SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Diploma

Course/ Subject Code: BE106502

Course/Subject Name: Concrete Technology

w.e.f.Academic Year:	2023-24
Semester:	5TH Semester/ 3rdYear
Category of the Course:	**Professional Core course**

Prerequisite:	Knowledge of basic engineering materials, fundamentals of strength of materials, elementary chemistry, and introductory material testing (cement, aggregate, etc.).
Rationale:	Rationale- Concrete is the most widely used construction material in the world made by mixing Portland cement with sand, crushed rocks and water. It plays an important role in Infrastructure and Private building construction. It is heterogeneous and has complex microstructure. Understanding the basic behaviour of concrete is very important for civil engineering students to become efficient civil engineering professionals. The course on Concrete technology acquaints the students with this second largest material in use after water. It will help the students to explore the material, its properties, intrinsic nature and application & also the recent advances in field of concrete technology.

Teaching and Examination Scheme:

Teaching Scheme(in Hours)			**Total Credits L+T+(PR/2)**	**Assessment Pattern and Marks**				**Total Marks**
				Theory		**Tutorial/Practical**		
L	**T**	**PR**	**C**	(E)	(M)	(I)	(V)	
3	0	2	4	60	40	30	20	150

Course Content:

Unit	**Content**	**Hours**	
1	**General** Historic development, Composition of concrete, Advantages of concrete over other materials, Advances and future trends in concrete, Overview of Sustainability and Concrete development.	**2**	**10**
2	**Ingredients of Concrete** Cement: Chemical composition, Hydration of cement, structure of hydrated cement, Tests on cement, Various types of cement Aggregates: Classification of aggregates , IS specifications, Properties of aggregates, Grading, Types of grading, Sampling & Testing of aggregates Water –	**10**	**25**

	General requirements & limiting values of impurities Admixtures: Additives & Admixtures, Types of admixtures, Applications, Mineral admixtures – Fly ash, silica fume, GGBS and other pozzolanic materials. Chemical Admixtures: Accelerators, Retarders, Water reducing admixutres, Plasticizers, Super plasticizers, Dosage and application		
3	**Fresh Concrete** Properties of fresh concrete, Definition and Measurement methods of workability as per IS and ASTM standards, factors affecting workability, Segregation & Bleeding, Slump loss, Re-tempering, Site preparations for concreting, Mixing, Conveying, Placing, Compaction, Finishing of concrete. Curing & various methods of curing.	**5**	**10**
4	**Hardened Concrete** Strengths of hardened concrete (Tensile & Compressive strength, Flexural & Bond strength), standard test methods as per IS and ASTM, Failure mechanism under compression & tension, Stress-strain behaviour of concrete, Overview of Modulus of elasticity, Dimensional stability Creep & Shrinkage	**5**	**10**
5	**Durability & Permeability of concrete** Causes of deterioration in concrete and durability problems, Factors affecting durability, Transport mechanism of gases & fluids in concrete, Cracking & causes of cracking, Carbonation induced & corrosion induced cracking, Alkali-aggregate reaction, Degradation by freeze & thaw, Sulphate attack, Durability under sea-water (marine environment).	**5**	**10**
6	**Mix design of Concrete** Principles of concrete mix design, Parameters and factors influencing mix design, Indian Standard methods of mix design, Acceptability criteria, variability of results, Various provisions of IS code for sound concrete.	**5**	**10**
7	**Special concrete and Concreting methods** High strength concrete, High performance concrete, Fiber reinforced concrete, Polymer modified concrete, Self-compacting concrete, Light weight concrete,Light-weight & heavy weight concrete, High volume fly ash concrete. Special concreting methods: Pumped concrete, Ready mix concrete, Under-water concreting, Hot & cold weather concreting, Precast concrete, Pre-placed concrete	**5**	**10**
8	**Miscellaneous Topics** Non-Destructive testing of concrete – Introduction to Destructive, semidestructive & Non-destructive testing methodology, Problems faced during Non-destructive evaluation, Test methods like Rebound Hammer test, Ultra-sonic pulse velocity, Penetration tests, Pull out tests. Overview of Fracture Mechanics – Origin of fracture mechanics, Understanding the	**5**	**10**

	quassi-brittle nature of concrete, Failure of concrete under low stress, Micro—cracking, crack propagation, stress concentration at openings.		

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**25**	**25**	**20**	**10**	**10**

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(as per Revised Bloom's Taxonomy)

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Explain the historical development, composition, and advantages of concrete, including sustainability aspects.	Apply
2	Describe properties, classification, and testing of ingredients like cement, aggregates, water, and admixtures..	Apply
3	Interpret fresh concrete properties, evaluate workability, and explain site procedures for mixing and curing.	Apply
4	Analyze mechanical properties and stress-strain behavior of hardened concrete, including failure modes.	Apply
5	Evaluate durability issues and deterioration mechanisms including cracking, carbonation, corrosion, etc.	Apply

