Scheme and Syllabus

3rd to 8th Semester

B. TECH (CIVIL ENGINEERING)

for Batch 2021-25 and onwards

Department of Civil Engineering

Amritsar Group of Colleges, Amritsar

SCHEME OF B.TECH CIVIL ENGINEERING

3rd Semester	**B.Tech (Civil Engineering)**							
Course code	**Course Name**	**Load Allocation**			**Marks Distribution**		**Total Marks**	**Credit**
		L	**T**	**P**	**Internal**	**External**		
AGCE - 21301	Strength of Materials	3	1	-	40	60	100	4
AGCE - 21302	Concrete Technology	3	-	-	40	60	100	3
AGCE - 21303	Environment Engineering - I	3	1	-	40	60	100	4
AGCE - 21304	Fluid Mechanics	3	1	-	40	60	100	4
AGCE - 21305	Building Materials & Construction	3	-	-	40	60	100	3
AGCE - 21306	Strength of Materials - Lab	-	-	2	30	20	50	1
AGCE - 21307	Concrete Technology - Lab	-	-	2	30	20	50	1
AGCE - 21308	Fluid Mechanics - Lab	-	-	2	30	20	50	1
AGFE - 21301	Functional English - I	-	1	-	50	0	50	1
AGMC-21301	Indian Constitution (Mandatory Course)	1	-	-	-	-	-	-
AGCE - 21309	Institutional Training	-	-	2	60	40	100	1
		16	**4**	**8**	**400**	**400**	**800**	**23**
	Contact Hours=	**28**						
AGMD - CE01	Basics of Civil Engineering*	3	1		40	60	100	4

* to be opted by students of other engineering disciplines for **Minor Degree in Civil Engineering**

4th Semester	**B.Tech (Civil Engineering)**							
Course code	**Course Name**	**Load Allocation**			**Marks Distribution**		**Total Marks**	**Credit**
		L	**T**	**P**	**Internal**	**External**		
AGCE - 21401	Structural Analysis	3	1	-	40	60	100	4
AGCE - 21402	Survey	3	1	-	40	60	100	4
AGCE - 21403	Environment Engineering - II	3	-	-	40	60	100	3
AGCE - 21404	Mathematics for Civil Engineering	3	-	-	40	60	100	3
AGCE - 21405	Design of Concrete Structures	3	1	-	40	60	100	4
AGCE - 21406	Survey - Lab	-	-	2	30	20	50	1
AGCE - 21407	Environment Engineering - Lab	-	-	2	30	20	50	1
AGCE - 21408	Building Drawing	-	-	2	30	20	50	1
AGAP - 21401	Engineering Aptitude - I	-	1	-	50	0	50	1
AGFE - 21402	Functional English - II	-	1	-	50	0	50	1
AGMC-21401	Essence of Indian Knowledge Tradition (Mandatory Course)	1	-	-	-	-	-	-
		16	**5**	**6**	**390**	**360**	**750**	**23**
	Contact Hours=	**27**						
AGMD - CE02	Engineering Materials and Testing*	3	1		40	60	100	4

* to be opted by students of other engineering disciplines for **Minor Degree in Civil Engineering**

SCHEME OF B.TECH CIVIL ENGINEERING

5th Semester	**B.Tech (Civil Engineering)**								
Course code	**Course Name**	**Load Allocation**			**Marks Distribution**		**Total Marks**	**Credit**
		L	**T**	**P**	**Internal**	**External**		
AGCE - 21501	Geotechnical Engineering	3	1	-	40	60	100	4
AGCE - 21502	Irrigation Engineering - I	3	1	-	40	60	100	4
AGCE - 21503	Transportation Engineering - I	3	-	-	40	60	100	3
AGCE - 21504x	Professional Elective Course - I	3	-	-	40	60	100	3
AGCE - 21505	Design of Advanced Concrete Structures (Skill Course-I)	1	-	4	30	20	50	3
AGCE - 21506	Structural Analysis - Lab	-	-	2	30	20	50	1
AGCE - 21507	Computer Aided Drawing-I Lab	-	-	2	30	20	50	1
AGCE - 21508	Geotechnical Engineering Lab	-	-	2	30	20	50	1
AGAP - 21502	Engineering Aptitude - II	-	1	-	50		50	1
AGCE - 21509	Survey Camp (On-site Training)	-	-	-	60	40	100	1
		13	**3**	**10**	**390**	**360**	**750**	**22**
	Contact Hours=	**26**						
AGMD - CE03x	Minor - 3* (Elective)	3	1		40	60	100	4

* to be opted by students of other engineering disciplines for **Minor Degree in Civil Engineering**

6th Semester	**B.Tech (Civil Engineering)**							
Course code	**Course Name**	**Load Allocation**			**Marks Distribution**		**Total Marks**	**Credit**
		L	**T**	**P**	**Internal**	**External**		
AGCE - 21601	Design of Steel Structures - I	3	1	-	40	60	100	4
AGCE - 21602	Hydrology	3	1	-	40	60	100	4
AGCE - 21603	Transportation Engineering - II	3	-	-	40	60	100	3
AGCE - 21604x	Professional Elective Course - II	3	-	-	40	60	100	3
AGCE - 21605	Professional Practices (Skill Course-II)	1	-	4	30	20	50	3
AGCE - 21606	Transportation Engineering - Lab	-	-	2	30	20	50	1
AGCE - 21607	Computer Aided Drawing-II Lab	-	-	2	30	20	50	1
AGCE - 21608	Basic MS Office - Lab	-	-	2	30	20	50	1
AGFE - 21603	Functional English - III	-	1	-	50	0	50	1
AGAP - 21603	Engineering Aptitude - III	-	1	-	50	0	50	1
		13	**4**	**10**	**380**	**320**	**700**	**22**
	Contact Hours=	**27**						
AGMD - CE04x	Minor - 4* (Elective)	3	1		40	60	100	4

* to be opted by students of other engineering disciplines for **Minor Degree in Civil Engineering**

SCHEME OF B. TECH CIVIL ENGINEERING

7th Semester	**B. Tech (Civil Engineering)**							
Course code	**Course Name**	**Load Allocation**			**Marks Distribution**		**Total Marks**	**Credit**
		L	**T**	**P**	**Internal**	**External**		
AGCE21701	Design of Steel Structures-II	3	1	-	40	60	100	4
AGCE21702	Irrigation Engineering – II	3	1	-	40	60	100	4
AGCE 21703x	Professional Elective Course-III#	3	-	-	40	60	100	3
AGOE 217yy	Open Elective Course	3	-	-	40	60	100	3
AGCE 21704	Project	-	-	4	60	40	100	2
AGCE 21705	Irrigation Engineering Drawing	-	-	2	30	20	50	1
AGCE 21706	Design of Steel Structures Lab	-	-	2	30	20	50	1
		12	**2**	**8**	**280**	**320**	**600**	**18**
	Contact Hours=	**22**						
AGMD - CE05x	Minor - 5* (Elective)	3	1		40	60	100	4

* to be opted by students of other engineering disciplines for **Minor Degree in Civil Engineering**

#AGCE 21703x shall be offered in online mode through SWAYAM platform. The student shall opt any one subjects from the ***list of Professional Elective Courses III*** as per availability on SWAYAM platform. Student shall produce the course completion certificate at the end of the semester and also appear in End-Semester-Examination for this course for transfer of credits as per the policy of AGC Amritsar.

8th Semester	**B. Tech (Civil Engineering)**							
Course code	**Course Name**	**Load Allocation**			**Marks Distribution**		**Total Marks**	**Credit**
		L	**T**	**P**	**Internal**	**External**		
AGCE - 21801	Semester Training	-	-	-	300	200	500	12
		0	**0**	**0**	**300**	**200**	**500**	**12**
	Contact Hours=	**0**						

3rd Semester	**AGCE-21301: Strength of Materials**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**		**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Determine the stresses, strains, and displacements in structures and their components due to the acting loads.
CO-2	Understand various fundamental issues of elasto-mechanics, i. e. the mechanics of solids, and deformable bodies, and able to understand concept of complex stresses and strains also can draw Mohr's circle.
CO-3	Draw shear-force and bending-moment diagrams for different types of loading.
CO-4	Understand concept of pure bending and shear stresses for simple, built up and composite sections.
CO-5	Understand the behaviour of axially/laterally/eccentrically loaded columns and torsional behaviour of circular shafts.
CO-6	Understand various theories regarding failure of any column or beam in building.

Part	**Content**	**CO**
I	Simple Stress and Strains: Introduction; Concept of stress and strain; Stress-strain curves for ductile, brittle materials; Generalized Hooke's law, Stress-strain diagram of ductile and brittle material, statically determinate and indeterminate problems, compound and composite bars, thermal stresses. Elastic constants, relations between various elastic constants and its use; Lateral strain, volumetric strain, poisons ratio	CO-1
	Complex stress and strains: Introduction; Normal stress, tangential stress; Rectangular block subjected to normal stress along and across two planes, combination of normal and tangential stress; Concept of principal stress and its computation; Mohr circle; Principal strains, computation of principal stresses from the principal strains.	CO-2
II	Shear force and Bending moment diagrams: General equilibrium equations , Introduction to the concept of reaction diagrams—shear force and bending moment; Role of sign conventions; Types of load, beams, supports; Shear force and bending moment diagrams: simply supported, overhang and cantilever beams subjected to any combination of point loads, uniformly distributed and varying load, and moment; Relationship between load, shear force and bending moment.	CO-3
III	Bending and Shear Stresses: Introduction; Assumptions and derivation of flexural formula for straight beams; Centroid of simple and built up section, second moment of area; Bending stress calculation for beams of simple and built up section, composite sections (flitched sections); Shear stress; Variation of bending and shear stress along the depth of section.	CO-4
	Columns and Struts: Stability of Columns; Buckling load of an axially loaded columns with various end conditions; Euler's and Rankine's formula; Columns under eccentric load, lateral load.	CO-5
IV	Torsion of Circular shafts: Torsion, basic assumptions, derivation of torsion equation; Sections under combined bending and torsion, equivalent bending and torsion.	
	Springs: Introduction; Classification; Applications Failure theories: Maximum principal stress theory, Maximum shear stress theory, Distortion, Energy theory, Strain Energy theory.	CO-6

References:

- Strength of Material by S. Ramamrutham
- Mechanics of Materials: E. Popov
- Strength of Materials: Rajput
- Strength of Materials: Sadhu Singh
- Strength of Materials by Gere, Cengage Learning.

3rd Semester	**AGCE-21302: Concrete Technology**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Know about concrete as an important construction material with wide range of applications
CO-2	Know about cement and admixtures as constituents of concrete and perform various tests on cement
CO-3	Know about aggregates as constituents of concrete and classify them as fine and coarse aggregates.
CO-4	Know about various properties of fresh and hardened concrete and effect of water cement ratio on various properties of concrete.
CO-5	Handle the fresh concrete and understand the importance of vibration in placing the concrete.
CO-6	Design the proportion of various constituents for a specified grade of concrete.

Part	**Content**	**CO**
I	**Introduction**: Concrete as a structural material, Constituent materials of concrete. Types of concretes, grades of concrete, advantages and disadvantages of concrete. Applications of concrete.	CO-1
	Cement: Types, basic chemistry, heat of hydration, testing of cement (Fineness, Consistency, Setting times, soundness, strength), Types of Portland cements, expansive cements, pozzolanas. Admixtures, types of admixtures.	CO-2
II	**Aggregates**: Classification of Aggregates, Mechanical properties (Bond, strength, toughness, hardness, specific gravity, bulk density, porosity and absorption, moisture content, bulking of sand, sieve analysis, fineness modulus, grading of aggregates, maximum aggregate size.	CO-3
III	**Properties of Fresh and Hardened Concrete**: Water-Cement Ratio, Workability, factors affecting workability, methods of determination of workability, density of fresh concrete, Compressive strength, flexural strength, split tensile strength, effect of water-cement ratio on strength of concrete.	CO-4
IV	**Handling of Concrete**: Batching and mixing, mixing time, concrete mixers, transportation of concrete, Ready Mix concrete, pumped concrete, vibration of concrete, internal and external vibrators, revibration, shotcrete, curing of concrete.	CO-5
	Mix-Design: Factors to be considered, water cement ratio, durability, workability, cement and aggregate content, design of concrete mix by IS-Code method (IS 10262: 2009)	CO-6

References:

- Concrete Technology by M.L. Gambhir, Tata Mc Graw Hills, New Delhi.
- Concrete Technology by M.S. Shetty, S. Chand and Co. New Delhi.
- Concrete Technology by A.M. Neville and J.J. Brooks, Pearson publishers, New Delhi.
- Properties of Concrete by A.M. Neville, Pearson publishers, New Delhi.

3rd Semester	**AGCE-21303: Environmental Engineering - I**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**		**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understand the concept of various demands of water and population forecasting procedure.
CO-2	Emphasize the environment, its cycle and transmission system for water supply.
CO-3	Assess the efficiencies of pumping systems and pumping operation.
CO-4	Know various quality parameters required to determine purity of water for drinking purpose.
CO-5	Know about treatments processes involved to treat water.
CO-6	Know various methods of transportation of water in urban and rural areas.

Part	**Content**	**CO**
I	**Introduction**: Beneficial uses of water, water demand, per capita demand, variations in demand, water demand for fire fighting, population forecasting and water demand estimation.	CO-1
	Water sources and development: Surface and ground water sources; Selection and development of sources; Assessment of potential; Flow measurement in closed pipes, intakes and transmission systems.	CO-2
II	**Pumps and pumping stations**: Types of pumps and their characteristics and efficiencies; Pump operating curves and selection of pumps; pumping stations.	CO-3
III	**Quality and Examination of Water**: Impurities in water, sampling of water, physical, chemical and bacteriological water quality parameters, drinking water quality standards and criteria.	CO-4
	Water treatment: Water treatment schemes; Basic principles of water treatment; Design of plain sedimentation, coagulation and flocculation, filtration – slow, rapid and pressure; Disinfection units; Fundamentals of water softening, fluoridation and deflouridation, and water desalination and demineralization, taste and odour removal.	CO-5
IV	**Transportation of Water**: Pipes for transporting water and their design, water distribution systems and appurtenances; Water supply network design and design of balancing and service reservoirs; operation and maintenance of water supply systems. **Rural water supply**: Principles, selection of source, rain water harvesting, quantitative requirements, low cost treatment techniques.	CO-6

References:

- Water Supply Engineering- Environmental Engg. (Vol. – I) by B.C. Punmia, Ashok Jain, Arun Jain, Laxmi Publications, New Delhi.
- Environmental Engg. - A design Approach by Arcadio P. Sincero and Gregoria P. Sincero,Prentice Hall of India, New Delhi.
- "Environmental Engg." By Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, McGraw Hill, International Edition
- Water Supply Engineering- Environmental Engg. (Vol. – I) by S.K. Garg, Khanna Publishers, Delhi.
- Water Supply and Sewerage by Steel EW and McGhee, Terence J.; McGraw Hill.

3rd Semester	**AGCE-21304: Fluid Mechanics**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**		**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Define the nature of a fluid and its properties and introduce viscosity effects on flow and characteristics of Newtonian and Non-Newtonian fluids.
CO-2	Quantify the stability of floating and submerged bodies through conceptual understanding.
CO-3	Use flow measurement devices for flow computations.
CO-4	Understand the concept of velocity and acceleration of fluid particle and verify Bernoulli's equation
CO-5	Understand the concept of laminar and turbulent flow.
CO-6	Understand the concept of boundary layer formation.

