Ph.D. Course work in Civil Engineering (Paper 3)

Index

ADVANCED DESIGN OF RC STRUCTURES				
Teaching Scheme				
Lectures	Seminar	Library Work	Total	
40	10	10	60	
Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No	Title of the book	Author Name	Publisher's Name	Publication year
1	Unified Theory of Concrete Structures	Hsu T. T. C. and Mo Y. L.	John Wiley & Sons	2010
2	Limit design of reinforced concrete structures	Krishnamurthy, K.T., Gharpure S.C. and A.B. Kulkarni	Khanna Publishers	1985
3	Reinforced Concrete Design	Lin T Y and Burns N H	Wiley	2004
4	Reinforced Concrete Structures	Park & Paunlay	Wiley	2004
5	Comprehensive RCC Design	Punmia B.C, Ashok Kumar Jain and Arun Kumar Jain	Laxmi Publications, New Delhi	
6	Reinforced Concrete Structural Elements: Behaviour Analysis and Design	Purushothaman. P.	Tata McGraw-Hill	1986

Assessments: As per SUK Guidelines

- **Theory Examination: is to be conducted by the university with duration of 3 hours per paper.**
- **Internal Examination is to be conducted by the concerned departments or research centers in the following form:**
  1. **For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each**
  2. **For paper – 3 the internal evaluation will be as follows:**

  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents	
Module 1: • Design of R C slabs by yield line method • Design of flat slabs	**8 Hrs.**
Module 2: • Design of grid or coffered floors • Design of continuous beams with redistribution of moments	**8 Hrs.**
Module 3: • Design of R C Chimneys	**8 Hrs.**
Module 4: • Design of R C silos • Design of R C bunkers	**8 Hrs.**
Module 5: **Formwork:** Introduction, Requirements of good formwork, Materials for forms, choice of formwork, Loads on formwork, Permissible stresses for timber, Design of formwork, Shuttering for columns, Shuttering for slabs and beams, Erection of Formwork, Action prior to and during concreting, Striking of forms. Recent developments in form work.	**8 Hrs.**

ADVANCES IN PRE-STRESSED CONCRETE

Teaching Scheme

Lectures	Seminar	Library Work	Total
40	10	10	60

Examination Scheme

Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No	Title of the book	Author Name	Publisher's Name	Publication year
1	Design of Pre-stressed Concrete Structures	T. Y. Lin	John Wiley & Sons, 3rd ed.	2010
2	Pre-stressed Concrete	N Krishna Raju	Tata McGraw Hill Publishing Co. Ltd, New Delhi, 6th ed.	2018
3	Pre-stressed Concrete	Raja Gopalan N	Narosa Publishing House, New Delhi, 2nd ed.	2010
4	Pre-stressed concrete	Pandit and Gupta	CBS	2009
5	Fundamentals of Pre-stressed Concrete	Sinha N.C. & Roy	S. C & Co	1985

Assessments: As per SUK Guidelines

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  1. **For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each**
  2. **For paper – 3 the internal evaluation will be as follows:**

  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: **Introduction – Theory, Behaviour and Materials** Introduction: Basic concept of pre-stressing (including advantages and disadvantages), Basic Definitions; Pre-stressing methods-Thermo elastic, chemical, Electrical; Material Properties - Concrete and Pre-stressing steel; Pre-stressing Systems- Pre-tensioning and Post-tension systems.	**8 Hrs.**

SDA: Group activity – Simple model preparation: Tendons, anchorage, strand, pre- stress concrete element.	
Module 2: **Losses in Pre-stress** Purpose of calculating losses – Elastic loss; creep; shrinkage; relaxation; anchorage losses and Friction loss. SDA: Understand reasons for losses in PSC structures through digital resources.	**8 Hrs.**
Module 3: **Analysis and Design for Flexure** Analysis of stresses by stress method, force method and load balancing method; Pre-Basic assumptions for calculating flexural stresses, Limit state of Serviceability–Stress (IS 1343-1987); Limit state of Collapse – Flexure and Shear (IS 1343- 2012). SDA: Calculation for the stresses and flexural moment carrying capacity of PT element as per IS 1343 using	**8 Hrs.**
Module 4: **Deflection and Design of Anchorage Zone** Factors influencing Deflections – Short term Deflections of un-cracked members; Prediction of long-term deflections due to creep and shrinkage. Check for transfer bond length in pre-tensioned beams; Determination of anchorage zone stresses in post-tensioned beams by Magnel's method, Guyon's method and IS 1343 method; Design of anchorage zone reinforcement. SDA: Prepare calculation for the deflection (short and long term) of PT elements using appropriate tools.	**8 Hrs.**
Module 5: **Special Topics** Detailing of Post-tensioned Beams and Slabs, Composite Construction of Pre- stressed and in-situ concrete; Pre-stressed Concrete Poles, Piles, Railway Sleepers – concepts; Construction Methodology of Bonded and Un-bonded PT Slabs. SDA: Group activity to prepare detailing and quantities of materials for PT slab and PT beam using appropriate software tool or conventional methods.	**8 Hrs.**

STRUCTURAL DYNAMICS

Teaching Scheme

Lectures	Seminar	Library Work	Total
40	10	10	60

Examination Scheme

Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No	Title of the book	Author Name	Publisher's Name	Publication year
1	Dynamics of Structures – "Theory and Application to Earthquake Engineering	Anil K. Chopra	2nd ed., PearsonEducation	
2	Earthquake Resistant Design of Building Structures	Vinod Hosur	WILEY (India)	
3	Vibrations, structural dynamics	M. Mukhopadhaya	Oxford IBH	
4	Structural Dynamics	Mario Paz	CBS publishers	
5	Structural Dynamics	Clough & Penzien	TMH	

Assessments: As per SUK Guidelines

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  1. **For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each**
  2. **For paper – 3 the internal evaluation will be as follows:**

  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: Introduction: Introduction to Dynamic problems in Civil Engineering, Concept of degrees of freedom, D'Alembert's principle, principle of virtual displacement and energy principles. Dynamics of Single degree-of-freedom systems: Mathematical models of Single-degree-of-freedom systems system, Free vibration response of damped and undamped systems including methods for evaluation of damping.	**8 Hrs.**

Module 2: Response of Single-degree-of-freedom systems to harmonic loading including support motion, vibration isolation, transmissibility. Numerical methods applied to Single-degree-of-freedom systems – Duhamel integral. Principle of vibration measuring instruments–seismometerand accelerometer.	**8 Hrs.**
Module 3: Dynamics of Multi-degree freedom systems: Mathematical models of multi-degree-of-freedom systems, Shear building concept, free vibration of undamped multi-degree-of-freedom systems–Natural frequencies and mode shapes–Orthogonality of modes.	**8 Hrs.**
Module 4: Response of Shear buildings for harmonic loading without damping using normal mode approach. Response of Shear buildings for forced vibration for harmonic loading with damping using normal mode approach.	**8 Hrs.**
Module 5: Approximate methods: Rayleigh's method, Dunkarley's method, Stodola's method. Dynamics of Continuous systems: Flexural vibration of beams with different end conditions. Stiffness matrix, mass matrix (lumped and consistent).	**8 Hrs.**

ADVANCED DESIGN OF STEEL STRUCTURES

Teaching Scheme

Lectures	Seminar	Library Work	Total
40	10	10	60

Examination Scheme

Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No	Title of the book	Author Name	Publisher's Name	Publication year
1	Design of Steel Structures	N. Subramanian	Oxford, IBH	
2	Design of Steel Structures	Duggal, S. K.	TataMcGraw-Hill,	
3	IS 800: 2007, IS 801-2010 , IS 811-1987			
4	BS5950 Part-8			
5	INSDAG Teaching Resource Chapter 11 to 20: www.steel-insdag.org			

Assessments: As per SUK Guidelines

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  1. **For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each**
  2. **For paper – 3 the internal evaluation will be as follows:**

  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: **Laterally Unrestrained Beams:** Lateral Buckling of Beams, Factors affecting lateral stability, IS 800 code provisions, Design Approach. Lateral buckling strength of Cantilever beams, continuous beams, beams with continuous and discrete lateral restraints, Mono- symmetric and non-uniform beams– Design Examples. Concepts of-Shear Center, Warping, Uniform and Non-Uniform torsion.	**8 Hrs.**

Module 2: **Beam- Columns in Frames:** Behaviour of Short and Long Beam-Columns, Effects of Slenderness Ratio and Axial Force on Modes of Failure, Biaxial bending, Strength of Beam Columns, Sway and Non-Sway Frames, Strength and Stability of rigid jointed frames, Effective Length of Columns, Methods in IS 800-Examples	**8 Hrs.**
Module 3: Steel Beams with Web Openings: Shape of the web openings, practical guide lines, and Force distribution and failure patterns. Analysis of beams with perforated thin and thick webs, Design of laterally restrained castellated beams for given sectional properties. Vierendeel girders (design for given analysis results)	**8 Hrs.**
Module 4: **Cold formed steel sections:** Techniques and properties, Advantages, Typical profiles, Stiffened and un stiffened elements, Local buckling effects, effective section properties, IS 801& 811 code provisions-numerical examples, beam design, column design.	**8 Hrs.**
Module 5: **Fire resistance:** Fire resistance level, Period of Structural Adequacy, Properties of steel with temperature, Limiting Steel temperature, Protected and unprotected members, Methods of fire protection, Fire resistance Ratings. Numerical Examples.	**8 Hrs.**

