, Punmia B.C, Laxmi Publications Co. , New Delhi.
2. Soil Mechanics and Foundation Engineering, Murthy V.N.S. 4th Edition, UBS Publishers and Distributors, New Age International Pvt Ltd Publishers
3. Geotechnical Engineering,C. Venkatramaiah , 3rd edition , New Age International Pvt Ltd Publishers, New Delhi.

Reference Book:

1. Foundation Analysis and Design, Bowles J.E. 5th Edition, McGraw Hill Pub. Co. New York.
2. Basic and Applied Soil Mechanics, GopalRanjan and Rao A.S.R., New Age International (P) Ltd., New Delhi.
3. Soil Mechanics and Foundation Engineering,K R Arora, STANDARD PUBLISHER DIST, New Delhi.

Web and Video link(s):

1. Formation of soil:
   https://youtu.be/1-6gsfl66HY?list=RDCMUCCDzHkpuIuD1ZC0wsCXUuPQ

2. Clay mineralogy:
   https://www.youtube.com/watch?v=VnaPywvwDnk
3. Soil as a 3-Phase system:
   https://www.youtube.com/watch?v=gfvU7I_bnoI
4. Index Properties of soil and Soil Classification:
   https://www.youtube.com/watch?v=vvLuXO17s9k
5. Flow of water through soil Part-1:
   https://www.youtube.com/watch?v=n2V35Bxr3H4&list=PL940DD62E8781E147&index=20
6. Flow of water through soil Part-2:
   https://www.youtube.com/watch?v=MztBQb683_I&list=PL940DD62E8781E147&index=21
7. Flow of water through soil Part-3:
   https://www.youtube.com/watch?v=JFtVYgxhRuo&list=PL940DD62E8781E147&index=22
8. Compaction of soils:
   https://www.youtube.com/watch?v=CKgDOF9S3hM&list=PL940DD62E8781E147&index=14
9. Compaction of soils:
   https://www.youtube.com/watch?v=-NVfrc3z5uA&list=PL940DD62E8781E147&index=15
10. Consolidation of soils:
    https://www.youtube.com/watch?v=LCCJL3m4_6A
11. Coefficient of consolidation:
    https://www.youtube.com/watch?v=e4VSGslfDHc
12. Compressibility Characteristics of soil:
    https://www.youtube.com/watch?v=hMlrCg7pQQU
13. Foundation settlement:
    https://www.youtube.com/watch?v=S3ZKKQHLgnQ
14. Shear strength of soil:
    https://www.youtube.com/watch?v=Aa4oGovhVA8
15. Lab: Specific Gravity and Field density:
    https://www.youtube.com/watch?v=RUYkn1kDvoI&list=PL3MO67NH2XxKxWtYte3GeJJN8LNQWcJqP&index=2
16. Lab: Grain size analysis:
    https://www.youtube.com/watch?v=VoY5Ms8DpW0&list=PL3MO67NH2XxKxWtYte3GeJJN8LNQWcJqP&index=4
17. Lab: Consistency Limits:
    https://www.youtube.com/watch?v=Aotqk7MhN1M&list=PL3MO67NH2XxKxWtYte3GeJJN8LNQWcJqP&index=7
18. Lab: Compaction of soils:
    https://www.youtube.com/watch?v=2IC_fKawf4Q&list=PL3MO67NH2XxKxWtYte3GeJJN8LNQWcJqP&index=10

19. Lab: Permeability of soils:
    https://www.youtube.com/watch?v=P3IJVyV_lGk&list=PL3MO67NH2XxKxWtYte3GeJJN8LNQWcJqP&index=12
20. Lab: Shear strength of soil Part-1:
    https://www.youtube.com/watch?v=OftfsrO7nVk&list=PL3MO67NH2XxKxWtYte3GeJJN8LNQWcJqP&index=14
21. Lab: Shear strength of soil Part-2:
    https://www.youtube.com/watch?v=TG9G1a2cV5g&list=PL3MO67NH2XxKxWtYte3GeJJN8LNQWcJqP&index=15
22. Lab: Shear strength of soil Part-3:
    https://www.youtube.com/watch?v=zZSXJCt3XhQ&list=PL3MO67NH2XxKxWtYte3GeJJN8LNQWcJqP&index=16

