DETAILED SYLLABUS

FOR

5th Semester B. TECH PROGRAMME

IN

CIVIL ENGINEEERING

FOR 2018-9019

ADMISSION BATCH ONWARDS

BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ODISHA

Chhend Colony, Rourkela

ODISHA-769004

B. Tech in Civil Engineering (Admission Batch: 2018-2019)

5th Semester

Fifth Semester					
Theory					
Sl. No.	Category	Course Code	Course Title	L-T-P	Credit
1	PC 11		Design of Concrete Structures	3-0-0	3
2	PC 12		Water and Waste Water Engineering	3-0-0	3
3	PC 13		Geotechnical Engineering	3-0-0	3
4	PE 2		Structural Analysis-II.	3-0-0	3
			Advance Mechanics of Material	3-0-0	
			Masonry Structure	3-0-0	
5	PE 3		Railway and Airport Engineering	3-0-0	3
			Pavement Design	3-0-0	
			Traffic Engineering	3-0-0	
6	MC 5		Universal Human Values		0
Total Credit (Theory)					**15**
Practical					
1	PC 14		Design of Concrete Structures Lab	0-0-3	2
2	PC 15		Water and Waste Water Engineering Lab	0-0-3	2
3	PC 16		Geotechnical Engineering Lab	0-0-3	2
4	PSI 2		Evaluation of Summer Internship	0-0-3	1
Total Credit (Practical)					**7**
Total Semester Credit					**22**

Design of Concrete Structures (3-0-0)

Module I **(10 Classes)**

Properties of concrete and reinforcing steel, philosophy, concept and methods of reinforced concrete design, introduction to limit state method, limit state of collapse and limit state of serviceability, application of limit state method to rectangular beams for flexure, shear, bond and torsion

Module II **(8 Classes)**

Design of doubly reinforced beams, design of T and L beams, design of one way and two way slabs, design of staircases.

Module III **(8 Classes)**

Design of short and long columns with axial and eccentric loadings, Design of isolated and combined column footings

Module IV **(8 Classes)**

Retaining walls, various forces acting on retaining wall, stability requirement, design of cantilever and counterfort retaining walls,

Module V **(6 Classes)**

Design of water tanks, design requirements, design of tanks on ground, under ground and elevated water tanks.

Books:

1. Design of Reinforced Concrete Structue by N. Subramanian, Oxford University Press
2. Limit State Design by A.K.Jain, Neemchand& Bros
3. Reinforced Concrete Design by S U Pillai & D. Menon, McGraw Hill
4. Design of concrete structures by J.N.Bandyopadhyay, PHI
5. Limit State Design of Reinforced Concrete -P.C Verghese
6. Reinforced Concrete Design by S.N.Sinha, McGraw Hill
7. RCC Design-B.C.Punmia, A.K.Jain and A.K.Jain-Laxmi Publications

Digital Learning Resources:

Course Name	Design of Reinforced Concrete Structures 12 weeks
Course Link	(https://nptel.ac.in/courses/105/105/105105105/)
Course Instructor	PROF. NIRJHAR DHANG, ,IIT Kharagpur

Water and Waste Water Engineering (3-0-0)

Module – I **(08 Classes)**

General requirement for water supply, sources, quality of water, intake, pumping and transportation of water.

Module – II **(06 Classes)**

Physical, chemical and biological characteristics of water and their significance, water quality criteria, water borne diseases, natural purification of water sources.

Module – III **(08 Classes)**

Engineered systems for water treatment : aeration, sedimentation, softening coagulation, filtration, adsorption, ion exchange, and disinfection. Design of water distribution system.

Module – IV **(08 Classes)**

Generation and collection of waste water, sanitary, storm and combined sewerage systems, quantities of sanitary waste and storm water, design of sewerage system Primary, secondary and tertiary treatment of wastewater. Waste water disposal standards,

Module –V **(10 Classes)**

Basic of microbiology. Biological wastewater treatment system : Aerobic processes activated sludge process and its modifications, trickling filter, RBC, Anaerobic Processes conventional anaerobic digester, High rate and hybrid anaerobic reactors, Sludge digestion and handling, Disposal of effluent and sludge, Design problems on water distribution, sewerage, water treatment units, wastewater treatment units and sludge digestion.

Books:

1. Water Supply Engineering-Environmental Engineering v.1 by S.K.Garg, Khanna Publishers
2. Sewage Disposal and Air Pollution Engineering - Environmental Engineering v.2 by S.K.Garg, Khanna Publishers
3. Water Supply and Sanitary Engineering by B.S.BirdiDhanpat Rai Publishing Company
4. Water Supply Engineering by B. C. Punmia and A.K.Jain, Laxmi Publications
5. Water and Wastewater Technology by M.J.Hammer, PHI

Digital Learning Resources:

Course Name	WATER SUPPLY ENGINEERING, Waste water Treatment and Recycling
Course Link	https://nptel.ac.in/courses/105/105/105105201 (https://nptel.ac.in/courses/105/105/105105178//)
Course Instructor	PROF. MANOJ KUMAR TIWARI Department of Civil Engineering IIT Kharagpur

Geotechnical Engineering- I (3-0-0)

Module-I **(8 classes)**

Origin of Soil: Rock Cycle and the origin of soil, clay mineralogy, mechanical analysis of soil, grain size distribution curve, particle shape and size, weight volume relationships, specific gravity, unit weight, void ratio, moisture content, and relationships, relative density. Consistency of soil: Atterberg limits - Liquidity index and consistency index, activity, soil structure. Engineering classification of soil: Types of Soil classification, IS, USCS, HRB and ASTM.

Module-II **(8 classes)**

Soil Hydraulics: Modes of occurrence of water in soil. Stress conditions in soil- total, effective and neutral stresses and relationships.

Permeability - Bernaulli's equation, Darcy's Law, hydraulic conductivity, laboratory determination of hydraulic conductivity, Factors affecting hydraulic conductivity, equivalent hydraulic conductivity in stratified soil.

Seepage- Laplace equation of continuity, flow nets, seepage calculation from a flow net, flow nets in anisotropic soils, seepage through earth dam, critical hydraulic gradient and quick sand condition.

Module-III **(6 classes)**

Soil Compaction: mechanism and principles, Laboratory compaction, factors affecting compaction, effect of compaction on soil properties, field compaction techniques.

Module-IV **(12 classes)**

Stress Distribution: Normal and shear stresses on a plane, Boussinesq's solution for a point load, line load, strip load, uniformly loaded circular and rectangular areas, Isobar and pressure bulb concept, stress distribution on horizontal and vertical planes, Newmark's chart and its application, contact pressure.

Shear Strength: Mohr-Coulomb failure criterion, shear strength parameters and determination: direct and tri-axial shear test, unconfined compression test, vane shear test. Other methods of determining the un-drained shear strength of soil, sensitivity and thixotropy of clay.

Module-V **(6 classes)**

Consolidation of soils: Consolidation and compaction, primary and secondary consolidation, Terzhaghi's theory of one dimensional consolidation, consolidation test, coefficient of consolidation.