DESIGN OF BRIDGES

Teaching Scheme

Lectures	Seminar	Library Work	Total
40	10	10	60

Examination Scheme

Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No	Title of the book	Author Name	Publisher's Name	Publication year
1	Essentialsof Bridge Engineering	Dr DJohnson Victor	& IBH Publishing Co New Delhi	
2	Design of Bridges	Dr N Krishna Raju	Oxford & IBH Publishing Co New Delhi	
3	Principles and Practice of Bridge Engineering	S P Bindra	Dhanpat Rai & Sons New Delhi	
4	IRC 6-1966 Standard Specifications And Course Code Of Practice For Road Bridges Section II Loads and Stresses		The Indian Road Congress New Delhi	
5	IRC 21-1966 Standard Specifications And Course Code Of Practice For Road Bridges Section III Cement Concrete (Plain and reinforced)		The Indian Road Congress New Delhi	

Assessments: As per SUK Guidelines

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- **Internal Examination is to be conducted by the concerned departments or research centers in the following form:**
  1. **For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each**
  2. **For paper – 3 the internal evaluation will be as follows:**

  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents	
Module 1: **Introduction & Design of Slab Culvert** Bridge Engineering and its development in past, Ideal site selection for Bridges, Bridge classifications, Forces acting on Bridge. Analysis for maximum BM and SF at critical sections for Dead and Live load as per IRC class A, B, AA tracked and wheeled vehicles. Structural design of slab culvert using limit state method with reinforcementdetails.	**8 Hrs.**
Module 2: **Box Culvert** Introduction to box culvert, advantage of structural continuity, Analysis for maximum BM and SF at critical sections using moment distribution method for various load combinations such as Dead, Surcharge, Soil, Water and Live load as per IRC class A, B, AA tracked and wheeled vehicles. Structural design of box culvert using limit state method with reinforcement details.	**8 Hrs.**
Module 3: **T Beam Bridge** Components of T Beam Bridge, Load transfer mechanism, Proportioning the of Components, Analysis of Slab using Pigeauds Method for maximum BM and SF at critical sections for Dead and Live load as per IRC class A, B, AA tracked and wheeled vehicles and design of Slab using limit state method with reinforcement details. Analysis of Cross Girder for maximum BM and SF at critical sections for Dead and Live load as per IRC class A, B, AA tracked and wheeled vehicles and design of slab using limit state method with reinforcement details. Analysis of Main Girder using Courbon's Method for maximum BM and SF at critical sections for Dead and Live load as per IRC class A, B, AA tracked and wheeled vehicles and design of Main Girder using limit state method with reinforcement details.	**8 Hrs.**
Module 4: **PSC Bridge** Introduction to Pre & Post Tensioning, Proportioning of Components, Analysis & Structural Design of Slab, Analysis of Main Girder Using Courbon's Method for IRC Class AA, Tracked vehicle, Calculations of Prestressing Force, Calculations of Stresses, Cable profile, Design of End Block, Detailing of Main Girder.	**8 Hrs.**
Module 5: **Balanced Cantilever Bridge** Introduction & Proportioning of Components, Analysis of Main Girder Using Courbon's Method for IRC Class AA, Tracked vehicle Design of Simply Supported Portion, Cantilever Portion, Articulation, using limit state method with reinforcement details	**8 Hrs.**

EARTHQUAKE RESISTANT STRUCTURES

Teaching Scheme

Lectures	Seminar	Library Work	Total
40	10	10	60

Examination Scheme

Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No	Title of the book	Author Name	Publisher's Name	Publication year
1	Dynamics of Structures– Theory and Application to Earthquake Engineering- 2nd ed.	Anil K. Chopra	Pearson Education	
2	Earthquake Resistant Design of Building Structures	Vinod Hosur	WILEY (india)	
3	Earthquake Resistant Design of Structures	Duggal	Oxford University Press	
4	Earthquake resistant design of structures	Pankaj Agarwal, Manish Shrikande	PHI India	
5	IS – 1893 (Part I): 2002, IS – 13920: 1993, IS – 4326: 1993, IS-13828: 1993			

Assessments: As per SUK Guidelines

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  1. **For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each**
  2. **For paper – 3 the internal evaluation will be as follows:**

  a) Seminars (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: Introduction to engineering seismology, Geological and tectonic features of India, Origin and propagation of seismic waves, characteristics of earthquake and its quantification– Magnitude and Intensity scales, seismic instruments. Earthquake Hazards in India, Earthquake Risk Evaluation and Mitigation. Structural behavior under gravity and seismic	**8 Hrs.**

loads, Lateral load resisting structural systems, Requirements of efficient earthquake resistant structural system, damping devises, base isolation systems.	
Module 2: The Response history and strong motion characteristics. Response Spectrum – elastic and inelastic response spectra, tripartite (D-V-A) response spectrum, use of response spectrum in earthquake resistant design. Computation of seismic forces in multi-storied buildings – using procedures (Equivalent lateral force and dynamic analysis) as per IS- 1893.	**8 Hrs.**
Module 3: Structural Configuration for earthquake resistant design, Concept of plan irregularities and vertical irregularities, Soft storey, Torsion in buildings. Design provisions for these in IS-1893. Effect of infill masonry walls on frames, modeling concepts of infill masonry walls. Behaviour of masonry buildings during earthquakes, failure patterns, strength of masonry in shear and flexure, Slenderness concept of masonry walls, concepts for earthquake resistant masonry buildings – codal provisions.	**8 Hrs.**
Module 4: Design of Reinforced concrete buildings for earthquake resistance-Load combinations, Ductility and energy absorption in buildings. Confinement of concrete for ductility, design of columns and beams for ductility, ductile detailing provisions as per IS1893. Structural behavior, design and ductile detailing of shear walls.	**8 Hrs.**
Module 5: Seismic response control concepts – Seismic demand, seismic capacity, Overview of linear and nonlinear procedures of seismic analysis. Performance Based Seismic Engineering methodology, Seismic evaluation and retrofitting of structures.	**8 Hrs.**

SUB-SURFACE INVESTIGATIONS AND GROUND IMPROVEMENT TECHNIQUES

Teaching Scheme

Lectures	Seminar	Library Work	Total
40	10	10	60

Examination Scheme

Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No	Title of the book	Author Name	Publisher's Name	Publication year
1	Engineering Principles of Ground Modifications	Hausmann	McGraw Hill	
2	Foundation Analysis and Design	J E Bowles	Tata McGraw Hill	
3	Subsurface Exploration and Sampling of Soils for Civil Engg. Purposes	Hvorslev M J		
4	Ground Improvement Techniques	P. Purushotham Raj		
5	Foundation Engineering	S P Brahma		

Assessments: As per SUK Guidelines

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  2. **For paper – 3 the internal evaluation will be as follows:**

  a) Seminars (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: SITE INVESTIGATION: Planning and experimental programme, investigations, exploration for preliminary design, exploration for detailed design, Geo- physical explorations, soundings, probings, boring, boring methods, excavation methods for explorations, ground water investigations, rock boring, miscellaneous exploratory techniques. Numerical problems	**8 Hrs.**

Module 2: SAMPLING AND IN-SITU FIELD TESTS: Types of samples, samplers, preservation, shipment and storage of samples, bore log, pore pressure measurements, core recovery, rock strength, rock quality designation In-situ field testing and laboratory investigation of soils and rock, measurement techniques: SPT, SCPT, DCPT, pressure meter, dilatometer, plate load test. Numerical problems.	**8 Hrs.**
Module 3: DATA INTERPRETATION: Data interpretation for determination of engineering properties of soils and their application to geotechnical design, preparation of site investigation reports	**8 Hrs.**
Module 4: SITE IMPROVEMENT: General methods of stabilization – shallow and deep, factors governing suitable method, compaction. Drainage: soil and filter permeability, filter criteria, drainage layout and pumping system, Pre-compression and consolidation: principles, sand drains, pore pressure distribution, electro-osmotic and chemical osmotic consolidation. Numerical problems	**8 Hrs.**
Module 5: STABILIZATION: Mechanical stabilization, lime, cement, bitumen, chemical etc. Grouting: Injection and principles, grouting pressure criteria, grouting equipment, injection chemicals, Thermal methods: heating and cooling effects on soils, equipment, Miscellaneous: moisture barriers and preventing techniques	**8 Hrs.**

REINFORCED SOIL STRUCTURES

Teaching Scheme

Lectures	Seminar	Library Work	Total
40	10	10	60

Examination Scheme

Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No	Title of the book	Author Name	Publisher's Name	Publication year
1	Designing with Geo synthetics	Koerner R H	Prentice Hall Inc.	1994
2	Reinforcements and Soil Structures	Jones, CJEP	Butterworth Publications	1996
3	Membranes in ground engineering	Rankilor, P R	John Wiley & Sons	1985
4	Soil Reinforcement with Geo textiles	Jewel R A	CIRIA	1996
5	Geo textiles hand book	Ingold J S and Miller K S	Thomas Telford Ltd.	1988