Course Outcome to Programme Outcome (CO-PO) Mapping

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Diploma

Course/ Subject Code: BE106502

Course/Subject Name: Concrete Technology

CO-PO Mapping					
PO \ CO	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
PO-1 Basic Engg Knowledge	3	3	3	3	3
PO-2 Problem Analysis	2	1	1	2	2
PO-3 Design/Development	3	2	3	3	3
PO-4 Investigations	3	2	2	2	2
PO-5 Modern Tool Usage	2	2	3	3	3
PO-6 Engineer & Society	-	-	-	-	-
PO-7 Environment & Sustainability	-	-	-	-	-
PO-8 Ethics	-	-	-	-	-
PO-9 Individual & Team Work	-	-	-	-	-
PO-10 Communication	-	-	-	-	-
PO-11 Project Management	-	-	-	-	-
PO-12 Lifelong Learning	-	-	-	-	-
CO-PSO Mapping					
PSO \ CO	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
PSO-1 (Design Skills))	3	2	3	3	3
PSO-2 Analytical Ability)	2	3	3	2	3
PSO-3 Use of Design Aids/Codes) Software/Tool Use	2	2	2	3	3

Reference Books –

- A.M.Neville ; Properties of Concrete
- D.F.Orchard; Concrete Technology
- P Kumar Mehta, Monteiro; Concrete Technology
- A R Santhakumar; Concrete Technology 5. M S Shetty; Concrete Technology
- M L Gambhir; Concrete Technology

List of Practical/ Exercise -

- Term work shall consist of tests on cement and aggregate, fresh concrete and hardened concrete.

- Term work shall include Presentation on the topics assigned by lab faculty member.
- Term work shall include field visit and students will have to submit a report on it.
- Oral/Practical marks include viva-voce on practical performed and submitted reports

Open Sources -

- www.nptel.iitm.ac.in/courses/

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE106502

Course/Subject Name: Transportation Engineering

w.e.f.Academic Year:	2022-23	
Semester:	5th SEM / 3rd YEAR	
Category of the Course:	PCC	

Prerequisite:	Surveying, Geotechnical Engineering, Mechanics of Materials
Rationale:	To comprehend basic requirements of Highway, Rail, Water and Air Transportation. To enable the students to apply the basic principles of geometric design, design of highway and traffic engineering in the field.

Teaching and Examination Scheme:

Teaching Scheme(in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial/Practical		
L	T	PR	C	(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weight age
1.	**Introduction** Importance of Transportation, Different modes of transportation, Overview of Road, Rail, Air and Water Transportation, Comparison of various modes of Transportation. Organizations and their functions - Central Road Research Institute (CRRI), Indian Road Congress (IRC), Railway Board (RB), Inland Waterways Authority of India (IWAI), Airport Authority of India (AAI), International Civil Aviation Organization (ICAO), Directorate General of Civil Aviation (DGCA).	**2**	5
2.	**Highway Transportation: Introduction** Highway planning and development in India, Classification of Rural and Urban roads, Highway alignment and surveys, Preparation of Detailed Project Report. Highway Geometric Design: Importance, highway cross section elements, sight distance, design of horizontal alignment, design of vertical alignment, design of intersection. Highway Materials: Components of highway pavement and materials used. Soil: Importance, Desirable properties, Index properties, Compaction, Strength evaluation tests. Aggregate: Functions, Desirable properties, Tests on road	**30**	71

	aggregates and quality control. Bituminous binders: Functions, Desirable properties, Tests on bitumen and quality control, Bitumen emulsion functions and classification, Modified bituminous binder functions and classification. Bituminous Mix: Desirable properties and requirement of design mix, general approach for design of bituminous mixes and introduction to Marshall Mix Design Method. Design and Construction of Pavement: Pavement component functions, factors affecting pavement design and basic pavement design of Flexible and Rigid pavement as per IRC guidelines, Steps for construction of highway on embankment and in cutting. Construction of embankment and subgrade, soil stabilization. Flexible Pavement: Construction of Granular Sub-Base/Drainage layer, Construction of Granular Base Course-WBM and WMM, Construction of bituminous pavement layers- base course and surface course, prime coat and tack coat. Rigid Pavement: Types of cement concrete pavement, components of cement concrete pavement and its functions, construction of cement concrete pavement, joints in cement concrete pavement-function and construction. Pavement Maintenance: Objective and classification of highway maintenance works. Distresses and maintenance measures in flexible and rigid pavements. Concept of pavement evaluation: Functional and Structural Highway Drainage, Arboriculture and Lighting: Requirements of drainage system, Surface drainage system, Sub-surface drainage system, Road Arboriculture, Highway lighting: Importance, Design factors and lighting layout. Traffic Engineering: Traffic characteristics, Traffic studies: Traffic Volume study, Spot speed studies, Travel time - Delay study, PCU, Origin and Destination studies, Parking studies, Road accident studies. Traffic regulations and control devices. Types of Intersections. Road safety aspect		
3.	**Rail Transportation** Role of Indian Railways in National Development, Basic requirement of railway alignment and functions of Permanent Way, Types of components and functions: Gauge, Rail, Fittings, Ballast, Embankments, Subgrade. Purpose: Coning of wheel, Super-elevation, points and crossing, signalling and interlocking, yard, junction and terminal.	**4**	10
4.	**Water Transportation** Harbour: Classification, components, site selection. Definitions: Harbour, Port, Plimsoll Line, Beam, Draft, Hull, Structures and functions: Jetty, Breakwater, Wharf, Dock, Lock, Quay, Mole, Dolphin. Mooring, Dredging. Natural Phenomenon: Tides, Waves, Wind, Currents. Navigational Aids: Lighthouse, Lightships, Buoys.	**3**	7

5.	**Air Transportation** Airport: Classification, Master plan, Site selection, Zoning laws, imaginary surfaces. Aircraft Component parts, Importance and Purpose: Wind rose diagram, Runway Orientation, Taxiway, Apron, terminal building, Marking and lighting on Runway, Taxiway and Apron	**3**	7
	Teaching hours	**42**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**15**	**12**	**10**	**8**	**5**