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Books:

1. Principles of Geotechnical Engineering by Braja M. Das, Cengage Learning
2. Soil Mechanics and Foundation Engineering, by K.R. Arora, Stanard Publishers
3. Soil Mechanics and Foundation Engineering by B.N.D. NarasingaRao, Wiley India Pvt.Ltd.
4. Basic and applied soil mechanics, by Gopal Ranjan, A S R Rao New Age International Publishers

Digital Learning Resources:

Course Name	GEOTECHNICAL ENGINEERING- 1
Course Link	(https://nptel.ac.in/courses/105/101/105101201
Course Instructor	Prof. Devendra Narain Singh, IIT Bombay 12 week

Structural Analysis-II (3-0-0)

Module – I **(10 Classes)**

Analysis of continuous beams and plane frames by slope deflection method and moment distribution method.

Module – II **(6 Classes)**

Aanalysis of continuous beam and simple portals by Kani's method

Module – III **(8 Classes)**

Analysis of two hinged and fixed arches for dead and live loads, Suspension cables with two hinged stiffening girders

Module – IV **(8 Classes)**

Matrix methods of analysis: flexibility and stiffness methods; Application to simple trusses and beams

Module – V **(8 Classes)**

Plastic Analysis: Plastic modulus, shear factor, plastic moment of resistance, Load factor, Plastic analysis of continuous beam and simple rectangular portals, Application of upper bound and lower bound theorems

Books:

1. Structural analysis by C.S. Reddy Mc Graw Hill
2. Structural Analysis by T.S. Thandamoorthy, Oxford University Press
3. Structural analysis a matrix approach by Pandit & Gupta, Mc Graw Hill.
4. Limit Analysis of Structures: Monikaselvam, Dhanpat Ray Publication
5. Indeterminate Structures: J.S.Kinney
6. Indeterminate Structural Analysis: C.K.Wang ,Mc Graw Hill
7. Structural Analysis by D.S.Prakash Rao, Universities Press
8. Matrix Analysis of Structures by P.K.Singh, Cengage Learning

Digital Learning Resources:

Course Name	Structural Analysis-II
Course Link	https://nptel.ac.in/courses/105/105/105105109/#
Course Instructor	Dr. P. Banerji Department of Civil Engineering IIT Bombay

Advance Mechanics of Solids (3-0-0)

Module I **(10 Classes)**

Theories of failure: Maximum principal stress theory, maximum shear stress theory, maximum strain theory, total strain energy theory, maximum distortion theory, octahedral shear stress theory graphical representation and comparison of theories of failure.

Module II **(4 Classes)**

Thick cylinders subjected to internal and external pressures, compound cylinders, computer application in analyzing stresses in thick cylinders.

Module III **(10 Classes)**

Unsymmetrical bending: Properties of beam cross selection, slope of neutral axis, stresses and deflection in unsymmetrical bending, shear centre.

Curved Beam: Bending of beam with large initial curvature, Stress distribution in beam with rectangular, circular and trapezoidal cross section, stresses in crane hooks, ring and chain links.

Module IV **(8 Classes)**

Elementary concept of theory of elasticity, stresses in three dimensional, equations of equilibrium and compatibility, plane stress, computer analysis of two dimensional state of stress or strain at a point.

Module V **(8 Classes)**

Advanced topics in strength of materials: Repeated stresses and fatigue in metals, concept of stress Concentration, notch and stress concentration factors.

Experimental stress analysis: Resistance strain gauges, strain Rosettes, Two dimensional photoelastic methods of stress analysis, stress optic law, light and dark field in a polariscope, Isoclinic and Isochromatic fringe patterns, Computer Analysis of strain from strain rosette measurement.

Books:

1 Advanced Mechanics of Solids, L.S. Srinath, Mc Graw Hill.
2. Advanced Mechanics of Materials, Kumar &Ghai, Khanna Publisher.
3. Strength of Materials by R. Subramaniam, Oxford University Press
4. Strength of Material by S. S. Ratan, McGraw Hill
5. Advanced Mechanics of Materials: Seely and Smith, John Willey, New York.
6. Mechanics of Materials by Gere & Timoshenko, CBS.

Digital Learning Resources:

Course Name	Advanced Strength of Materials
Course Link	https://nptel.ac.in/courses/112/101/112101095/
Course Instructor	Prof. S.K. Maiti Department of Mechanical EngineeringIIT Bombay

Masonry Structures (3-0-0)

Module-I **(8 Classes)**

Introduction, Masonry units, materials and types: History of masonry, Characterics of Brick, stone, clay block, concrete block, stabilized mud block masonry units-Strength, modulus of elasticity and water absorption.

Module-II **(8 Classes)**

Strength of Masonry in Compression:Behaviour of Masonry under compression, strength and elastic properties, influence of masonry unit and mortar characteristics, effect of masonry unit height on compressive strength, influence of masonry bonding patterns on strength, prediction of strength of masonry in Indian context, failure theories of masonry under compression.

Module-III **(8 Classes)**

Flexural and shear bond, flexural strength and shear strength:Bond between masonry unit and mortar, tests for determining flexural and shear bond strengths, factors affecting bond strength, effect of bond strength on compressive strength,

Module-IV **(8 Classes)**

Design of load bearing masonry buildings:Permissible compressive stress, stress reduction and shape reduction factors, increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile and shear stresses, Effective height of walls and columns, opening in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action, lintels; Wall carrying axial load, eccentric load with different eccentricity ratios, wall with openings, freestanding wall; Design of load bearing masonry for buildings up to 3 to 8 storeys using BIS codal provisions.

Module-V **(8 Classes)**

Earthquake resistant masonry buildings: Behaviour of masonry during earthquakes, concepts and design procedure for earthquake resistant masonry, BIS codal provisions
Masonry arches, domes and vaults:Components and classification of masonry arches, domes and vaults, historical buildings, construction procedure.

Books:

1. Dayaratnam P, “Brick and Reinforced Brick Structures”- Oxford & IBH
2. Sinha B.P & Davis S.R., “Design of Masonry structures”- E & FN Spon
3. Hendry A.W.,“Structural masonry”- Macmillan Educaon Ltd., 2nd edion.
4. Curtin, “Design of Reinforced and Prestressed Masonry”- Thomas Telford.
5. Sven Sahlin, “Structural Masonry”-Prence Hall.

Digital Learning Resources:

Course Name	DESIGN OF MASONRY STRUCTURES
Course Link	https://nptel.ac.in/courses/105/106/105106197
Course Instructor	PROF. ARUN MENON Department of Civil Engineering IIT Madras

Railway and Airport Engineering (3-0-0)

MODULE-I **(8 Classes)**

History of Indian railways, component parts of railway track, problems of multi gauge system, coning of wheels, alignments and survey, permanent way track components, Type of rail sections, creep of rails, wear and failure in rails , Ballast requirements, sleeper requirements, types of sleepers, various train resistances

MODULE-II **(8 Classes)**

Geometric design: Gradients and grade compensation, various speeds on a railway track, super-elevation, horizontal and vertical curves, Points and crossings, Design of simple turn-out, Signalling and interlocking,

MODULE-III **(8 Classes)**

Airport site selection, Air craft characteristics, various surface of an airport, Wind rose diagram, Geometric elements of run way and taxiway , holding apron, parking configuration , terminal building , visual aids, air traffic control, airport marking and lighting.