E-Books/Resources:

1. https://www.sciencedirect.com/topics/engineering/geotechnical-engineering
2. https://www.sciencedirect.com/topics/engineering/geotechnical-engineer
3. https://www.icevirtuallibrary.com/toc/jgeen/current
4. https://www.tandfonline.com/journals/yjge20
5. https://www.tandfonline.com/toc/yjge20/current
6. https://www.icevirtuallibrary.com/page/ice-news/142-top-geotech-books
7. https://www.amazon.in/Introduction-Geotechnical-Engineering-2e/dp/9332507619
8. https://www.shortform.com/best-books/genre/best-geotechnical-engineering-books-of-all-time

COURSE ARTICULATION MATRIX
(GEO-TECHNICAL ENGINEERING - P21CV604)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2		
CO2		2												2	
CO3		2												2	
CO4				2											2
CO5									2			2			2

3-HIGH, 2-MEDIUM, 1-LOW

BUILDING SERVICES [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – VI**			
Course Code:	**P21CVO6051**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Gain the knowledge of different building services and their types used in buildings.
- Understand requirements and constraints in providing building services suitable forbuildings.
- Determine design factors of building services suitable for buildings.
- Understand concepts of Elevators & Escalators, their types, working principle & design principles and type of energy conservation technologies suitable for buildings.
- Determine factors of building services like ventilation, thermal comfort & illumination inbuildings.

UNIT – I	**Thermal comfort in Buildings and Ventilation**	**8 Hours**

Thermal comfort in buildings: Factors affecting, heat transfer through buildings, thermal properties of building materials, insulation materials for buildings. Communication systems- terminologies, necessity, systems of communication.

Ventilation: Definition, Necessity, Functional Requirements of Ventilation, Types of Ventilation- Natural Ventilation and Artificial Ventilation.

Self-study component:	Industrial vents and ventilation systems

UNIT – II	**Electrical Wiring , Fire Protection**	**8 Hours**

Electrical Wiring: Planning of Electrical Supply System, - Systems of wiring- domestic and commercial buildings, - Materials and Devices used in Wiring. Earthing- Procedure and Types, Inspection and Testing of Installation, Electrical Supply layout and conventional symbols of electrical items.

Fire protection: Necessity, fire hazards, characteristics and types of fire resistant materials, fire load and its calculation, fire resistant construction – walls and columns, floors and roofs, wall openings, escape elements and strong room construction, fire protection equipment.

Self-study component:	General fire safety requirements.

UNIT – III	**Illumination of Buildings, Acoustics**	**8 Hours**

Illumination of Buildings: Definition, laws of illumination, principles of illumination, artificial lighting, day lighting, flood lighting, Introduction to various types of lamps.

Acoustics:-Definition of terminologies, Behavior of Sound in enclosures, Acoustic materials-properties, Acoustical Defects & Remedies, design of assembly halls, theatre.

Self-study component:	Amplification equipments, Auditorium and musical Studio.

UNIT – IV	**Noise Control in Buildings, Elevators and Escalator**	**8 Hours**

Noise Control in Buildings: Sound insulation-Materials, Types- Horizontal Barriers & Vertical Barriers.

Elevators: Components of a typical elevator, types, working principle, principles of design of an elevator.

Escalator: Necessity, Components of a typical escalator, working principle.

Self-study component:	Design considerations of escalator.

UNIT – V	**Energy Conservation in Buildings**	**8 Hours**

Energy Conservation in Buildings: Necessity, Advantages and Limitations , Introduction to Zero Energy Buildings& Green Buildings , Energy efficient building design- Passive solar design technique, Thermal storage, Cooling strategies, high performance insulation.