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(as per Revised Bloom's Taxonomy)

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Design highway geometrics & pavements per IRC codes	C
2	Analyze pavement distresses and maintenance strategies	N
3	Conduct traffic studies and interpret results	A
4	Solve railway track alignment problems	A
5	Plan harbor/airport components using transport charts.	C

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE106502

Course/Subject Name: Transportation Engineering

Course Outcome to Programme Outcome (CO-PO) Mapping. (Scale: 1-Low, 2-Medium, 3-High)

CO-PO Mapping					
PO \ CO	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
PO-1 Basic Engg Knowledge	3	3	3	3	3
PO-2 Problem Analysis	3	3	3	3	3
PO-3 Design/Development	3	2	2	2	3
PO-4 Investigations	2	3	3	2	2
PO-5 Modern Tool Usage	2	2	2	1	2
PO-6 Engineer & Society	3	2	3	2	2
PO-7 Environment & Sustainability	2	2	2	1	2
PO-8 Ethics	1	1	1	1	1
PO-9 Individual & Team Work	1	1	2	1	1
PO-10 Communication	2	2	2	2	2
PO-11 Project Management	2	2	2	2	2
PO-12 Lifelong Learning	2	2	2	2	2
CO-PSO Mapping					
PSO \ CO	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
PSO-1 Programming Skills	1	1	1	1	1
PSO-2 Analytical Ability	3	3	3	2	2
PSO-3 Software Tools Use	2	2	2	1	2

Reference Books/Suggested Learning Resources:

- Huang Y. H., Pavement Analysis and Design. Prentice Hall, Englewood Cliffs, New Jersey, USA, 1993, ISBN-0-13-655275-7
- Yoder E. J. and Witczak M. W., Principles of Pavement Design, John Wiley and Sons, New York, 1975
- Tang, Pavement Design
- Mannering F. L., Kilareski W. P. and S. S. Washburn, Principles of Highway Engineering and Traffic Analysis. Wiley India Pvt. Ltd., New Delhi.
- Atkins H.N., Highway Construction and Maintenance, Soils, and Concretes, Reston Publishing Company, Reston VA, 1983.
- Watson J. P., Highway Construction and Maintenance, Longman Scientific and Technical, New York, 1989.

- Dr. Sharma S. K., Principles, Practice and Design of Highway Engineering (Including Airports), S. Chand & Company Ltd.
- Chakraborty Partho, Das Animesh, Principles of Transportation Engineering, PHI
- Khanna S.K., Justo C.E.G., Highway Engineering, Nem Chand & Bros., Roorkee.
- Bindra S.P., A course in Highway Engineering, Dhanpat Rai Publications
- Kadiyali L. R. and Lal, N. B., Principles & Practice of Highway Engineering, Khanna Publishers, Delhi.
- Khanna S. K., Arora M. G. and Jain S.S., Airport Planning and Design, Nem Chand and Bros.
- IRC:58-2015, Guidelines for the Design of Plain Jointed Rigid Pavement for Highways
- IRC:37-2018, Guidelines for the Design of Flexible Pavements,
- Specifications for Road and Bridges, Ministry of Road Transport & Highways (MoRTH)

Open Sources Software and Website:

- www.nptel.iitm.ac.in/courses/

List of Practical/ Exercise -

- Determination of aggregate crushing Value
- Determination of aggregate impact value
- Determination of Los Angeles Abrasion value
- Determination of shape tests on aggregate
- Determination of California Bearing Ratio values
- Determination of viscosity of Bitumen
- Determination of softening point of bitumen
- Determination of ductility of the bitumen
- Determination of flash point and fire point of bitumen
- Determination of Bitumen content
- Determination of stripping value of road aggregate
- Determination of Marshall Stability value for Bituminous mix

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Diploma

Course/ Subject Code: BE106503

Course/Subject Name: Design of Structures

w.e.f.Academic Year:	2023-24
Semester:	5TH Semester/ 3rdYear
Category of the Course:	**Professional Core course**

Prerequisite:	Knowledge of basic engineering materials, fundamentals of strength of materials, elementary chemistry, and introductory material testing (cement, aggregate, etc.).
Rationale:	Rationale- This subject is applications of structural engineering principles to design basic structural elements using of reinforced concrete and steel as materials. The subject is specifically aim to develop understanding of various design philosophy, Indian codal provisions, design basis used in design of basic elements of framed structures and its detailing requirement

Teaching and Examination Scheme:

Teaching Scheme(in Hours)			**Total Credits L+T+(PR/2)**	**Assessment Pattern and Marks**				**Total Marks**
				Theory		**Tutorial/Practical**		
L	**T**	**PR**	**C**	(E)	(M)	(I)	(V)	
3	0	2	4	60	40	30	20	150

Course Content:

Unit	**Content**	**Hours**	
1	**Introduction**: Objectives, Properties of Reinforced Concrete and Structural Steel, Loads & load combinations, Methods of Analysis, Codes & specifications, Design Philosophies - Working stress Method, Ultimate Load Method, Limit State Method, Plastic Method	**2**	**10**
2	**Philosophy of Limit state design for RC structures:** Limit state of collapse & serviceability, partial safety factors for material & loading.Limit State of Flexure: Stress-strain characteristics of concrete & reinforcing steel, Type of section-under reinforced, over reinforced & balance section, Neutral Axis depth, Moment of Resistance for singly reinforced, doubly reinforced and flanged sections.Limit state of Axial,Shear and Torsion, combined flexure & torsion,Bond &	**10**	**25**