MODULE-IV **(8 Classes)**

Harbour Engineering: Classification of Harbour basin, general layout of harbours, Docks, Different components of docks.

MODULE-V **(8 Classes)**

Inland waterways, Inland water transportation in India, classification of waterways, economics of inland waterways transportation, national waterways

Books:

1. A text book of railway engineering , By S.C.Saxena and M.G.Arora
2. Railway Engineering by Satish Chandra & MM Agrawal, Oxford University Press.
3. Transportation Engineering, Volume-II- Railways, Airports, Docks and Harbours, Bridges and Tunnels by C. venkatramaih, Universities Press
4. Air-port Engineering by S.K.Khanna and M.G.Arora

Digital Learning Resources:

Course Name	Transportation Engineering II
Course Link	https://nptel.ac.in/courses/105/107/105107123/
Course Instructor	Prof. Rajat Rastogi, IIT Roorkee

Pavement Design (3-0-0)

Module – I **(08 Classes)**

Introduction: Classification of pavements, Difference between highway and runway pavements, Factors affecting structural design, Characteristics of traffic loading, Concept of VDF and Computation of design traffic.

Module – II **(10 Classes)**

Principles of pavement design: Concepts of structural and functional failures, Performance criteria; Analysis of pavements: ESWL, Analysis of flexible and concrete pavements.

Module – III **(10 Classes)**

Design of pavements: IRC, AASHTO and other important methods of design of bituminous and concrete pavements.

Module – IV **(06 Classes)**

Pavement evaluation techniques: Benkelman beam, Falling weight deflectometer and other equipments.

Module – V **(06 Classes)**

Concepts of pavement maintenance management.

Books:

1. Principles of Pavement Design, E. J. Yoder & M.W. Witzack, John Wiley
2. Pavement Design by R Srinivasa Kumar, Universities Press
3. Principles of Transportation Engineering, P. Chakroborty& A. Das, PHI Publication
4. Pavement Analysis and Design, Y. H. Huang, Prentice Hall

Digital Learning Resources:

Course Name	Advanced Transportation Engineering
Course Link	https://nptel.ac.in/courses/105/104/105104098/
Course Instructor	Prof. A. Das, Prof. ParthaChakraborty,IIT Kanpur,

Traffic Engineering (3-0-0)

MODULE-I **(08 Classes)**

TRANSIT SYSTEM AND ISSUES

Introduction to Mass Transport, Role of various modes of Mass Transport, Transport System Performance at National, State, Local and International levels, National Transport Policy, Urban transportation problems and their impact, Modes of mass transit- their planning, construction and operation, Case studies of existing mass transit systems
Technical and economic evaluation of mass transit projects

MODULE-II **(08 Classes)**

PUBLIC TRANSIT SYSTEM

Urban Transport System, Public Transport System Re-genesis and Technology, Physical performance of Public Transport System, Public Transport and Urban Development Strategies, Mass Transit concepts- Trip interchanges and assignments, Characteristics of Rail Transit, Vehicle Characteristics

MODULE-III **(08 Classes)**

BUS TRANSIT PLANNING AND SCHEDULING

Route Planning and Scheduling, Bus Transport System, Performance and Evaluation, Scheduling, Conceptual patterns of bus service, Network Planning and Analysis, Bus Transport System Pricing, Bus Transit System Integration, Analytical Tools and Techniques for Operation and Management, Bus Rapid Transit Systems, Case Studies

MODULE-IV **(06 Classes)**

RAIL TRANSIT TERMINALS AND PERFORMANCE EVALUATION

Performance Evaluation, Efficiency, Capacity, Productivity and Utilisation, Performance Evaluation Techniques and Application, System Network Performance, Transit Terminal Planning and Design

MODULE-V **(10 Classes)**

IMPACT OF TRANSIT

Policies and Strategies for Mass Transport, Need for Integrated Approach, Unified Transport Authorities, Institutional arrangement, Urban Transport Fund, Parking Policies, Private Sector in Mass Transport, Bus and Rail Integration, Co-ordination of Feeder Services, Transit Oriented Land Use Development., Case Studies, Urban Transportation and Land use, Impact of Transport Development on Environment, Remedial measures, Policy Decisions, Recent Trends in Mass Transportation Planning and Management

Books

1. Michael J.Bruton , "An Introduction to Transportation Planning", Hutchinson,1985
2. Michael D.Meyer and Eric J.Miller , "Urban Transportation Planning – A Decision Oriented Approach", McGraw Hill Book Company, New York,1984
3. F.D.Hobbs, "Traffic Planning and Design", PoargamonOress
4. John W.Dickey, "Metropolitan Transportation Planning" – Tata McGraw Hill Publishing Company Limited, New Delhi, 1980
5. Paul H.Wright, "Transportation Engineering – Planning and Design", John Wiley and Sons, New York, 1989.

Digital Learning Resources:

Course Name	Urban transportation planning
Course Link	https://nptel.ac.in/courses/105/107/105107067/
Course Instructor	Dr. M. Parida IIT Roorkee ,

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5Th Semester

Universal HumanValues

(Self, Society and Nature)

Pre-requisites: Universal Human Values: Self & Family (desirable); 4-day Harmony-2 Workshop (co-requisite). Please refer to AICTE Model Curriculum-Vol-II.

1. Objective:

The objective of the course is four-fold:

A. Sensitization of student towards issues in society and nature.
B. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.
C. Strengthening of self reflection.
D. Development of commitment and courage to act.

(For elaboration on some of the above, consult course description for Universal Human Values 1: Self and Family, AICTE Model Curriculum-VOL-II).

2. Course Topics :

In this Universal Human Values course, the focus is more on understanding society and nature on the basis of self and human relationships.

i) Purpose and motivation for the course.
ii) Recapitulation (from the previous course) on ideas of self, pre-conditioning, and natural acceptance.
iii) Harmony in the self. Understanding human being as co-existence of self and body. Identifying needs and satisfying needs of self and body. Self-observations. Handling peer pressure.
iv) Recapitulation on relationships. Nine universal values in relationships. Reflecting on relationships in family. Hostel and institute as extended family. Real life examples.
v) Teacher-student relationship. Shraddha. Guidance. Goal of education.
vi) Harmony in nature. Four orders of nature – material order, plant order, animal order and human order. Salient features of each. Human being as cause of imbalance in nature. (Film **"Home"** can be used.)
vii) Human being as cause of imbalance in nature. Depletion of resources – water, food, mineral resources. Pollution. Role of technology. Mutual enrichment not just recycling.
viii) Prosperity arising out of material goods and understanding of self. Separation of needs of the self and needs of the body. Right utilization of resources. lkekU; vkdka{kk ,oa egRokdka{kk, Understanding the purpose they try to fulfil.

ix) Recapitulation on society. Five major dimensions of human society. Fulfilment of the individual as major goal. Justice in society. Equality in human relationships as naturally acceptable. Establishment of society with abhaya (absence of fear).

x) Ethical human conduct. Values, character and netikataa.

xi) Professional ethics. Conduct as an engineer or scientist.