Part	**Content**	**CO**
I	**Fluid and their properties**: Concept of fluid, difference between solids, liquids and gases; ideal and real fluids, density, specific weight and relative density, viscosity and its dependence on temperature; surface tension and capillarity, vapour pressure and cavitation, Newtonian and non-Newtonian fluids, laminar and turbulent flow.	CO-1
	Fluid Statics: Concept of pressure, Pascal's law and its engineering hydrostatic paradox. Action of fluid pressure on plane (horizontal, vertical) submerged surface, resultant force and center of pressure, force on a curved surface due to hydrostatic pressure. Buoyancy and floatation, stability of floating and submerged bodies, Meta centric height and its determination.	CO-2
II	**Flow Measurement**: Manometers, Pitot tubes, venturimeter and orifice meters, orifices, mouth pieces, notches (Rectangular and V-notches) and weirs (Sharp crested Weirs).	CO-3
III	**Fluid Kinematics**: Classification of fluid flows, velocity and acceleration of fluid particle, local and convective acceleration, normal & tangential acceleration streamline, pathline and streakline, flow rate and discharge mean velocity continuity equation in Cartesian co-ordinates. Rotational flows- Rotational velocity and circulation, stream & velocity potential functions. **Fluid Dynamics**: Euler's equation, Bernoulli's equation and steady flow energy equation; representation of energy changes in fluid system, impulse momentum equation.	CO-4
IV	**Laminar**: meaning of terms, Flow through circular section pipe, flow between parallel plates, stokes law. Transition from laminar to turbulent, Critical velocity and critical Reynolds Number, **Turbulent**:- Turbulent flows, Equation for velocity distribution in smooth and rough pipes (no derivation).	CO-5
	Boundary Layer Analysis: Assumption and concept of boundary layer theory. Boundary-layer thickness, displacement, momentum & energy thickness, Laminar sub-layer, smooth and rough boundaries.	CO-6

References:

- Fluid Mechanics & Hydraulic Machines : Dr. R.K. Bansal
- Hydraulic and Fluid Mechanic by P.N.Modi & S.M.Seth
- Engineering Fluid Mechanics by R.J.Garde & A.G.Mirajgaoker
- Fluid Mechanics by Douglas JF, Gasiorek JM, Swaffield JP; Pitman
- Fluid Mechanics : Streetes VL & Wylie EB; McGraw Hill book company.
- Fluid Mechanics by White
- Introduction to Fluid Mechanics by Robert W.Fox& Alan T.McDonald
- Fluid Mechanics by Potter, Cengage Learning

3rd Semester	**AGCE-21305: Building Materials and Construction**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Demonstrate knowledge about bricks, stones, aggregates and their quality.
CO-2	Examine quality of cement and concrete based on their test results.
CO-3	Have knowledge on miscellaneous materials like plastics, Iron and steel and some composite materials.
CO-4	Supervise and inspect masonry construction, mainly brick and stone masonry.
CO-5	Have knowledge on various building components.
CO-6	Understand the importance of various building services.

Part	**Content**	**CO**
I	**Building Stones and Aggregates:** General, Characteristics of a good building stone, Common building stone of India & their Uses-Artificial stones, Classification of aggregate, properties, sieve analysis, fineness modulus. **Bricks:** General**,** Qualities of good bricks, Classification of bricks, Tests on bricks.	CO-1
	Cement: Composition of cement, Manufacturing process (brief), Varieties of cement, Hydration of cement, Properties, testing of cement. Selection of suitable type of cement. Plaster, Plastering and pointing.	CO-2
II	**Concrete:** Introduction, Constituents, batching of materials, Manufacturing process, transportation and placing of concrete, compaction of concrete, curing of concrete workability, Methods to determine workability, segregation and bleeding of concrete, Strength of concrete and factors affecting it. BIS method of mix design	
	Miscellaneous materials: **Plastic:** Definition, classification, characteristics and uses, extruded profiles, pipes and their fittings. **Steel:** Commercial forms of iron & steel & their uses. **Composite Materials**: Ferro-cement, Wood-plastic composite (WPC), Fibre reinforced plastics, Fibre reinforced concrete, Fly ash concrete, Light-weight concrete and Polymer concrete.	CO-3
III	**Masonry Construction**: Introduction, terms used in brick & stone masonry, Dressing of stones, Classifications of stone masonry, bonds in brick work, reinforced brick work, Defects in brick masonry, composite stone & brick masonry, glass block masonry.	CO-4
	Building Components: **Walls**: Load bearing and non-load bearing walls, Thickness considerations, partition and cavity walls. **Foundation**: functions and Types of foundations, causes of failures of foundation and remedial measures **Arches and Lintels**: Functions of arches and lintels, terms used in Arches; different types of arches.	CO-5
IV	**Roofs and Floors**: Terms used, Types of roof trusses and roof coverings, types of floors commonly used and their suitability for different buildings, **Doors and Windows**: terms used, location of doors and windows, types of doors and windows, ventilators. **Stairs & Stair cases**: Terms used, Suitability of location, stairs in multi-storeyed buildings, residential and public buildings, dimensions, classification, types of stairs, **Damp Proofing**: Causes and Sources of dampness in buildings, bad effects of dampness, methods of damp proofing, materials used for DPC.	
	Building Services: Plumbing service, Electrical services, Air conditioning, Acoustics and sound insulation, Fire protection measures, Lift & escalators.	CO-6

References:

- Building Construction by Sushil Kumar, Standard Publisher and Distributors.
- Building Construction by B. C. Punima, Laxmi Publisher House
- Building Material, Rangawala
- Concrete Technology, MS Shetty

3rd Semester	**AGCE-21306: Strength of Materials – Lab**				
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understand the behavior of Ductile and Brittle material in tension
CO-2	Understand the behavior of Ductile and Brittle material in compression
CO-3	Perform Izod and Charpy test to get impact strength.
CO-4	Perform Rockwell & Brinell hardness test to get hardness of a material.
CO-5	Understand the behavior of Ductile and Brittle material in torsion.
CO-6	Exhibit his/her creativity and conceptual understanding of the subject Strength of Materials

Part	**Experiment**	**CO**
A	1. Draw Stress Strain curve for Ductile and Brittle material in tension.	CO-1
	2. Draw Stress Strain curve for Ductile and Brittle material in compression.	CO-2
	3. To determine the impact strength by Izod and Charpy test.	CO-3
	4. To determine hardness of given material by Rockwell & Brinell hardness testing machine.	CO-4
	5. Draw shear stress, shear strain curve for ductile / brittle material in torsion strength test.	CO-5
B	To make a mini project that demonstrates a concept, based on the content of AGCE – 21301 (Strength of Materials)	CO-6

3rd Semester	**AGCE-21307: Concrete Technology - Lab**				
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Determine the consistency and setting times of cement.
CO-2	Determine strength of cement.
CO-3	Determine various properties of aggregates.
CO-4	Ascertain quality standards of fresh concrete.
CO-5	Determine compressive and tensile strength of hardened concrete.
CO-6	Exhibit his/her creativity and conceptual understanding of the subject of Concrete Technology.

Part	**Experiment**	**CO**
A	To determine the Standard Consistency of cement. To determine the IST and FST of cement.	CO-1
	To determine the compressive strength of cement.	CO-2
	To determine the Fineness Modulus of given aggregate sample by sieve analysis. To determine the Specific gravity of Fine and Coarse Aggregates.	CO-3
	To determine the workability of fresh concrete by various methods.	CO-4
	To determine the compressive strength and split tensile strength of concrete.	CO-5
B	To make a mini project that demonstrates a concept, based on the content of AGCE – 21302 (Concrete Technology)	CO-6

3rd Semester	**AGCE-21308: Fluid Mechanics - Lab**				
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understand the significance of meta-centre of floating vessels.
CO-2	Verify Bernoulli's equation and interdependence of various heads.
CO-3	Calibrate and use orifice-meter for measurement of discharge through pipes.
CO-4	Calibrate and use venturi-meter for measurement of discharge through pipes.
CO-5	Compute discharge flowing through an open channel using a notch.
CO-6	Exhibit his/her creativity and conceptual understanding of the subject Fluid Mechanics

Part	**Experiment**	**CO**
A	1. To determine meta-centric height of a floating vessel under loaded / unloaded conditions.	CO-1
	2. To verify Bernoulii's energy equation by studying flow through variable area duct.	CO-2
	3. To determine the coefficient of discharge for an orifice-meter.	CO-3
	4. To determine the coefficient of discharge for a venture-meter.	CO-4
	5. To determine the discharge coefficient for a Vee notch or rectangular notch.	CO-5
B	To make a mini project that demonstrates a concept, based on the content of AGCE – 21304 (Fluid Mechanics)	CO-6

3rd Semester	**AGFE-21301: Functional English - I**				
Internal Marks:	**50**		**L**	**T**	**P**
External Marks:	**0**		**0**	**1**	**0**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Self Introduction to prepare students to face one to one interaction.
CO-2	Body Language detail to prepare students in non-verbal communication.
CO-3	Vocabulary based session to improve language proficiency of students.
CO-4	Basic Grammar to make students proficient in English correspondence.
CO-5	Book reading to improve reading skills of students.
CO-6	Formal/ Informal Letter writing to make students proficient in written correspondence.

Part	**Content**	**CO**
I	Components of Self Introduction, Exemplary Performances, Student Performances on Self Introduction along with resume.	CO-1 CO-2
II	This section includes Common Vocabulary and its usage. Synonyms and Antonyms as a part of vocabulary to be done.	CO-3
	This section includes editing, omission, gap filling, rearranging jumbled sentences to test knowledge of passive voice, reported speech, articles and the other determiners, modals, tense, etc. Basic Grammar such as Tenses, Voice, Narration shall be done.	CO-4
III	Connect The Dots by Rashmi Bansal shall be prescribed for honing reading skills and comprehension in depth.	CO-5
IV	Formal/ Informal Letter Writing**,** Basic Format, Example, Practice shall be done.	CO-6

References:

- www.Indiabix.com
- English Grammar by Wren and Martin
- www.freshersworld.com
- www.alison.com

3rd Semester	**(Mandatory Course): AGMC-21301: Indian Constitution**				
Internal Marks:	**-**		**L**	**T**	**P**
External Marks:	**-**		**1**	**0**	**0**
Total Marks:	**-**		**Credits**		**0**

Part	**Content**	**CO**
-	• Meaning of the constitution law and constitutionalism. • Historical perspective of the Constitution of India. • Salient features and characteristics of the Constitution of India. • Scheme of the fundamental rights. • The scheme of the Fundamental Duties and its legal status. • The Directive Principles of State Policy – Its importance and implementation. • Federal structure and distribution of legislative and financial powers between the Union and the States. • Parliamentary Form of Government in India – The constitution powers and status of the President of India. • Amendment of the Constitutional Powers and Procedure. • The historical perspectives of the constitutional amendments in India. • Emergency Provisions: National Emergency, President Rule, Financial Emergency. • Local Self Government – Constitutional Scheme in India. • Scheme of the Fundamental Right to Equality. • Scheme of the Fundamental Right to certain Freedom under Article 19. • Scope of the Right to Life and Personal Liberty under Article 21	-

3rd Semester	**AGCE-21309: Institutional Training**				
Internal Marks:	**60**		**L**	**T**	**P**
External Marks:	**40**		**0**	**0**	**2**
Total Marks:	**100**		**Credits**		**1**

Course Outcomes: After going through this training, students will be able to:	
CO-1	Abide by traffic rules as responsible citizens of the country.
CO-2	Contribute towards environment protection and spread awareness further.
CO-3	Understand fire exit symbols in public buildings and operate basic fire extinguishers if needed.
CO-4	Think towards alternate sources of energy for better future.
CO-5	Understand importance of water, reduce its wastage and conserve water.
CO-6	Exhibit his/her creativity and conceptual understanding of the subject.

Part	**Training Activity**	**CO**
A	**Road Safety:** Awareness through seminar/videos/discussions.	CO-1
	Environment protection: Students contribution in waste segregation and recycling. Opportunities of start-ups.	CO-2
	Fire Fighting: Fire-exit-plans, fire fighting system in AGC Amritsar.	CO-3
	Non-Conventional Energy: Students innovations/contribution.	CO-4
	Water Conservation: saving water, water harvesting from rain and other sources, groundwater recharge.	CO-5
B	**Model/Prototype:** students are required to develop some model/prototype that exhibits their understanding of subject matter and contributes innovatively in the above mentioned areas.	CO-6

4th Semester	**AGCE-21401: Structural Analysis**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**		**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Analyse various elements of buildings and identify determinate/indeterminate structures and compute slope and deflections by geometric methods.
CO-2	Perform analysis and compute slope and deflections in determinate beams, simple frames and trusses by using energy method
CO-3	Analyse three hinged arch and girders under different loading conditions.
CO-4	Draw bending-moment/shear-force diagrams for single/multiple concentrated rolling loads
CO-5	Draw influence line diagrams for beams, girders, frames and ILD for displacements and bar forces in trusses.
CO-6	Analyse cables and suspension bridges.

Part	**Content**	**CO**
I	**Determinate Structures**: Concept of determinacy; Governing differential equation for slope and deflection of straight beams, determination of slope and deflection by Geometric methods (Double integration; Macaulay's method; Moment area method; Conjugate beam method).	CO-1
	Analysis of plane trusses, compound trusses and complex trusses using method of joints, method of sections and tension coefficients. Determination of slope and deflection of beams, frames and trusses by Energy Methods (Strain energy, Betti's and Maxwell's laws of reciprocal deflections, virtual work and Castigliano's theorems)	CO-2
II	**Arches and Girders:** Analysis of determinate arches, Internal forces Reaction diagram--Bending moment, shear force, radial shear, normal thrust diagrams. Analysis of three-hinged arch of various shapes under different loading conditions. Analysis of three hinged stiffening girders under different loading conditions.	CO-3
III	**Moving Loads and Influence Line Diagrams**: Concept of influence line diagram, rolling loads; Bending moment and shear force diagrams due to single and multiple concentrated rolling loads, uniformly distributed moving loads; Equivalent UDL;	CO-4
	Muller Breslau principle; Influence lines for beams, girders with floor beams and frames; calculation of the maximum and absolute maximum shear force and bending moment; Concept of envelopes; Influence line for displacements; Influence line for bar force in trusses.	CO-5
IV	**Analysis of Cables and Suspension Bridges**: General cable theorem, shape, elastic stretch of cable, maximum tension in cable, cables under different loading conditions. pressure on supporting towers, suspension bridges.	CO-6

References:

- Basic structural Analysis C.S.Reddy; Tata McGraw-Hill Education
- Analysis of Structures Vol- I and Vol.-II Vazirani&Ratwani; Khanna Publishers
- Intermediate structural Analysis C.K.Wang; McGraw-Hill
- Advanced Structural Analysis, A.K. Jain, Nem Chand & Bros., Roorkee.
- Theory of Structures, Vol. I, S.P. Gupta &G.S.Pandit, Tata McGraw Hill, New Delhi.

4th Semester	**AGCE-21402: Survey**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**		**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understand the concept of surveying with reference to chain surveying, Compass surveying and Plane table surveying.
CO-2	Understand the concept and significance of elevations and compute elevations by various procedures.
CO-3	Apply the knowledge of elevations to prepare contour maps and use them for various projects.
CO-4	Know about theodolites and tacheometers and use them to find distances and elevations of points.
CO-5	Understand the concept of Photogrammetry and Remote sensing.
CO-6	Know about concept and utility of GIS and GPS in Civil Engineering.

Part	**Content**	**CO**
I	**Basic Surveying**: Definition, principles of surveying, types of surveys, maps, scale of map. Calculation of areas by application of Formulae - The Trapezoidal Rule and The Simpson's Rule. Chain Surveying: Measurement of distances with chain and tape, chain and tape corrections, Ranging, direct & indirect ranging, offsets, Compass Surveying: bearing and its measurement with prismatic compass, calculation of angles from bearings. Plane Table Surveying: Setting up the plane table and methods of plane tabling.	CO-1
II	**Levelling**: Definitions of terms used in levelling, types of Levels, Setting up a Level, booking and reducing the levels by rise & fall method and height of instrument method, correction due to curvature and refraction, Trigonometric Levelling: Height, distance and RL of inaccessible objects.	CO-2
	Contouring: Definition, horizontal equivalent, contour interval, characteristics of contours, methods of contouring, interpolation of contours, uses of contour maps.	CO-3
III	**Theodolites and Tacheometers**: Temporary & permanent adjustment of transit Theodolite, traversing with a Theodolite, adjustment of closing error by Bowditch & transit rules. Calculation of vertical and horizontal distances, Subtense bar. Tacheometric levelling with both angle of depression and elevation, errors due to curvature & refraction.	CO-4
IV	**Photogrammetry & Remote Sensing**: Introduction, Basic Principles of photogrammetry, Photo-Theodolite, Elevation of a Point by Photographic Measurement, Aerial Camera, Scale of Vertical Photograph, Introduction to remote sensing, interaction of EMR with Earth Surface Working Principles and Instrumentation.	CO-5
	GIS & GPS: Introduction, concepts and terminology, Utility of GIS, Essential components of a GIS, Introduction, working principle and various applications of GPS related to Civil Engineering.	CO-6

References:

- Surveying, by C.L. Kochher – DanpatRai& Sons
- Surveying, Volume – I & II, by B.C. Punmia, Ashok K. Jain and Arun K. Jain – Laxmi Publications (P) Ltd.
- Surveying – III (Higher Surveying), by B.C. Punmia, Ashok K. Jain and Arun K. Jain – Laxmi Publications (P) Ltd.
- Surveying by Kanetkar
- Kaplan, E.D., Understanding GPS : Principles and applications
- Campbell, J.B. Taylvor and Francis, "Introduction to Remote Sensing".