	Anchorage, Development length, splicing		
3	**Limit state design of RC structural Element** Design of Beams Simply supported, cantilever and continuous beams Design of Slab: One way, two way simply supported and continuous slabs Design of Column: Classifications, Assumptions, Design of Short Columns under axial load Design of Foundations: Design of isolated footing under axial load and uni-axial bending, combined footing.	**5**	**10**
4	**Philosophy of Limit state design for Steel** Limit state of collapse & serviceability, partial safety factor for material and loading, Type & behavior of sections – Plastic, compact, semi compact, slender. Connections: Bolted connections – bearing type, behavior of bolted joints, Design strength of ordinary & HSFG bolts. Welded connections- Fillet and Butt weld, design of simple connections such as lap and butt joints, truss joint connections.	**5**	**10**
5	**Limit state design of Steel components** Axial force design Tension member: types of tension member, behavior, modes of failure, Design of tension member, splices, lug angle. Compression member: Behaviour, classification of sections, possible modes of failure, elastic buckling of slender member, design of compression member having single & built-up section, lacing & battening, Design for Beams and Beam-Columns: Type of sections, classification, Lateral stability, Design strength of laterally restrained and unrestrained beams, shear strength, deflection, web buckling & crippling, Design of simply supported beam. Combined axial and flexural design of member (Beam-Column) Footing : slab based, gusseted base foundation	**5**	**10**
	TOTAL hours		

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**25**	**25**	**20**	**10**	**10**

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(as per Revised Bloom's Taxonomy)

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Diploma

Course/ Subject Code: BE106503

Course/Subject Name: Design of Structures

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Explain the historical development, composition, and advantages of concrete, including sustainability aspects.	Apply
2	Describe properties, classification, and testing of ingredients like cement, aggregates, water, and admixtures..	Apply
3	Interpret fresh concrete properties, evaluate workability, and explain site procedures for mixing and curing.	Apply
4	Analyze mechanical properties and stress-strain behavior of hardened concrete, including failure modes.	Apply
5	Evaluate durability issues and deterioration mechanisms including cracking, carbonation, corrosion, etc.	Apply

Course Outcome to Programme Outcome (CO-PO) Mapping

CO-PO Mapping					
PO \ CO	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
PO-1 Basic Engg Knowledge	3	3	3	3	3
PO-2 Problem Analysis	2	1	1	2	2
PO-3 Design/Development	3	2	3	3	3
PO-4 Investigations	3	2	2	2	2
PO-5 Modern Tool Usage	2	2	3	3	3
PO-6 Engineer & Society	-	-	-	-	-
PO-7 Environment & Sustainability	-	-	-	-	-
PO-8 Ethics	-	-	-	-	-
PO-9 Individual & Team Work	-	-	-	-	-
PO-10 Communication	-	-	-	-	-
PO-11 Project Management	-	-	-	-	-

PO-12 Lifelong Learning	-	-	-	-	-
CO-PSO Mapping					
PSO \ CO	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
PSO-1 (Design Skills))	3	2	3	3	3
PSO-2 Analytical Ability)	2	3	3	2	3
PSO-3 Use of Design Aids/Codes) Software/Tool Use	2	2	2	3	3

Reference Books –

- A.M.Neville ; Properties of Concrete
- D.F.Orchard; Concrete Technology
- P Kumar Mehta, Monteiro; Concrete Technology
- A R Santhakumar; Concrete Technology 5. M S Shetty; Concrete Technology
- M L Gambhir; Concrete Technology

List of Practical/ Exercise -

- Term work shall consist of tests on cement and aggregate, fresh concrete and hardened concrete.
- Term work shall include Presentation on the topics assigned by lab faculty member.
- Term work shall include field visit and students will have to submit a report on it.
- Oral/Practical marks include viva-voce on practical performed and submitted reports

Open Sources -

- www.nptel.iitm.ac.in/courses/

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE106504

Course/Subject Name: Structural Analysis-II

w.e.f.Academic Year:	2022-23	
Semester:	5th SEM / 3rd YEAR	
Category of the Course:	Program Elective	

Prerequisite:	Structural Analysis-I
Rationale:	This subject is conceptual applications of principles of mechanics of rigid and deformable bodies in Engineering. This subject helps in determining statics response of statically indeterminate framed structures. In addition to this, the topics related to applications of Energy Principles, Moving loads will helps the students in developing the basic concepts of structural analysis. Use of professional software in structural analysis is a need of the day and hence it is included in this course.

Teaching and Examination Scheme:

Teaching Scheme(in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial/Practical		
L	T	PR	C	(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weight age
1.	**Statically Indeterminate structure** Classical methods Slope Deflection Method: Analysis of continuous beams for various loading including settlement/ rotation of support, analysis of simple portal frame with sway. Moment Distribution Method: Analysis of plane frames including sway, use of symmetry of structure up to two storeyed / two bay frames.	**10**	**24**
2.	**Statically Indeterminate structures** Matrix methods Matrix Methods: Types of skeletal structures, Internal forces and deformations. Introduction and applications of stiffness method to analyze beams, Trusses and plane frames by system approach. Introduction and applications of Flexibility method to analyze beams, Trusses and plane frames by system approach.	**12**	**29**