Design of Concrete Structures Lab(0-0-3)

1. Workability test of concrete:Slump test, compaction factor test and flow table test
2. Cube Test of Concrete(Nominal Mix)
3. Cylinder Test for Concrete(Nominal Mix): Determination of axial stress, longitudinal strain, lateral strain and Poision's ratio. Plotting of stress-strain curve and determination of modulus of elasticity.
4. Split Tensile Strength Test of Concrete
5. Prism test for determining modulus of rupture of concrete
6. Design of Concrete Mix (As per Indian Standard Method)
7. Failure of RC beam in bending and shear (two point and one point loading)
8.Complete design of a simple load bearing residential building comprising of beams, slab, column, footing, staircases, etc. and the detailing of steel reinforcement.

Course Name	**Design of Concrete Structures Lab**
Course Link	https://nptel.ac.in/courses/105/107/105107067/
Course Instructor	,

WATER SUPPLY AND SANITARY ENGINEERING LAB

LIST OFEXPERIMENTS:

1. ***Analysis of water Quality Parameter***

    a) Measurement of pH, Electrical conductivity
    b) Determination of Turbidity of water samples.
    c) Determination of Chlorides in water.
    d) Determination of Iron and Fluoride in water.
    e) Determination of Acidity and Alkalinity of water.
    f) Determination of Sulphate in water.
    g) Determination of Hardness of water.
    h) Determination of Residual Chlorine of water.
    i) Determination of Total Dissolved Solids.
    j) Determination of optimum coagulant dosage.
    k) Microbiological culture analysis of bacterial samples
    l) MPN Test

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2. ***Analysis of Waste Water Characteristics***

    a) Determination of Total Solids, Settlable Solids, Dissolved Solids, Suspended Solids and Volatile Solids.
    b) Determination of Dissolved Oxygen, COD and BOD.
    c) Determination of Ammonia–nitrogen and Nitrates.

Digital Learning Resources:

Course Name	Environmental Engineering 1
Course Link	https://ee1-nitk.vlabs.ac.in/
Course Instructor	NIT Suratkal,

GEOTECHNICAL ENGINEERING-1 LAB

1. *Determination of specific gravity of soil grains*
2. *Determination of grain size distribution of soil*
   (a)Sieve test (b) Hydrometer/ pipette test
3. *Determination of Atterberg limits of soil*
   Liquid limit (b) plastic limit (c) shrinkage limit
4. *Measurement of soil compaction in the field*
   Core cutter method (b) Sand replacement method
5. *Determination of Density – Water content relationship of soil.*
   Proctor compaction test (ii) Modified Proctor compaction test (c) Use of Proctor penetration needle
6. *Determination of relative density of granular soil*
7. *Determination of shear strength parameters of soil*
   (a)Shear Box test (b) Tri-axial compression test (c) Unconfined compression test (d) Vane shear test
8. *Determination of consolidation characteristics of soil using fixed ring Oedometer*
9. *Determination of California Bearing Ratio (CBR) of soaked and un-soaked soil specimens*
10. *Determination of coefficient of permeability of soil*
    (a)Constant head permeameter (b) Falling head permeameter

Digital Learning Resources:

Course Name	Soil Mechanics Lab
Course Link	http://smfe-iiith.vlabs.ac.in/
Course Instructor	IIIT Hyderabad

BIJUPATNAIKUNIVERSITY OF TECHNOLOGY, ODISHA

ROURKELA

Curriculum and Syllabus

B. Tech (*Civil Engineering)* from the Admission Batch 2018-19

Semester (6th)

Sixth Semester							
Theory							
Sl. No.	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**	**University Marks**	**Internal Evaluation**
1	PC		Design of Steel Structures	3-0-0	3	100	50
2	PC		Hydrology &Irrigation Engineering	3-0-0	3	100	50
3	BS		Optimization in Engineering	3-0-0	3	100	50
4	PE		Foundation Engineering	3-0-0	3	100	50
			Ground Improvement Techniques.	3-0-0			
			Environmental Geo Techniques	3-0-0			
5	OE		Human Resources Management	3-0-0	3	100	50
			Artificial Intelligence and Machine Learning	3-0-0			
			Renewable Power Generation Systems	3-0-0			
6	MC*****	RIK6F001	Essence of Indian Knowledge Tradition-1	3-0-0	0	-	100 (Pass mark is 37)
Total Credit (Theory)					**15**		
Total Marks						**500**	**250**
Practical							
1	PC		Steel Structures Lab	0-0-3	2		100
2	PC		Irrigation Engineering Lab	0-0-3	2		100
3	PSI		Future Ready Contributor Develop Model Lab	0-0-3	2		100
4	PSI		Seminar - I	0-0-3	1		100
Total Credit (Practical)					**7**		
Total Semester Credit					**22**		
Total Marks							**400**
SUMMER INTERNSHIP TRAINING FOR 45 DAYS							

***Mandatory Non-Credit Courses (MC) result will be reflected with Pass (P) / Fail (F) grade. Thus the grade obtained will not be affecting the grade point average. However it shall appear on the grade sheet as per AICTE rule.**

6th Semester	RCI6C001	Design of Steel Structures	L-T-P 3-0-0	3 Credits

Module I **10 HOURS**

Introduction, advantages/disadvantages of steel, structural steel, rolled steel section, various types of loads, design philosophy.

Limit state design method, limit states of strength and serviceability, probabilistic basis for design Riveted, bolted and pinned connections,

Welded connections-assumptions, types, design of fillet welds, intermittent fillet weld, plug and slot weld, failure of welded joints, welded joints vs bolted and riveted joints

Module II **6 HOURS**

Tension members, types, net cross-sectional area, types of failure, slenderness ratio, design of tension members, gusset plate.

Module III **6HOURS**

Compression members, effective length, slenderness ratio, types of cross-section, classification of cross section,

Design of axially loaded compression members, lacing, battening, design of column bases, and foundation bolts.

Module IV **8 HOURS**

Design of beams, types of c/s, lateral stability of beams, lateral torsional buckling, bending and shear strength, web buckling and web crippling, deflection, design procedure.

Module V **6HOURS**

Plate girders- various elements and design of components Eccentric and moment connections, roof trusses

Books:

1. Design of Steel Structures- Limit State Method by N. Subramanian, Oxford University Press
2. Limit State Design of Steel structures by S.K. Duggal, Mc-Graw Hill
3. Design of steel structures by S.S.Bhavikatti, I.K. International Publishing house.
4. Design of Steel Structures by K. S. Sairam, Pearson
5. Steel Design by William T. Segui, Cengage Learning
6. Fundamentals of Structural Steel Design by M.L.Gambhir, Mc Graw Hill
7. Steel Structures-Design and Practice by N. Subramanian, Oxford University Press

Books:

Digital Learning Resources:

Course Name	Design of Steel Structure
Course Link	https://nptel.ac.in/courses/105/105/105105162/
Course Instructor	PROF. DAMODAR MAITY

6th Semester	RCI6C002	Hydrology&Irrigation Engineering	L-T-P 3-0-0	3 Credits

MODULE-I **09HOURS**

Hydrologic cycle, World water balance; Forms, types & measurement of precipitation; Mean precipitation over an area; Curves of precipitation: Depth-area-duration, Intensity-duration-frequency & Depth-duration-frequency; Probable maximum precipitation; World's greatest observed rainfalls; Abstractions of precipitation: Measurement of evaporation; Evapotranspiration & its equations; Infiltration: measurement & indices.