Self-study component:	LEED Certification for buildings.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Select** the design factors for providing ventilation, thermal comfort & in construction of buildings. **(PO1, PSO2)**	Applying	L3
CO2	**Select** the design factors of electric and fire protection in building construction. **(PO1, PO2, PSO1)**	Applying	L3
CO3	**Choose** the design factors for providing illumination, acoustics and noise control construction of buildings. **(PO2, PSO2)**	Applying	L3
CO4	**Choose**& suggest type of elevators & escalators based on working principle & design principles. **(PO1, PSO2)**	Applying	L3

Text Book:

1. A Text Book on Building Construction by P. C. Varghese, Prentice Hall of India publications.
2. Mechanical and Electrical Systems in Buildings, by Tao, Prentice Hall publications.
3. Acoustics and noise control-theory, design by S. K. Kandaswamy (Ed), practice-allied publishers.

Reference Book:

1. Mechanical Services for Buildings by Eastop, Longman Publications.
2. IS: SP - 41and SP:32 - Hand book on functional requirements of buildings.

Web and Video link(s):

1. Ventilation & Thermal comfort in buildings: https://www.youtube.com/watch?v=4EfViDwMIYc
2. Electrical Wiring, Fire protection: https://www.youtube.com/watch?v=0LNklcBhl_Q&list=PLp6ek2hDcoNCb0R8gxk1WzpTN94eXs9vb
3. Illumination of Buildings, Acoustics: https://www.youtube.com/watch?v=yyqhgnc5cWI&list=PLbRMhDVUMngeGSqPVkrc8G_kApltxEEos
4. Noise Control in Buildings: https://www.youtube.com/watch?v=tL38R49GVvU

5. Energy Conservation in Buildings: https://www.youtube.com/watch?v=ubDMIAJydPc

E-Books/Resources:

1. https://books.google.nr/books?id=_kAvTMzKGhAC&printsec=copyright#v=onepage&q&f=false
2. https://www.google.co.in/books/edition/Handbook_of_Energy_Efficiency_in_Buildin/06RBDwAAQBAJ?hl=en&gbpv=1&dq=energy+conservation+in+buildings&printsec=frontcover
3. https://www.google.co.in/books/edition/Introduction_to_Design_for_Civil_Enginee/djOSxkrJ4H4C?hl=en&gbpv=1&dq=3.+Acoustics+and+noise+control-theory,+design+by+S.K.Kandaswamy(Ed),+practice-allied+publishers&printsec=frontcover

COURSE ARTICULATION MATRIX (BUILDING SERVICES - P21CVO6051)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1													2	
CO2	1	1											2		
CO3		2												2	
CO4	1													2	

3-HIGH, 2-MEDIUM, 1-LOW

HIGHWAY TRAFFIC AND SAFETY MEASURES [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	**P21CVO6052**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand the knowledge of various traffic characteristics.
- Understand the importance of traffic studies and design of parking facilities.
- Understand the importance of accident studies in the present scenario.
- Understand the importance of traffic regulation and control.
- Understand the basic concept of various types of traffic intersection and its design.

UNIT – I	Traffic Characteristics	8 Hours

Introduction: Definition, objectives of Traffic Engineering and scope of Traffic Engineering.
Traffic Characteristics: Road user characteristics – human factors including reaction time and vehicular characteristics affecting road design and traffic flow, resistance to the motion of vehicles – Reaction time of driver –Numerical Problems.

Self-study component:	PCU concept for mixed traffic condition.

UNIT – II	Traffic Studies	8 Hours

Data collection, analysis and interpretation of results of classified traffic volume, spot speed, delay studies, running speed and journey speed studies, origin and destination surveys. Design of on-street and off-street parking facilities, pedestrian facilities, safety devices and different types of Urban Roads.

Self-study component:	Bus bays, Design features of expressways.

UNIT – III	Accident Studies	8 Hours

Accident characteristics, causes, studies, investigations and analysis of individual accidents, statistical analysis, Numerical Problems. Road safety issues, various measures for road safety - engineering, educational and enforcement measures, Short term and long term measures. Road safety education and training.

Self-study component:	Cost of road accidents.

UNIT – IV	Traffic Regulation and Control	8 Hours

Traffic regulations and control - Regulation on vehicles, drivers and traffic flow, Traffic control devices – Types & objectives of markings, signs, signals and delineators, one-way streets.