3.	**Energy Principles and Approximate methods** Energy Principles: Castigliano's theorems, Application of castigliano's 1st and 2ndtheorm to statically determinate and indeterminate framed structure – beams, plane truss & plane frames. Approximate methods: Forces in the framed structure subjected to Vertical and lateral loads.	**10**	**24**
4.	**Structure subjected to Moving loads** Influence line diagrams ILD for statically determinate beams- I.L.D of support reaction, shear force and moment bending moment for beams subjected to u.d.l and several point loads, criteria for maximum effects, ILD for statically determinate trusses, forces in members for u.d.l and point loads ILD for statically indeterminate beams: Muller-Breslau's principle, steps for obtaining I.L for reaction and internal forces in propped cantilever and continuous beams, qualitative I.L diagram for rigid jointed structures having higher degree of statically indeterminacy.	**8**	**19**
5.	Computer Applications in Structural Engg. (for Laboratory only) Use of professional software such as STAAD-Pro, SAP, ETABS etc. for determining response of structure related to the topics of this course.	**2**	**4**
	Teaching hours	**42**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**15**	**12**	**8**	**8**	**7**

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(as per Revised Bloom's Taxonomy)

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Analyze indeterminate structures using classical methods	N
2	Apply matrix methods for structural systems	A

3	Compute forces using energy principles	A
4	Evaluate structural response to moving loads	E
5	Model structures using professional software	C

Course Outcome to Programme Outcome (CO-PO) Mapping. (Scale: 1-Low, 2-Medium, 3-High)

CO-PO Mapping					
PO \ CO	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
PO-1 Basic Engg Knowledge	3	3	3	3	3
PO-2 Problem Analysis	3	3	3	3	3
PO-3 Design/Development	2	3	2	2	3
PO-4 Investigations	3	3	3	3	3
PO-5 Modern Tool Usage	2	2	2	2	3
PO-6 Engineer & Society	2	2	2	2	2
PO-7 Environment & Sustainability	2	2	2	2	2
PO-8 Ethics	1	1	1	1	1
PO-9 Individual & Team Work	2	2	2	2	2
PO-10 Communication	2	2	2	2	2
PO-11 Project Management	2	2	2	2	2
PO-12 Lifelong Learning	2	2	2	2	2
CO-PSO Mapping					
PSO \ CO	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
PSO-1 Programming Skills	3	3	3	3	3
PSO-2 Analytical Ability	2	3	2	2	3
PSO-3 Software Tools Use	2	2	2	2	3

Reference Books/Suggested Learning Resources:

- Junarkar S. B. & Shah H. J.; Mechanics of Structures Vol-II; Charotar publishing house,Anand
- Wang C. K.; Intermediate Structural Analysis; Tata McGraw Hill book Company, NewDelhi
- Gere & Weaver; Matrix Analysis of framed structures, CBS Publications
- Ryder G.H.; Strength of Materials; Mcmillan
- Gere & Timoshenko; Mechanics of Materials; CBS Publishers & Distributors, Delhi

Open Sources Software and Website:

- www.nptel.iitm.ac.in/courses/

List of Practical/ Exercise -

- The students will have to solve at least five examples and related theory from each topic as an assignment/tutorial.
- At least 50% problems will have to solve with professional software and compare results.
- Experiments may be designed and carried our related to the topics of the course.
- Practical examinations shall consist of oral based on term-work and above course.

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE106505

Course/Subject Name: Pavement Design and Highway Construction

w.e.f.Academic Year:	2022-23	
Semester:	5th SEM / 3rd YEAR	
Category of the Course:	Program Elective	

Prerequisite:	Transportation Engineering, Geotechnical Engineering
Rationale:	1. To Design appropriate Pavement for the roads 2.To enable the construction procedure of roads

Teaching and Examination Scheme:

Teaching Scheme(in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial/Practical		
L	T	PR	C	(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weight age
1.	**Pavement Materials and Characterization** Soil : Characterization for Earthwork, Subgrade. Effective CBR, Concept of Modulus of resilient of subgrade, Aggregate :Granular Subbase and Base layer - road aggregates used for WBM, WMM, Aggregate used in Bituminous layer, Its characteristics, gradation- Fullers equation, physical properties requirements for rural road and high-volume road., Concept of Modulus of resilient of sub base and base course as per IRC 37, Bituminous material : Bitumen, Emulsion, Modified bitumen, bituminous mix – Volumetrics, concept of modulus of resilient per IRC 37, Quality control and Quality Assurance plan for highway.	5	12
2.	**Design of Highway Pavement** **Flexible Pavement:** Factors affecting pavement design, ESWL, EWLF, VDF, Stress analysis – Boussinesq's theory, Burmister's two- and three-layer theory, Flexible pavement design as performance criteria- subgrade rutting criteria and fatigue cracking criteria for bituminous layer. Pavement design using IITPAVE software for granular base and granular sub base, cementitious base, cementitious sub base. Overview on Pavement design for low volume road using locally available material as	15	36