Assessments: As per SUK Guidelines

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  a) Seminars (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: Historical background: Introduction to reinforced soil structures, comparison with reinforced cement concrete structures. Reinforced Earth: Principles, concepts and Mechanisms of reinforced earth	**8 Hrs.**
Module 2: Materials used, properties, laboratory testing and constructional details, metallic strips, metallic grids, geo textiles, geo grids, geo membranes and geo composites, their functions and design principles.	**8 Hrs.**

Module 3: DATA INTERPRETATION: Data interpretation for determination of engineering properties of soils and their application to geotechnical design, preparation of site investigation reports	**8 Hrs.**
Module 4: Design applications of reinforced soil structures in pavements, embankments, slopes, retaining walls and foundations, reinforced soil structures for soil erosion control problems, geo synthetic clay liners	**8 Hrs.**
Module 5: Design applications of reinforced soil structures : Slopes, Soil Nailing ,Case studies of reinforced soil structures, discussion on current literature and design problems	**8 Hrs.**

SOIL DYNAMICS

Teaching Scheme

Lectures	Seminar	Library Work	Total
40	10	10	60

Examination Scheme

Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No	Title of the book	Author Name	Publisher's Name	Publication year
1	Soil Dynamics and Machine Foundation (4010)	Swami Saran	Galgotia Publications Pvt. Ltd.	
2	Soil Dynamics	Prakash, S.	McGraw Hill Book Company	1981
3	Foundation for Machines Analysis and Design	Prakash S. and Puri V. K	John Wiley& Sons	1998
4	Vibration Analysis and Foundation Dynamics	Kameswara Rao, N. S. V.	Wheeler Publication Ltd.	1998
5	Vibrations of Soils and Foundations	Richart, F. E. Hall J. R and Woods R. D.	PrenticeHall Inc.	1970

Assessments: As per SUK Guidelines

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  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: Theory of vibration–single degree, two degree and multi degree of freedom system. Free and forced vibration, transient response, resonance and its effects.	**8 Hrs.**

Module 2: Wave Propagation–theory and application to dynamic problems, dynamic soil properties-general, laboratory and field methods, factors affecting. Different properties, vibration inducing and measuring instruments.	**8 Hrs.**
Module 3: Shear strength and liquefaction of soils- stress, strain, strength characteristics of soils under dynamic loads. Factors affecting, resonance column test, triaxial test under dynamic loads. Liquefaction of soils and factors influencing liquefaction, dynamic earth pressure, retaining wall problems under dynamic loads.	**8 Hrs.**
Module 4: General principles of machine foundation design- introduction, design criteria, types and requirements of machine foundations, foundations for reciprocating machines, foundations for forge hammers, foundations for turbo generators.	**8 Hrs.**
Module 5: Vibration isolation–Introduction, mechanical isolators, isolation by artificial barriers, active and passive isolation, case histories of foundation of isolation	**8 Hrs.**

SOIL STRUCTURE INTERACTION

Teaching Scheme

Lectures	Seminar	Library Work	Total
40	10	10	60

Examination Scheme

Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No	Title of the book	Author Name	Publisher's Name	Publication year
1	Foundation analysis and design	J E Bowles	McGraw Hill, NY	
2	Soil Mechanics in Engineering Practice	Karl Terzaghi and R B Peck	John Wiley and Sons, NY	1967
3	Analysis and Design of Foundations and Retaining Structures	S Prakash	Sarita Prakashana, Meerut	1979
4	Soil Mechanics and Foundation Engineering	S K Garg	Khanna Publications	
5	Geotechnical Engineering	C Venkataramaiah	New Age International Publishers	

Assessments: As per SUK Guidelines

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  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: Soil-Foundation Interaction: Introduction to soil-foundation interaction problems, Soil behavior, Foundation behavior, Interface behavior, Scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behavior, Time dependent behavior.	**8 Hrs.**

Module 2: Beam on Elastic Foundation- Soil Models: Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness. Plate on Elastic Medium: Thin and thick plates, Analysis of finite plates, Numerical analysis of finite plates, simple solutions.	**8 Hrs.**
Module 3: Plates on Elastic Continuum: Thin and thick rafts, Analysis of finite plates, Numerical analysis of finite plates.	**8 Hrs.**
Module 4: Elastic Analysis of Pile: Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap..	**8 Hrs.**
Module 5: Laterally Loaded Pile: Load deflection prediction for laterally loaded piles, Subgrade reaction and elastic analysis, Interaction analysis, Pile-raft system, Solutions through influence charts. An introduction to soil-foundation interaction under dynamic loads.	**8 Hrs.**

OPEN CHANNEL HYDRAULICS

Teaching Scheme

Lectures	Seminar	Library Work	Total
40	10	10	60

Examination Scheme

Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No	Title of the book	Author Name	Publisher's Name	Publication year
1	Open Channel Hydraulics	Chow, V.T.	McGraw Hill. N York	1979
2	Open Channel Flow	Henderson	McMillan Pub. London	1966
3	Flow in Open Channels	Subramanya, K	Tata McGraw Hill Pub.	1996
4	Mechanics of Sediment Transportation and Alluvial Stream Problems	Grade and Ranga Raju, K.G.	Wiley Eastern, N Delhi	1980
5	Open – Channel Flow	Chaudhry M.H.	Prentice Hall of India, N Delhi	1994

Assessments: As per SUK Guidelines

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  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: Basic Concepts of Free Surface Flow, classification of flow, velocity & pressure distribution. Conservation laws, continuity equation, momentum equation, Specific energy, Application of momentum & energy equation, Channel transition, Hydraulic jump. Critical flow.	**8 Hrs.**
Module 2: Uniform flow: flow resistance, equation of flow resistance, compound channel, Computation of normal flow depth..	**8 Hrs.**

Module 3: Gradually varied flow, Governing equation, classification of water surface profiles, and computation of GVF. Unsteady Rapidly Varied Flow. Application of conservation laws. Positive and Negative Surges. Moving hydraulic Jump, Spillways, Energy dissipaters. Critical slope and limit slope.	**8 Hrs.**
Module 4: Hydraulics of Mobile bed channel, Initiation of Motion of sediment, Critical analysis of Shield's diagram, Bed forms, and Predication of bed form. Sediment load: Suspended load, Bed load, total bed material load, measurement and estimation of sediment load. Design of Stable Channels: Regime and Tractive force Methods.	**8 Hrs.**
Module 5: Introduction to Bridge Hydraulics: Water ways, Afflux, Scour: Local scour, abutment scour, Indian practice of design for scour.	**8 Hrs.**

URBAN HYDROLOGY, STORM DRAINAGE AND MANAGEMENT				
Teaching Scheme				
Lectures	Seminar	Library Work	Total	
40	10	10	60	
Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No	Title of the book	Author Name	Publisher's Name	Publication year
1	Storm water Hydrology and Drainage	Stephenson D	Elsevier Publications, 2nd Edition	1981
2	Urban Hydrology	Hall J. M	Elsevier Applied Science Publishing Company, 1st Edition	1984
3	Storm water Modelling	Overtens D.E. and Medows M. E.	Academic Press, 2nd Edition	1976
4	Urban Water Infrastructure Planning, Management, and Operations	Grigg, N.S	John Wiley & Sons, 2nd Edition	1986
5	Introduction to Hydrology	Viessman W.I., Knapp J.W., Lewis G.L. and Henbrough T.E.	Harper and Row Publishing Company, 2nd Edition	1977

Assessments: As per SUK Guidelines

- **Theory Examination: is to be conducted by the university with duration of 3 hours per paper.**
- **Internal Examination is to be conducted by the concerned departments or research centers in the following form:**
  1. **For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each**
  2. **For paper – 3 the internal evaluation will be as follows:**

  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents	
Module 1: **Urban Hydrologic Process**: Process of urbanization–Water in Urban ecosystem–Urban water subsystems–Urban hydrologic cycle. Impact of urbanization on urban runoff and stream flow quantity–Impact of urbanization on quality of runoff and stream flow – Erosion due to urban runoff.	**8 Hrs.**
Module 2: **Storm water Modeling:** Analysis of hydrologic changes due to urbanization- Approaches to study – Data collection and analysis–Probabilistic and statistical approaches. Modelling of urban water quantity–Types of models– Rainfall, Runoff modeling; urban watershed modeling (quantity)–Rational Method (or coefficient method), Runoff hydrograph, unit hydrographs–10 min synthetic unit hydrograph–Linear reservoir model (Viessman) – Chen and Shubinski model–QUURM Model–TVA model. Urban watershed modellingfor water quality of runoff and stream water quality.	**8 Hrs.**
Module 3: **Urban Drainage Systems**: Sanitary and combined sewer systems–components–Design considerations for fixing sewer capacity–Infiltration into and exfiltration from sewers-causes Infiltration inflow analysis–Field investigations–Control measures. Design consideration of the components of the sewer systems–Performance of the sewer system both under dry weather flow condition and under storm water impact-Sewer sediment.	**8 Hrs.**
Module 4: **Storm Water Management**: Urban storm runoff quantity and quality management – Mitigation of damaging effects of urban storm runoff Structural and non-structural control measures – Storm water management models.	**8 Hrs.**
Module 5: **Urban Drainage Systems Maintenance**: Maintenance management of UDS and its subsystems–Drainage system– Storm drain conveyance system–Pump stations–Open channel–Illicit connections and discharges–Spill response– Other considerations (limitations and regulations).	**8 Hrs.**