Self-study component:	Roadside furniture's

UNIT – V	Traffic Intersection	8 Hours

Geometric Design of Intersections; Types of Intersections; Design Principles for Intersections; Design of At-grade Intersections – Channelization, Objectives; Rotary Intersection – Concept, Advantages and Disadvantages; Grade separated Interchanges – Types, warrants and Design standards.

Self-study component:	Traffic Islands and Design standards

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	***Apply*** the knowledge of engineering fundamentals for understanding various road user and vehicular characteristics. **(PO1, PSO1)**	Applying	L3
CO2	***Compare*** traffic stream characteristics and understand the elements of highway safety and approaches to accident studies. **(PO3, PSO3)**	Analyzing	L4
CO3	***Interpret*** the concept of traffic regulations and traffic control devices. **(PO4, PSO2)**	Evaluating	L5
CO4	***Test for*** various traffic studies and design of different highway components. **(PO3, PSO2)**	Analyzing	L4

Text Book(s):

1. Traffic Engineering & Transport Planning – L.R. Kadiyali- Khanna publishers.
2. Highway Engineering Nemchand & Bros- Khanna & Justo-Roorkee (UA).
3. Traffic Engg. - Matson & Smith:-Mc.Graw Hill and Co.
4. Traffic flow theory – Drew- Mc. Graw Hill and Co.

Reference Book(s):

1. Traffic Engineering. Pignataro- Prentice Hall.
2. Highway Capacity Manual – 2000.

Web and Video link(s):

1. Current Scenario of Transportation in India: https://www.youtube.com/watch?v=0oFTBnIafTU
2. Traffic Stream Characteristics: https://www.youtube.com/watch?v=3XaTwQIugJ4
3. Traffic Studies: Part – I: https://www.youtube.com/watch?v=0yzgMc110po
4. Traffic Studies: Part – II: https://www.youtube.com/watch?v=1TKhZ90lngs
5. Intersection Control and Signalization: https://www.youtube.com/watch?v=uCPlvu-bzDw&t=23s

E-Books/Resources:

1. https://www.researchgate.net/publication/279847458_Road_safety_in_India_A_Public_Health_Concern
2. https://www.researchgate.net/publication/30862152_Road_Safety_in_India_Challenges_and_Opportunities
3. https://etrr.springeropen.com/articles/10.1186/s12544-019-0351-y
4. http://tripp.iitd.ac.in/assets/publication/Road_Safety_in_India2018.pdf
5. https://www.roadsafetyfacility.org/country/india

COURSE ARTICULATION MATRIX
(HIGHWAY TRAFFIC AND SAFETY MEASURES – P21CVO6052)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2			2												2
CO3				2										2	
CO4			2											2	

3-HIGH, 2-MEDIUM, 1-LOW

SUSTAINABILITY CONCEPTS IN ENGINEERING [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	**P21CVO6053**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3: 0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Learn about the principles, indicators and general concept of sustainability.
- Apprehend the local, regional and global impacts of unsustainable designs, products and processes.
- Student shall be able to apply the sustainability concepts in engineering
- Know built environment frame work sand their use
- Understand how building and design is judged and valued by clients and stakeholders and how to implement sustainability.

UNIT – I	**Introduction**	**8 Hours**

Sustainability - Introduction, Need and concept of sustainability, Social-environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM), Environmental legislations in India - Water Act, Air Act.

Self-study component:	Sustainable development goals.

UNIT – II	**Global Environmental Issue**	**8 Hours**

Resource degradation, Climate change, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon foot print Carbon sequestration – Carbon capture and storage (CCS). Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking.

Self-study component:	Risk assessment methods, LCA frameworks.

UNIT – III	**Sustainable Design**	**8 Hours**

Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification- GRIHA & IGBC Certification for buildings, Energy efficient building design- Passive solar design technique, Thermal storage, Cooling strategies, high performance insulation. Sustainable cities, Sustainable transport.

Self-study component:	Green economy, Community Solutions for Sustainable Development.