	per IRC SP-72. Drainage consideration in pavement design **Rigid Pavement:** Design factors, Westergaard's stress analysis, load stress, temperature stress, Design based on fatigue behaviour of concrete, IRC-58 design method – Fatigue concept (using IIT RIGID), Design of joints, Friberg's analysis of dowel bar design, Design of tie bar. Overview on Pavement design for low volume road as per IRC SP-62		
3.	**Construction of Pavement** **Flexible pavement:** Construction procedure of embankment, subgrade, Sub base (Granular, sub base), Drainage layer, filter /separation layer, Base course-WBM, WMM, Lime stabilized, cement stabilized (Granular layer), Bituminous mix – Binder course and wearing course, its selection, its gradation, compaction and density requirements. Selection of different bituminous mix treatment as per functional and structural requirements of Construction procedure as per specification of MORTH **Rigid pavement:** Earthwork, Granular sub base, drainage layer, Dry lean concrete as per IRC-49, Pavement quality concrete construction requirements as per IRC:15 and IRC:58 and MORTH, Importance of joints and its provision Interlocking Concrete Block Pavement (ICBP) and Its procedure of laying, requirements, Pattern of blocks, Strength requirement as per guidelines of IRC SP 63.	10	24
4.	**Maintenance of pavement** **Flexible pavement:**IRC-82, need of maintenance, types, planning, system approach, types of defects, symptoms, location, cause, severity level and treatment. Preventive and periodical renewals, its warrants and treatments. **Rigid pavement:** Maintenance and its methodology as per IRC: SP:83, Design of overlay.	6	14
5.	**Introduction to New Technology** Recycle aggregate pavement as per IRC:120 (RAP), Cold in place (CIP), Hot in place (HIP), plant mix technology, Methodology of construction, Cold mix technology as per IRC SP100, White topping – Conventional, Ultra-thin white topping as per IRC SP-76, , Stone matrix asphalt as per IRC SP-79, Warm mix asphalt as per IRC SP 101, Micro surfacing ,slurry seal as per IRC SP-81.	6	14
	Teaching hours	**42**	**100**

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE106505

Course/Subject Name: Pavement Design and Highway Construction

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**15**	**12**	**8**	**8**	**7**

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(as per Revised Bloom's Taxonomy)

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Characterize pavement materials using standard tests	A
2	Design flexible/rigid pavements per IRC codes	C
3	Execute construction as per MORTH specifications	A
4	Evaluate maintenance needs using IRC guidelines	E
5	Recommend new technologies for sustainable roads	C

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE106505

Course/Subject Name: Pavement Design and Highway Construction

Course Outcome to Programme Outcome (CO-PO) Mapping. (Scale: 1-Low, 2-Medium, 3-High)

CO-PO Mapping					
PO \ CO	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
PO-1 Basic Engg Knowledge	3	3	3	3	3
PO-2 Problem Analysis	3	3	3	3	3
PO-3 Design/Development	2	3	2	2	3
PO-4 Investigations	3	2	3	3	2
PO-5 Modern Tool Usage	2	3	2	2	3
PO-6 Engineer & Society	2	3	3	3	3
PO-7 Environment & Sustainability	2	2	2	2	3
PO-8 Ethics	1	1	1	1	1
PO-9 Individual & Team Work	2	2	3	2	2
PO-10 Communication	2	2	2	2	2
PO-11 Project Management	2	2	3	2	2
PO-12 Lifelong Learning	2	2	2	2	3
CO-PSO Mapping					
PSO \ CO	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
PSO-1 Programming Skills	3	3	3	3	3
PSO-2 Analytical Ability	2	3	2	2	3
PSO-3 Software Tools Use	2	3	2	2	3

Reference Books/Suggested Learning Resources:

- Relevant IRC Codes
- Huang Y. H., Pavement Analysis and Design. Prentice Hall, Englewood Cliffs, New Jersey, USA, 1993, ISBN-0-13-655275-7
- Yoder E. J. and Witczak M. W., Principles of Pavement Design, John Wiley and Sons, New York, 1975
- Dr. Sharma S. K., Principles, Practice and Design of Highway Engineering (Including Airports), S. Chand & Company Ltd.
- Chakraborty Partho, Das Animesh, Principles of Transportation Engineering, PHI
- Khanna S.K., Justo C.E.G., Highway Engineering, Nem Chand & Bros., Roorkee.
- Kadiyali L. R. and Lal, N. B., Principles & Practice of Highway Engineering, Khanna Publishers, Delhi.
- Martin Rogers, Bernard Enright, Highway Engineering, Willey Blackwell
- Paul H. Wright, Karen K. Dixon, Highway Engineering, John Wiley & Sons, 7th edition, 2004
- Specifications for Road and Bridges, Ministry of Road Transport & Highways (MoRTH)
- Rao G.V. Principles of Transportation and Highway Engineering, Tata McGraw-Hill Publishing Company Ltd., New Delhi, India, 1996.
- Huang, Y.H. Pavement Analysis and Design, Pearson Prentice Hall, New Jersey, USA, 2004.

Open Sources Software and Website:

- http://www.nptel.iitm.ac.in/courses/

List of Practical/ Exercise -

- Bituminous mix design
- Determination of CBR value of various mix
- Determination of overlay thickness

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE106506

Course/Subject Name: Soil Mechanics

w.e.f.Academic Year:	2022-23	
Semester:	5th SEM / 3rd YEAR	
Category of the Course:	Program Elective	

Prerequisite:	Engineering Mechanics, Basic Geology
Rationale:	Soil Mechanics is fundamental subject consisting of determination of various soil properties based on soil investigation as per need and type of project in conjunction with building byelaws and construction practices. Thorough understanding of Soil Mechanics will help an engineer to decide the most optimum design based on rigorous analysis for any infrastructural projects. Further knowledge will act as a key to enter into mutli-disciplinary folds of this subject into various other civil engineering schemes. The course/elective on Soil Mechanics provides the students in-depth knowledge of soil parameters and its determination, use of parameters in design and analysis, various numerical/analytical approaches using software, through IS codes and construction practices.