MODULE-II **09HOURS**

Major methods for Measurement of stage, velocity & streamflow; Stage-discharge relationship: linear & log-log; Runoff characteristics of streams; Runoff volume estimation by Curve Number method; Flow mass curve & reservoir capacity estimation; Hydrographs: components, affecting factors & base flow separation methods; Unit hydrographs (UHs): derivation, use & limitations; UHs of different durations; Peak flood estimation by Rational method, empirical formulae, enveloping curves & Gumbel's Method.

MODULE-III **09HOURS**

Irrigation: necessity, advantages & disadvantages; Water distribution techniques in farms: free flooding, border flooding, check flooding, basin flooding, furrow irrigation, sprinkler irrigation & drip irrigation; Crop water requirement: duty, delta, base period & crop period; Irrigation efficiencies; Soil moisture - irrigation frequency relationship; Irrigation channels: classification & alignment; Distribution system, water losses in irrigation channels; Stable & regime channel design: comparison of Kennedy's & Lacey's Theories; Irrigation canal lining: types, advantages, economics & preliminary design.

MODULE-IV **09HOURS**

Types of Cross-Drainage (CD) Works, , Design considerations for CD works; Diversion Head works: Types of weirs and barrages, Layout of a diversion head works; Design of weirs and barrages: Comparison among Bligh's creep theory, Lane's weighted creep theory and Khosla's method of independent variables, Exit gradient; Canal Falls: Necessity, Proper location, Types,Gravity Dams: Typical cross section, Various forces acting on gravity dam, Combination of forces for design, Modes of failure and criteria for structural stability, High and low gravity dams, Typical section of low gravity dam; Earth Dams: Types, Causes of failure, Preliminary section, Seepage control. Spillways: Brief study of various types.

Books:

1. Irrigation Engineering and Hydraulic Structures by S. K. Garg, Khanna Publication, New Delhi
2. Irrigation Engg. By B.C. Punmia and Pande, Laxmi Publication, New Delhi
3. Engineering Hydrology by K Subramanya, McGraw Hill Education, New Delhi
4. Hydrology Principles Analysis Design by H M Raghunath, New Age International Publishers, New Delhi

Digital Learning Resources:

Course Name	IRRIGATION AND DRAINAGE
Course Link	https://nptel.ac.in/courses/126/105/126105010/
Course Instructor	PROF. DAMODHARA RAO MAILAPALLI Department of Agricultural and Food Engineering IIT Kharag

6th Semester		Optimization in Engineering	L-T-P 3-0-0	3 Credits

Module I: **(10 Hours)**

Idea of Engineering optimization problems, Classification of optimizationalgorithms, modeling of problems and principle of modeling. Linear Programming:Formulation of LPP, Graphical solution, Simplex method, Big-M method, Revised simplex method, Duality theory and its application, Dual simplex method , Sensitivity analysis in linear programming.

Module II: **(10 Hours)**

Transportation problems:Finding an initial basic feasible solution by NorthwestCorner rule, Least Cost rule, Vogel's approximation method, Degeneracy, Optimalitytest, MODI method, Stepping stone method. **Assignment problems:** Hungarian method for solution of Assignment problems. Integer Programming: Branch and Bound algorithm for solution of integer programming problems.

Module III: **(12 Hours)**

Non-linear programming: Introduction to non-linear programming. Unconstraintoptimization: Fibonacci and Golden Section Search method. Constrained optimization with equality constraint: Lagrange multiplier, Projected gradient method. Constrained optimization with inequality constraint: Kuhn-Tucker condition, Quadratic programming.

Module IV: **(6 Hours)**

Queuing models: General characteristics, Markovian queuing model, M/M/1model, Limited queue capacity, multiple server, Finite sources, Queue discipline.

Books:

[1] Operations Research- Principle and Practice, A. Ravindran, D. T. Philips, J. Solberg, Second edition, Wiley India Pvt Ltd.
[2] Operation Research, Prabhakar Pai ,Oxford University Press
[3] Optimization for Engineering Design, Kalyanmoy Deb, PHI Learning Pvt Ltd.
[4] Operations Research, H.A.Taha, A.M.Natarajan, P.Balasubramanie, A.Tamilarasi, Pearson Education, Eighth Edition.
[5] Engineering Optimization, S S Rao, New Age International Pvt Ltd, 2003.
[6] Linear and Non-linear Optimization, **S**tephen G. Nash, A. Sofer, McGraw Hill, 2nd Edition.
[7] Engineering Optimization, A.Ravindran, K.M.Ragsdell, G.V.Reklaitis, Wiley India Pvt. Ltd, Second edition.
[8] Operations Research, F.S.Hiller, G.J.Lieberman, Tata McGraw Hill, Eighth Edition, 2005.
[9] Operations Research, P.K.Gupta, D.S.Hira, S.Chand and Company Ltd, 2014.

Digital Learning Resources:

Course Name	CONSTRAINED AND UNCONSTRAINED OPTIMIZATION
Course Link	https://nptel.ac.in/courses/111/105/111105100/
Course Instructor	PROF. ADRIJIT GOSWAMI, PROF. DEBJANI CHAKRABORTY Department of Mathematics IIT Kharagpur

6th Semester	RCI6D001	Foundation Engineering	L-T-P 3-0-0	3 Credits

Foundation Engineering **8 HOURS**

Module:I

Lateral Earth Pressure and Retaining Structures: Concept of earth pressure, Earth pressure at rest,active and passive earth pressure for both cohesionless and cohesive soils, Earth pressure theories:Rankine's theory, Coulomb's Wedge theory, Graphical methods: Rebhan's and Culmann's graphicalsolutions, Stability conditions for retaining walls.

Module: II **10HOURS**

Bearing Capacity: Definitions, Rankine's analysis, Types of failures: General and local shear failure,Terzaghi's Analysis, Brinch-Hansen analysis, Meyerhof's analysis, Vesics's bearing capacityequation, Effect of water table on bearing capacity, IS code method for computing bearing capacity,

Field Methods: Plate load test and its limitations, Standard penetration test.

Shallow Foundations: Types of foundations: Spread footing, combined and strap footing, mat or raftfooting, Settlement of footings.

Module: III **10HOURS**

Deep Foundations: Difference between shallow and deep foundations, Types of deep foundations.

Pile Foundations: Types of piles, pile driving, load carrying capacity of piles-static and dynamic formulae, Pile load test and its limitations, correlation with penetration tests, Group action in pilessettlementand efficiency of pile groups in clay, negative skin friction, Under reamed pile foundation. Basics of well foundation - types, component parts and ideas about the forces acting on a well foundation.

Module: IV **8 HOURS**

Subsoil Exploration: Necessity and planning for subsoil exploration, Methods - direct (test pits and trenches), indirect (sounding, penetration tests and geophysical methods).

Soil sampling – types of samples, standard penetration test, static and dynamic cone penetration test, in-situ vane shear test, Rock coring, soil exploration report.