UNIT – IV	**Clean Technology and Energy**	**8 Hours**

Energy sources: Basic concepts-Conventional and non-conventional, solar energy, Fuel cells,

Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans, Geothermal energy. Rainwater harvesting.		
Self-study component:	Social and Environmental Sustainability	
UNIT – V	**Green Engineering**	**8 Hours**
Green Engineering concepts, Sustainable Urbanization, industrialization and poverty reduction; Social and technological change, Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis.		
Self-study component:	Green sustainable materials.	

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Interpret** the sustainability concepts; understand the role and responsibility of engineers in sustainable development. **(PO2, PO3, PSO3)**	Understanding	L2
CO2	**Utilize** scientific approach to quantify and rationalize sustainability and resource availability. **(PO2, PO3, PO7, PSO2)**	Applying	L3
CO3	**Make use of** sustainability concepts in construction practices, designs, product developments and processes across various engineering disciplines. **(PO3, PO7, PSO2)**	Applying	L3
CO4	**Develop** green engineering concepts and become a lifelong advocate of sustainability in society. **(PO6, PO7, PSO2)**	Applying	L3

Text Book:

1. Allen, D.T. and S Honnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley. A.S; Adebayo, A. O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.

Reference Book:

1. Mackenthun, K. M.,Basic Concepts in Environmental Management, Lewis Publication.
2. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency PublicationsRating System, TERI Publications - GRIHA Rating System.
3. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
4. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
5. Malcolm Dowden, Climate Change and Sustainable Development: Law, Policy and Practice.
6. Daniel A. Vallero and Chris Brasier, "Sustainable Design: The Science of Sustainability

and Green Engineering", Wiley-Blackwell.

7. Sustainable Engineering Practice: An Introduction, Committee on Sustainability, American Society of Civil Engineers.

Web and Video link(s):

1. Life Cycle Assessment – Introduction: https://www.youtube.com/watch?v=VNgtajZVAKE&list=PL3MO67NH2XxL8WmVnN3j2wX8v5THwi0sw
2. RISK Assessment – Toxicology: https://www.youtube.com/watch?v=hZNYuL5BYoI&list=PL3MO67NH2XxL8WmVnN3j2wX8v5THwi0sw&index=7
3. Green Sustainable Materials: https://www.youtube.com/watch?v=fNWuBJMooAw&list=PL3MO67NH2XxL8WmVnN3j2wX8v5THwi0sw&index=29
4. Design for Sustainability: https://www.youtube.com/watch?v=ljjwZ5uVL68&list=PL3MO67NH2XxL8WmVnN3j2wX8v5THwi0sw&index=31
5. Sustainable Engineering Design Principles: https://www.youtube.com/watch?v=fH_iIVPTujE&list=PL3MO67NH2XxL8WmVnN3j2wX8v5THwi0sw&index=34
6. Urbanization in Western Ghats and Biodiesel: https://www.youtube.com/watch?v=uvSBN3nX2z0
7. Environmental Sustainability: https://www.youtube.com/watch?v=Crd3CFq5B4s

E-Books/Resources:

1. https://www.mdpi.com/2071-1050/13/17/9942
2. https://www.researchgate.net/publication/277340208_Environmental_Sustainability_Research_Growth_and_Trends
3. https://www.sciencedirect.com/science/article/abs/pii/S2214993722001312
4. https://www.sciencedirect.com/science/article/abs/pii/S2214993722001579
5. https://www.sciencedirect.com/science/article/abs/pii/S2214993722001567

COURSE ARTICULATION MATRIX
(SUSTAINABILITY CONCEPTS IN ENGINEERING – P21CVO6053)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	2												2
CO2		2	1				1							2	
CO3			2				1							1	
CO4						1	1							1	

3-HIGH, 2-MEDIUM, 1-LOW

MUNICIPAL SOLID WASTE MANAGEMENT

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21CVO6054**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3: 0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- To provide detailed knowledge and skills in the management, treatment, disposal and recycling options for solid wastes, while focusing on key engineering and technical aspects involved.
- Understanding of the basic principles of waste and resource management will be supplemented, where appropriate, by practical problem-solving exercises in the context of civil engineering

UNIT – I	**Introduction**	**8 Hours**

Functional elements of municipal solid waste (MSW) management system, Sources: Sources of Solid waste, Types of solid waste, Physical and Chemical composition of municipal solid waste. Generation rate. Environmental implications of open dumping of MSW, Construction debris – management & handling. Rag pickers and their role.