Teaching and Examination Scheme:

Teaching Scheme(in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial/Practical		
L	T	PR	C	(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weight age
1.	**Slope Stability** Infinite and finite slopes, factor of safety, type of slope failure, stability of infinite slopes, finite slopes forms of slip surfaces, limit equilibrium method and critical stage instability analysis, effects of tension crack and submergence, C-analysis-method of slices, taylor's stability no., use of Bishop's method.	8	19
2.	**Distribution of Soils** Causes of stress in soil, geostatic stress, Boussinesque's equation, stress distribution diagrams,New-mark's influence chart Westergard's equation, contact pressure, stresses due to triangular and other loadings.	5	12

3.	**Subsurface Investigation** Objectives of exploration, planning of exploration program, soil samples and soil samplers,field penetration tests: SPT, SCPT, DCPT.,Introduction to geophysical methods,Bore log and report writing. Tests will be covered in lab sessions.	6	14
4.	**Shear Strength** Stress-Strain relationship in soil – Failure criteria – Mohr - Coulomb's failure theory – Shear parameters under different drainage conditions – Pore pressure parameters, – Analytical predictions of pore water pressure – stress dilatancy theory – results of plain strain shear tests – Forces on shear parameters – Stress path and its applications – Rheological models. Tests will be covered in lab sessions.	6	14
5.	**Bearing Capacity of Shallow Foundation** Introduction, significant depth, design criteria, modes of shear failures. Detail study of bearing capacity theories (Prandtl, Rankine, Terzaghi, Skempton), bearing capacity determination using IS Code, Presumptive bearing capacity. Settlement, components of settlement & its estimation, permissible settlement, Proportioning of footing for equal settlement, allowable bearing pressure. Bearing capacity by use of penetration test data and by plate load test. Bearing capacity of raft. Factors affecting bearing capacity including Water-Table. Contact pressure under rigid and flexible footings. Floating foundation. Types of pavements & its design. Tests will be covered in lab sessions.	7	17
6	**Pile foundations :** Introduction, load transfer mechanism, types of piles according to their composition, their method of installation and their load carrying characteristics, piles subjected to vertical loads- pile load carrying capacity from static formula,dynamic formulae (ENR and Hiley), penetration test data & Pile load test.Pile group: carrying capacity, efficiency and settlement. Negative skin friction. Underreamed pile foundationits concept,design & field installation.	7	17
7	**Introduction to Geosynthetics** Definition, types of geosynthetics, properties of geosynthetics and various foundation/poor soil/civil engg applications.	3	7
	Teaching hours	**42**	**100**

Suggested Specification Table with Marks (Theory):

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE106506

Course/Subject Name: Soil Mechanics

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	15	12	8	8	7

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(as per Revised Bloom's Taxonomy)

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Classify soils and determine index properties	A
2	Analyze slope stability using limit equilibrium methods	N
3	Design shallow foundations per IS codes	C
4	Evaluate pile foundation capacity and group effects	C
5	Conduct field tests (SPT, CPT) and interpret results	A

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE106506

Course/Subject Name: Soil Mechanics

Course Outcome to Programme Outcome (CO-PO) Mapping. (Scale: 1-Low, 2-Medium, 3-High)

CO-PO Mapping					
PO \ CO	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
PO-1 Basic Engg Knowledge	3	3	3	3	3
PO-2 Problem Analysis	3	3	3	3	3
PO-3 Design/Development	2	2	3	3	2
PO-4 Investigations	3	3	2	2	3
PO-5 Modern Tool Usage	2	2	2	2	3
PO-6 Engineer & Society	2	3	3	2	2
PO-7 Environment & Sustainability	2	2	2	2	2
PO-8 Ethics	1	1	1	1	1
PO-9 Individual & Team Work	1	1	1	1	2
PO-10 Communication	2	2	2	2	2
PO-11 Project Management	2	2	2	2	2
PO-12 Lifelong Learning	2	2	2	2	2
CO-PSO Mapping					
PSO \ CO	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
PSO-1 Programming Skills	1	1	1	1	1
PSO-2 Analytical Ability	3	3	3	3	3
PSO-3 Software Tools Use	2	2	2	2	3

Reference Books/Suggested Learning Resources:

- B.C. Punamia; Soil Mechanics & Foundation Engineering; Laxmi Pub. Pvt. Ltd., New Delhi
- Alamsingh; Soil Mechanics & Foundation Engineering; CBS Publishers & Distributors, Delhi
- Das Braja M; Principles of Geotechnical Engineering; Thomson Asia Pvt. Ltd.
- Gopal Ranjan, Rao A.S.R.; Basic and applied soil mechanics; New age int. (p) ltd
- Arora K.R.; Soil Mechanics & Foundation Engineering; Standard Pub., Delhi
- Taylor D.W.; Fundamentals of Soil Mechanics; Asia Publishing House, Mumbai
- Bowles, J.E., "Foundation Analysis and Design, 5th Edition, McGraw Hill, New York, 1995.
- Relevant IS Codes
- V. N. S. Murthy; Soil Mechanics & Foundation Engineering; CRS Press, Taylor & Francis Group, New York

Open Sources Software and Website:

- http://nptel.ac.in/
- http://ocw.mit.edu/courses/civil-and-environmental-engineering

List of Practical/ Exercise -

- Auger boring/sampling
- Standard/dynamic cone penetration test
- Static cone penetration test
- In situ permeability test
- Free swell and swell potential
- Swelling pressure test
- Model pile load test.
- Planning site investigations for a real life problem- project mode tests.SPT

