# 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 |
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**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:**

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|---|---|
| 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 |
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**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<br>Department of Mathematics IIT Kharagpur |

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

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|---|---|
| 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 |
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**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?**<br>*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**<br>*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**<br>*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**<br>*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 |

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| | | *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**<br>*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**<br>*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**<br>*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**<br>*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 |

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|---|---|---|---|
| | | *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**<br>*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**<br>*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**<br>*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