Self-study component:	Solid waste management 2000 rules with 2016 amendments.

UNIT – II	**Collection of solid waste**	**8 Hours**

Services and systems Haul and stationary container system numerical, equipment's,

Transportation: Need of transfer operation, transfer station, transport means and methods,

Self-study component:	Route optimization

UNIT – III	**Treatment**	**8 Hours**

Processing Techniques: Components separation, volume reduction, size reduction, chemical reduction and biological processing problems.

Composting: Aerobic and anaerobic composting, factors affecting composting, Indore and Bangalore processes, mechanical and semi mechanical composting processes.

Self-study component:	Vermicomposting

UNIT – IV	**Sanitary Land Filling and Incineration**	**8 Hours**

Sanitary Land Filling: Different types, trench area, Ramp and pit method, site selection, Basic steps involved, leachate & gas collection and control methods.

Incineration: Process – 3 T's, factors affecting incineration process, incinerators – types, Prevention of air pollution, pyrolysis, design criteria for incineration.

Self-study component:	Prevention of site pollution

UNIT – V	Waste, Recycle and Reuse	8 Hours

Sources, collection, treatment and disposal:- Biomedical waste and E-waste.

Recycle and Reuse: Material and energy recovery operations, reuse in other industries, plastic wastes, environmental significance and reuse.

Self-study component:	Disposal of E-waste

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Identify** improper practices of solid waste disposal and their environmental implications. Know the basic engineering principles of solid waste management and engineered disposal options. **(PO1, PO6, PO7, PSO1)**	**Applying**	**L3**
CO2	**Show** the need for economics in collection and transportation of solid waste. Discuss various types of collection systems and analyze system dynamics. **(PO6, PO8, PSO3)**	**Understanding**	**L2**
CO3	Understand the management concepts, **illustrate** 4R approach, apply PPP model and community involvement for effective management of solid waste. **(PO5, PO7, PSO2)**	**Understanding**	**L2**
CO4	**Develop** a concise idea on various conventional and advanced treatment options for solid waste. **(PO4, PO6, PSO1)**	**Applying**	**L3**

Text Book:

1. Tchobanoglous G., Theissen H., and EIiassen R., "Solid Waste Engineering Principles and Management Issues"
2. McGraw Hill, New York. Pavoni J.L., "Handbook of Solid Waste Disposal

Reference Book:

1 Peavy, Rowe and Tchobanoglous, "Environmental Engineering", McGraw Hill.

2 Mantell C.L., (1975), "Solid Waste Management", John Wiley.

Web and Video link(s):

1 Introduction to solid waste: https://www.youtube.com/watch?v=k0ktJRoRcOA

2 Solid waste management: https://www.youtube.com/watch?v=sMeUGwpvLtk

3 Municipal Solid Waste Management (Civil Engineering): https://www.digimat.in/nptel/courses/video/105103205/L01.html

4 Primary collection SWM: https://www.digimat.in/nptel/courses/video/105103205/L09.html

5 Solid waste types, methods, challenges and solutions: https://www.youtube.com/watch?v=T_pIJiZ8JYI

6 Types and sources of SWM https://www.digimat.in/nptel/courses/video/105103205/L03.html

E-Books/Resources:

1. Waste Management | Journal | ScienceDirect.com by Elsevier
2. Solid waste management challenges for cities in developing countries - ScienceDirect

COURSE ARTICULATION MATRIX
(MUNICIPAL SOLID WASTE MANAGEMENT - P21CVO6054)

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

3-HIGH, 2-MEDIUM, 1-LOW

CAD LABORATORY –II

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – VI

Course Code:	**P21CVL606**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**30**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students:

1. Be aware of the Scale Factors, Sections of drawings.
2. Draft the detailing of RC and Steel Structural member.
3. Students will be able to use structural software.