GROUND WATER HYDROLOGY				
Teaching Scheme				
Lectures	Seminar	Library Work	Total	
40	10	10	60	
Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No	Title of the book	Author Name	Publisher's Name	Publication year
1	Numerical Groundwater Hydrology	A. K. Rastogi	Penram International Publishing (India) Pvt.Ltd.	2007
2	Ground Water Hydrology	Todd D.K. & Mays, L.W.	3 Ed, Wiley	
3	Ground Water	Raghunath H.M.	New Age Publishers	2007

Assessments: As per SUK Guidelines

- **Theory Examination: is to be conducted by the university with duration of 3 hours per paper.**
- **Internal Examination is to be conducted by the concerned departments or research centers in the following form:**
  1. **For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each**
  2. **For paper – 3 the internal evaluation will be as follows:**

  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: General Water Balance, Regional Ground Water Balance, Distribution of Subsurface Water, Different Types of Aquifers, Heterogeneity and Anisotropy, Occurrence of Ground Water in Hydro Geological Formations, Structure and Types of Wells. –Problems on estimation of basic parameters.	**8 Hrs.**
Module 2: Governing Equation of Groundwater Flow in Aquifers. Derivation of General Differential Equations for Ground Water Flow, Regional Ground Water Problems, Governing Equations for Transient Flow Conditions.	**8 Hrs.**
Module 3:	**8 Hrs.**

Models for Ground Water Analysis: Introduction, Major Applications of Groundwater Models, Numerical Modelling of Groundwater Systems, Groundwater Modelling by the Finite Difference (FD). –Problems. Pollution of Groundwater: Hydrodynamic Dispersion of Pollutants in Groundwater Environment (Advection dispersion, Molecular diffusion) Optimization models for management of groundwater quantity and quality.	
Module 4: Well Hydraulics: Analysis of Steady Radial Flow Towards a Well in a confined Aquifer, Dupuit Forcheimmer (DF) Theory of free Surface Flow For Steady Flow in Unconfined Aquifers, Analysis of Steady Radial Flow in Laterlly Stratified Phreatic Aquifers. Problems on well Hydraulics.	**8 Hrs.**
Module 5: Artificial Recharge: Spreading methods, Induced-recharge method, Recharge- well method, Subsurface dams, Wastewater discharge, Recharge by urban storm runoff, Case history. Geophysical Methods in Groundwater Exploration, Introduction, Electrical Resistivity Method, Analytical Derivation for Resistivity in Vertical Electrical Sounding, Seismic Retraction Method, Determination of Aquifer Thickness, Geologic and Hydrologic methods, Hydrogeologic well logging, Tracer techniques**.**	**8 Hrs.**

IRRIGATION TECHNOLOGY AND IRRIGATION WATER MANAGEMENT

Teaching Scheme

Lectures	Seminar	Library Work	Total
40	10	10	60

Examination Scheme

Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No.	Title of the book	Author Name	Publisher's Name	Publication year
1	Irrigation, Water Resources & Water Power Engineering	Modi. P. N.	Standard Publishers, New Delhi	
2	Irrigation and water power engineering	B. C. Punmia, Pande, Ashok kumar and Arunkumar Jain	Laxmi Publications (P) LTD.	
3	Water Resources Systems Planning and Management	Chaturvedi. M.C	Tata McGraw Hill. NY	
4	Water Resources Engineering	Linsley, R. K. and Frazinini, J. B.	2nd Ed. McGraw Hill, NY	
5	Economics of Water Resources Systems Planning	James L.D and Lee R.R.	McGraw Hill. NY	

Assessments: As per SUK Guidelines

- **Theory Examination: is to be conducted by the university with duration of 3 hours per paper.**
- **Internal Examination is to be conducted by the concerned departments or research centers in the following form:**
  1. **For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each**
  2. **For paper – 3 the internal evaluation will be as follows:**

  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: **Introduction:** Types & Techniques of Irrigation including advanced techniques, Present situation of irrigation in India Soil-Moisture Irrigation Relationship, Estimating depth and frequency of irrigation.	**8 Hrs.**

Module 2: Soil and Land Management in Agriculture: classification and surveys-land capability farm development, grading-equipment, land management techniques.	**8 Hrs.**
Module 3: Crop requirements and irrigation scheduling : Major Indian crops times of sowing and harvesting –critical periods of growth moisture stress, Duty & delta of crops, Irrigation scheduling, Consumptive use of Crop- Blanney-Criddle, Thornth wait penman, Christiansen methods, Water-use efficiency, scope of computerization in irrigation.	**8 Hrs.**
Module 4: Water conveyance Computing the capacity of canals, Losses in water canals, Distribution of water into the fields through water courses, Lined canals	**8 Hrs.**
Module 5: Reclaimation of Water Logged and Saline Soils: Glances of water logging- design of surface and subsurface drains, Saline and alkaline lands reclamation and management of Salt affected lands.	**8 Hrs.**

CONSTRUCTION PROJECT AND MANAGEMENT				
Teaching Scheme				
Lectures	Seminar	Library Work	Total	
40	10	10	60	
Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No.	Title of the book	Author Name	Publisher's Name	Publication year
1	Construction Project Management: Planning, Scheduling and Control	Chitkara, K.K	Tata McGraw-Hill Publishing Company, New Delhi	1998
2	Project Management	Choudhury S	McGraw-Hill Publishing Company, New Delhi	1988
3	Project Management for Construction Fundamental Concepts for Owners, Engineers, Architects and Builders	Chris Hendrickson and Tung Au	Prentice Hall, Pittsburgh	2000
4	PERT and CPM	Srinath L.S	East West Press Pvt Ltd New Delhi	
5	Modern Construction Management	Frank Harris and Roland McCaffer	4th Ed. Blackwell Science Ltd.	

Assessments: As per SUK Guidelines

- **Theory Examination: is to be conducted by the university with duration of 3 hours per paper.**
- **Internal Examination is to be conducted by the concerned departments or research centers in the following form:**
  1. **For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each**
  2. **For paper – 3 the internal evaluation will be as follows:**

  a) Seminars (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents	
Module 1: Introduction: Construction Projects- Concept, Project Categories, Characteristic of projects, project life cycle phase. Project Management- Project Management Function, Role of Project Manager.	**8 Hrs.**
Module 2: Project Feasibility Reports: Introduction, Significance in feasibility report- Technical analysis, Financial analysis, Economic analysis, Ecological analysis,Flow diagram for feasibility study of a project. Project planning Scope: Planning Process, Objectives, Types of Project plans, Resource Planning Process.	**8 Hrs.**
Module 3: Scheduling: Introduction to software's in construction scheduling (MSP, Primavera, Construction manager), Project Monitoring & Controlling Bar Charts, Work Breakdown Structure, Time estimates, Applications of CPM and PERT, A- O-N Network-Logic and Precedence diagrams, advantages, Drawing A-O-N network from A-O-A network and related problems.	**8 Hrs.**
Module 4: Time Cost relationship: Direct and indirect cost, step in optimization of cost, related problem. Allocation of resources: Histogram, Resource smoothening, Resource leveling and related problem. Project updating using CPM network and related numerical problems.	**8 Hrs.**
Module 5: Resources: Scheduling, Monitoring and Updating. Line of Balance Scheduling. Resource Planning-Leveling and Allocation. Introduction to Building Information Model (BIM).	**8 Hrs.**

ADVANCED CONSTRUCTION MATERIALS AND GREEN BUILDINGS

Teaching Scheme

Lectures	Seminar	Library Work	Total
40	10	10	60

Examination Scheme

Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No.	Title of the book	Author Name	Publisher's Name	Publication year
1	Alternative Building Materials and Technologies	K. S. Jagadish, B. V.Venkatarama Reddy and KS Nanjunda Rao	New Age International Publishers	
2	Concrete Technology	Gambhir M. L.	McGraw Hill Education	2006
3	Concrete Technology	Shetty M.S.	S. Chand and Company Ltd. Delhi	2003
4	Building Materials	M. L. Gambhir	Neha Jamwal, Tata McGraw Hill Publ	
5	Sustainable Construction: Green Building Design and delivery	C. J. Kibert	3rd Ed., John Wiley, Hoboken, New Jersey	2008

Assessments: As per SUK Guidelines

- **Theory Examination: is to be conducted by the university with duration of 3 hours per paper.**
- **Internal Examination is to be conducted by the concerned departments or research centers in the following form:**
  1. **For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each**
  2. **For paper – 3 the internal evaluation will be as follows:**

  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: Introduction: Energy in building materials, Environmental issues concerned to building materials, Embodied energy and life- cycle energy, Global warming and construction industry, Green concepts in buildings, Green building ratings IGBC and LEED manuals– mandatory requirements, Rainwater harvesting & solarpassive architecture. Environmental friendly and cost effective building technologies, Requirements for buildings of different climatic regions.	**8 Hrs.**

