IPS Academy

Institute of Engineering & Science

(*A UGC Autonomous Institute, Affiliated to RGPV, Bhopal*)

Scheme & Syllabus Based on AICTE Flexible Curricula

B. Tech, Chemical Engineering Department

III Semester (Second Year)

For admitted in July 2022 (*w.e.f. July, 2023*)

S. No.	Course Type	Course Code	Course Title	Hrs./ Week			Credits
				L	T	P	
1	BSC	MA04(B)	Laplace Transform and Complex Analysis	2	1	-	3
2	PCC	CH01	Chemical Engineering Thermodynamics-I	3	1	-	3
3	PCC	CH02	Fluid Mechanics	3	1	-	3
4	PCC	CH03	Chemical Process Calculation	3	1	-	3
5	PCC	CH04	Fluid Particle Mechanics	3	1	-	3
6	HSMC	HS03	Innovation and Creativity	-	-	2	1
7	LC	CH02(P)	Fluid Mechanics	-	-	2	1
8	LC	CH04(P)	Fluid Particle Mechanics	-	-	2	1
9	SBC	CS01(P)	Computer Programming	-	-	2	1
10	MLC	MLC01	Energy & Environmental Engineering	1	-	-	Audit
Total Credits							19

- **Basic Science Course (BSC), Program Specific Mathematics, (MA04)**
  (Any One Course)

(a) Numerical Method and Transforms
(b) Differential Equations
(c) Continuous and Discrete Transforms
(d) Laplace Transforms and Complex Analysis

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Course Code	Semester	Course Title	Load	Credit
BSC-MA 04(B)	III	Laplace Transform and Complex Analysis	2L:1T:0P (04hours)	Credits:03

Course Objective: Mathematics is the basic necessity for the foundation of engineering and technology. The main objective of this course is to teach mathematical methods, develop mathematical skills and increase students thinking power.

Course Content

MODULE- 1: (10 Hours)

Laplace transform, Properties of Laplace transform, Laplace transform of periodic functions, finding inverse Laplace transform by different methods, Convolution theorem, Evaluation of integrals by Laplace transforms.

MODULE- 2: (8 Hours)

Laplace transforms application: Solution of ODEs by Laplace transforms method, Solution of simultaneous ODEs by Laplace transformation. Solutions of one-dimensional heat and wave equations and Laplace equation.

MODULE- 3: (10 Hours)

Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy's and Euler's equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

MODULE- 4: (9 Hours)

Complex variables: Complex number, polar form of complex number, triangle inequality.

MODULE- 5: (8 Hours)

Residue theorem: Residue theorem and applications for evaluation real integrals, power series, radius of convergence, Taylor's series and Laurent's series.

Course Outcomes: At the end of this course student will be able to

CO1: Understand basic concepts of Laplace transforms in practical problems appearing in Chemical engineering.

CO2: Understand basic concepts of ODEs by Laplace transforms method in practical problems appearing in Chemical engineering. Evaluate improper integrals, Calculate integrals using special techniques.

CO3: Recall and generalize fundamentals of differentiations and apply to engineering problems.

CO4: Identify and apply the concept of vector integration in different engineering problems.

CO5: Recognize and apply the concept of Complex number in engineering problems.

Textbooks/References:

1. G.B. Thomas and R.L.Finney, Calculus and Analytic geometry, Pearson, 14th Edition, 2018.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th Edition, 2018.
3. T. Veerarajan, Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2017
4. B.V. Ramanna, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 2017
5. R.K. Pandey, Vector Calculus, Oxford, 2012.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43th Edition, 2015.
7. Differential Calculus by Shanti Narayan, S. Chand and company, New Delhi

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Course Code	Semester	Course Title	Load	Credit
PCC-CH01	III	Chemical Engineering Thermodynamics-I	3L: 1T: 0P (04hours)	Credits:03

Course objective-The objective of this course is to understand the theory and applications of classical thermodynamics, thermodynamic properties, equations of state, methods used todescribe, compression and expansion of fluids.

Course content-

MODULE 1: **(06 Hours)**

Basic concepts of work & heat system, properties and state of systems; first law of thermodynamics; application, batch flow processes; steady & unsteady state flow.

MODULE 2: **(12 Hours)**

Critical properties corresponding state compressibility, PVT behavior of pure fluids viral equation, cubic equation, generalized correlation & eccentric factor, behavior of liquid, second law of T.D, & its application. Adiabatic reactions, Equilibrium in homogeneous and heterogeneous reactions.

MODULE 3: **(08 Hours)**

Carnot cycle, Carnot theorem, thermodynamics temperature scales, concept of entropy, calculation of entropy for various systems, entropy for real system.

MODULE 4 **(05 Hours)**

Effect of pressure on specific heat, Joule Thompson effect, third law of thermodynamics & its applications.

MODULE 5: **(08 Hours)**

Compression & Expansion of fluids; single stage, multiple stage requirements & efficiency along with effect & engineering along with effects clearance, compression of real gas.

Course outcome-

CO1: Ability to understand basic concepts of thermodynamics and first law.