4th Semester	**AGCE-21403: Environmental Engineering - II**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understand the systems of sanitation and sewerage system of waste water engineering.
CO-2	Learn about house drainage, system of plumbing and drainage layouts of residences.
CO-3	Know about different characteristics of domestic and industrial sewage.
CO-4	Understand and design various units of sewage treatment.
CO-5	Understand and design tanks and ponds of low cost sanitation systems.
CO-6	Know about wastewater treatment plants and advanced wastewater treatment.

Part	**Content**	**CO**
I	**Introduction:** Terms & definitions, systems of sanitation and their merits and demerits. Separate system, Combined system and Partially combined system of sewerage, choice of sewerage system and suitability to Indian conditions. **Sewerage System:** Generation and estimation of community Sewage, flow variations, storm water flow. Design of sewers, construction & maintenance of sewers, sewer appurtenances.	CO-1
II	**House Drainage:** Principles of house drainage, traps, sanitary fittings, systems of plumbing, drainage lay out for residences.	CO-2
	Characteristics of Sewage: Composition of domestic and industrial sewage, grab and composite sampling. Physical, Chemical and microbiological characteristics of sewage, biological decomposition of sewage, BOD and BOD kinetics, effluent disposal limits.	CO-3
III	**Treatment of Sewage:** Introduction to unit operations and processes - Primary treatment; screening (theory), grit chamber (theory), rectangular and circular sedimentation tanks (theory and design), Secondary treatment units; Activated Sludge Process (theory and design), High rate and Low rate trickling filters (theory and design). Sludge Handling and disposal; thickening, stabilization, dewatering, drying and disposal.	CO-4
IV	**Low Cost Sanitation Systems:**Imhoff tanks (theory and design), septic tank (theory and design), soakage pit/soil absorption systems; stabilization ponds (theory and design); macrophyte ponds (Theory); oxidation ponds (theory and design), Oxidation ditches (Theory); and constructed wetland systems.	CO-5
	Wastewater Treatment Plants and Advanced Wastewater Treatment: Treatment Plants; site selection, plant design, operation and maintenance aspects. Advanced wastewater treatment for nutrient removal, disinfection and polishing.	CO-6

References:

- Waste Water Engineering. (Environmental Engineering.-II) by B.C.Punmia, Ashok Jain, Laxmi Publications, New Delhi.
- Environmental Engineering. - A design Approach by Arcadio P. Sincero and Gregoria P. Sincero, Prentice Hall of India, New Delhi.
- "Waste Water Engineering - Treatment and Reuse" by Metcalf & Eddy, TMH, New Delhi.
- "Environmental Engineering." By Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, McGraw Hill, International Edition
- Environmental Engineering (Vol. II) by S.K. Garg, Khanna Publishers, Delhi.

4th Semester	**AGCE-21404: Mathematics for Civil Engineering**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Describe the key terminology, concepts tools and techniques used in statistical analysis and establish relationship between various parameters of a process through regression analysis.
CO-2	Know about piecewise continuous functions, Laplace transforms and its properties; use of Laplace transform and Inverse transform for solving initial value problems.
CO-3	Form and solve partial differentia equations in two variables.
CO-4	Know the concept of complex differentiation and also the concept of complex integration by the methods of residues and Cauchy integral formula.
CO-5	Apply numerical methods to find the solution of algebraic equations using different methods under different conditions, and numerical solution of system of algebraic equations.
CO-6	Solve differential equation by initial value problem and Calculate data with help of Interpolation and curve fitting.

Part	**Content**	**CO**
I	**Basic Statistics:** Meaning, functions and limitations of statistics. Measures of Central Tendency: Types of average - Arithmetic mean (Simple and Weighted) median, mode Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation and Coefficient of variation.Meaning, assumptions and limitations of a simple correlation and regression analysis	CO-1
	Laplace Transforms: Laplace transforms of various standard functions and properties, Inverse Laplace Transformation(only formula's),Applications to solution of ordinary linear differential equations with constant coefficients	CO-2
II	**Partial Differential Equations:** Formation of partial differential equations. Solution of Homogenous partial differential equations with constant coefficients.	CO-3
III	**Function of Complex variable:** Analytic function, Cauchy- Riemann equations, Harmonic functions, Cauchy's integral theorem, Cauchy's integral formula .Application of residues for finding Integration of function of complex variables.	CO-4
IV	**Solution of Equations:** Solution of Algebraic and Transcendental equations by Bisection method, Regula- Falsi method, Newton - Raphson Method. Solution of linear system of equations by Gauss- Elimination method, Guass - jardan method. Interpolation. (Newton forward – Backward, Newton divided difference, Lagrange's interpolation).	CO-5
	Curve fitting: Fitting of Data in straight line, second degree equation, linear curve and Exponential curve by least Square method. Solution of linear differential equations by initial value problems.(Euler methods and R.K order methods).	CO-6

References:

- KreyszingE.. Advanced Engineering Mathematics , Eighth edition. John wiely. New Delhi
- Grewal B.S. Higher Engineering Mathematics. Khanna Publisher. New Delhi.
- Ian N. Sneedon. Elements of Partial differential equation. Mcgraw – Hill. Singapore.
- Bindra. J. S. Applied Engineering. Volume – III. Kataria Publications.
- Advanced Engineering Mathematics, O'Neil.CengageLearing.
- Babu Ram Advance Engineering Mathematics. Pearson Education.
- N.P Bali. Laxmi Publication.

4th Semester	**AGCE-21405: Design of Concrete Structures**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**		**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understand the objective of analysing any structure and their design approaches with the understanding of properties of Concrete and Steel. Recognize various design philosophies of reinforced concrete structures.
CO-2	Compute various parameters of design equations and understand the concept of neutral axis and moment of resistance.
CO-3	Design the singly reinforced beams with the understanding of Shear, Bond, Anchorage, Development Length and Torsion.
CO-4	Compute various parameters of design equations and understand the concept of neutral axis and moment of resistance of doubly reinforced beams and flanged beams.
CO-5	Design the compression members under axial load with biaxial and uniaxial bending.
CO-6	Design and provide the reinforcement details for one-way slabs and two-way slabs.

Part	**Content**	**CO**
I	Objectives and Methods of Analysis and Design Properties of Concrete and Steel. Design Philosophies of Working Stress Method and Limit State Method Limit State of Collapse – Flexure	CO-1
II	Computation of Parameters of Governing Equations Determination of Neutral Axis Depth and Computation of Moment of Resistance	CO-2
	Numerical Problems on Singly Reinforced Rectangular Beams Shear, Bond, Anchorage, Development Length and Torsion	CO-3
III	Doubly Reinforced Beams – Theory and Problems Flanged Beams – Theory and Numerical Problems	CO-4
IV	Compression Members: Definitions, Classifications, Guidelines and Assumptions, Design of Short Axially Loaded Compression Members, Design of Short Compression Members under Axial Load with Uniaxial and biaxial Bending, Preparation of Design Charts, Design of Slender Columns	CO-5
	Reinforced Concrete Slabs: One-way slabs and Two-way Slabs	CO-6

References:

- Properties of Concrete by A.M.Neville – Prentice Hall
- Concrete Technology by M.S.Shetty. – S.Chand& Co.;
- Concrete Technology by M.L. Gambhir. – Tata Mc. Graw Hill Publishers, New Delhi
- Concrete Technology by A.R. Santha Kumar, Oxford university Press, New Delhi
- Advanced Design of Structures N. Krishna Raju
- Advanced RCC Design Pillai&Mennon; Tata MacGraw Hill
- Limit State Design Ramachandra
- Limit State Design A.K. Jain
- Limit State Design of Reinforced Concrete P.C. Vergese

4th Semester	**AGCE-21406: Survey - Lab**				
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Use chain surveying and compass surveying for plotting details of an area.
CO-2	Use plane table surveying for plotting details of an area.
CO-3	To compute Elevation of a point by using Level.
CO-4	Use the theodolite for measuring horizontal/ vertical angle by theodolite.
CO-5	Compute distances and levels of points by optical observations.
CO-6	Exhibit his/her creativity and conceptual understanding of the subject AGCE – 21402 (Survey).

Part	**Experiment**	**CO**
A	1. Ranging a line, measuring its bearing and taking offsets to plot details of an area.	CO-1
	2. plotting details of an area by plane table surveying	CO-2
	3. To perform levelling by Rise and Fall / Height of Instrument method.	CO-3
	4. Measurement of Horizontal/Vertical angles by theodolite.	CO-4
	5. Measurement of horizontal and vertical distances using theodolite/Tacheometer.	CO-5
B	To make a mini project that demonstrates a concept, based on the content of AGCE – 21402 (Survey)	CO-6

4th Semester	**AGCE-21407: Environmental Engineering - Lab**				
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Decide the acidic or basic character of a water sample.
CO-2	Determine hardness of a water sample.
CO-3	Decide the extent of acidic or basic character of a water sample.
CO-4	Find the chloride content of a given water sample.
CO-5	Determine the amount of solids dissolved in a given water sample.
CO-6	Exhibit his/her creativity and conceptual understanding of the subject.

Part	**Experiment**	**CO**
A	1. To measure the pH value of a water/waste water sample.	CO-1
	2. Determination of Hardness of a given water sample.	CO-2
	3. To find acidity/alkalinity of a given water sample.	CO-3
	4. To find chlorides in a given sample of water/waste water.	CO-4
	5. Determination of total solids, dissolved solids, suspended solids of a given water sample..	CO-5
B	To make a mini project that demonstrates a concept, based on the content of AGCE – 21303 (Environmental Engineering -I) and AGCE – 21403 (Environmental Engineering -II)	CO-6

4th Semester	**AGCE-21408: Building Drawing**				
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Have knowledge of the provisions made in National Building Code. (SP7:2016 Vol. 1&2)
CO-2	Decide a suitable plan for a residential building.
CO-3	Prepare an optimum wall plan for a building.
CO-4	Prepare and read sectional plans of buildings.
CO-5	Prepare and read sectional plans of public buildings and supervise the building construction work.
CO-6	Exhibit his/her creativity and conceptual understanding of the subject.

Part	**Experiment**	**CO**
A	1. To study the guidelines / specifications of National Building Code. (SP7:2016 Vol. 1&2)	CO-1
	2. To prepare line plan & elevation of a residential building as per given set of requirements.	CO-2
	3. To prepare wall plan for the residential building of Sr. No. 2.	CO-3
	4. To prepare the sectional plan and sectional elevation of a two room building.	CO-4
	5. To prepare the sectional plan and sectional elevation of a public building.	CO-5
B	To make a mini project that demonstrates a concept, based on the content of AGCE – 21305 (Building Materials & Construction)	CO-6

4th Semester	**AGAP-21401: Engineering Aptitude - I**				
Internal Marks:	**50**		**L**	**T**	**P**
External Marks:	**0**		**0**	**1**	**0**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Develop a Proper Understanding of the Number system
CO-2	Understand the Concept of HCF & LCM to solve problems related to Racetracks, Traffic lights etc.
CO-3	Recognize parts and wholes both visually and numerically
CO-4	Recognize and apply Ratios,Proportions and Percentage to solve real-life problems
CO-5	Recognize company's revenues and expenditures over a specified period of time,
CO-6	Understand the concept of time value of money

Part	**Content**	**CO**
I	**Number System:**Various types of numbers ,Face Value & Place value of a digit in a numeral, Divisibility Tests **Problems on Numbers:**To find Unknown numbers	CO-1
II	**HCF &LCM:**Factors and multiples to find Highest Common Factor and Least Common Multiple of fractions, Comparison of Fraction	CO-2
	Decimal and Fractions: Operations on Decimal and Fractions	CO-3
III	**Ratio & Proportion :**Tricks to Find ratio and Proportions **Percentage:** Concept of Percentage , Tricks to find Percentage	CO-4
IV	**Profit & loss:** Cost Price, Selling Price, Profit, Loss, Profit Percentage and Loss Percentage	CO-5
	Simple & Compound Interest: Interest computed annually, half yearly and Quarterly..	CO-6

References:

- Quantitative Maths :Arihant Publishers.
- Objective Mathematics : R S Aggarwaal.
- Quantitative Maths : TMH Publications

4th Semester	**AGFE-21402: Functional English - II**				
Internal Marks:	**50**		**L**	**T**	**P**
External Marks:	**0**		**0**	**1**	**0**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Self Introduction and Body Language to prepare students to face one to one interaction.
CO-2	Spoken Activity such as Topic Presentation or extempore to hone spoken skills of students.
CO-3	Vocabulary based session to improve language proficiency of students.
CO-4	Basic Grammar to make students proficient in English correspondence.
CO-5	Book reading to improve reading skills of students.
CO-6	Formal/ Informal Letter writing to make students proficient in written correspondence.

Part	**Content**	**CO**
I	Components of Self Introduction, Exemplary Performances, Student Performances on Self Introduction along with resume.	CO-1
II	This section includes Spoken Activity such as Topic Presentation or extempore to hone spoken skills of students.	CO-2
	This section includes Root words and its usage.	CO-3
III	This section includes editing, omission, gap filling, rearranging jumbled sentences to test knowledge of passive voice, reported speech, articles and the other determiners, modals, tense, etc. Basic Grammar such as Tenses, Voice, Narration shall be done.	CO-4
IV	IKIGAI shall be prescribed for honing reading skills and comprehension in depth.	CO-5
	Formal/ Informal Letter Writing**,** Basic Format, Example, Practice shall be done.	CO-6

References:

- www.Indiabix.com
- English Grammar by Wren and Martin
- www.freshersworld.com
- www.alison.com

ESSENCE OF INDIAN KNOWLEDGE TRADITION
AGMC-21402

Internal Marks: -	**L**	**T**	**P**
External Marks: -	**1**	**-**	**-**
Total Marks: -			

Course Outcomes:

1. Understand the concept of traditional knowledge and its importance
2. Know the need and importance of protecting traditional knowledge.
3. Know the various enactments related to the protection of traditional knowledge.
4. Understand the concepts of Intellectual property to protect the traditional knowledge.
5. Understand significance of traditional knowledge in different sectors

INTRODUCTION TO TRADITIONAL KNOWLEDGE: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge

PROTECTION OF TRADITIONAL KNOWLEDGE: Protection of traditional knowledge: The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

LEGAL FRAMEWORK AND TK: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); **B:** The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indicators act 2003.

TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY

Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge,

Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

TRADITIONAL KNOWLEDGE IN DIFFERENT SECTORS: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK. 139.

Reference Books:

1. **Traditional Knowledge System in India**, by Amit Jha, 2009.
2. **Traditional Knowledge System and Technology in India** by Basanta Kumar Mohanta and
Vipin Kumar Singh, Pratibha Prakashan 2012.
3**."Knowledge Traditions and Practices of India"** Kapil Kapoor1, Michel Danino2

List of Professional Elective Courses

5th Semester	B.Tech (Civil Engineering)							
Course code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credit
		L	T	P	Internal	External		
AGCE – 21504A	Advance Structural Analysis	3	-	-	40	60	100	3
AGCE – 21504B	Pre-stressed Concrete	3	-	-	40	60	100	3
AGCE – 21504C	Elements of Earthquake Engineering	3	-	-	40	60	100	3
AGCE – 21504D	Infrastructure Development and Management	3	-	-	40	60	100	3

6th Semester	B.Tech (Civil Engineering)							
Course code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credit
		L	T	P	Internal	External		
AGCE – 21604A	Earth and Earth Retaining Structures	3	-	-	40	60	100	3
AGCE – 21604B	Foundation Engineering	3	-	-	40	60	100	3
AGCE – 21604C	Rock Mechanics and Engineering Geology	3	-	-	40	60	100	3
AGCE – 21604D	Reinforced Earth and Geo-textiles	3	-	-	40	60	100	3

5th Semester	**AGCE-21501: Geotechnical Engineering**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**		**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understand basic Concept of Soil Mechanics and index properties of Soil.
CO-2	Monitor the compaction process in the field.
CO-3	Analyze consolidation differential equation for settlement of soils.
CO-4	Evaluate permeability of different soils under different conditions.
CO-5	Evaluate earth pressure with different earth-pressure-theories.
CO-6	Test the strength of soil in shear and settlement.