Module 2: Alternative Building Materials: Lime, Pozzolana cements, Raw materials, Manufacturing process, Properties and uses. Fibers- metal and synthetic, Properties and applications. Fiber reinforced plastics, Matrix materials, Fibers organic and synthetic, Properties and applications. Building materials from agro and industrial wastes, Types of agro wastes, Types of industrial and mine wastes, Properties and applications. Masonry blocks using industrial wastes. Construction and demolition wastes	**8 Hrs.**
Module 3: Special Concretes: Definition & Introduction, General properties, Advantages, Disadvantages, Applications, High density concrete, Shrinkage compensating concrete, Mass concrete, Roller compacted concrete. Light weight concrete, High strength concrete, Ultra-high strength concrete (reactive powder concrete), High workability concrete/Self compacting concrete, Fiber reinforced concrete, Polymer-concrete composites.	**8 Hrs.**
Module 4: Introduction and definition of Sustainability. Carbon cycle and role of construction material such as concrete and steel, etc. CO2 contribution from cement and other construction materials. Control of energy use in building, ECBC code, codes in neighboring tropical countries, features of LEED and TERI Griha ratings, Performance ratings of green buildings.	**8 Hrs.**
Module 5: Non-renewable sources of energy and Environmental aspects – energy norm, coal, oil , natural gas, Nuclear energy, Global temperature, Green house effects, global warming. Acid rain - Causes, effects and control methods. Regional impacts of temperature change..	**8 Hrs.**

CONSTRUCTION EQUIPMENT AND SAFETY MANAGEMENT

Teaching Scheme

Lectures	Seminar	Library Work	Total
40	10	10	60

Examination Scheme

Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No.	Title of the book	Author Name	Publisher's Name	Publication year
1	Construction Planning, Equipment and Methods	Peurify R.L. Ledbette. W.B.	McGraw Hill Co.,	
2	Civil Engineering Construction	Antil J.M.	McGraw Hill Book Co.	
3	Construction equipment and its Management	S C Sharma	Khanna Publications	
4	Hand Book on Construction Safety Practices		SP 70, BIS	2001
5	Construction Safety	Jimmy W. Hinze	Prentice Hall Inc.	1997

Assessments: As per SUK Guidelines

- **Theory Examination: is to be conducted by the university with duration of 3 hours per paper.**
- **Internal Examination is to be conducted by the concerned departments or research centers in the following form:**
  1. **For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each**
  2. **For paper – 3 the internal evaluation will be as follows:**

  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: Plants and Equipment for production of materials: Crushers, mixers, bituminous mixing plants, concrete mixing plants, advantages, choice,	**8 Hrs.**
Module 2: Construction Equipment: Operations, applications and performance of dozers, excavators, graders, compactors, pavers, haulers, crawler, wheel tractors, power shovels, Cranes, hauling equipment's.	**8 Hrs.**

Module 3: Selection of Construction Equipment: Task considerations, cost considerations, engineering considerations, equipment acquisition options, Maintenance of Equipment: Repairs, log maintenance, safety during operation, economical life of equipment.	**8 Hrs.**
Module 4: Safety in Use of Construction equipment's: Human Factors in Construction Safety management Motivation: Management, Supervisors, Workers, Motivational schemes	**8 Hrs.**
Module 5: Safety Management: Role of first line supervisors, Role of middle managers, Role of workers, top management practices, safety audit, Safety in site preparation, Design, safety culture, Top Management, Company Activities and Safety-Safety Personnel, Sub-contractual Obligation-Project Coordination and Safety Procedures	**8 Hrs.**

COMPOSITE AND SMART MATERIALS				
Teaching Scheme				
Lectures	Seminar	Library Work	Total	
40	10	10	60	
Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No.	Title of the book	Author Name	Publisher's Name	Publication year
1	Mechanic of Composite Materials	Robart M Jones	McGraw Hill Publishing Co.	2015
2	Analysis and Performance of Fiber Composites	Bhagwan D Agarawal, and Lawrence J Brutman	John Willy and Sons	2006
3	Mechanics of composite materials and structures	Madujit Mukhopadyay	University Press	2004
4	Piezoelectric actuator modeling using MSC/NASTRAN and MATLAB	Mercedes C. Reaves and Lucas G. Horta	NASA/TM-2003-212651, Langley Research Center, Hampton, Virginia	2003
5	Lecture notes on Smart Structures	Inderjit h Chopra	Department of Aerospace Engg., University ofMaryland	

Assessments: As per SUK Guidelines

- **Theory Examination: is to be conducted by the university with duration of 3 hours per paper.**
- **Internal Examination is to be conducted by the concerned departments or research centers in the following form:**
  1. **For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each**
  2. **For paper – 3 the internal evaluation will be as follows:**

  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents	
Module 1: Introduction to Composite materials: Classifications and applications. of fibers, volume fraction and load distribution among constituents, minimum & critical volume fraction, compliance & stiffness matrices, coupling.	**8 Hrs.**
Module 2: Anisotropic elasticity: Unidirectional and anisotropic lamina, thermo-mechanical properties, micro- mechanical analysis, classical composite lamination theory, Cross and angle–play laminates, symmetric, anti-symmetric and general asymmetric laminates, mechanical coupling, laminate stacking,	**8 Hrs.**
Module 3: Analysis of simple laminated structural elements: Ply-stress and strain, lamina failure theories - first fly failure, environmental effects, manufacturing of composites	**8 Hrs.**
Module 4: Smart materials: Introduction, Types of smart structures, actuators & sensors, embedded & surface mounted, piezoelectric coefficients, phase transition, piezoelectric constitutive relation..	**8 Hrs.**
Module 5: Beam modeling with strain actuator, bending extension relation.	**8 Hrs.**

CONSTRUCTION ECONOMICS AND FINANCE

Teaching Scheme

Lectures	Seminar	Library Work	Total
40	10	10	60

Examination Scheme

Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No.	Title of the book	Author Name	Publisher's Name	Publication year
1	Managerial Economics	Peterson, H.C., Lewis, W.C.	Prentice Hall of India Pvt. Ltd.	2001
2	Modern Macroeconomics	Parkin, M. & Bade R.	4th Edition, Prentice Hall	1996
3	Human Resources & Personnel Management	Werther& Davis	McGraw Hill	1996
4	Manpower planning	Edwards, John et.al.	John Wiley, New York	1983
5	Management control systems	Anthony, R.N. Govindrajan, V., Irwin	Th McGraw Hill Publications, 10 Edition	2000

Assessments: As per SUK Guidelines

- **Theory Examination: is to be conducted by the university with duration of 3 hours per paper.**
- **Internal Examination is to be conducted by the concerned departments or research centers in the following form:**
  1. **For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each**
  2. **For paper – 3 the internal evaluation will be as follows:**

  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: Economics; Definition and importance and scope Finance: Definition and scope, Sources of finance, Financial Management; Meaning and Scope, Supply and Demand Mechanism, Time value of money, discounted cash flow, NPV, ROR, Problems	**8 Hrs.**

Module 2: Pricing; objectives, determinants, absorption, marginal costing. Financial analysis, Process of Decision making: CapitalBudgeting, budgetary control, standard costing and variance, investment appraisal. Practical problems	**8 Hrs.**
Module 3: Quantifying alternatives for decision making; Bases of comparison, Incremental analysis, Benefit-Cost analysis, Capital budgeting; Profit, loss and Breakeven analysis, Practical Problems	**8 Hrs.**
Module 4: Working capital cycle, Working capital management, Financial statements; Balance sheet and its components, profit & loss account, fund flow statement. Financial ratios and their importance. Project appraisal, project yield, taxation and inflation	**8 Hrs.**
Module 5: Risk and uncertainty-SWOT analysis, Turnkey activities; cost control, performance budgeting. Equipment economics: Equipment costs, Ownership and operating costs, Buy/Rent/Lease options, Replacement analysis, depreciation and amortization.	**8 Hrs.**

ADVANCED CONCRETE TECHNOLOGY

Teaching Scheme

Lectures	Seminar	Library Work	Total
40	10	10	60

Examination Scheme

Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No.	Title of the book	Author Name	Publisher's Name	Publication year
1	High performance concrete	Aitcin P.C.	E and FN, Spon London	1998
2	CONCRETE, Microstructure, Properties and Materials	Kumar Mehta.P, Paul J.N.Monterio	Tata McGraw Hill	
3	Chemical admixtures in concrete	Rixom R and Mailvaganam N.	E and FN, Spon London	1999
4	Light Weight concrete	Rudnai.G.	Akademiaikiado, Budapest	1963
5	Short A and Kinniburgh.W	Light Weight Concrete	Asia Publishing House	1963

Assessments: As per SUK Guidelines

- **Theory Examination: is to be conducted by the university with duration of 3 hours per paper.**
- **Internal Examination is to be conducted by the concerned departments or research centers in the following form:**
  1. **For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each**
  2. **For paper – 3 the internal evaluation will be as follows:**

  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: **Fibre reinforced concrete:** History, mechanism, different types of fibres, Aspect ratio, Volume of fibres, orientation of fibres, balling effect, properties of fibre reinforced concrete, applications of fibre reinforced concrete. Types of Fibre reinforced concrete. **Ferro cement:**	**8 Hrs.**