CO2: Capability to estimate PVT behaviors and critical properties of fluids.

CO3: To provide knowledge & application of second law of thermodynamics.

CO4: To provide knowledge & application of third law of thermodynamics.

CO5: To analyze effect of pressure on specific heat, compression & expansion of fluids.

Text/Reference Book-

1. K.V Narayanan (2010). A Textbook of Chemical Engineering Thermodynamics. (1st Edition). PHI learning private limited, New Delhi
2. J. M. Smith, H.C. Ness, M. Abbott (2009). Introduction to Chemical Engineering Thermodynamics. (7th Edition). McGraw Hill Education.
3. Daubert, T. E. (Thomas E.), 1937- Chemical Engineering Thermodynamics. (1stEdition McGraw-Hill) New York.
4. Stanley I. Sandler, Thermodynamics, 5th Edition, John Wiley & Sons 2017.

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Scheme & Syllabus Based on AICTE Flexible Curricula

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Course Code	Semester	Course Title	Load	Credit
PCC-CH02	III	Fluid Mechanics	3L: 1T: 0P (04hours)	Credits:03

Prerequisite(s): Engineering Mechanics

Course objective-The objective of this course is to understand basic concepts of fluid flow and its application to chemical process industries including pipe flow and fluid machinery.

Course content-

MODULE 1 : (09 Hours)

Properties and classification of fluids; fluid statics: pressure at a point, pressure variation in static fluid absolute and gauge pressure, manometers, dimensional analysis and dynamic similitude dimensional homogeneity, use of Buckingham pi-theorem, calculation of dimensionless numbers.

MODULE 2: (08 Hours)

Fluid flow phenomena, introduction to non-Newtonian fluid; introduction to compressible flow. velocity field; stream function; rotational and Irrotational flow, integral and differentialanalysisforfluidmotion,streamtubes,continuityequation,boundarylayertheory, flow in boundary layer, flow past immersed bodies, packed bed, fluidized bed.

MODULE 3: (08 Hours)

Navier-Stokes equation, Euler's equation of motion along with a streamline and derivation of Bernoulli's equation, application of Bernoulli's equation, energy correction factor, linear momentum equation for steady flow, momentum correction factor.

MODULE 4: (07 Hours)

Introduction to laminar and turbulent flow, concept of Reynolds number and friction factor; friction factor for rough and smooth pipe, losses of head due to friction in pipes and fittings.

MODULE 5: (08 Hours)

Fluid Measurements and Machines, velocity measurement (Pitot tube, Prandtl tube, current meters etc.) flow measurement (orifices, nozzles, mouth pieces, orifice meter, nozzle meter, venturi-meter, weirs and notches). Pumps, Blower, power & head requirement for pumps, energy losses in piping system, valves and fittings.

Course Outcomes:

After completion of this course, the students are able to:

CO1: Basic concept of fluid static, viscosity, pressure & vapor pressure and dimensional analysis

CO2: Different types of flow, streamlines & continuity equation

CO3: Euler's equation of motion, Bernoulli's equation, linear momentum equation, momentumcorrection factor.

CO4: Laminar & turbulent flow, concept of Reynolds number & friction factor.

CO5: Fluid Measurements and velocity measurement, working of pump, fan blowers and valves and fittings.

Text/Reference Book-

1. McCabe W.L., Smith J.C. and Harriott P. (2017) Unit Operations of Chemical Engineering", 7th Ed., McGraw Hill.
2. Nevers N.D. (2005) Fluid Mechanics for Chemical Engineers, 3rd Ed., McGraw HillEducation.
3. Darby R. (2001) Chemical Engineering Fluid Mechanics, 2nd Ed., Marcel Dekker Inc.New York.
4. Denn. M. (1979) Process Fluid Mechanics, Prentice Hall.

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Course Code	Semester	Course Title	Load	Credit
PCC-CH03	III	Chemical Process Calculation	3L:1T:0P (04hours)	Credits:03

Course objective-The objective of this course to understand and apply the basics of calculations related to material and energy flow in the processes. In addition to make practical approach to solve industrial related material energy balance problems.

Course content-

MODULE 1: (9 hours)

Mathematical and Engineering calculation- Units, different unit systems, conversion of unit from one system to other, dimensions, dimensional analysis, dimensional group, fundamental of mole concept, composition of solid, liquid and gases, Basic Stoichiometric Calculations.

MODULE 2: (10 hours)

Ideal Gases & Vapor pressure- Introduction of ideal gas, behavior of ideal gases, real gas, Vander Waal equation, compressibility factor method to solve cubic equation, vapor pressure, Raoult's Law, Humidity, relative humidity, humid heat, humid volume, dew point, humidity chart and its use.

MODULE 3: (12 hours)

Material balance without chemical reaction - Fundamental of conservation of mass, Introduction of component balance, solving material balance without simultaneous equation for different unit operations, solving material balance at steady state and unsteady state, recycle, by pass and purge calculations.

MODULE 4: (10 hours)

Material balance with chemical reaction- Introduction of component balance, solving material balance with chemical reactions, recycles, by pass and purge calculation with chemical reactions, combustion calculations.