Part	**Content**	**CO**
I	**Introduction:** Concept of Soil Mechanics and Geotechnical Engineering. Formation of soil, Types of soil, Need and importance of studying soil mechanics & foundation engineering. **Index Properties:** Concept of phase diagram. Determination of moisture content, in situ density and specific gravity of soil as per Indian Standards. Weight-Volume relationships and related numerical problems. Properties of fine grain soils especially clay and determination of Atterberg Limits of clayey soils. Grain size analysis of coarse and fine grain soils.	CO-1
	Compaction: Definition and object of compaction and concept of O.M.C. and zero Air Void Line. Modified proctor Test. Factors affecting compaction Effect of compaction on soil properties and their discussion. Field compaction methods- their comparison of performance and relative suitability. Field compacative effort, Field control of compaction by proctor.	CO-2
II	**Consolidation:** Difference between compaction and consolidation. Concept of various consolidation characteristics i.e. a_v, m_v and c_v, primary and secondary consolidation. Terzaghi's Differential equation and its derivation. Boundary conditions for Terzaghi's solution for one dimensional consolidation concept of c_v, t_v & U. Consolidation test determination of c_v from curve fitting methods, consolidation pressure determination. Normally consolidated and over consolidated clays. Effect of disturbance on *void ratio-Logσ* curves of normally consolidated clays, importance of consolidation settlement in the design of structures.	CO-3
III	**Permeability:** Definition and concept of Darcy Law. Determination of Coefficient of Permeability in lab by various methods. Average coefficient of permeability in stratified soils. Seepage forces and pressure. Concept of Critical hydraulic gradient. Bulking of sand.	CO-4
	Earth Pressure: Determination of effective, total and neutral stress in soil. Determination of Lateral Earth pressure on retaining walls by Rankine and Coulomb theories with their relative merits and demerits. Boussinesq's and Westergard analysis to determine pressure below point load, uniformly loaded circular and rectangular area.	CO-5
IV	**Strength of Soil:** Concept of Shear Strength , Mohr Failure Envelope. Tests to determine shear strength of soil in lab and Field, Vane Shear Test. Drainage conditions in Triaxial test. Skempton's Pore Pressure Parameters. Types of failure in shallow foundations.Failure due to settlement, equations to compute settlement / permissible settlement as per Indian Standards.	CO-6

References:

- Soil Mech. & Foundation Engg, by K.R.Arora Standard Publishers Distributors
- Geotechnical Engineering, by P. Purshotama Raj Tata Mcgraw Hill
- Soil Mech. & Foundation Engg., by V.N.S.Murthy CBS Publishers & Distributors.
- Principle of Geotechnical Engineering by B.M.DasCengage Publisher
- Basic and applied Soil Mechanics by GopalRanjan and A.S.R.Rao New Age International Publishers
- Geotechnical Engineering by Gulati and Datta, Tata McGraw Hill
- Problems in Soil mechanics and Foundation Engineering by B.P.Verma, Khanna Publishers

5th Semester	**AGCE-21502: Irrigation Engineering - I**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**		**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understand basics of irrigation engineering, its importance, necessity and various methods of irrigation.
CO-2	Design different types of irrigation canals.
CO-3	Design lined canals to reduce losses in canals and prevent waterlogging.
CO-4	Analyse the yield, porosity and interference among the irrigation wells.
CO-5	Understand the process of planning of water resources projects.
CO-6	Understand various river training works.

Part	**Content**	**CO**
I	**Introduction:** Importance of Irrigation engineering. Its necessity. Purpose and objective of irrigation. **Methods of Irrigation:** Water requirement of crops. Factors affecting water requirement. Quality of irrigation water. Impurities in irrigation water. Consumptive use of water (Evapo-transpiration). Factors affecting consumptive use of water. Water depth or delta. Duty of water. Base Period. Relation between delta, duty and base period.	CO-1
	Canal Irrigation: Classification of canals. Canal alignment. General considerations for alignment. Alignment of field channel or water courses. Silt theory. Kennedy Theory. Lacey's theory. Lacey's theory applied to channel design. Drawbacks of Kennedy theory. Comparison of Lacey's and Kennedy theory. Design of Unlined canals based on Kennedy and Lacey's theory.	CO-2
II	**Losses in Canals, Water Logging and Drainage:** Losses in canals. Water Logging. Causes and effects of water logging. Remedial measures. Drainage of land. Types of drains. Design considerations for Surface drains. Under drains or tile drains. Layout of Tile drain system. **Lined Canals:** Types of lining. Selection of lining types. Economics of Lining of canals. Calculation of benefits. Annual cost of extra expenditure on lining. Maintenance of lining of canals. Measurement of discharge in channels. Area velocity method. Chemical method. Weir method, stage discharge curves. Design of Lined canals. Method of providing drainage behind lining.	CO-3
III	**Tube Well Irrigation:** Tube Wells. Types of strainers. Aquifers. Porosity. Specific Yield. Specific Retention. Storage coefficient. Yield of an open well. Interference among wells. Selection of suitable sites for Tube well.	CO-4
	Investigation and Preparation of Irrigation Projects: Introduction. Various purposes served by WRD projects (Water Resource Development Projects), Classification of WRD Projects. Water resources of multi purpose projects. Compatibility of Multi purpose projects and use.Planning of WRD Projects.Estimation of Benefit Cost ratio. Capital Budgeting. Some common pitfalls of Water resources planning.	CO-5
IV	**River Training Works:** River Training. Classification of river training works. Guide Bank systems. Design consideration. Groynes or Spurs. Repelling Groynes. Impermeable and permeable Groynes. Pitched Islands. Natural and artificial cut-offs and design considerations. Artificial Cut-offs.	CO-6

References:

- Principles & practice of Irrigation Engg.S.K.Sharma; S. Chand, Limited.
- Irrigation & Water Power Engg.B.C. Punmia, PandeB.B.Lal; Laxmi Publications (p) Ltd
- Fundamentals of Irrigation Engg.Dr. Bharat Singh; Nem Chand & Bros
- Irrigation Engg.& Hydraulic Structure S.R.Sahasrabudhe; S. K. Kataria& Sons
- Irrigation Engg.& Hydraulic Structure Varshney, Gupta & Gupta; Nem Chand and Brothers
- Irrigation Engg.& Hydraulic Structure Santosh Kumar Garg; Khanna Publishers

5th Semester	**AGCE-21503: Transportation Engineering - I**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understand characteristics of road transport, Highway development and planning.
CO-2	Compute various design parameters of highways
CO-3	Know about various materials and construction techniques used for highways.
CO-4	Evaluate a pavement for its construction in water logged areas.
CO-5	Perform various studies related to traffic.
CO-6	Know different traffic signs and signals.

Part	**Content**	**CO**
I	**Introduction:** Importance of Transportation, Different Modes of Transportation, Characteristics of Road Transport. **Highway Development & Planning**: Principles of Highway Planning, Road Development in India, Classification of Roads, Road Patterns, Planning Surveys.	CO-1
	Highway Alignment: Requirements, Alignment of Hill Roads, Engineering Surveys. **Highway Geometric Design**: Cross Section Elements, Carriageway, Camber, Sight Distances, Horizontal Curves, Extra-widening, Super-elevation, Vertical Curves.	CO-2
II	**Highway Materials**: Properties of Sub-grade and Pavement Component Materials, Testson Sub-grade Soil **Highway Construction**: Earthen/Gravel Road, Water Bound Macadam, Wet Mix Macadam, Bituminous Pavements, Cement Concrete Pavements.	CO-3
III	**Highway Drainage and Maintenance**: Importance of drainage and maintenance, Surface Drainage and Subsoil Drainage, Construction in Water-logged areas, Pavement Failures, Pavement Evaluation, Maintenance and Strengthening Measures. **Highway Economics & Financing**: Total Transportation Cost, Economic Analysis, Sources of Highway Financing.	CO-4
	Traffic Characteristics: Road User Characteristics, Driver Characteristics, Vehicular Characteristics. **Traffic Studies**: Volume Studies, Speed Studies, O-D Survey, Parking Study.	CO-5
IV	**Traffic Safety and Control Measures**: Traffic Signs, Markings, Islands, Signals, Cause and Type of Accidents, Use of Intelligent Transport System. **Traffic Environment Interaction**: Noise Pollution, Vehicular Emission, Pollution Mitigation Measures.	CO-6

References:

- Khanna S.K., and Justo, C.E.G. "Highway Engineering", Nem Chand and Brothers, Roorkee, 1998.
- Kadiyali, L.R. "Principles and Practice of Highway Engineering", Khanna Publishers, New Delhi, 1997.
- Flaherty, C.A.O. "Highway Engineering", Volume 2, Edward Arnold, London, 1986.
- Sharma, S.K. "Principles, Practice & Design of Highway Engineering", S. Chand &
- Company Ltd., New Delhi, 1985.
- Mannering, "Principles of Highway Engineering & Traffic Analysis", Wiley Publishers, New Delhi.

5th Semester	**AGCE-21504A: Advanced Structural Analysis** (Professional Elective Course – I)

Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Evaluate static and kinematic indeterminacy of different structures.
CO-2	Analyse indeterminate structures by Slope Deflection method
CO-3	Analyse indeterminate structures by Moment distribution method and Rotation contribution method
CO-4	Analyse indeterminate structures by consistent deformation method and theorem of three moments
CO-5	Analyse indeterminate frames by Portal method and Cantilever method
CO-6	Draw influence line diagrams for indeterminate structures

Part	**Content**	**CO**
I	**Indeterminate Structures:** Concept of indeterminate /redundant structures; Static and kinematic indeterminacies; stability of structures; internal forces, fixed-end moments.	CO-1
	Indeterminate Structural Systems: Pin-jointed and rigid-jointed structural systems, Deformation of redundant structures-sway and non-sway frames, Static equilibrium and deformation compatibility checks, Effects of support settlement and lack of fit by conventional method (Slope Deflection method)	CO-2
II	**Fixed Beam** - member loading, sinking of supports, Analysis of redundant beams, frames, trusses, arches using following methods: **a) Conventional Methods:** Moment distribution method and Rotation contribution method (Kani's Method).	CO-3
III	**Fixed Beam** - member loading, sinking of supports, Analysis of redundant beams, frames, trusses, arches using following methods: **b) Classical Methods:** Methods of consistent deformation, Theorem of three moments.	CO-4
	Fixed Beam - member loading, sinking of supports, Analysis of redundant beams, frames, trusses, arches using following methods: **c) Approximate Methods:** Portal method; Cantilever method	CO-5
IV	**Influence Line Diagrams:** Concept and application in the analysis of statically indeterminate structures; Influence line for bar forces in the statically indeterminate trusses, beams and frames.	CO-6

References:

- Basic structural analysis - C.S. Reddy Tata McGraw-Hill
- Intermediate structural analysis - C. K. Wang. McGraw Hill
- Indeterminate structural analysis - J. Sterling Kinney Addison-Wesley Educational Publishers
- Theory of structures - B.C. Punima, Laxmi Publications
- Structural Analysis, DevdasMenon, Narosa Publishers.

5th Semester	**AGCE-21504B: Pre-stressed Concrete** (Professional Elective Course – I)				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understand the concept of pre-stressing in concrete.
CO-2	Analyse pre-stress and resultant stresses at different sectors.
CO-3	Analyse internal resisting forces and deflections in pre-stressed beams.
CO-4	Analyse flexure in pre-stressed beams by strain compatibility method.
CO-5	Design pre-stressed members for shear and torsion.
CO-6	Design pre-stressed beams and slabs.

Part	**Content**	**CO**
I	**Materials for pre-stressed concrete and pre-stressing systems** High strength concrete and high tensile steel, tensioning devices, pre-tensioning systems, post-tensioning systems.	CO-1
	Analysis of pre-stress Analysis of pre-stress, resultant stresses at a sector, pressure line or thrust line	CO-2
II	**Analysis of pre-stress and bending stresses** Internal resisting couple, concept of load balancing, losses of pre-stress, deflection of beams.	CO-3
III	**Strength of pre-stressed concrete sections in flexure,** Types of flexural failure, strain compatibility method as per IS:1343 (2012) code procedure	CO-4
	Strength of pre-stressed concrete sections in shear and torsion Design for limit state of shear and torsion according to IS: 1343 (2012) Transfer of pre-stress in pre-tensioned members.	CO-5
IV	**Design of pre-stressed concrete beams and slabs** Transfer of pre-stress in post tensioned members, design of anchorage zone reinforcement, design of simple beams, cable profiles, design of slabs.	CO-6

References:

- N. Krishna Raju, Prestressed concrete, Tata McGraw Hill
- T.Y. Lin, Ned H. Burns, Design of Prestressed Concrete Structures, John Wiley & Sons.
- P. Dayaratnam, Prestressed Concrete, Oxford & IBH
- R. Rajagopalan, Prestressed Concrete.
- IS 1343 2012 Code of Practice for Prestressed Concrete

5th Semester	**AGCE-21504C: Elements of Earthquake Engineering** (Professional Elective Course – I)

Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understand basic terminology and concept of earthquakes.
CO-2	Understand the theory of vibrations during earthquakes.
CO-3	Analyse the motion of single degree of freedom under damped and undamped conditions
CO-4	Perform force analysis
CO-5	Understand the concepts of seismic design and lateral strength.
CO-6	Know the provisions laid down in IS 4326 and IS 13920.

Part	**Content**	**CO**
I	Introduction to Earthquakes, Causes of Earthquakes, Basic Terminology, Magnitude, Intensity, Peak ground motion parameters. Past Earthquakes and Lessons learnt, Various Types of Damages to Buildings.	CO-1
	Introduction to theory of Vibrations, Sources of Vibrations, Types of Vibrations, Degree of Freedom, Spring action and damping.	CO-2
II	Equation of motion of S.D.O.F. systems, Undamped, Damped system subjected to transient forces, general solution, green's function.	CO-3
III	Lateral Force analysis, Floor Diaphragm action, moment resisting frames, shear walls.	CO-4
IV	Concepts of seismic design, Lateral Strength, Stiffness, ductility and structural configuration. Introduction to provisions of IS 1893-2002 Part-I for buildings. Estimation of lateral forces due to earthquake.	CO-5
	Introduction to provisions of IS 4326. Introduction to provision of IS 13920.	CO-6

References:

- Earthquake Resistant Design of Structures, Pankaj Agrawal, Manish Shrikhande, PHI Learning
- Dynamics of Structures: Theory and Applications to Earthquake Engineering, AK Chopra, Prentice Hall
- Dynamics of Structures, R.W. Clough and Joseph Penzien, McGraw-Hill Education
- Structural Dynamics by Mario & Paz, Springer.
- Earthquake Resistant Design by David J. Dowrick, Wiley India Pvt Ltd
- Elements of Earthquake Engg by Jai Krishna, A.R. Chandrasekaran, Brijesh Chandra, South Asian Publishers.
- IS 1893-2002 Indian Standard Criteria for Earthquake Resistant Design of Structures.
- IS 4326-1993 2002 Indian Standard for Earthquake Resistant Design and Construction of Buildings.
- IS 13920-1993 2002 Ductile detailing of Reinforced Concrete Structures subjected to Seismic Forces.

5th Semester	**AGCE-21504D: Infrastructure Management and Development** (Professional Elective Course – I)

Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Know the impact of infrastructural development on socio-economic and related issues.
CO-2	Know the chronology of development of government policies and their legal framework.
CO-3	See the construction sector as an important component of infrastructural development
CO-4	Understand the importance of infrastructural management in highways sector and irrigation projects.
CO-5	Understand the importance of infrastructural management in power projects.
CO-6	Understand the importance of infrastructural management in development of airports and railways.