Sl. No.	List of Experiments	
I	**PART-I: Detailing of RCC Structures**	**15 Hours**
	1. Beams – Simply supported, Cantilever and Continuous. 2. Slab – One way, two way and Continuous. 3. Staircase – Doglegged 4. Column footing - Column and footing (Square and Rectangle). (NOTE: Drawings to be prepared for given structural details. Also Bar Bending Schedule should be prepared for above drawings)	
II	**PART-II: Detailing of Steel Structures**	**15 Hours**
	1. Connections – Beam to beam, Beam to Column by Bolted and Welded Connections. 2. Built-up Columns with lacings and battens 3. Column bases and Gusseted bases with bolted and welded connection. (NOTE: Drawings to be prepared for given structural details)	

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understand** basic concepts of beam, slab staircase and column footing, draw detailed drawings of beams, slabs element, staircase and column footing for given structural details. **(PO1, PO2, PO5, PO12, PSO1, PSO2)**	Understanding	L2
CO2	**Understand** basic concepts of beam, slab staircase and column footing, draw detailed drawings of staircase and column footing for given structural details. **(PO1, PO2, PO5, PO12, PSO1, PSO2)**	Understanding	L2
CO3	**Understand** basic concepts of steel connections for simple beam to beam and built up columns and column bases, draw detailed drawings of simple beam to beam and built up columns and column bases for given structural details. **(PO1, PO2, PO5, PO12, PSO1, PSO2)**	Applying	L3

Text Book:

1. N Krishna Raju, "Structural Design and Drawing of Reinforced Concrete and Steel", University Press.
2. Krishna Murthy, "Structural Design and Drawing. Concrete Structures", CBS Publishers, New Delhi.

Reference Book:

1. SP 34: Handbook on Concrete Reinforcement and Detailing, Bureau of Indian Standards IS 13920:2016, Ductile Design and Detailing Of Reinforced Concrete Structures subjected to Seismic Forces - Code of Practice, Bureau of Indian Standard.

Web and Video link(s):

1. https://youtube.com/watch?v=bTdKMYGYUxc&si=EnSIkaIECMiOmarE
2. https://youtube.com/watch?v=Qr-qcT2P4AA&si=EnSIkaIECMiOmarE
3. https://youtube.com/watch?v=v0pt0L773Wc&si=EnSIkaIECMiOmarE

E-Books/Resources:

1. https://www.thesourcecad.com
2. https://www.scribd.com/document/421474046/Cad-Lab-Manual

COURSE ARTICULATION MATRIX
(CAD LABORATORY II - P21CVL606)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2			3							1	1	2	
CO2	1	2			3							1	1	2	
CO3	1	2			3							1	1	2	
3-HIGH, 2-MEDIUM, 1-LOW															

Mini - Project [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	**P21CVMP607**	**Credits:**	**02**
Teaching Hours/Week (L:T:P)	**0:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**26**	**SEE Marks:**	**50**

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students. (or Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications)

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. **The marks awarded for the project report shall be the same for all the batch mates.**

(ii) **Interdisciplinary**: CIE shall be group-wise at the college level with the participation of all the guides of the college through Dean (III). The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE for Mini-project:

- **Single discipline**: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department through Viva-Voce examination.
- **Interdisciplinary**: Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) through Viva-Voce examination conducted separately at the departments to which the student/s belongs to.

Employability Enhancement Skills (EES) - VI
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – VI

Course Code:	**P21HSMC608**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:2:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**28**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable students to:

- Explain the basic concepts in Race and games, Linear equations, mensuration, height and distance.
- Apply the logical skills in decoding Number, letter series and Game based assessments.
- Calculations involving Time, Speed and distance, HCF & LCM, Averages and Partnerships

UNIT – I	**10 Hours**

Quantitative Aptitude: Race and games, Linear equations

Logical Reasoning: Number and letter series

Self-Study: Types of cryptarithm.

UNIT – II	**10 Hours**

Quantitative Aptitude: Mensuration, Height & distance.

Logical Reasoning: Game based assessments.