Books:

1. Principles of Foundation Engineering by B. M. Das, Cenage Learning
2. Basic and Applied Soil Mechanics by Gopal Ranjan and A. S. R. Rao, New Age International Publishers
3. Geotechnical Engineering by C. Venkatramiah, New Age International Publishers
4. Geotechnical Engineering by S. K. Gulati & Manoj Gupta, Mc Graw Hill
5. Soil Mechanics and Foundations by B. C. Punmia et al., Laxmi Publications
6. Soil Mechanics & Foundation Engineering by B.N.D. Narasinga Rao, Wiley

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Digital Learning Resources:

Course Name	FOUNDATION ENGINEERING
Course Link	https://nptel.ac.in/courses/105/105/105105176/
Course Instructor	PROF. KOUSIK DEB Department of Civil Engineering IIT Kharagpur

6th Semester	RCI6D002	Ground Improvement Techniques.	L-T-P 3-0-0	3 Credits

Module – I **8 HOURS**

Introduction, Necessity of ground improvement, selection of ground improvement techniques, stabilization ofexpansive soil.

Module-II **8 HOURS**

Dewatering, Well points-Vacuum / electro osmotic methods, Analysis of seepage, Two Dimensional Flow, heattreatment, ground freezing., Analysis and design of dewatering systems.

Grouting types, Properties, Method of grouting, Ground selection and control.

Module – III **8 HOURS**

Compaction, Methods of compaction, Engineering properties of compacted soil, Field compaction and its control. dynamic compaction, Vibro flotation, Compaction piles, Consolidation, Sand drains, Preloading, Stone columns, Construction methods, Merits and demerits of various techniques

Module – IV **6 HOURS**

Soil stabilization, Use of chemical additives,

Module – V **6 HOURS**

Reinforced earth, Concept, Materials, Application and design, Use of geo-synthetics and geo-cells in construction work.

Books:

1.Grond improvement techniques by P.P.Raj, Laxmi Publications.
2.Foundation Design and Construction, M.J. Tomlinson
3. Foundation Engineering, G.A. Leonard, Tata McGraw Hill
4. Modern Geotechnical Engineering, Alam Singh, IBT Publishers
5.GeotechnicalEngineering.ShashKGulati&ManojDatta,TataMc-GrawHill

Digital Learning Resources:

Course Name	Ground Improvement Techniques - Video course
Course Link	https://nptel.ac.in/courses/105/108/105108075/
Course Instructor	Dr. G.L. Sivakumar Babu Department of Civil Engineering, IISc Bangalore

6th Semester	RCI6D003	Environmental Geo Techniques	L-T-P 3-0-0	3 Credits

Module- I **8 HOURS**

Introduction: Scope, importance, waste generation, subsurface contamination, Geosynthetics: Types, functions, applications.

Module- II **8 HOURS**

Forms of waste and their properties: Municipal waste, mineral waste, industrial waste, hazardous waste, index properties, strength, compressibility and permeability of municipal and mineral waste.

Module- III **8 HOURS**

Selection of waste disposal sites, factors affecting site selection, Landfills for municipal and hazardous waste: components of landfills, layouts, dailycells, base lining systems.

Module- IV **6HOURS**

Ash ponds and mine tailing impoundments: slurry deposition of mine tailing and coal ash in impoundments, layouts, components, design of tailing dam/ash dykes.

Module- V **6HOURS**

Remediation: Principle of remediation: Planning, source control, soil gas extraction, soil washing, and bio-remediation.

Books:

1. Geotechnology of waste management, I. S. Oweis and R. P. Khera, Butterwarths, London.
2. Engineering with geosynthetics, Ed. G. V. Rao and G.V.S.S. Raju, Tata McGraw Hill
3. Geotechnical practice for waste disposal, D. E. Daniel, Chapman and Hall, London.

Digital Learning Resources:

Course Name	ENVIRONMENTAL GEOTECHNICS
Course Link	https://nptel.ac.in/courses/105/101/105101196/
Course Instructor	PROF. D. N. SINGH, Department of Civil Engineering, IIT Bombay

6th Semester		Human Resources Management	L-T-P 3-0-0	3 Credits

Module I: **8 HOURS**

Concept scope and objectives of HRM. Relationship between HRM and HRD. The challengesfor HRM – Environmental, organizational and Individual. Role and functions of HR managers inthe changing business scenario. Human Resources Planning – overview, Recruitment – concept,objectives, legal framework regulating recruitment in India, Selection – Objectives and methods,Test and interviews, Induction and orientation, validity and reliability of Tests and interviews.

Module II: **8 HOURS**

Career Planning – concept, objectives. Different stages of career and its implications, Methods ofcareer planning and development, Promotion – types and process, Transfer – types. Separationsincluding lay off and retrenchment. Performance Management – concept and objectives.

Module III: **6 HOURS**

Performance Appraisal – concept objectives and methods – management by objectives (MBO),Assessment centre, 360 degree feedback. Appraisal errors. Competency mapping – concept,objectives and the process.

Module IV: **8 HOURS**

Compensation Management – objectives and principles. wage & salary. Wage concept – minimum wage, Fair wage, living wage. nominal wage and real wage. Components of wages, methods of wage determination, job evaluation – methods wage differentials and its functions.

Module V: **6 HOURS**

Training and Development – Training need Assessment, Types of Training Programs – on the job and off the job training programs, Evaluation of effectiveness of training programs.

Books

1. Personnel & HRM – P. subha Rao, Himalaya Publishing House.
2. HRM - Text and cases – Aswathappa, THM
3. Managing Human Resources – Gomez, Belkin &Cardy, PHI. HRM – Snell, Bohlander, Vohra – Cengage Publication

Digital Learning Resources:

Course Name	PRINCIPLES OF HUMAN RESOURCE MANAGEMENT
Course Link	https://nptel.ac.in/courses/110/105/110105069/
Course Instructor	PROF. ARADHNA MALIK, Department of Management Studies, IIT KGP

6th Semester		Artificial Intelligence and Machine Learning	L-T-P 3-0-0	3 Credits

Module-I: **(12 hours)**

INTRODUCTION –The Foundations of Artificial Intelligence; - INTELLIGENT AGENTS – Agents and Environments, Good Behaviour: The Concept of Rationality, the Nature of Environments, the Structure of Agents, SOLVING PROBLEMS BY SEARCH – Problem-Solving Agents, Formulating problems, Searching for Solutions, Uninformed Search Strategies, Breadth-first search, Depth-first search, Searching with Partial Information, Informed (Heuristic) Search Strategies, Greedy best-first search, A* Search, CSP, Means-End-Analysis.