Part	Content	CO
I	**Introduction:** Impact of Infrastructure development on economic development, standard of living and environment. Reasons for rise of public sector and government in infrastructural activities. Changed socio-economic scenario and current problems and related issues.	CO-1
	Policies on Infrastructure Development: A historical review of the Government policies on infrastructure. Current public policies on transportations, power and telecom sectors. Plans for infrastructure development. Legal framework for regulating private participation in roads and highways, Ports & Airports, Power and Telecom.	CO-2
II	**Construction and Infrastructure:** Construction component of various infrastructure sectors. Highway, ports and aviation, oil and gas, power, telecom, railways, irrigation. Current scenario, future needs, investment needed, regulatory framework, government policies and future plans. Technological and methodological demands on construction management in infrastructure development projects.	CO-3
III	**Infrastructure Management:** Importance, scope and role in different sectors of construction. **Highway Sector:** Repayment of Funds, Toll Collection Strategy, Shadow tolling, and direct tolls, Maintenance strategy, Review of toll rates & structuring to suit the traffic demand. **Irrigation Projects:** Large / Small Dams - Instrumentation, monitoring of water levels, catchments area, rainfall data management, prediction, land irrigation planning & policies, processes Barrages, Canals.	CO-4
IV	**Power Projects:** Power scenario in India, Estimated requirement, Generation of Power distribution strategies, national grid, load calculation & factors, Hydropower - day to day operations, management structures, maintenance, Thermal Power, Nuclear Power.	CO-5
	Airports: Requisites of domestic & International airports & cargo & military airports, facilities available, Terminal management, ATC. **Railways:** Mass Rapid Transport System MRTS, LRT, Multi-modal Transport System.	CO-6

References:

- Chandra, Prassanna, "Projects, Planning, Analysis, Selection, Financing, Implementation and Review", Tata McGraw-Hill, New Delhi, 2006.
- Raghuram, G. & Jain, R., "Infrastructure Development & Financing Towards a Public-Private Partnership", Macmillan India Ltd., New Delhi, 2002.
- India Infrastructure Report 2001 & 2002, Oxford University Press, New Delhi, 2001/02.
- NICMAR, "Construction Business Opportunities in Infrastructure Development in India", NICMAR, Mumbai, 2001.
- Parikh Kirit S., "India Development Report, 1999-2000", Oxford University Press, New Delhi, 2002.
- GOI Rakesh Mohan Committee, "The India Infrastructure Report", National Council of Applied Economic Research, New Delhi, 1996

5th Semester	**AGCE-21505: Design of Advanced Concrete Structures (Skill Course-I)**				
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**1**	**0**	**4**
Total Marks:	**50**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Analyze and design different types of staircases as per the stipulations of IS 456.
CO-2	Analyze and design the different types of shallow foundations.
CO-3	Analyze and design the circular, semi-circular and continuous beam for the RCC structures.
CO-4	Analyze and design the retaining wall construction in hilly areas, basements etc.
CO-5	Analyze and design RCC circular & rectangular water tank resting on ground for storage purposes.
CO-6	Analyze and design the spherical and conical domes for the lightning through the roofs.

Part	**Content**	**CO**
I	**Stairs**: Types and Design of Stairs	CO-1
II	**Foundations**: Theory and Design: Isolated Footing (Square, Rectangular), Combined Footing (Rectangular, Trapezoidal, Strap).	CO-2
	Beams: Design of Continuous beams and curved beam.	CO-3
III	**Retaining Wall**: Design of Retaining walls: Cantilever type retaining wall, Counterfort type retaining wall.	CO-4
	Water Tanks: Introduction to water retaining structures. Design of circular and rectangular water tanks resting on ground.	CO-5
IV	**Domes**: Introduction to Domes, Design of spherical and conical domes.	CO-6

References:

- IS 456-2000*- Indian Standard. Plain and Reinforced concrete -Code of practice
- IS 3370- Code of practice for concrete structures for storage of liquids
- Design Aid SP 16
- Explanatory hand book SP24.
- Detailing of Reinforcement SP 34 Note: The codes marked with * are permitted in examination.

5th Semester	**AGCE-21506: Structural Analysis – Lab**				
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Verify Clark-Maxwell's theorem and understand deflection in simply supported beams.
CO-2	Compute Flexural Rigidity of a given beam
CO-3	verify the Moment- area theorem for slope and deflection of a given beam
CO-4	Compute moment required to produce a given rotation
CO-5	Understand behavior of columns and struts with different end conditions
CO-6	Exhibit his/her creativity and conceptual understanding of the subject AGCE 21401 – (Structural Analysis)

Part	**Experiment**	**CO**
A	Deflection of a simply supported beam and verification of Clark-Maxwell's theorem.	CO-1
	To determine the Flexural Rigidity of a given beam.	CO-2
	To verify the Moment- area theorem for slope and deflection of a given beam.	CO-3
	To determine the moment required to produce a given rotation (rotational stiffness) at one end of the beam when the other end is pinned.	CO-4
	Study of behavior of columns and struts with different end conditions.	CO-5
B	To make a mini project that demonstrates a concept, based on the content of AGCE 21401 – (Structural Analysis)	CO-6

5th Semester	**AGCE-21507: Computer Aided Drawing-I – Lab**				
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	draw the different types of stairs and their elements of the stairs use for different types of structures.
CO-2	draw the different types of foundations and their elements use for the residential and commercial buildings.
CO-3	draw the retaining walls use in buildings and hilly areas.
CO-4	draw the various elements of domes for the buildings for the lightning and decorative purposes.
CO-5	draw the elements of water tanks resting on the ground for the storage purposes.
CO-6	Exhibit his/her creativity and conceptual understanding of the subject AGCE – 21507 (CADD LAB-I).

Part	**Experiment**	**CO**
A	To make 2D Drawing of Straight and Dog legged stair	CO-1
	To make 2D Drawing of Isolated Square Footing and Combined Rectangular Footing	CO-2
	To make 2D Drawing of Cantilever Retaining Wall and Counterfort Retaining Wall	CO-3
	To make 2D Drawing of Spherical Dome and Conical Dome	CO-4
	To make 2D Drawing of Rectangular Water Tanks and Square Water Tanks	CO-5
B	To make a mini project that demonstrates a concept, based on the content of AGCE – 21507 (CADD LAB-I)	CO-6

5th Semester	**AGCE-21508: Geotechnical Engineering – Lab**				
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Compute in-situ density of soil by core cutter and sand replacement method.
CO-2	Evaluate cassagrande limits of a soil sample.
CO-3	Perform grain size analysis of sand
CO-4	Compute maximum dry density of a soil sample.
CO-5	Compute Relative Density of soil
CO-6	Exhibit his/her creativity and conceptual understanding of the subject AGCE – 21501 (Geotechnical Engineering).

Part	**Experiment**	**CO**
A	Determination of in-situ density by core cutter method. Determination of in-situ density by Sand replacement method.	CO-1
	Determination of Liquid Limit & Plastic Limit.	CO-2
	Grain size analysis of sand and determination of uniformity coefficient (Cu) and coefficient of curvature (Cc).	CO-3
	Determination of OMC and Maximum Dry Density of soil by light compaction.	CO-4
	Determination of Relative Density of soil.	CO-5
B	To make a mini project that demonstrates a concept, based on the content of AGCE – 21501 (Geotechnical Engineering)	CO-6

5th Semester	**AGAP-21502: Engineering Aptitude - II**				
Internal Marks:	**50**		**L**	**T**	**P**
External Marks:	**0**		**0**	**1**	**0**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Learn and practice Aptitude questions based on *"Problems on Ages"* and improve their skills in order to face the interview, competitive exams.
CO-2	Understand the relationships among things or finite groups of things.
CO-3	Outline the various formulas for calculating area , volume and surface area.
CO-4	Use a calendar to determine a Date and Day.
CO-5	Use a time schedule to determine ending time of a given event.
CO-6	Find out missing part of an element by subsequent comparison.

Part	**Content**	**CO**
I	**Problem on Ages**: Shortcut method to simplify questions based on Age	CO-1
	Venn Diagrams: Applications of Sets	CO-2
II	**Area , volume and surface area** : Cuboid, Cube, Parallelepiped, Cylinder, Sphere	CO-3
III	**Calendar and Time** :To find odd days in an ordinary year, Leap year, Days of week related to odd days	CO-4
	Clocks : Hands of Clock, Angle Traced by Hands	CO-5
IV	**Chain Rule** :Direct Proportion **,**Indirect Proportion	CO-6

References:

- Quantitative Maths: Arihant Publishers.
- Objective Mathematics: R S Aggarwal.
- Quantitative Maths: TMH Publications

5th Semester	**AGCE-21509: Survey Camp (On-site Training)**				
Internal Marks:	**60**		**L**	**T**	**P**
External Marks:	**40**		**0**	**0**	**0**
Total Marks:	**100**		**Credits**		**1**

Course Outcomes: After going through this training, students will be able to:	
CO-1	Perform reconnaissance survey in any terrain.
CO-2	Execute shifting of Reduce Level from a Temporary/Permanent Benchmark by Fly-Levelling.
CO-3	Plot details of an area by plane tabling.
CO-4	Use optical measurements and plot the spot levels on a survey sheet.
CO-5	Interpolate contours in a sheet of spot levels.
CO-6	Write the report of the training exercise of Survey Camp.

Part	**Training Activity**	**CO**
-	**Reconnaissance Survey:** To perform reconnaissance survey for fixing survey station points (preferably in hilly region)	CO-1
	Fly-Levelling: To shift Reduce Level from a Temporary/Permanent Benchmark by performing Fly-Levelling and compute the RLs of survey stations.	CO-2
	Detailing: To plot details of the area by plane tabling.	CO-3
	Spot Levelling: To perform spot leveling by optical measurements using Theodolite/Total Station.	CO-4
	Interpolation of Contours: To perform interpolation of contours in the spot levels obtained above and prepare a topographic map of the area	CO-5
	Report: To write a detailed report of the entire exercise of Survey Camp.	CO-6

6th Semester	**AGCE-21601: Design of Steel Structures - I**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**		**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Know about rolled steel sections and design and analyse the bolted and welded connections.
CO-2	Design and analyse steel tension members**.**
CO-3	Design and analyse steel compression members.
CO-4	Design and analyse various members of steel under combined forces
CO-5	Design and analyse column bases.
CO-6	Classify and design structural steel components of industrial building.

Part	**Content**	**CO**
I	**Introduction and connections**: Properties of structural steel, I.S. rolled sections, I.S. specifications. Bolted and welded connections for axial and eccentric loads.	CO-1
	Tension members: Design of members subjected to axial tension.	CO-2
II	**Compression members**: Design of axially loaded members, built-up columns, laced and battened columns including the design of lacing and battens.	CO-3
III	**Flexural members**: Design of laterally restrained and un-restrained rolled and built-up sections.	CO-4
	Column bases: Design of slab base, gusseted base.	CO-5
IV	**Roof truss**: Design loads, combination of loads, design of members (including purlins) and joints, detailed working drawings.	CO-6

References:

- Limit state design of steel structures: S K Duggal, McGraw Hill
- Design of steel structures: N Subramanian Oxford Higher Education
- Design of steel structures (Vol. 1): Ram Chandra Standard Book House - Rajsons
- Design of steel structures (by limit state method as per IS: 800-2007): S SBhavikatti I K International Publishing House
- IS 800: 2007 (General construction in steel-Code of practice)*
- SP: 6(1) (Handbook for structural engineers-Structural steel sections)* * permitted in Examination.

6th Semester	**AGCE-21602: Hydrology**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**		**Credits**		**4**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understand the hydrological cycle, its components and the concept of catchment.
CO-2	Apply knowledge of hydrology in computing average precipitation, and other hydrological computation related to rainfall.
CO-3	Understand concept of abstractions like Evaporation, Transpiration and Infiltration.
CO-4	Understand the concept of runoff and measurements of stage and stream velocity.
CO-5	Compute stream-flow discharge using direct and indirect methods.
CO-6	To compute different hydrographs for varied designs as per need.

Part	**Content**	**CO**
I	**Introduction:** Hydrological cycle, scope and application of hydrology to engineering problems, water budget equation, drainage basins and its characteristics, hypsometric curves.	CO-1
	Precipitation: Forms and types of precipitation, measurement of precipitation, recording and non recording rain-gauges, rain-gauge station, rain-gauge network, estimation of missing data, presentation of rainfall data, mean precipitation, depth -area -duration relationship, frequency of point rainfall, probable maximum precipitation.	CO-2
II	**Evaporation & Transpiration:** Process, evaporimeters and empirical relationships, reservoir evaporation and methods of its control, transpiration, evapotranspiration and its measurement, Penman's equation and potential evapotranspiration. **Infiltration:** Infiltration process, infiltration capacity and measurement of infiltration, infiltration indices.	CO-3
III	**Runoff:** Factor affecting run-off, estimation of runoff, rainfall-run off relationships, measurement of stage-staff gauge, wire gauge, automatic stage recorder and stage hydrograph, measurement of velocity-current meters, floats.	CO-4
	Methods of stream flow measurement: area velocity method, moving boat method, slope area method, electromagnetic method, ultra-sonic method and dilution technique, stage-discharge relationship.	CO-5
IV	**Hydrograph:** Discharge hydrograph, components and factors affecting shape of hydrograph, effective rainfall, unit hydrograph and its derivation, unit hydrograph of different durations, use and limitations of UH, triangular UH, Snyder's synthetic UH.	CO-6

References:

- Engineering Hydrology by K.Subramanya, TMH, New Delhi
- Hydrology by H.M.Raghunath.
- Hydrology for Engineers by Linsely, Kohler, Paulhus.
- Elementary Hydrology by V.P.Singh.

6th Semester	**AGCE-21603: Transportation Engineering - II**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understand the Indian Railway gauges , railway track and components.
CO-2	Learn about geometric design of railway track , points and crossing.
CO-3	Understand various station and yards, signalling and interlocking of railway engineering.
CO-4	Understand the track speed and air transport.
CO-5	Know about airport planning, design and runway.
CO-6	Acquire knowledge of taxiway, aircraft parking and visual aids of air transport.

Part	**Content**	**CO**
I	**Introduction to Railway Engineering**: History of Railways, Development of Indian Railway, Organisation of Indian Railway, Important Statistics of Indian Railways. Railway Gauges: Definition, Gauges on World Railways, Choice of Gauge, Uniformity of Gauge, Loading Gauge, Construction Gauge. **Railway Track**: Requirements of a Good Track, Track Specifications on Indian Railways, Detailed Cross-Section of Single/Double Track on Indian Railways. Components of Railway Track: Rails, Sleepers, Ballast, Sub-grade and Formation, Track Fixtures & Fastenings, Coning of Wheels, Tilting of Rails, Adzing of Sleepers, Rail Joints, Creep of Rails.	CO-1
II	**Geometric Design of Railway Track**: Alignment, Gradients, Horizontal Curve, Super elevation, Equilibrium Cant, Cant Deficiency, Transition Curves. **Points and Crossings**: Functions, Working of Turnout, Various types of Track Junctions and their layouts, Level-crossing.	CO-2
	Railway Stations & Yards: Site Selection, Classification & Layout of Stations, Marshalling Yard, Locomotive Yard, Equipment at Railway Stations & Yards, **Signalling and Interlocking**: Objectives, Classification of Signals, Types of Signals in Stations and Yards, Automatic Signalling, Principal of Interlocking.	CO-3
III	**Modernization of Railway Tracks**: High Speed Tracks, Improvement in existing track for high speed, Ballast less Track, MAGLEV, TACV Track. **Introduction to Airport Engineering**: Air Transport Scenario in India and Stages of Development, National and International Organizations.	CO-4
IV	**Airport Planning**: Aircraft Characteristics, Factors for Site Selection, Airport Classification, General Layout of an Airport. Obstructions and Zoning Laws, Imaginary Surfaces, Approach Zones and Turning Zones. **Runway Orientation and Design:** Head Wind, Cross Wind, Wind Rose Diagram, Basic Runway Length, Corrections, Geometric Design Elements, Runway Configuration.	CO-5
	Taxiway and Aircraft Parking: Aircraft Parking System. Main Taxiway, Exit Taxiway, Separation Clearance, Holding Aprons. **Visual Aids**: Marking and Lighting of Runway and Taxiway, Landing Direction Indicator, and Wind Direction Indicator, IFR/VFR.	CO-6

References:

- Chandra S., and Aggarwal, "Railway Engineering", M.M. Oxford University Press, N Delhi, 2007.
- Saxena, S.C, & Arora, S.P, "A Text Book of Railway Engineering", Dhanpat Rai and Sons, 1997.
- J. S. Mundrey, "Railway Track Engineering", McGraw Hill Publishing Co., 2009
- Khanna, S.K., Arora, M.G., and Jain, S.S., "Airport Planning and Design", Nem Chand & Bros. Roorkee, 1999.
- Horenjeff, R. and McKelvey, F., "Planning and Design of Airports", McGraw Hill Company, New York, 1994.
- Norman J. Ashford, SalehMumayiz, Paul H. Wright, "Airport Engineering: Planning, Design and Development of 21st Century", Wiley Publishers, 2011

6th Semester	**AGCE-21604A: Earth and Earth Retaining Structures** (Professional Elective Course – II)

Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Classify earthen dams and understand their design details.
CO-2	Analyse earthen dams for seepage and stability.
CO-3	Compute earth pressure in varied conditions by the application of various earth pressure theories.
CO-4	Analyse and design rigid retaining structures
CO-5	Analyse and design flexible retaining structures
CO-6	Understand types and construction techniques of diaphragm walls and coffer dams.