Definition, different materials used, casting techniques, properties of Ferro cement, applications..	
Module 2: **Light Weight Concrete:** Introduction, classification, properties, strength and durability, mix proportioning and problems **High Density Concrete**: Radiation shielding ability of concrete, materials for high density concrete, mix proportioning, properties in fresh and hardened state, placement methods.	**8 Hrs.**
Module 3: **Ready mix concrete:** Concept, ready mix concrete plants, difficulties faced and their solution , use of admixtures in ready mix concrete, economics and quality control aspects of ready mix concrete. **High Performance Concrete:** Constituents, mix proportioning, properties in fresh and hardened states, applications & limitations	**8 Hrs.**
Module 4: **Polymer concrete:** Polymers, resins, polymerization, different types of polymer concrete like polymer impregnated concrete, polymer concrete (Resin concrete) and polymer modified concrete, their properties and applications. **Self-compacting concrete:** Development of SCC, basic principles and requirements , workability tests for SCC, mix design of SCC, acceptance criteria for SCC, adoption of SCC in the precast industry, present status of SCC	**8 Hrs.**
Module 5: Concrete from Industrial wastes: a. Blast furnace slag cement concrete b. Fly-ash concrete c. Silica fume concrete d. Recycled aggregate Concrete .	**8 Hrs.**

ENERGY AND BUILDINGS				
Teaching Scheme				
Lectures	Seminar	Library Work	Total	
40	10	10	60	
Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No.	Title of the book	Author Name	Publisher's Name	Publication year
1	Energy Efficient Buildings In India	Mili Majumdar	The Energy Research Institute	
2	Energy-EfficientBuildingSystems	Lal Jayamaha	McGraw Hill Publication	
3	Solar Energy and thermalprocesses	JA Duffie & WA Beckman	John Wiley	
4	Energy Conservation Building		Code, 2007	
5	Handbook of functional requirement of buildings		SP: 41:1987	

Assessments: As per SUK Guidelines

- **Theory Examination: is to be conducted by the university with duration of 3 hours per paper.**
- **Internal Examination is to be conducted by the concerned departments or research centers in the following form:**
  1. **For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each**
  2. **For paper – 3 the internal evaluation will be as follows:**

  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: Conservation & energy efficiency concepts-overview of significance of energy use-Renewable and Non- Renewable, energy and their significance, Global energy and environmental resources, Impact of temperature change, Energy crises Energy processes in buildings.	**8 Hrs.**
Module 2:	**8 Hrs.**

Solar energy fundamentals & practices in building design- solar astronomical relations and radiation physics and measurements, design decision for optimal orientation of building, shadow analysis.	
Module 3: Heating and ventilation design- Human thermal comfort, climatological factors, material specifications and heat transfer principles, thermal performance evaluation, Heat loss from buildings, design of artificial ventilation system, design of insulators	**8 Hrs.**
Module 4: Design audits & economic optimization-Concept of cost/benefit of energy conservation & carbon footprint estimation. Energy efficient lighting system design: Basic terminologies and standards, day lighting and artificial lighting design, auditing.	**8 Hrs.**
Module 5: Computerenergysimulationprograms-Needforenergysimulationprogramsand its working, Energy simulation tools, Implementation of computer simulation programs .	**8 Hrs.**

TRAFFIC ENGINEERING AND MANAGEMENT			
Teaching Scheme			
Lectures	Seminar	Library Work	Total
40	10	10	60

Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No.	Title of the book	Author Name	Publisher's Name	Publication year
1	Traffic Engineering and Transportation Planning	Kadiyali L.R.	Khanna Publication,New Delhi	
2	Traffic and Highway Engineering	Nicholas J. Garber, Lester A. Hoel	Third Edition Thompson Learning	
3	Highway, Traffic Analysis and Design	Salter R J and Hounsell NB	Macmillan Press Ltd., London	
4	Traffic Engineering	Matson T M, Smith W S , Hurd F W	McGraw Hill Book Co, NY, USA	
5	Traffic Flow Theory and Control	Drew D R	McGraw Hill Book Co, NY, USA	

Assessments: As per SUK Guidelines

- **Theory Examination: is to be conducted by the university with duration of 3 hours per paper.**
- **Internal Examination is to be conducted by the concerned departments or research centers in the following form:**
  1. **For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each**
  2. **For paper – 3 the internal evaluation will be as follows:**

  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: Traffic Studies & Analysis: Scope, traffic elements-Characteristics-vehicle, road user :and road - Traffic studies-speed & delay, traffic volume, O & D, parking and accidents-Sample size, study methodology - Data analysis & inferences.	**8 Hrs.**

Module 2: Traffic Flow Analysis: Macroscopic, Microscopic & Mesoscopic approach–Types of Flow-Traffic stream characteristics– Space–Time diagram–Relationship between speed, flow & density-Level of service & capacity analysis–Shockwave theory	**8 Hrs.**
Module 3: Intersection Design: Types of intersections - Conflict diagrams –Control hierarchy- Design of rotaries & at-grade intersections – Signal design - Grade separated intersections & their warrants.	**8 Hrs.**
Module 4: Geometric Design : Cross sections–Sight distances–Super elevation–Horizontal & vertical alignments–Safety considerations Road Safety Audit : Global & Local perspective–Road safety issues–Road safety programmes–Types of RSA, planning, design, construction & operation stage audits – Methodology – Road safety audit measures	**8 Hrs.**
Module 5: Traffic Regulation & Traffic Safety Management : Speed, vehicle, parking, enforcement regulations-Mixed traffic regulation - Management techniques, one-way, tidal flow, turning restrictions etc.–Transportation System Management Process–TSM planning & Strategies Use of software: PTV VISSIM / VISUM (Traffic Flow Simulations), SIDRA (intersections), etc..	**8 Hrs.**

INFRASTRUCTURE FOR SMART CITY PLANNING				
Teaching Scheme				
Lectures	Seminar	Library Work	Total	
40	10	10	60	
Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No.	Title of the book	Author Name	Publisher's Name	Publication year
1	Regional Development and Planning for the 21st Century: New Priorities and New Philosophies	Allen G.Noble, (Eds)	Aldershot, USA	1988
2	Handbook of Local and Regional Development	Andy Pike, Andres Rodriguez- Pose, John Tomaney	Taylor & Francis	2010
3	Fifty years of Dutch National Physical Planning	Andreas Faludi and Sheryl Goldberg	Alexandrine Press, Oxford	1991
4	Form Based Codes: A Guide for Planners, Urban Designers, Municipalities, and Developers	Daniel G. Parolek, AIA, Karen Parolek, Paul C. Crawford, FAICP	John Wiley & Sons	2008

Assessments: As per SUK Guidelines

- **Theory Examination: is to be conducted by the university with duration of 3 hours per paper.**
- **Internal Examination is to be conducted by the concerned departments or research centers in the following form:**
  1. **For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each**
  2. **For paper – 3 the internal evaluation will be as follows:**

  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents	
Module 1: INTRODUCTION Understanding – Dimensions – Global experience, Global standards and performance bench marks, Practice codes. India 100 smart cities policy and mission, Smart city planning and development, Financing smart cities development, Governance of smart cities.	**8 Hrs.**
Module 2: GREEN BUILDING CONCEPTS AND SUSTAINABLE DEVELOPMENT Green projects in smart cities, sustainability–green building–Rating system–Energy efficient building–energy saving systems ,	**8 Hrs.**
Module 3: WATER SUPPLY AND DRAINAGE Water–sources of water, treatment and storage, transportation and distribution, quality, networks, distribution losses, water harvesting, recycling and reuse, norms and standards of provision, institutional arrangements, planning provisions and management issues. Sanitation–points of generation, collection, treatment, disposal, norms and standards, grey water disposal, DEWATS, institutional arrangements, planning provisions and management issues. Municipal and other wastes–generation, typology, quantity, collection, storage, transportation, treatment, disposal, recycling and reuse, wealth from waste, norms and standards, institutional arrangements, planning provisions and management issues. Power–Sources of power procurement, distribution networks, demand assessment, norms and standards, planning provisions and management	**8 Hrs.**
Module 4: SMART URBAN TRANSPORT SYSTEMS Elements of Infrastructure (Physical, Social, Utilities and services), Basic definitions, concepts, significance and importance; Data required for provision and planning of urban networks and services; Resource analysis, Provision of infrastructure. Role of transport, types of transport systems, evolution of transport modes, transport problems and mobility issues. Urban form and Transport patterns, land use–transport cycle, concept of accessibility. Hierarchy, capacity and geometric design elements of roads and intersections. Basic principles of Transport infrastructure design. Urban transport planning process–Transport, environment and safety issues. Principles and approaches of Traffic Management, Transport System Management	**8 Hrs.**
Module 5: E- GOVERNANCE AND IOT The concept of management, concept of e-management & e-business, e-Government Principles, Form e-Government to e- governance, e-governance and developing countries, Designing and Implementing e-Government Strategy, E governance: Issues in implementation. IOT fundamentals, protocols, design and development, data analytics and supporting services, case studies.	**8 Hrs.**

PAVEMENT DESIGN AND ANALYSIS			
Teaching Scheme			
Lectures	Seminar	Library Work	Total
40	10	10	60

Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No.	Title of the book	Author Name	Publisher's Name	Publication year
1	Principles of Pavement Design	Yoder and Witczak	John wily and sons	1975
2	Design of functional pavements	Yang	McGraw Hill Book Co.	
3	Pavement Analysis	Huang	Elsevier Publications	
4	Design & Performance of Road Pavements	David Croney, Paul Croney	McGraw Hill Book Co.	
5	Modern Pavement Management	W. Ronald Hudson, Ralph Haasand Zeniswki	McGraw Hill and Co. IRC37-2001, IRC81-1997, IRC58–2002, IRC59–1976, IRC101-1988, Indian Roads Congress	

Assessments: As per SUK Guidelines

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  2. **For paper – 3 the internal evaluation will be as follows:**

  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents	
Module 1: Road Pavements and pavement layers- types, functions, choice Factors affecting design and performance of flexible and rigid pavements–Pavement design factors, loads–axle load distribution, ESWL, EWL, VDF due to varying load sand CSA.	**8 Hrs.**
Module 2: Sub grade support-CBR and plate bearing tests, Resilient Modulus, fatigue tests, permanent deformation Pavement material Characteristics, climatic, drainage and environmental factors, their effects and evaluation. Factors affecting design and performance of airport pavements.	**8 Hrs.**
Module 3: Stresses and Deflection/strain in flexible pavements: Application of elastic theory, stresses, deflections/train sin single, two and three layer system, Application sin pavement design problems	**8 Hrs.**
Module 4: Flexible pavement design: Emperical, semi- empirical and theoretical design approaches, principle, advantages and application. Design steps by CBR method as per IRC, outline of other common design methods such as AASHTO and Asphalt Institute methods, Problems.	**8 Hrs.**
Module 5: Rigid pavement design: Determination of ESWL, EWL for dual and dual tandem wheel load sin Rigid pavements, General design principle, Stresses in rigid pavements, stresses due to wheel load sand temperature variations, design of cement concrete Pavements (joint sand slab thickness) as per I R C guidelines. Design features of CRCP, SFRC and ICBP, Problems.	**8 Hrs.**

URBAN TRANSPORT PLANNING				
Teaching Scheme				
Lectures	Seminar	Library Work	Total	
40	10	10	60	
Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

Sl. No.	Title of the book	Author Name	Publisher's Name	Publication year
1	Transportation Engineering: An Introduction	C. JotinKhisty and B. Kent Lall	3rd Edition, Pearson	2016
2	Transportation Engineering and Planning	C.S. Papacostas and P.D. Prevedouros	Third Edition, Prentice Hall of India Pvt. Ltd.	2015
3	Principles of Urban Transport Systems Planning	Hutchinson, B.G.	McGraw Hill	1974
4	Modelling Transport	Juan de Dios Ortuzar and Luis G. Willumsen	4th Edition, JohnWiley and Sons	2011
5	Transportation Planning Handbook	Michael D. Meyer	Fourth Edition, Institute of Transportation Engineers, John Wiley & Sons Inc.	2016

Assessments: As per SUK Guidelines

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  2. **For paper – 3 the internal evaluation will be as follows:**

  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents	
Module 1: Urban Transportation Problems & Policy: Urban transportation Issues, Travel Characteristics, Evolution of Planning Process, Supply and Demand – Systems approach; NUTP, Recommendations of 12th FYP and NTDP Travel Demand Modelling: Trends, Overall Planning process, Long term - Short term planning, Demand Function, Independent Variables, Travel Attributes, Assumptions in Demand Estimation, Sequential, and Simultaneous Approaches, Aggregate and Disaggregate Techniques, Tour based models, and Activity based models.	**8 Hrs.**
Module 2: Data Collection and Inventories: Collection of data – Organization of surveys and Analysis, Study Area, Zoning, Types and Sources of Data, Road Side Interviews, Home Interview Surveys, Commercial Vehicle Surveys, Sampling Techniques, Expansion Factors, Accuracy Checks, Use of Secondary Sources, Economic data–Income– Population– Employment– Vehicle Ownership Trip Generation Models: UTPS Approach, Trip Generation Analysis: Zonal Models, Category Analysis. Household Models, Trip Attraction models, Commercial Trip Rates.	**8 Hrs.**
Module 3: Trip Distribution Models: Trip Distribution: Growth Factor Methods, Gravity Models, Opportunity Models, Time Function Iteration Models. Mode Split Analysis: Mode Choice Behavior, Competing Modes, Mode Split Curves, Models and Probabilistic Approaches–Logit Model	**8 Hrs.**
Module 4: Traffic Assignment Techniques: Diversion Curves, Basic Elements of Transport Networks, Coding, Route Properties, Path Building Criteria, Skimming Tree, All- or-Nothing Assignment, Capacity Restraint Techniques, Reallocation of Assigned Volumes, Equilibrium Assignment, Multipath Assignment Technique.	**8 Hrs.**
Module 5: Corridor Identification-Plan preparation and evaluation: Master plans, Selection of Corridor, Corridor Identification, Corridor deficiency Analysis; TOD; Travel Forecasts to Evaluate Alternative Improvements, Impacts of New Development on Transportation Facilities; Pivot Point Analysis, Environmental and Energy Analysis.	**8 Hrs.**

Solid Waste Management				
Teaching Scheme				
Lectures	Seminar	Library Work	Total	
40	10	10	60	
Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

1. Bhide. A. D. and Sundaresan. B. B., "Solid Waste Management", Indian National Scientific Documentation Centre, 1st Edition, 1983.
2. CPHEEO, "Manual on Municipal Solid waste management", Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000
3. Tchobanoglous G., "Integrated Solid Waste Management", Tata McGraw-Hill Publishing Company Limited, 1st Edition, 1993.
4. Vesilind, Worrell and Reinhart, "Solid Waste Engineering", Cengage Learning India Pvt. Ltd.,
5. Masters G., "Introduction to Environmental Engineering and Science", Pearson Education, 2004
6. Peavy, Rowe and Tchobanoglous, "Environmental Engineering", Tata McGraw-Hill Publishing Company Limited, 1st Edition, 1985.
7. "MSW Rules 2016", Swachh Bharat Mission and Smart Cities Program of India

Assessments: As per SUK Guidelines

- **Theory Examination: is to be conducted by the university with duration of 3 hours per paper.**
- **Internal Examination is to be conducted by the concerned departments or research centers in the following form:**
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  2. **For paper – 3 the internal evaluation will be as follows:**

  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: Sources, Types, Composition, Physical, Chemical and Biological properties. Solid Waste Management: Objectives, Functional elements, Environmental impact of mismanagement,: Present Indian Scenario and scope to improve system for different functional elements of solid waste management system.	**8 Hrs.**
Module 2: Solid Waste Generation Rate: Definition, Typical values for Indian cities, Factors affecting. Storage and collection: General considerations for waste storage at source, Collection components, Types of collection systems and its design, Transportation of solid waste: Means and methods, Routing of vehicles. Transfer station: Need, Types, factors affecting Capacity, Location and economic Viability.	**8 Hrs.**

Module 3: Waste Processing Techniques: Purpose, Mechanical volume and size reduction, component separation techniques. Material Recovery and Recycling: Objectives, Recycling program elements, Commonly recycled materials and processes. Energy recovery from solid waste: Parameters affecting, Fundamentals of thermal processing, Pyrolysis, Incineration, Refuse derived fuels, Energy recovery, case studies under Indian conditions. .	**8 Hrs.**
Module 4: Benefits, Processes, Stages, Technologies, Factors affecting, Properties of compost. Vermicomposting, Biomethanation	**8 Hrs.**
Module 5: Site selection, Types, Principle, Processes, Land filling methods, Leachate and landfill gas management, Design of a landfill facility, closure, post-closure plans, and rehabilitation of dumpsites.	**8 Hrs.**
Module 6: Waste Management legislation in India, integrated management-Public awareness; Role of NGO's; Introduction to various initiatives of the Govt. of India such as Swachh Bharat Mission, Smart Cities as well as Make in India; Biomedical; C and D waste Generation, identification, storage, collection, transport, treatment, and disposal, occupational hazards and safety measures	**8 Hrs.**

Air Pollution and Control				
Teaching Scheme				
Lectures	Seminar	Library Work	Total	
40	10	10	60	
Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

1. Wark and Warner, “Air Pollution”, C.F., H.R. Publication, 1st Edition, 1978.
2. Nevers N., "Air Pollution control Engineering" McGraw-Hill, New York, 2nd edition, 1995.
3. Martin Crawford, “Air Pollution and Control”, Tata McGraw Hill Publication, 1st Edition, 1976
4. Richard W. Boubel and Bruce Turner, "Fundamentals of Air Pollution", Academic Press, New York, Third edition, 1994.
5. Stern A. C., “Air Pollution Vol. I and II”, Allied Publishers Limited, 1st Edition, 1994.
6. Rao H.V.N. and Rao M. N., "Air Pollution", Tata McGraw Hill, 1st Edition, 1989.