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE106507

Course/Subject Name: Remote Sensing and GIS

w.e.f.Academic Year:	2022-23	
Semester:	5th SEM / 3rd YEAR	
Category of the Course:	Open Elective Subject	

Prerequisite:	Engineering Mechanics, Basic Geology
Rationale:	To develop a basic understanding about Geo-Spatial techniques and its applications. To enable the students to apply the tools to solve various problems related to Civil Engineering

Teaching and Examination Scheme:

Teaching Scheme(in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial/Practical		
L	T	PR	C	(E)	(M)	(I)	(V)	
2	0	2	3	60	40	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weight age
1.	**Fundamental of remote sensing** Definition –Components of Remote Sensing –Active and Passive Remote Sensing – Electro Magnetic Spectrum – Interaction of EMR With the Earth's Surface – Interactions with the Atmosphere Energy Sources and Radiation. Active and Passive Remote Sensing. Energy Interaction with the Earth Surface Features. Data Acquisition and Recording. Remote Sensing Data Products.	**5**	**18**
2.	**Image interpretation and digital image processing** Introduction to Digital Image and Imaging Sensors- Data Formats of Digital Image- Display of Digital Image - Image Processing Systems – Strategies – Keys – Equipment – Fundamentals of Image Classification and Analysis.	**4**	**14**
3.	**Geographic information system** Introduction to GIS- Definitions of GIS and related terminology - Components of GIS – GIS Data – Georeferenced data – introduction to data input and output in GIS– Fundamentals of data quality and Management	**6**	**21**

4.	**Spatial data analysis** Characteristics of Map Coordinate systems- Introduction to Map projections- Geo-referencing Frameworks and Reference Coordinate Systems. GIS analysis functions – Retrieval – Reclassification – Buffering and Neighborhood – Overlaying – Data Output – Fundamentals of GIS Analysis functions	**6**	**21**
5.	**Software** GIS and Image interpretation Software – Salient features – Capabilities and Limitations. Data management in public domain GIS software- Attribute Data Management	**4**	**14**
6	**Applications** Application of Remote Sensing / GIS– Case studies. GIS and Remote Sensing – Usefulness in Civil Engineering.	**3**	**11**
	Teaching hours	**28**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**15**	**12**	**8**	**8**	**7**

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(as per Revised Bloom's Taxonomy)

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Interpret remote sensing data and EMR interactions	U
2	Process digital images using GIS software tools	A
3	Design geodatabases for civil engineering projects	C
4	Analyze spatial data using buffering/overlay operations	N
5	Evaluate GIS solutions for infrastructure planning	E

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE106507

Course/Subject Name: Remote Sensing and GIS

Course Outcome to Programme Outcome (CO-PO) Mapping. (Scale: 1-Low, 2-Medium, 3-High)

CO-PO Mapping					
PO \ CO	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
PO-1 Basic Engg Knowledge	3	3	3	3	3
PO-2 Problem Analysis	3	3	3	3	3
PO-3 Design/Development	1	2	3	2	3
PO-4 Investigations	3	3	2	3	2
PO-5 Modern Tool Usage	2	3	3	3	3
PO-6 Engineer & Society	2	3	3	3	3
PO-7 Environment & Sustainability	2	2	2	2	3
PO-8 Ethics	1	1	1	1	1
PO-9 Individual & Team Work	1	1	2	1	2
PO-10 Communication	2	2	2	2	2
PO-11 Project Management	2	2	2	2	2
PO-12 Lifelong Learning	2	2	2	2	2
CO-PSO Mapping					
PSO \ CO	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
PSO-1 Programming Skills	1	2	2	2	1
PSO-2 Analytical Ability	3	3	3	3	3
PSO-3 Software Tools Use	2	3	3	3	3

Reference Books/Suggested Learning Resources:

- Lilliesand T.M. and Kiefer R.W., Remote Sensing and image Interpretation, John Wiley and Sons, New York, 2004.
- Burrrough P.A and McDonnel R.A., Principles of Geographic Information Systems, Oxford university press, 1998
- A.M. Chandra and S.K. Ghosh,Remote Sensing and Geographical information System, Narosa Publishing House, New Delhi, 2006
- BhattaB.,Remote Sensing and GIS, Oxford University Press, New Delhi, 2008
- Stan Aronoff, "Geographical Information Systems", WDL Publications, Ottawa, Canada, 1989.
- Agrawal N.K., Essentials of GPS, Spatial Network Pvt. Ltd., Hyderabad, 2004.
- Bhatta B., Remote Sensing and GIS, Oxford University Press, New Delhi, 2008
- Manual of Remote Sensing (Edited), Series of volumes.
- Lo C.P. and Yeung Albert K.W., Concepts and Techniques of Geographical Information Systems, Prentice-Hall of India Pvt. Ltd. New Delhi, 2006

Open Sources Software and Website:

- CCRS Canada Centre for Remote Sensing
- NASA Remote Sensing Tutorial - http://rst.gsfc.nasa.gov/
- TELSAT, Belgium - http://eoedu.belspo.be/en/guide/index.htm
- http://www.landsat.org/ (Free)
- SRTM 90m Digital Elevation Data (Free) http://srtm.csi.cgiar.org/

List of Practical/ Exercise -

- Projects on Water Resource Mapping and Management.
- Projects on Land Use Mapping and LandResource Management.
- Projects on Site Selection for major infrastructure.
- Projects on Natural Disaster Mitigation and Management.