Part	Content	CO
I	**Earthen Dam** Introduction to Earthen dams, types of dams, selection of type of dam based on material availability, foundation conditions and topography **Design details**: crest, free board, slopes (upstream and downstream), slope protection (upstream and downstream), central and inclined cores, types and design of filters.	CO-1
	Seepage analysis and control: seepage through dam and foundations – control of seepage in earth dam and foundation **Stability analysis**: critical stability conditions, evaluation of stability by Bishop's and sliding wedge methods under critical conditions **Construction techniques**: methods of construction, quality control **Instrumentation:** measurement of pore pressures	CO-2
II	**Earth pressure theories**: Rankine's and Coulomb's earth pressure theories for cohesionless and cohesive backfills, computation of earth pressures for various cases, inclined – with surcharge – submerged and partly submerged – stratified backfills	CO-3
III	**Rigid retaining structures**: active and passive earth pressures against gravity retaining walls, computation of earth pressures by trial wedge method, a mathematical approach for completely submerged and partly submerged backfills, perched water table, importance of capability tension in earth pressure. Graphical methods of earth pressure computation, trial wedge method for coulomb's and Rankine's conditions for regular and irregular ground and wall conditions, friction circle method. Design considerations of gravity retaining wall and cantilever retaining walls.	CO-4
IV	**Flexible retaining structures**: types and methods of construction – design strength parameters, safety factor for sheet pile walls, computation of earth pressures against cantilever sheet piles in cohesionless and cohesive soils, anchored sheet piles, free earth method, fixed earth method, Rowe's moment reduction method, stability of sheet piling.	CO-5
	Diaphragm walls and coffer dams: types of diaphragm walls and their construction techniques in various soil types, earth pressure on braced cuts and coffer dams, design considerations of coffer dams.	CO-6

References:

- Huntington, Earth pressure on retaining walls.
- Bowles, Foundation Analysis and Design.
- Jones, Earth Reinforcements & Soil structures.
- Prakash, Ranjan & Sasan, Analysis & Design of Foundation & Retaining Structures

6th Semester	**AGCE-21604B: Foundation Engineering** (Professional Elective Course – II)

Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understanding the procedures of soil investigation.
CO-2	Compute earth pressure in varied conditions by the application of various earth pressure theories.
CO-3	Analyse bearing capacity of shallow foundations using different theories.
CO-4	Design shallow foundations.
CO-5	Compute functional parameters for the design of pile foundations.
CO-6	Evaluate allowable bearing pressure for Caissons and Wells.

Part	Content	CO
I	**Soil Investigation:** Object of soil investigation for new and existing structures. Depth of exploration for different structures. Spacing of bore Holes. Methods of soil exploration and relative merits and demerits. Types of soil sample. Design features of sampler affecting sample disturbance. Geophysical exploration by seismic and resistivity methods.	CO-1
	Earth Pressure: Terms and symbols used for a retaining wall. Movement of all and the lateral earth pressure. Earth pressure at rest. Rankine states of plastic equilibrium, Ka and Kp for horizontal backfills. Rankine's theory both for active and passive earth pressure for Cohesionless backfill with surcharge and fully submerged case. Cohesive backfill condition. Coulomb's method for cohesion less backfill. Merits and demerits of Ranking and Coulomb's theories, Culmann's graphical construction (without surcharge load).	CO-2
II	**Shallow Foundation:** Type of shallow foundations, Depth and factors affecting it. Definition of ultimate bearing capacity, safe bearing capacity and allowable bearing capacity. Rankine's analysis and Terzaghi's analysis. Types of failures. Factors affecting bearing capacity. Skemptons equation. B.I.S. recommendations for shape, depth and inclination factors. Plate Load test and standard penetration test.	CO-3
III	**Design of Shallow Foundation** Bosussinesq equation for a point load, uniformly loaded circular and rectangular area, pressure distribution diagrams. Newmarks chart and its construction. Comparison of Bosussinesq and Westerguard analysis for a point load. Causes of settlement of structures, Comparison of immediate and consolidation settlement, suitable situation for provision of rafts, Proportioning of rafts, Methods of designing raft foundation.	CO-4
IV	**Pile Foundations:** Necessity and uses of piles, Classification of piles, Merits and demerits of different types based on composition. Use of Engineering News Formula and Hiley's Formula for determination of allowable load. Determination of point resistance and frictional resistance of a single pile by Static formulas. Piles in Clay, Safe load on a Friction and point Bearing pile. Pile in sand, Spacing of piles in group, Factors affecting capacity of pile group.	CO-5
	Caissons and Wells: Major areas of use of caissons, advantages and disadvantages of open box and pneumatic caissons. Essential part of a pneumatic caisson. Components of a well foundation. Calculation of allowable bearing pressure. Conditions for stability of a well, Forces acting on a well foundation. Computation of scour depth.	CO-6

References:

- Soil Mech. & Foundation Engg, by K.R. Arora, Standard Publishers Distributors
- Soil Mech. & Foundation Engg., by V.N.S. Murthy
- Basic and applied Soil Mechanics by Gopal Ranjan and A.S.R. Rao, New Age International
- Soil Mech. & Foundations by Muni Budhu Wiley, John Wiley & Sons
- Geotechnical Engineering by Gulhati and Datta, Tata McGraw - Hill Education
- Foundation Engineering by Varghese P.C, PHI Learning.
- Foundation Analysis and Design by Bowles J.E, Tata McGraw - Hill Education

6th Semester	**AGCE-21604C: Rock Mechanics and Engineering Geology** (Professional Elective Course – II)

Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understand the concepts of general geology.
CO-2	Understand various rocks and minerals and their structural geology.
CO-3	Understand the geological considerations for different engineering projects.
CO-4	Evaluate various engineering properties of rocks in laboratories.
CO-5	Evaluate various in situ engineering properties of rocks.
CO-6	Identify suitable techniques for improvement of engineering properties of rock masses.

Part	Content	CO
I	**General Geology**: Importance of Engg. Geology applied to Civil Engg. Practices. Weathering, definition, types and effect. Geological works of rivers, wind, glaciers as agents of erosion, transportation and deposition.	CO-1
	Rocks & Minerals: Minerals, their identification, igneous, sedimentary & metamorphic rocks. Classification of rocks for engineering purposes. Rock quality designation (RQD). **Structural Geology**: Brief idea about stratification, apparent dip, true dip, strike and in conformities. Folds, faults & joints: definition, classification relation to engineering operations.	CO-2
II	**Engineering Geology**: Geological considerations in the engineering projects like tunnels, highways, foundation, dams, reservoirs. **Earthquake:** Definition, terminology, earthquake waves, intensity, recording of earthquake.	CO-3
III	**Engineering properties of rocks and laboratory measurement**: Uniaxial compression test, tensile tests, permeability test, shear tests, size and shape of specimen rate of testing. Confining pressure, stress strain curves of typical rocks. Strength of intact and fissured rocks, effect of anisotropy, effect of saturation and temperature	CO-4
IV	**In-situ determination of engineering properties of rock masses**: Necessity of in-situ tests, uniaxial load tests in tunnels and open excavations, cable tests, flat jack test, shear test, pressure tunnel test. Simple methods of determining in situ stresses, bore hole test	CO-5
	Improvement in properties of Rock masses: Pressure grouting for dams and tunnels, techniques for improvement of properties of rock masses, rock reinforcement, rock bolting.	CO-6

References:

- Introduction to Rock Mechanics : Richard E. Goodman.
- Engg. Behaviour of rocks : Farmar, I.W.
- Rock Mechanics and Engg. : Jaager C.
- Fundamentals of Rock Mechanics : Jaager and Cook
- Engineering Geology : D.S.Arora
- Engineering Geology : Parbin Singh
- Rock Mechanics for Engineering : B.P. Verma.

6th Semester	**AGCE-21604D: Reinforced Earth and Geo-textiles** (Professional Elective Course – II)

Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understand the mechanism of reinforced earth techniques
CO-2	Describe various Geo-synthetics.
CO-3	Evaluate various properties of Geo-synthetics.
CO-4	Design geo-grids.
CO-5	Test various Geomembranes
CO-6	Design different liquid contaminant liners.

Part	**Content**	**CO**
I	**Reinforced Earth:** The mechanisms of the reinforced earth techniques, Design principles, Materials used for construction, Advantages of reinforced earth, Reinforced earth construction with GI sheets and strips	CO-1
	Geosynthetics: An overview, Description of Geotextiles, Geogrids, Geonets, Geomembranes, Geocomposites, Geocells, Designing with Geotextiles,	CO-2
II	**Properties and functions of geosynthetics:** Geotextile properties and test methods, Functions of Geotextile, Design methods for separation, stabilization, filtration, Drainage, Soil anchors.	CO-3
III	**Designing with Geogrids:** Geogrid properties and test methods, Designing with Geonets, Geonet properties and test methods, Designing with Geomembranes,	CO-4
IV	**Properties of Geomembranes:** Geomembrane properties and test methods, construction practices with Geotextiles, Geogrids, Geonets, Geomembranes.	CO-5
	Design of liquid Contaminant liners: liquid contaminant liners, Covers for reservoirs- Water conveyance (Canal liners), solid material liners, underground storage tanks, Improvement in bearing capacity.	CO-6

References:

- Robert M. Koerner, Designing with Geosynthetics, Prentice Hall – 1989
- G.V Rao & GVS Suryanarayana Raju, Engineering with Geosynthetics, Tata Mc Graw Hill
- Publishing Co. New Delhi
- Korener, Construction & Geotechnical Methods In Foundation Engineering, McGraw Hill
- Shukla, S.K. and Yin, J.H. Fundamental of Geosynthetic Engineering, Taylor & Francis
- Swamisaran, Reinforced Soil and its Engineering Application, New Age Publication
- Gulati, S.K. and Datta, M., Geotechnical Engineering, TMH

6th Semester	**AGCE-21605: Professional Practices (Skill Course-II)**

Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**1**	**-**	**4**
Total Marks:	**50**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Analyze complete set of estimate and their parameters.
CO-2	Know the concept of specifications of building and roads.
CO-3	Analyze rates of different works involved in a structure.
CO-4	Distinguish various procedures involving tender and accounting procedures and project planning and management.
CO-5	Evaluate various construction networks involving PERT and CPM.
CO-6	Analyze cost and contracts in planning different components of Civil Engineering projects.

Part	**Content**	**CO**
I	**Estimates**- Introduction, Method of building estimates and its types, site plan, index plan, layout plan, plinth area, floor area, Technical sanction, administrative approval, estimate of buildings, roads, earthwork, R.C.C. works, masonry platform, complete set of estimate.	CO-1
II	**Specifications**- For different classes of building and roads specification.	CO-2
	Analysis of rates- For earthwork, concrete work, D.P.C., brick work, plastering, pointing, roadwork.	CO-3
III	**Types of contracts**- Tenders, tender form, submission and opening of tenders, measurement book, muster roll, piecework agreement and work order. **Accounts**- Division of accounts, cash, receipt of money, cash book, temporary advance, imprest, accounting procedure. **Project planning & management**- time, activity & event, bar chart, Milestone chart, uses & draw backs.	CO-4
IV	**PERT** :Construction of PERT network, time estimates, network analysis, forward pass & backward pass, slack, critical path, data reduction, suitability of PERT for research project, numerical problems. **CPM** :Definitions, network construction, critical path, fundamental rules, determination of project schedule, activity time estimates, float types, their significance in project control, numerical problems.	CO-5
	Cost Analysis and Contract :Type of costs, cost time relationships, cost slopes, conducting a crash programme, determining the minimum total cost of project, when to update,updating a project.	CO-6

References:

- Estimating and Costing by B.N. Datta, UBSPD, New Delhi.
- Estimating and Costing by G.S. Birdie, Dhanpat Rai Publication New Delhi.
- Estimating and Costing by V.N. Chakravorty, Calcutta.
- Civil Engg. Contracts & Estimates by B.S. Patil, Orient-Longman Ltd., New Delhi.
- PERT and CPM by L.S. Srinath, East-West Press.
- Construction Planning and Equipment, R.L. Peurifoy, TMH New Delhi.
- Construction Planning and Management by U.K. Shrivastava, Galgotia Publications pvt. Ltd.

6th Semester	**AGCE-21606: Transportation Engineering – Lab**				
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	perform shape test and impact value test on road aggregates
CO-2	perform crushing value test and los angles abrasion value test on road aggregates
CO-3	perform Penetration Test on bitumen sample
CO-4	perform Softening Point Test on bitumen sample
CO-5	perform Ductility Test on bitumen sample
CO-6	Exhibit his/her creativity and conceptual understanding of the subjects AGCE – 21503 (Transportation Engineering - I) and AGCE 21603 (Transportation Engineering - II).

Part	**Experiment**	**CO**
A	To perform Shape Test on road aggregates (Flakiness and Elongation Index) To perform Impact Value Test on road aggregates	CO-1
	To perform Crushing Value Test on road aggregates To perform Los Angles Abrasion Value Test on road aggregates	CO-2
	To perform Penetration Test on bitumen sample	CO-3
	To perform Softening Point Test on bitumen sample	CO-4
	To perform Ductility Test on bitumen sample	CO-5
B	To make a mini project that demonstrates a concept, based on the content of AGCE – 21503 (Transportation Engineering - I) and AGCE 21603 (Transportation Engineering - II).	CO-6

6th Semester	**AGCE-21607: Computer Aided Drawing-II – Lab**				
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	draw different welded and bolted connections
CO-2	draw beam to beam and beam to column connections (seated and framed)
CO-3	draw plan and elevation of a built up column
CO-4	draw plan and elevation of a column base and gusseted base
CO-5	draw elevation and sections of a roof truss
CO-6	Exhibit his/her creativity and conceptual understanding of the subject AGCE-21601 (Design of Steel Structures-I)

Part	**Experiment**	**CO**
A	To draw different welded and bolted connections	CO-1
	To draw beam to beam and beam to column connections (seated and framed)	CO-2
	To draw plan and elevation of a built up column	CO-3
	To draw plan and elevation of a column base and gusseted base.	CO-4
	To draw elevation and sections of a roof truss.	CO-5
B	To make a mini project that demonstrates a concept, based on the content of AGCE-21601 (Design of Steel Structures-I)	CO-6

6th Semester	**AGCE-21608: Basic MS Office - Lab**				
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	create a document and apply different formatting options
CO-2	Create his/her own resume using different options in MS Word.
CO-3	Use headers and footers along with page titles in a document.
CO-4	Insert and use tables in to a document
CO-5	Create different drawing objects using insert shapes in an MS word document
CO-6	Create any document as per need using different options in MS Word.

Part	**Experiment**	**CO**
A	To create a document and apply different formatting options	CO-1
	To create a document and apply different formatting options	CO-2
	Create a multi-page document and insert page breaks, section breaks, header and footer.	CO-3
	Insert a table in to a document and prepare marksheet of your class.	CO-4
	To draw college logo in a documents using insert shapes option.	CO-5
B	Write a detailed essay on your self with an attractive cover page design.44	CO-6

6th Semester	**AGFE-21603: Functional English - III**				
Internal Marks:	**50**		**L**	**T**	**P**
External Marks:	**0**		**0**	**1**	**0**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Self Introduction and Body Language to prepare students to face one to one interaction.
CO-2	Spoken Activity such as Group Discussion to hone spoken skills and interpersonal communication of students.
CO-3	Vocabulary based session to improve language proficiency of students.
CO-4	Resume writing and cover letter writing to make students proficient in English correspondence.
CO-5	Book reading to improve reading skills of students.
CO-6	Corporate Profile Report to make students aware of companies of their stream and their selection criteria.