Module-II: **(12 hours)**

ADVERSARIAL SEARCH – Games, The Mini-Max algorithm, optimal decisions in multiplayer games, Alpha-Beta Pruning, Evaluation functions, Cutting off search, LOGICAL AGENTS – Knowledge-Based agents, Logic, Propositional Logic, Reasoning Patterns in Propositional Logic, Resolution, Forward and Backward chaining - FIRST ORDER LOGIC – Syntax and Semantics of First-Order Logic, Using First-Order Logic , Knowledge Engineering in First-Order Logic - INFERENCE IN FIRST ORDER LOGIC – Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution

Module-III: **(6 hours)**

UNCERTAINTY – Acting under Uncertainty, Basic Probability Notation, The Axioms of Probability, Inference Using Full Joint Distributions, Independence, Bayes' Rule and its Use, PROBABILISTIC REASONING – Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distribution, Exact Inference in Bayesian Networks, Approximate Inference in Bayesian Networks

Module-IV: **(10 hours)**

LEARNING METHODS – Statistical Learning, Learning with Complete Data, Learning with Hidden Variables, Rote Learning, Learning by Taking Advice, Learning in Problem-solving, learningfrom Examples: Induction, Explanation-based Learning, Discovery, Analogy, FormalLearning Theory, Neural Net Learning and Genetic Learning. Expert Systems: Representingand Using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition.

Books:

[1] Elaine Rich, Kevin Knight, & Shivashankar B Nair, Artificial Intelligence, McGraw Hill,3rd ed.,2009

[2] Stuart Russell, Peter Norvig, *Artificial Intelligence -A Modern Approach*, 2/e, Pearson, 2003.

[3] Nils J Nilsson, *Artificial Intelligence: A New Synthesis*, Morgan Kaufmann Publications,2000

[4] Introduction to Artificial Intelligence & Expert Systems, Dan W Patterson, PHI.,2010

[5] S Kaushik, Artificial Intelligence, Cengage Learning, 1st ed.2011

Digital Learning Resources:

Course Name: Artificial Intelligence Search Methods For Problem Solving
Course Link: https://swayam.gov.in/nd1_noc20_cs81/preview
Course Instructor: Prof. D. Khemani, IIT Madras

Fundamentals of Artificial Intelligence

Course Name:
Course Link: https://swayam.gov.in/nd1_noc20_me88/preview
Course Instructor: Prof. S. M. Hazarika, IIT Guwahati

Course Name: Introduction to Machine Learning
Course Link: https://nptel.ac.in/courses/106/105/106105152
Course Instructor: Prof. S. Sarkar, IIT Kharagpur

Course Name: Machine Learning
Course Link: https://nptel.ac.in/courses/106/106/106106202
Course Instructor: Prof. Carl Gustaf Jansson, IIT Madras

6th Semester		Renewable Power Generation Systems	L-T-P 3-0-0	3 Credits

Module I: **(15 Hours)**

Introduction: Conventional energy Sources and its Impacts, Non conventional energy– seasonalvariations and availability, Renewable energy – sources and features, Distributed energy systemsand dispersed generation (DG). Solar Energy: Solar processes and spectral composition of solar radiation. Solar Thermal system-Solar collectors, Types and performance characteristics, Applications-Solar water heating systems(active & passive) , Solar space heating & cooling systems , Solar desalination systems, Solar cooker.Solar photovoltaic system-Operating principle, Photovoltaic cell concepts, Cell, module, array,Losses in Solar Cell, Effects of Shadowing-Partial and Complete Shadowing, Series and parallelconnections, Cell mismatching, Maximum power point tracking, Applications-Battery charging,Pumping, Lighting, Peltier cooling. Modelling of PV cell.

Module II: **(10 Hours)**

Wind Energy: Wind energy, Wind energy conversion; Wind power density, efficiency limit for windenergy conversion, types of converters, aerodynamics of wind rotors, power ~ speed and torque speed characteristics of wind turbines, wind turbine control systems; conversion to electricalpower: induction and synchronous generators, grid connected and self excited induction generatoroperation, constant voltage and constant frequency generation with power electronic controlsingle and double output systems, reactive power compensation, Characteristics of wind powerplant, Concept of DFIG.

Module III: **(9 Hours)**

Biomass Power: Principles of biomass conversion, Combustion and fermentation, Anaerobic digestion, Types of biogas digester, Wood gassifier, Pyrolysis, Applications. Bio gas, Wood stoves,Bio diesel, Combustion engine, Application.

Module IV: **(6 Hours)**

Hybrid Systems: Need for Hybrid Systems, Range and type of Hybrid systems, Case studies ofDiesel-PV, Wind-PV, Microhydel-PV, Biomass-Diesel systems, electric and hybrid electric vehicles.

Books:

[1] Godfrey Boyle“Renewable Energy- Power for a Sustainable Future”,Oxford University Press.
[2] B.H.Khan, “Non-Conventional Energy Resources”,TataMcGrawHill, 2009.
[3] S. N. Bhadra, D. Kastha, S. Banerjee, “Wind Electrical Systems”,Oxford University Press, 2005.
[4] S. A. Abbasi, N. Abbasi, “Renewable Energy Sources and Their Environmental Impact”, Prentice Hall of India, New Delhi, 2006

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Digital Learning Resources:

Course Name:	Energy Resources and Technology
Course Link:	https://nptel.ac.in/courses/108/105/108105058/
Course Instructor:	Prof. S Banerjee, IIT Kharagpur

6th Semester	RIK6F001	Essence of Indian Knowledge Tradition-1	L-T-P 3-0-0	0 Credits

Course Objective:

The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care system.

Course Outcomes:

- Ability to understand, connect up and explain basics of Indian Traditional knowledge modern scientific perspective.

Course Content:

- Basic Structure of Indian Knowledge System (i) वेद, (ii) उपवेद (आयुर्वेद, धनुर्वेद, गान्धर्वेद, स्थापत्य आदि) (iii) वेदांग (शिक्षा, कल्प, निरुत, व्याकरण, ज्योतिष छंद), (iv) उपाङ्ग (धर्म शास्त्र, मीमांसा, पुराण, तर्कशास्त्र)
- Modern Science and Indian Knowledge System
- Yoga and Holistic Health care
- Case Studies.

Books:

1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014
2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan
3. Fritzof Capra, Tao of Physics
4. Fritzof Capra, The wave of Life
5. V N Jha (Eng. Trans,), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation, Velliarnad, Amaku,am
6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta
7. GN Jha (Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, VidyanidhiPrakasham, Delhi, 2016
8. RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, VidyanidhiPrakasham, Delhi, 2016 9. P R Sharma (English translation), ShodashangHridayam

6th Semester	**RCI6C201**	**Steel Structures Lab**	**L-T-P 0-0-3**	**2 Credits**

1. Design and detailing of steel roof trusses/ industrial buildings
2. Design of columns(with lacing and battening) and column bases
3. Design of plate girders and gantry girder
4. Detailing of structural steel connections, seated and framed connections

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Course Name	Design of Steel Structure	
Course Link	https://nptel.ac.in/courses/105/105/105105162/	
Course Instructor	PROF. DAMODAR MAITY	

6th Semester	RCI6C202	Irrigation Engineering Lab	L-T-P 0-0-3	2 Credits

Design of Irrigation Structure (Sessional/Practical) (0-0-3)
Course Objectives:
Gaining knowledge regarding design of various hydraulic structures and Irrigation systems.
Course Content:
1. Canal design:
a.Canal Dimension study
b.Canal Fall: Design of any one fall.

2. Land drainage: Depth and spacing of Tile drains.

3. Design of Cross Drainage Works

4. Gravity Dam Design
a.Profile of the dam, Forces on Dam, Safety of Dam
b.Shear stress, Principal Stress on Dam

5. Earthen Dam:
a.Seepage line determination
b.Slope stability design

6. Design and detailing of any one type of fall.

7. Spillway: design of any one type of spillway

Books:
1. S.K. Garg, Irrigation Engineering and Hydraulic Structure , Khanna publisher.