Assessments: As per SUK Guidelines

- **Theory Examination: is to be conducted by the university with duration of 3 hours per paper.**
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  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: Air pollution: sources and types and effects on biosphere, National and international air emission standards; air pollution emission inventory; emission factor; air quality index; Strategy for effective control of air pollution in India, Introduction to air pollution control act, and international agreements for mitigating global air pollution effects.	**8 Hrs.**
Module 2: Physics of atmosphere, Solar radiation, Wind circulation, Lapse rate, Inversion, Stability conditions, Pasquil stability model, maximum mixing depth, Wind rose, Plume behavior, Global effects of air pollution: Green house effects, acid rain and ozone layer depletion, Heat island effect, Visibility, Photochemical reaction	**8 Hrs.**
Module 3: Eddy diffusion model, the Gaussian dispersion model, point source, Line source, maximum ground level concentration, Determination of stack height, sampling time	**8 Hrs.**

corrections, Effects of inversion trap Definition, distribution and source of different particulate matter, Terminal settling velocity, basics of hood and duct design for particulate collection.	
Module 4: Operation design and component detailing of Settling chamber, Cyclone, Wet collectors, Fabric filter, and Electrostatic precipitator	**8 Hrs.**
Module 5: Principles of absorption, Adsorption, Basic design of absorption and adsorption units, Incineration and after burner, Control of SO2, NOx	**8 Hrs.**
Module 6: Automobile Source Emission of pollutants from automobiles, Photochemical smog, Reduction of emissions by different methods, Alternative fuels and their utilizations	**8 Hrs.**

Environmental Management System				
Teaching Scheme				
Lectures	Seminar	Library Work	Total	
40	10	10	60	
Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

1. Canter, L. W., Environmental Impact Assessment, McGraw-Hill, 2nd Edition, 1997.
2. Agarwal, N. P., Environmental Reporting and Auditing, Raj Pub., 1st Edition, 2002.
3. Judith, P. and Eduljee, G., Environmental Impact Assessment for Waste Treatment and Disposal Facilities, John Wiley & Sons, 1st Edition, 1994.
4. "Environmental Auditing", Published by CPCB, Govt. of India Publication, New Delhi.
5. Mhaskar, A.K., Environmental Audit", Media Enviro Publications, 2002.
6. K. Whitelaw and Butterworth, ISO 14001: Environmental System Handbook, 1997.

Assessments: As per SUK Guidelines

- **Theory Examination: is to be conducted by the university with duration of 3 hours per paper.**
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  2. **For paper – 3 the internal evaluation will be as follows:**

  a) Seminars (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: Ecological aspects: Salient features of major Eco Systems, Energy Transfer, Population Dynamics, Ecological imbalance, Preservation of Biodiversity. Land Pollution, Water Pollution due to sewage, industrial effluents and leachate, Pollution due to Nuclear Power Plants, Radioactive Waste, Thermal pollution, causes and control. Noise Pollution: Decibel Levels, Monitoring, Hazards, Control measures.	**8 Hrs.**
Module 2: **Environmental Ethics**: Ethics in society, Environmental consequences, Responsibility for environmental degradation, Ethical theories and codes of Ethics, Changing attitudes, Sustainable development. **Environmental Legislation:** Water (prevention and control of pollution) act 1974, The environmental act 1986, The Noise Pollution (Regulation and Control) Rules, 2000. Environmental economics.	**8 Hrs.**

Module 3: Definitions and Concept, Scope, Objectives, Types of impacts, Elements of EIA, Baseline studies. Methodologies of EIA, Prediction of impacts and its methodology, Uncertainties in EIA, Status of EIAs in India.	**8 Hrs.**
Module 4: Definitions and concepts, Scope and Objectives, Types of audit, Accounts audit, Environmental audit statement, Qualities of environment auditor. Environmental Impact Statement (EIS)	**8 Hrs.**
Module 5: ISO and ISO 14000 Series: Introduction, Areas covered in the series of standards, Necessity of ISO certification. Environmental management system: Evolution, Need, Elements, Benefits, ISO 14001 requirements, Steps in ISO 14001 certification, ISO 14001 and sustainable development, Integration with other systems (ISO 9000, TQM, Six Sigma), Benefits of integration.	**8 Hrs.**
Module 6: Definition, Importance, Development, Structuring, Monitoring, Cost aspects. Strategy for siting of Industries, Environmental Labeling, Life-Cycle Assessment.	**8 Hrs.**

Physico-Chemical Methods for Water and Wastewater Treatment				
Teaching Scheme				
Lectures	Seminar	Library Work	Total	
40	10	10	60	
Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

1. Peavy H, S, Rowe D, R, and Tchobanoglous G, "Environmental Engineering", McGraw-Hill Book Company, Indian edition 2017.
2. 2. Metcalf and Eddy "Wastewater Engineering Treatment and Reuse", Tata McGraw Hill Publication, Indian Edition 2017.
3. 3. Davis, M, L, and Cornwell, D, A, "Introduction to Environmental Engineering", Tata McGraw Hill Publishing Company, Special Indian Edition, 2010.
4. Unit Operations and Processes in Environmental Engineering, 2nd Edition, by Tom D. Reynolds and Paul A. Richards, PWS Publishing Company, 1995.

Assessments: As per SUK Guidelines

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  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: Review of conventional unit operations and processes in water and wastewater treatment Transport processes, Kinetics and Reaction rates, System material balance, Hydraulic/transport flow regimes, Reactor Engineering (CMBR, CMFR, CMFRS, PFR, PFRD), Processes and rates of gas transfer	**8 Hrs.**
Module 2: Types of aerator, Design of gravity aerators ,Coagulation and flocculation, Stability and destabilization of colloids, Transport of colloidal particles, Design of rapid and slow mix units, Types of settling, Design of sedimentation tanks, Tube settler, Grit chamber (horizontal flow and aerated)	**8 Hrs.**
Module 3: Gravity and pressure filtration, filter hydraulics, Analysis of filtration process, Backwash hydraulics, Rate control patterns and methods, Design of dual media and pressure filter	**8 Hrs.**

Module 4: Causes and Types of adsorption, Adsorption equilibria and adsorption isotherm, Process, Analysis and design of batch and continuous flow activated carbon adsorber Ion Exchange process, Exchange materials and capacity, Exchange reactions, Design and operation of softener for hardness and TDS removal	**8 Hrs.**
Module 5: Membrane separation processes, Design and operation of Reverse osmosis,Ultrafiltration, and Electrodialysis.Membrane fouling: Causes, and Control.	**8 Hrs.**
Module 6: Kinetics of disinfection,Ozone disinfection: Chemistry, System components, Modeling. UV disinfection: Source, System components, Estimation of UV dose. Principles and theories of Chemical oxidation.	**8 Hrs.**

Biological Methods for Wastewater Treatment				
Teaching Scheme				
Lectures	Seminar	Library Work	Total	
40	10	10	60	
Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100

Textbooks and References:

1. Peavy H, S, Rowe D, R, and Tchobanoglous G, "Environmental Engineering", McGraw-Hill Book Company, Indian edition 2017.
2. 2. Metcalf and Eddy "Wastewater Engineering Treatment and Reuse", Tata McGraw Hill Publication,Indian Edition 2017.
3. 3. Karia, G, L, and Christian R, A, "Wastewater treatment", PHI learning private limited, 2008.
4. Unit Operations and Processes in Environmental Engineering, 2nd Edition, by Tom D. Reynolds and Paul A. Richards, PWS Publishing Company, 1995.

Assessments: As per SUK Guidelines

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  a) **Seminars** (Submission and Presentation)- 10 marks

  b) **Review s Literature :** Submission and Presentation- 10 marks

(Papers will have separate passing head for theory examination and internal evaluation 32+8=40)

Course Contents

Module 1: Fundamentals: Measurement of organic pollutant, Biochemical transformation, Bioreactor configuration, Aerobic, Anoxic and Anaerobic Biochemical operations,Kinetics of Bio-chemical operations: Biomass growth, Substrate utilization, Yield Kinetics of (Aerobic/Anoxic, Anaerobic) biomass growth	**8 Hrs.**
Module 2: Review of conventional activated sludge process (ASP), aerated lagoon and waste stabilization ponds,Modelling aerobic suspended growth in complete-mix and plug flow reactor with and without recycle,Design and operation of sequential batch/cyclic ASP and membrane bioreactor,Biological filtration, Eckenfelder model for performance of packed tower with and without recirculation,Design and operation of rotating biological contactor.	**8 Hrs.**
Module 3: Biological nitrogen and phosphorous removal, Kinetics of nitrification and denitrification	**8 Hrs.**

Process design of ASP, SBR and RBC for carbon oxidation – nitrification and denitrification	
Module 4: Design and operation of Upflow Anaerobic Sludge Blanket system,Sludge processing: Sludge mass-volume relationship, Process fundamentals of Thickening,,Stabilization, Conditioning, and Dewatering,Design and operation of gravity thickener, dissolved air flotation tank, anaerobic digester, belt press and sludge drying bed	**8 Hrs.**
Module 5: Design and operation of decentralized wastewater treatment systems Moving Bed Bio-reactor,Anaerobic filter, Modified septic tank,Constructed Wetland (CW): Classification and application, Design and operation of horizontal flow subsurface, Vertical flow systems Emerging concepts in CW, Sludge treatment constructed wetland,Design and operation of Water hyacinth system.	**8 Hrs.**
Module 6: Land treatment systems: Processes, Removal mechanisms, Design and operation of slow rate,rapid infiltration and overland flow systems.	**8 Hrs.**