Part	**Content**	**CO**
I	Mock interview to provide one (students) with an opportunity to practice one's interviewing skills in an environment similar to an actual interview.	CO-1
II	This section includes Group discussion is a task, which is generally aimed at understanding and evaluating candidate's behavior in a group.	CO-2
	This section includes word power, analogies, sentence correction and verbal reasoning.	CO-3
III	Resume writing and cover letter writing to make students proficient in English correspondence.	CO-4
IV	Rich Dad Poor Dad shall be prescribed for honing reading skills and comprehension in depth.	CO-5
	Corporate Profile Report to make students aware of companies of their stream and their selection criteria.	CO-6

References:

- English Grammar by Wren and Martin
- www.Indiabix.com
- www.freshersworld.com
- www.alison.com

6th Semester	**AGAP-21603: Engineering Aptitude - III**				
Internal Marks:	**50**		**L**	**T**	**P**
External Marks:	**0**		**0**	**1**	**0**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Enhance the logical thinking of students
CO-2	How likely events could happen and so the risks could be determined and resolved professionally
CO-3	Understand he time taken by an individual or a group of individuals to complete a piece of work
CO-4	Understand different relations among the members of a family
CO-5	Determine if a system of linear equations has no solution, one solution, or infinitely many solutions
CO-6	Use *Quadratic equations in real life*

Part	**Content**	**CO**
I	**Odd man out series:** Concept of odd man out series with different Types	CO-1
	Probability: Definition, Formulas, Examples ,Events ,Equally Likely Events, Complementary Events	CO-2
II	**Time & Work** :Concept, Tricks and Formulas	CO-3
III	**Blood Relations:** How is A related to B Blood Relation? Are husband and wife blood related? What is Generation in blood relation?	CO-4
IV	**Linear Equations:** Substitution Method, Elimination Method.	CO-5
	Quadratic Equations: Important Formulas ,Roots of Quadratic Equation, Nature of Roots ,Solving Quadratic Equations.	CO-6

References:

- Quantitative Maths: Arihant Publishers.
- Objective Mathematics: R S Aggarwal.
- Quantitative Maths: TMH Publications.

List of Professional Elective Courses-III

7th Semester	B. Tech (Civil Engineering)							
Course code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credit
		L	T	P	Internal	External		
AGCE 21703A	Solid Waste Management	3	-	-	40	60	100	3
AGCE 21703B	Principles and Applications of Remote Sensing	3	-	-	40	60	100	3
AGCE 21703C	Sustainable Transportation Systems	3	-	-	40	60	100	3
AGCE 21703D	Urban Transportation Systems	3	-	-	40	60	100	3
AGCE 21703E	Bridge Engineering	3	-	-	40	60	100	3
AGCE 21703F	Engineering Seismology	3	-	-	40	60	100	3
AGCE 21703G	Ground Improvement Techniques	3	-	-	40	60	100	3

The above courses shall be taken up by students in online mode through SWAYAM platform. The student shall opt any one subject from this list as per availability on SWAYAM platform. Student shall produce the course completion certificate at the end of the semester and also appear in End-Semester-Examination for these courses for transfer of credits as per the policy of AGC Amritsar.

List of Open Elective Courses

7th Semester	B. Tech (All Streams)							
Course code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credit
		L	T	P	Internal	External		
Offered by Department of Civil Engineering								
AGOE 21701	Air Pollution and Control	3	-	-	40	60	100	3
AGOE 21702	Disaster Management	3	-	-	40	60	100	3
Offered by Department of Mechanical Engineering								
AGOE 21703	Product Design and Development	3	-	-	40	60	100	3
AGOE 21704	Material Management	3	-	-	40	60	100	3
Offered by Department of Electrical Engineering								
AGOE 21705	Non-Conventional Energy Sources	3	-	-	40	60	100	3
AGOE 21706	Electrical Power Utilization	3	-	-	40	60	100	3
Offered by Department of Computer Science and Engineering								
AGOE 21707	Software |Engineering Methodologies	3	-	-	40	60	100	3
AGOE 21708	Fundamentals of Information Security	3	-	-	40	60	100	3
Offered by Department of Management Studies								
AGOE 21709	Management of Human Resources	3	-	-	40	60	100	3
AGOE 21710	Basics of Management	3	-	-	40	60	100	3

The student shall opt any one of the above courses offered by any department other that his/her parent department.

7th Semester	**AGCE-21701: Design of Steel Structures-II**				
Internal Marks:	40		L	T	P
External Marks:	60		3	1	0
Total Marks:	100		Credits		4

Course Outcomes: After studying the course, students will be able to:	
CO-1	Describe the elements of a plate girder, distinguish between riveted and welded plate girders.
CO-2	Design a plate girder with curtailment of flanges, splicing and various type of stiffeners.
CO-3	Design economical, safe and simple to assemble steel truss bridge for pedestrian crossing purpose.
CO-4	Analyze and design gantry girder for the industrial buildings.
CO-5	know the design specifications for the various elements of the industrial shed like column bracket and mill bents.
CO-6	Analyze and design various components of railway bridge, like stringer, main girders and cross girders.

Part	**Content**	**CO**
I	Elements of a plate girder, design of bolted and welded plate girders.	CO-1
	Design of a plate girder with curtailment of flanges, splicing and various type of stiffeners.	CO-2
II	Foot Bridge: Design of steel foot bridge with parallel booms and carrying wooden/RCC decking, using welded joints.	CO-3
III	Industrial Buildings: Complete design of an industrial shed including Gantry girder.	CO-4
IV	Elements of Industrial Building: Column bracket, Mill bent with constant moment of inertia, Lateral and longitudinal bracing for column bent.	CO-5
	Railway Bridge and Elements: Design of single-track railway bridge with lattice girders having parallel chords (for B.G.) Stringer, Cross girder, Main girders with welded joints, Portal sway bracings, Bearing rocker and rollers.	CO-6

References:

- Limit state design of steel structures: S K Duggal
- Design of steel structures: N Subramanian
- Design of steel structures (Vol. 2): Ram Chandra
- Design of steel structures: L S Negi
- Design of steel structures (by limit state method as per IS: 800-2007): S S Bhavikatti
- IS 800: 2007 - General construction in steel-Code of practice **(permitted in Examination)**
- SP: 6(1) - Handbook for structural engineers-Structural steel sections **(permitted in Examination)**

7th Semester	AGCE-21702: Irrigation Engineering-II				
Internal Marks:	40		L	T	P
External Marks:	60		3	1	0
Total Marks:	100		Credits		4

Course Outcomes: After studying the course, students will be able to:	
CO-1	Differentiate components of diversion headworks and silt control devices based on their functions.
CO-2	Design complete structure of a weir through understanding of its types, modes of failure and protection elements.
CO-3	Apply the knowledge of various seepage theories to design the impervious floors for various hydraulic structures.
CO-4	Compare and design canal regulation works.
CO-5	Design canal falls and cross drainage works.
CO-6	Understand the concept of canal outlets.

Part	Content	CO
I	**Head Works**: Types of head works, Functions of a diversion head works, components of a diversion head work and their design considerations, silt control devices.	CO-1
	Design of Weirs: Weirs versus barrage, types of weirs, main components of weir, causes of failure of weir and design considerations with respect to surface flow, hydraulic jump and seepage flow. Design of barrage or weir.	CO-2
II	**Theories of Seepage**: Seepage force and exit gradient, assumptions and salient features of Bligh's Creep theory, Limitations of Bligh's Creep theory, salient features of Lane's weighted Creep theory and Khosla's theory, Comparison of Bligh's Creep theory and Khosla's theory, Determination of uplift pressures and floor thickness.	CO-3
III	**Canal Regulators**: Offtake alignment, cross-regulators – their functions and design, Distributary head regulators, their design, Canal Escape.	CO-4
	Canal Falls: Necessity and location, types of falls and their description, selection of type of falls, Principles of design, Design of Sarda type fall, straight glacis and Inglis or baffle wall falls.	CO-5
IV	**Cross-Drainage works**: Definitions, choice of type, Hydraulic design consideration, Aqueducts their types and design, siphon aqueducts – their types and design considerations, super passages, canal siphons and level crossing.	
	Canal Out-lets: Essential requirements, classifications, criteria for outlet behaviours, flexibility, proportionality, sensitivity, sensitiveness, etc.	CO-6

References:

- Irrigation Engg. & Hydraulic Structure by Santosh Kumar Garg, Khanna Publishers.
- Design of Irrigation Structures by R.K. Sharma, Oxford IBH Pub
- Irrigation Engg. and Hydraulics Structures by S.R. Sahasrabudhe, Katson Publishing House.
- Irrigation Practice and Design Vol. I to VII by K.B. Khushlani. Oxford IBH Pub
- Irrigation with Resources and with Power Engineering by P.N. Modi Standard Book House
- Irrigation Engg. Vol. I & II by Ivan E. Houk, John Wiley and sons

7th Semester	**AGCE21703A: Solid Waste Management**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**		**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Characterise the solid waste.
CO-2	Understand the concept of waste handling.
CO-3	Illustrate waste collection, transportation and segregation.
CO-4	Classify different techniques of treatment and disposal of solid waste.
CO-5	Understand about hazardous waste.
CO-6	Illustrate the latest rules and guidelines of solid waste management.

Part	**Content**	**CO**
I	**Introduction:** Evolution of *Solid Waste Management*, sources/types and characteristics of solid waste.	CO-1
	Generation: Generation of solid waste, factors affecting solid waste generation, waste handling and storage.	CO-2
II	**Collection transportation and separation:** Collection methods of solid waste, collection tools and equipment, transportation of solid waste, transportation vehicles. latest techniques in separation and processing of solid waste.	CO-3
III	**Treatment and disposal:** Chemical transformation (combustion/incineration). biological treatment, composting, anaerobic digestion, land filling, recycling.	CO-4
	Hazardous waste: definition, management of biomedical waste, industrial waste and e-waste.	CO-5
IV	**Legal aspects:** present scenario, solid waste management rules for different types of wastes, latest amendments.	CO-6

References:

- Christensen, H. T., Solid Waste Technology & Management, Wiley, 2010, Volume 1 & 2
- Haug, T. R., The Practical Handbook of Compost Engineering, Lewis Publishers, 1993
- Reinhart, R. D. and Townsend, G. T., Landfill Bioreactor Design & Operation, CRC Press, 1997, 1st Edition
- Tchobanoglous, G. and Kreith, F., Handbook of Solid Waste Management, McGraw Hill, 2002, 2nd Edition
- Tchobanoglous, G., Theisen and Vigil, Integrated Solid Waste Management: Engineering Principles and Management Issues, McGraw Hill, 1993.

7th Semester	**AGCE21703B: Principles and Applications of Remote Sensing**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**		**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Explain basic concepts of remote sensing.
CO-2	Understand the image acquisition in the visible domain.
CO-3	Distinguish between various types of image resolution concepts.
CO-4	Understand the remote sensing in the visible domain.
CO-5	Express his understanding on RS platforms.
CO-6	Classify various domains of applications of remote sensing.

Part	**Content**	**CO**
I	**Introduction:** Introduction, Physics of remote sensing, Remote sensing satellites, Different types of sensors, electromagnetic radiation, basic laws Radiometry, Interaction of electromagnetic radiation with terrain features.	CO-1
	RS in visible domain: RS image acquisition, Satellite Image - Characteristics and formats, Image histogram, Introduction to Image rectification, Image Enhancement, Radiance to reflectance, atmospheric and topographic correction.	CO-2
II	**Resolution concepts:** Spatial resolution, Spectral resolution, Radiometric resolution, Temporal Resolution, Spectral reflectance curves, Spectral indices.	CO-3
III	**Remote Sensing in non-visible domain:** Thermal infrared remote sensing. Passive microwave radiometry, Active microwave remote sensing: RADAR Imaging.	CO-4
	RS Platforms: Platforms used for RS data acquisition and characteristics. LIDAR, Common remote sensing datasets and data portals.	CO-5
IV	**Applications:** Use of remote sensing for land use and land cover monitoring, water resources management.	CO-6

References:

- Rees, W. G. (2012), Physical Principles of Remote Sensing, Third Edition, Cambridge University Press
- Joseph, G. and Jeganathan, C. (2018), Fundamentals of Remote Sensing, Third Edition, Universities Press
- Jensen, J. R. (2007), Remote sensing of the environment: An earth resource perspective, Second edition, Pearson
- Lillesand, T. M., Kiefer, R. W. and Chipman, J. W. (2008), Remote sensing and image interpretation, Sixth or Seventh edition, Wiley

7th Semester	**AGCE 21703C: Sustainable Transportation Systems**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**		**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understand the concept EIA.
CO-2	To know about public transportation system
CO-3	Analyse the non motorised transportation planning.
CO-4	Design the pedestrian infrastructure.
CO-5	To know about urban transport and sustainability
CO-6	To know about multimodel transportation system.

Part	**Content**	**CO**
I	**Introduction:** Environmental Impact Assessment (EIA) and Transportation systems, Land-use plans, zoning schemes, and provisions	CO-1
	Urban and regional transport: -Urban and regional transport planning**,** Impacts on humans, flora and fauna, soil, water, air, climate and landscape	CO-2
II	**Base Line Conditions: -**Establishment of baseline conditions w.r.t soil, water and air quality**,** Noise, air, and water pollution modelling.	CO-3
III	**Modelling of impacts: -**Modelling of impacts and scenario-based analysis**,** Assessment of potential project impacts including indirect, cumulative, and synergistic impacts.	CO-4
	EIA:- Decision support systems for EIA of transport infrastructures and abatement measures.	CO-5
IV	**Sustainable transportation systems: -**Case studies of highway, railway, and airport projects, Open LCA tool for life Cycle Assessment, STAN for material flow analysis.	CO-6

References:

- Assessment & Decision Making for Sustainable Transport, European Conference of Ministers of Transport, OECD Publishing 2004.
- Wood, C. and Wood, C., "Environmental Impact Assessment: A Comparative Review", Prentice Hall. 2002.
- Petts, J., "Handbook of Environmental Impact Assessment", Blackwell Publishing. 1999.
- Sucharov, L.J. and Baldasano, J.M., "Urban Transport and the Environment, Vol. II", Computational Mechanics Publications. 1996.
- Zannetti P. (Ed.), "Environmental Modeling, Vol. I", Computational Mechanics Publication, Elsevier Applied Science. 1993.

7th Semester	AGCE21703D: Urban Transportation Systems				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**		**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understand the challenges in urban transportation system.
CO-2	know about public transportation system
CO-3	Analyse the non-motorised transportation planning.
CO-4	Design the pedestrian infrastructure.
CO-5	Describe urban transport and sustainability
CO-6	Illustrate multimodal transportation system.

Part	Content	CO
I	**Overview of Urban Transportation**-Urbanization and Transport, Key issues in urban transportation, Challenges in urban transportation, Travel demand modelling overview Vehicular Level of Service (LOS) overview,	CO-1
	Public Transportation-Introduction to public transportation, Basic operating elements of public transportation, Bus Transportation, financing public transportation**,** Transit marketing, Rail transportation, Intermediate Public Transportation, measuring performance of transit systems**,** Advanced operation concepts of public transportation**,** Bus and Rail Transit Capacity, Station Capacity, and Transit Stop Location.	CO-2
II	**Non-motorized Transportation (NMT) Planning:** Introduction to NMT Systems, Assessing existing NMT scenarios, Data collection and analysis in NMT Planning, Complementarity and Selection of Interventions, Alternative Selection through Economic and Financial Analysis, Basic NMT Characteristics, Pedestrian Data Collection, and Flow Characteristics, PTS Case Studies Pedestrian flow characteristics on facilities.	CO-3
III	**Pedestrian Level of Service:** Pedestrian Level of Service (PLOS) based on Flow models, Other types of Pedestrian Level of Service (PLOS), HCM 2010 Methodology for PLOS, HCM 2010 Methodology for PLOS (contd.), Bicycle Facilities and Level of Service (BLOS), BLOS and Bicycle Compatibility Index (BCI), NMT Design Principles, Design of Pedestrian Infrastructure, Design of Cycling Infrastructure.	CO-4
	Urban Transport and Sustainability- Travel Demand Management (TDM) overview, Push measures cases, Parking, Transit Oriented Development (TOD), Introduction to Intelligent Transportation Systems (ITS), ITS components, applications and communication, ITS Architecture, Electronic Toll Collection (ETC), Public Bicycle Sharing (PBS) System with ITS.	CO-5
IV	**Multimodal Transportation:** Multimodal transportation (MMT) environment, Multimodal Level of Service (MMLOS, Design of multimodal transfer facilities, Park and Ride (P&R) Facility, An Introduction to Pedestrian Road Safety and associated Risk Factors, Road crash estimation and elements of predictive methods, Predicting Vehicle-Pedestrian and Vehicle-Bicycle conflicts , Environmental Concerns of Urban Transport ,Sustainable strategies for Urban Transportation.	CO-6

References:

- Travel Demand Management and Road User Pricing: Success, Failure and Feasibility, edited by Gerd Sammer& Wafaa Saleh (2009), AshGate
- The Implementation and Effectiveness of Transport Demand Management Measures -An International Perspective, edited by Stephen Ison, Tom Rye, (2008), Ashgate
- Sustainable Transport: Planning for Walking and Cycling in Urban Environments, edited by Rodney Tolley (2003) Woodhead Publishing Ltd.
- Fruin, J.J. Pedestrian Planning and Design, McGraw Hill Publication, 1987
- Hudson, M. The Bicycle Planning, Open Books, 1982
- Fundamentals of Intelligent Transportation Systems Planning, by Mashrur A. Chowdhury, Adel WadidSadek, (2003) Artech House, Inc. Boston
- http://local.iteris.com/itsarch/index.htm

- Perspectives on Intelligent Transportation Systems (ITS), by Joseph M. Sussman, (2008) MIT, Springer.
- Ceder, A., 2016. Public Transit Planning and Operation: Modeling, Practice and Behavior, 2nd Ed., CRC Press
- Traffic & Highway Engineering, Garber, N.J., and Hoel, L.A., 5 th Edition, Cengage Learning, 2015

7th Semester	**AGCE21703E: Bridge Engineering**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**		**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understand Reinforced Concrete bridges.
CO-2	The difference between culverts and bridges.
CO-3	Understand the construction of various types of bridges.
CO-4	Know about the various types of spans in bridges.
CO-5	Understand the elements of bridges.
CO-6	Understand the latest technologies in bridges.