2. J.K.Sharma and Laxmi Narain, Analysis and Design of Hydraulic Structures, Krishna Prakashan Media.
3. Dr. V.C. Agarwal, Irrigation Engineering And Hydraulic Structures, S.K. Kataria& Sons

Digital Learning Resources:

Course Name	IRRIGATION AND DRAINAGE
Course Link	https://nptel.ac.in/courses/126/105/126105010/
Course Instructor	PROF. DAMODHARA RAO MAILAPALLI Department of Agricultural and Food Engineering IIT Kharag

6th Semester		Future Ready Contributor Program	L-T-P 0-0-3	2 Credits

Outcomes: The Future-ready Contributor Program aims to accomplish the following outcomes in the lives of students–

- Improve the employability of students by giving them the right work ethic and thinking that employers are looking for.
- Build their confidence with which they can go into any job and contribute meaningfully.
- Improve their ability to engage better in the workplace and to be able to handle the challenges that come up there.
- Build their career-worthiness and help them develop into future-ready contributors with ability to navigate a career in a volatile, changing world.
- Widen their choices of career and success, so that they are able to open up more opportunities for themselves and take up unconventional career pathways.
- Enable them recognize how they as technical professionals, can participate and make a positive contribution to their communities and to their state.

The Program content is also designed to expose students to real-world workplace scenarios and sensitize them to some of the challenges faced in society around them, especially in the local communities around them and in their own state of Odisha.

The Contributor Program syllabus has been evolved and fine-tuned over several years, to –

a) address the changing need and contemporary challenges being faced by industry and what employers of today are looking for in the people they hire;
b) working extensively with universities and students and an appreciation of their challenges and concerns;
c) guided by the higher ideas and principles of practical Vedanta in work.

Sr. No.		Content	Total Hrs
1	**Part 1 : Developing self-efficacy and basic inner strength**	**Who is a Future-ready Contributor?** *In this topic, students understand the new work environment, expectations from future workforce, and importance of being a future-ready contributor. This enables students to transform their expectation of themselves in work*	3 hrs lab sessions (discovery-based facilitator led)
2		**Self-esteem & Growth Identity** *In this topic, students learn how to develop a deeper and more resilient self esteem and how to adopt a growth identity/ mindset, that is more appropriate to the demands of the future workplace.*	Same as above
3		**Become a Creator of one's destiny** *In a "victim stance", we see the career environment as full of difficulties and hurdles. We feel powerless or blame our circumstances for not having many opportunities. This makes us fearful of uncertainty and makes us settle for jobs where we remain mediocre. In this topic, students discover the "creator of destiny stance" to challenges and situations. This stance helps them take ownership & responsibility to shape destiny, build a new future & find answers to challenges; and stop being complainers.*	Same as above
4	**Part 2 : Building ability to make more effective career choices**	**Achieving Sustainable Success** *In this topic, students discover how to achieve sustainable or lasting success, by making themselves success-worthy. Where their focus shifts to building one's "engine of success" rather than being on chasing the "fruits of success". This is important, because over a lifetime of work, all people go through ups and downs – where the fruits are not in their control. People who are focused on the fruits of success, fall prey to disappointment, loss in motivation, quitting too early, trying to find shortcuts – when fruits don't come. Whereas people focused on building their engine of success continue to contribute steadily, irrespective of whether fruits come or not. This helps them make better choices in life, that leads to steady success & long-term career fulfillment in an uncertain world.*	Same as above
5		**Career Development Pathways for a changing world**	Same as above

		In this topic, students explore a range of diverse "career development models" and the possibilities for contribution each opens up to them. This helps them open up hidden opportunities that such an environment offers. And free themselves from a herd mentality when making career choices.	
6		**Make an impact in every part of one's life** *In this topic, students learn how to expand the contribution possible in any role they have. This helps them take charge of own career growth & discover their power to contribute in any role or job.*	Same as above
7	**Part 3 : Building ability to become solution and value creating individuals in the world**	**Think Solutions** *The market environment in which organizations are operating, is becoming increasingly dynamic and uncertain. So, employers are increasingly seeking out people who can innovate and figure out solutions in the face of any challenge (unlike in the past when it was the people who were most efficient and productive, who were valued by organizations). At the heart of innovation lies this way of thinking of "finding solutions" rather than "seeing problems or roadblocks". Students learn how to build this way of thinking, in this topic.*	Same as above
8		**Value Thinking** *Companies are also looking for employees who do not just work hard, or work efficiently or productively - but those who will make a valuable difference to the fortunes of the company. This difference may come from innovation, but it may also come from focusing on the right things and identifying what really matters – both to the company and to the customers. In this topic, students learn how to build this capability.*	Same as above
9		**Engaging Deeply** *The environment we live in is becoming increasingly complex because more and more things are getting interconnected, new fields are emerging, technologies are rapidly changing, capabilities and knowledge one is trained in will become fast obsolete. In such a scenario, the student's ability to quickly understand and master what is going on, dive deep, get involved in any area, rapidly learn new capabilities that a job demands, is*	Same as above

		important. In this topic, students learn how to engage deeply. Learning how to dive deep, to quickly understand what is going on, get involved in any area, and rapidly learn.	
10	**Part 4 : Building ability to work collaboratively and as good citizens of organizations and the country**	**Enlightened self-interest & collaboration at work** *The changing nature of work in organizations and in the global environment, is increasingly demanding that people work more collaboratively towards shared goals and more sustainable goals. A key to working successfully when multiple stakeholders are involved, is "thinking in enlightened self-interest". In this topic, students learn how to widen their thinking from "narrow self-interest" to "enlightened self-interest" to work more effectively in teams & collaboratives.*	Same as above
11		**Human-centered thinking & Empathy** *In this topic, students learn to recognize & respond to human needs and challenges – the way of thinking at the heart of user-centric designs & customer-centricity.*	Same as above
12		**Trust Conduct** *The biggest currency in a sustainable career is "trust" i.e. being trusted by team members, bosses, customers. When we are trusted, people listen to us, they are willing to give us the chance to grow, give us the space to make mistakes, and work seamlessly with each other without always having to "prove ourselves". In this topic, students learn how to build trust with people they engage with.*	Same as above
Contribution Project Lab Sessions		*3 Contribution projects that help them apply contributor thinking. After students complete their project work (beyond the classroom), each project ends with this 3 hr lab session where they build their project output and present.*	9 hrs (3 hr lab sessions for each of 3 projects)
Project work		*The above Contribution Projects require research, and may need field work beyond the classroom that students are expected to do.*	Beyond classroom

Lab Sessions:

- Students will have to attend twelve discovery-based lab sessions to build new models of thinking & capacities (3 hrs per module)
- They will work closely with their peers to discuss and understand these new models of thinking.
- Their learning will be facilitated by trained college faculty.

Contribution Projects

- Three contribution projects that help them apply contributor thinking
- These will require research and also may need field work
- Each ends with a 3 hr lab session where they build their project output and present