Self-Study: Inferred meaning, Chain rule.

UNIT – III	**08 Hours**

Quantitative Aptitude: Time, Speed and distance, HCF & LCM, Averages and Partnerships

Self-Study: Decimal fractions

Course Outcomes: On completion of this course, students are able to:

CO – 1:	Solve the problems based on Race and games, Linear equations, mensuration, height and distance.
CO – 2:	Solve logical reasoning problems based on Number, letter series and Game based assessments.
CO – 3:	Solve the problems based on HCF & LCM, averages and partnerships.

Text Book(s):

1. Quantitative aptitude by Dr. R. S Agarwal, published by S.Chand private limited.
2. Verbal reasoning by Dr. R. S Agarwal, published by S. Chand private limited.

Reference Book(s):

1. Quantitative Aptitude by Arun Sharma, McGraw Hill Education Pvt Ltd
2. A Modern Approach to Verbal & Non-Verbal Reasoning by R.S. Agarwal.
3. CAT Mathematics by Abhijith Guha, PHI learning private limited.

COURSE ARTICULATION MATRIX [Employability Enhancement Skills (EES) - VI**]**												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO-1	2	2	-	-	-	-	-	-	-	-	-	2
CO-2	2	2	-	-	-	-	-	-	-	-	-	2
CO-3	2	2	-	-	-	-	-	-	-	-	-	2

Universal Human Values and Professional Ethics [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	**P21UHV609**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**1 : 0 : 0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**25 + 5**	**SEE Marks:**	**50**

Course objectives:

This course is intended to:

1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
4. This course is intended to provide a much-needed orientation input in value education to the young enquiring minds.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the activities will develop students' theoretical and applied skills.
3. State the need for UHV activities and its present relevance in the society and Provide real-life examples.
4. Support and guide the students for self-study activities.
5. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
6. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student in every activity, leading to continuous selfevolution.
7. Encourage the students for group work to improve their creative and analytical skills.

Module - 1

Introduction to Value Education **(3 hours)**

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations

Module - 2
Harmony in the Human Being : (3 hours) Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health
Module - 3
Harmony in the Family and Society : (3 hours) Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order
Module - 4
Harmony in the Nature/Existence : (3 hours) Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence
Module - 5
Implications of the Holistic Understanding – a Look at Professional Ethics : (3 hours) Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession
Course outcome (Course Skill Set) At the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); • They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. • They would have better critical ability. • They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). • It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction. Expected to positively impact common graduate attributes like: 1. Ethical human conduct 2. Socially responsible behaviour 3. Holistic vision of life 4. Environmentally responsible work 5. Having Competence and Capabilities for Maintaining Health and Hygiene 6. Appreciation and aspiration for excellence (merit) and gratitude for all

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.
- CIE paper shall be set for 25 questions, each of the 02 marks. The pattern of the question paper is MCQ (multiple choice question). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

The sum of two tests, will be out of 100 marks and will be scaled down to 50 marks
Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for **50 questions,** each of the 01 marks. **The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books for READING:

Text Book and Teachers Manual

- The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1
- The Teacher‟s Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)
14. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
15. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.

16. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
17. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
18. A N Tripathy, 2003, Human Values, New Age International Publishers.
19. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
20. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
21. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
22. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
23. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Web links and Video Lectures (e-Resources):

Value Education websites,

- https://www.uhv.org.in/uhv-ii,
- http://uhv.ac.in,
- http://www.uptu.ac.in
- Story of Stuff,
- http://www.storyofstuff.com
- Al Gore, An Inconvenient Truth, Paramount Classics, USA
- Charlie Chaplin, Modern Times, United Artists, USA
- IIT Delhi, Modern Technology – the Untold Story
- Gandhi A., Right Here Right Now, Cyclewala Productions
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
- https://fdp-si.aicte-india.org/8dayUHV_download.php
- https://www.youtube.com/watch?v=8ovkLRYXIjE
- https://www.youtube.com/watch?v=OgdNx0X923I
- https://www.youtube.com/watch?v=nGRcbRpvGoU
- https://www.youtube.com/watch?v=sDxGXOgYEKM