Part	**Content**	**CO**
I	**Introduction:** Introduction and Reinforced Concrete Slab Bridge Decks.	CO-1
	Culverts and Bridges: Box Culverts and Pipe Culverts: Steel Truss Bridges.	CO-2
II	**Types of Bridges**: Plate Girder Bridges, Arch Bridges, Suspension Bridges, Cable-Stayed Bridges, Balanced Cantilever Bridges.	CO-3
III	**RCC and steel bridges**: Prestressed Concrete Bridges and Composite Bridges, Rigid Frame Bridges and Continuous Girder Bridges.	CO-4
	Elements of Bridges: Piers, Abutments and Foundations, Bridge Bearings, Joints and Appurtenances	CO-5
IV	**Construction Techniques**: Construction, Maintenance and Rehabilitation of Bridges, Advanced Topics in Bridge Engineering.	CO-6

References:

- N. Krishna Raju, Design of Bridges, Oxford & IBH Publishing Co. Pvt. Ltd.
- D.J. Victor, Essentials of Bridge Engineering, Oxford & IBH Publishing Co. Pvt. Ltd.
- S. Ponnuswamy, Bridge Engineering, McGraw Hill Education.
- T.R. Jagadeesh and M.A. Jayaram, Design of Bridge Structures, PHI Learning Pvt. Ltd.
- W.F. Chen, and L. Duan, Bridge Engineering Handbook, CRC Press, Taylor & Francis Group.
- G. Parke and N. Hewson, ICE manual of Bridge Engineering, Thomas Telford Publishing.

7th Semester	**AGCE21703F: Engineering Seismology**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**		**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Know about the cause and sources of earthquakes.
CO-2	Know about the intensity and magnitude measurement and comparison with history.
CO-3	Identify the frequency and motions with the latest techniques
CO-4	Know about the zones and model predictions of the various parts of the country.
CO-5	Understand the map representation and seismic hazard parameters.
CO-6	Understand and analysis the case studies with examples.

Part	**Content**	**CO**
I	**Introduction:** Introduction to earthquake hazards- Global seismicity and Seismic risk, History of Engineering Seismology and Earthquake types. Elastic Rebound Theory; Earthquake sources; Plate tectonics, and Plate Boundaries: Continental Drift.	CO-1
	Waves and Measurement: Theory of Wave Propagation Seismic wave propagation, Types of seismic waves, Wave characteristics and Shadow zones. Concept of Earthquake Measurement, Seismic Intensity and Magnitudes Scales, Past earthquake Energy and Comparable Explosive tests.	CO-2
II	**Identifications:** Earthquake Instruments, Sensors and Data Loggers, Mechanical and Digital sensors; Seismic Station. Interpretation of Seismic Records: Identification of made events and natural earthquake; Time and frequency domain characteristic of ground motion.	CO-3
III	**Zones and predictions:** Regional Seismicity, Earthquakes in India and Most important Global Earthquakes; Concept of Seismic Zonation and Methodology for Seismic micro-zonation. Predictive Models in Earthquake Engineering- Attenuation Relation; Intensity, Duration and Ground Motion Predictive Relations.	CO-4
	Regional representation: Earthquake Catalogue preparation, Source Map preparation; Homogenization and Declustering of earthquake data and preparation of Seismotectonic maps. Seismic Hazard Parameters: a and b values, Recurrence relations and Maximum magnitude: Region Specific Approach for estimation Parameters and Selection of predictive equations.	CO-5
IV	**Determinations:** Seismic Hazard Analysis: Deterministic and Probabilistic Methods; Rupture based approach. Seismic Hazard Analysis Case studies and Worked examples.	CO-6

References:

- Earthquake Geotechnical Engineering, Steven L. Kramer
- Earthquake Hazard Analysis: Issues and Insights, Leon Reiter

7th Semester	**AGCE21703G: Ground Improvement Techniques**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Understand the concept of ground improvement.
CO-2	Analyse the compaction of soil.
CO-3	Understand the process of drainage system.
CO-4	Know different plastic effect on environment.
CO-5	Understand the plastic waste management system.
CO-6	Know about plastic resource recovery.

Part	**Content**	**CO**
I	**Introduction:** Introduction of course, shallow densification.	CO-1
	Compaction of Soil: Deep dynamic compaction, Rapid impact compaction.	CO-2
II	**Drainage System:**Vibrocompaction, Drainage,and Dewatering.	CO-3
III	**Plastic Effect**: Impactof Plastics on Marine Life, Effect on Wildlife, Human Health, and Environment.	CO-4
	Plastic Waste Management Practices – Use of Plastic waste in roads, issues and challenges.	CO-5
IV	**Possible Alternate Materials to Plastics** –Greener Alternatives, Plastics Resource Recovery and Circular Economy.	CO-6

References:

- Engineering Principles of Ground Modifications by Manfred R. Hausmann
- Ground Improvement Techniques by P Purushothama Raj
- Principle and Practice of Ground Improvement by Jie Han

7th Semester	**AGOE 21701: Air Pollution and Control**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Identify theimpacts of air pollution on humans, animals, water bodies, and soil.
CO-2	Analyse the lapse rate and air quality monitoring.
CO-3	Understand the emissions inventory and applications of remote sensing.
CO-4	Understand indoor air pollution, its sources, types, and health impacts.
CO-5	Know air pollution control devices and equipment.
CO-6	Know the emerging technologies and strategies to mitigate air pollution.

Part	**Content**	**CO**
I	**Air Pollution:** Introduction and Impacts of air pollution on human health, vegetation, animals, building materials, structures, and atmosphere, soil and water bodies. Sources, classification and formation/transformation of air pollutants: Meteorology and Atmospheric Stability.	CO-1
	Lapse Rate, Plume Behaviour, and Air Quality Monitoring, Air Quality Index (AQI). Air Quality Modelling, Gaussian dispersion models: point, line, and area source models	CO-2
II	**Emissions Inventory:** Transport, Industrial, Agricultural, Residential and Commercial sectors. Application of Remote sensing/Satellite data in emission inventory and source apportionment using receptor modelling.	CO-3
III	**Indoor air pollution:** sources, types and health impacts. Sampling, assessment and evaluation of Indoor air quality. Global and regional environmental issues of air pollution: Ozone depletion, Climate change, Global warming, Acid rain.	CO-4
	Air pollution control devices, and equipment. Air pollution emission standards, National and international policies, acts, rules, and regulations.	CO-5
IV	**Emerging technologies and strategies** to mitigate air pollution, Current challenges and way forward. Lab-based measurements of air pollutants.	CO-6

References:

- Wark, K., Warner, C.F., and Davis, W.T., "Air Pollution: Its Origin and Control", Addison-Wesley Longman. 1998.
- Boubel, R.W., Fox, D.L., Turner, D.B., Stern, A.C., "Fundamentals of Air Pollution", Academic Press. 2005.
- Seinfeld, J.H., Pandis, S.N., "Atmospheric Chemistry and Physics", John Wiley. 2006.
- Lodge, J.P. (Ed.), "Methods of Air Sampling and Analysis", CRC Press. 1988.
- Gurjar, B.R., Molina, L., Ojha, C.S.P. (Eds.), "Air Pollution: Health and Environmental Impacts", CRC Press. 2010.

7th Semester	**AGOE 21702: Disaster Management**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**0**	**0**
Total Marks:	**100**		**Credits**		**3**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Students will be able to understand different level of disasters in various regions.
CO-2	To able to understand the prevent and preparedness against the disaster.
CO-3	To be able to understand the risk and management for disaster.
CO-4	Know about the various government and non-government agencies role in management.
CO-5	To be able to understood the various tools and techniques to identify the level of disaster.
CO-6	To be able to understand about the method of dissemination and learn from experiences.

Part	**Content**	**CO**
I	**Introduction to Disaster Management**: Define and describe disaster, hazard, emergency,vulnerability, risk and disaster management; Identify and describe the types of natural and non-natural disasters. Important phases of Disaster Management Cycle.	CO-1
	Disaster Mitigation and Preparedness: *Natural Hazards*: causes, distribution pattern, consequences and mitigation measures for earth quake, tsunami, cyclone, flood, landslide drought etc. *Man-madehazards*: causes, consequences mitigation measures for various industrial hazards/disasters, Preparedness for natural disasters in urban areas.	CO-2
II	**Hazard and Risk Assessment: A**ssessment of capacity, vulnerability and risk, vulnerability and risk mapping, stages in disaster recovery and associated problems. **Emergency Management Systems (EMS):** Emergency medical and essential public health services, response and recovery operations, reconstruction and rehabilitation.	CO-3
III	**Capacity Building:** Gender sensitive disaster management approach and inculcate new skills and sharpen existing skills of government officials, voluntary activists, development of professional and elected representative for effective disaster management, role of media in effective disaster management, overview of disaster management in India, role of agencies like NDMA, SDMA and other International agencies, organizational structure, role of insurance sector, DM act and NDMA guidelines..	CO-4
	Application of Geoinformatics and Advanced Techniques: Use of Remote Sensing Systems (RSS) and GIS in disaster Management, role of knowledge based expert systems in hazard scenario, using risks-time charts to plan for the future, early warning systems.	CO-5
IV	**Integration of public policy**: Planning and design of infrastructure for disaster management, Community based approach in disaster management, methods for effective dissemination of information, ecological and sustainable development models for disaster management. **Case Studies:** Lessons and experiences from various important disasters with specific reference to Civil Engineering.	CO-6

References:

- Natural Hazards in the Urban Habitat by Iyengar, C.B.R.I., Tata McGraw Hill.Pub
- Natural Disaster management, Jon Ingleton (Ed), Published by Tudor Rose, Leicester

7th Semester	**AGCE 21704: Project**				
Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**0**	**0**	**2**
Total Marks:	**100**		**Credits**		**2**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Identify the current issues related to civil engineering local/ reginal/ national/global.
CO-2	Analyse the existing research, identify the gray areas, and articulates specific objectives.
CO-3	Create time bound project execution plan.
CO-4	Organise and analyse the research data.
CO-5	Articulate specific research findings after analysing the results.
CO-6	Create/prepare a research document in the form of a report.

Part	**Content**	**CO**
I	**Selection of topic and its justification:** a topic should be short, specific and should represent the quantum of work covered under the project domain.	CO-1
	Review of literature, research gap, and objectives: the student shall study the existing literature related to the project domain. On the basis of research gaps, the student shall frame specific objectives that he will be working on during the project work.	CO-2
II	**Methodology, execution plan and scheduling:** the methodology shall clearly present the flow of work, its scheduling and expected time of completion of project.	CO-3
III	**Project execution/result analysis:** the student shall carry out the project work as per the planned methodology and analyse the results of study to understand their trends and patterns.	CO-4
	Conclusions: the student shall explicitly present the project findings in the form of specific conclusions. These conclusions should be in line with the framed objectives.	CO-5
IV	**Report writing:** a clear and concise report shall be prepared which should clearly present the topic, its justification, literature review, methodologies, results and discussions, conclusions and references.	CO-6

References:

- All research articles/books/codes related to the selected area of project

7th Semester	**AGCE 21705: Irrigation Engineering Drawing**				
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Draw different falls in irrigation engineering as per design
CO-2	Understand the difference between the various regulators use in canals.
CO-3	Explain structure of launching aprons.
CO-4	Draw and read the drawings of vertical drop weirs.
CO-5	understand the construction of impervious floor.
CO-6	Design the transitions for cross drainage works.

Part	**Content**	**CO**
I	Design and draw SARDA fall.	CO-1
	Design and draw Canal head regulator.	CO-2
II	Draw Launching Apron as per guidelines for vertical drop weir.	CO-3
III	Draw plan, elevations and sectional elevations of a vertical drop weir	CO-4
	Impervious floors using Bligh's creep theory including hydraulic gradient line.	CO-5
IV	Design and Draw the Expansion & Contraction Transitions of an aqueduct (for bed width and top width) using Mitra's formula and Chaturvedi's formula)	CO-6

References:

- Irrigation Engg. & Hydraulic Structure by Santosh Kumar Garg, Khanna Publishers.
- Design of Irrigation Structures by R.K. Sharma, Oxford IBH Pub
- Irrigation Engg. and Hydraulics Structures by S.R. Sahasrabudhe, Katson Publishing House.
- Irrigation Practice and Design Vol. I to VII by K.B. Khushlani. Oxford IBH Pub
- Irrigation with Resources and with Power Engineering by P.N. Modi Standard Book House
- Irrigation Engg. Vol. I & II by Ivan E. Houk, John Wiley and sons

7th Semester	**AGCE 21706: Design of Steel Structures Lab**				
Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**		**Credits**		**1**

Course Outcomes: After studying the course, students will be able to:	
CO-1	Create and read drawings of plate girders
CO-2	Understand various details of splices and stiffeners used in plate girders.
CO-3	Draw and read drawings of plate girders
CO-4	Create and read drawings of a Gantry girder
CO-5	Create and read drawings of elements of industrial buildings
CO-6	Create and read drawings of railway bridges

Part	**Content**	**CO**
I	Design and draw details of a plate girder with bolted / welded connections.	CO-1
	Draw the details of web splice, flange-splice and different types of stiffeners in a plate girder.	CO-2
II	Design and draw details of a steel foot bridge	CO-3
III	Design and draw details of a Gantry girder	CO-4
	Design and draw details of elements of industrial buildings	CO-5
IV	Design and draw details of elements of a railway bridge	CO-6

References:

- Limit state design of steel structures: S K Duggal
- Design of steel structures: N Subramanian
- Design of steel structures (Vol. 2): Ram Chandra
- Design of steel structures: L S Negi
- Design of steel structures (by limit state method as per IS: 800-2007): S S Bhavikatti
- IS 800: 2007 - General construction in steel-Code of practice
- SP: 6(1) - Handbook for structural engineers-Structural steel sections

8th Semester	**AGCE 21801: Semester Training**				
Internal Marks:	**300**		**L**	**T**	**P**
External Marks:	**200**		**0**	**0**	**0**
Total Marks:	**500**		**Credits**		**12**

Course Outcomes: After going through this training, students will be able to:	
CO-1	Communicate effectively with peers.
CO-2	Differentiate the layout of various industrial shops.
CO-3	Participate constructively and ethically in the industrial process.
CO-4	Describe detailed specifications of machinery/equipment/tool/software.
CO-5	Analyse the scope of training received towards his/her career goals.
CO-6	Write the report on an industrial project.

Part	**Training Activity**	**CO**
-	Interaction with HR and communicate the details of the supervisor to the department	CO-1
	General layout of Industry/construction site.	CO-2
	Participation in assigned tasks (Ethical & Constructive).	CO-3
	Description of machinery/equipment/tools/software used during training.	CO-4
	Analyse the scope of training received towards his/her career goals.	CO-5
	Report writing on the industrial project.	CO-6