MODULE 5: (9 hours)

Energy balance – Laws of thermo chemistry Heat capacity, calculation of enthalpy changes, Energy Balance for unit operations, calculation of standard heat of reaction, heats of formation, combustion, solution, mixing etc., effect of pressure and temperature on heat of reaction, energy balance with chemical reaction.

Course Outcomes:

After completion of this course, the students are able to:

CO1: Unit conversion, concept of stoichiometry, mole and composition.

CO2: Behavior of liquids as well as gases and concept of humidity.

CO3: Material balance across equipment's used in process industries.

CO4: Material balance for chemical reactions involves in chemical process industries.

CO5: Energy balance including and excluding chemical reaction.

Text/Reference Book-

1. Hougen O.A.; Watson K.M.; Ragatz R.A. Chemical Process Principles Part I, CBS pub. 2004.
2. Himmelblau D.M. Basic Principles and Calculations in Chemical Engineering, PHI.2012
3. Bhatt B.I.; Vora S.M.; Stoichiometry, 4th Edition McGraw Hill Education. 2004
4. Narayanan, K.V.; Lakshmikutty B. Stoichiometry and Process Calculations, PHI. 2016.

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Scheme & Syllabus Based on AICTE Flexible Curricula

B. Tech, Chemical Engineering Department

Course Code	Semester	Course Title	Load	Credit
PCC-CH04	III	Fluid Particle Mechanics	3L:1T:P (04hours)	Credits:03

Prerequisite(s): Engineering Mechanics

Course objective-The objective of this course is to understand basic principles of various mechanical operations, construction and working of the equipment's.

Course content-

MODULE 1: (08 Hours)

Solids, Characteristics of Solid particles, Particle size, Average particle size, Specific surface area of mixture, Screen analysis, Standard screens, Standard screens, Capacity and effectiveness of screen, Ideal and actual screens, Screening Equipment–Grizzly screens, Gyrating screens, Trommels, Shaking screens, Oscillating screens.

MODULE 2: (08 Hours)

Size reduction, Mechanism of Size reduction, Crushing Efficiency, Energy and power requirement, Rittinger's, Law, Kick's and Bond's Law, Work index, Size reduction equipments-crushers, grinders, ultrafine grinders and cutting machines.

MODULE 3: (08 Hours)

Mixing- Mixing of liquids with liquids, liquids with solids and solids with solids, power requirements. Mixing equipment-Kneaders, dispersers and masticators, Banbury Mixer, MullerMixer, Pug mills, Ribbon Blenders, Tumbling Mixers.

MODULE 4: (12 Hours)

Classification of solid particles, Magnetic Separation, Electrostatic Separator, Floatation, Sedimentation, Thickeners, Cyclone Separator, Filtration, Filter Media, Filter Aid, Equipments for filtration-Pressure filters, Leaf filters, Continuous rotary filters.

MODULE 5: (10 Hours)

Transportation, handling and fluidization: Selection of conveying devices for solids: Conveyers-Belt conveyors, Screw conveyor, Chain and Flight conveyors, Bucket Elevators, Pneumatic conveyors, storage bins & silos. Fluidization: Particulate & aggregative fluidization characteristic of fluidized bed, pressure drop through a fluidized bed.

Course Outcomes:

After completion of this course, the students are able to:

1: Evaluate size, surface and population of particles, & screen analysis of solids.

2: Principle of size reduction, crushing, grinding, pulverizing and ultra-fining.

3: Mixing equipment and calculate power requirements

4: Principle of separation techniques for system involving solids, liquids and gases, sedimentation and filtration.

5: Transportation of materials, particulate and aggregative fluidization, pressure drop through fluidized bed.

Text/Reference Book-

1. Perry RH & Don WG; (2008) Perry's Chemical Engineering Hand Book (8th Edition);New York Chicago; Mc Graw Hill.
2. Banchero & Badger; (1998) Introduction to Chemical Engineering (6th Reprint); theUniversity of California, Mc Graw Hill.
3. McCabe W.L., Smith J.C. and Harriott P. (2017) Unit Operations of Chemical Engineering", 7th Ed., McGraw Hill.
4. Narayan CM & Bhattacharya BC; (2014); Mechanical Operations for ChemicalEngineers (3rd Edition); Khanna Publishers, New Delhi.

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Course Code	Semester	Course Title	Load	Credit
HSMC-HS03	III	Innovation and Creativity	0L: 0T: 2P (01 hrs)	Credits:01

Pre requisite(s): Nil

Course Objectives:

1. To give an insight into creativity and innovation
2. To develop an appreciation for innovation among students, and
3. To enhance sensitivity to creativity and innovation

MODULE 1: (06 hrs)

Meaning and concept of creativity, Process, Nature and characteristics of creativity, Factors affecting creativity.

MODULE 2: (06 hrs)

Difference between Invention & Innovation, Importance & Principles of Innovation, Process of Innovation, Domain wise Innovations, How to safe guard innovations.

Module 3: (06 hrs)

Traditional V/s Creative Thinking, Individual Creativity Techniques: Meditation, Self Awareness, & Creative Focus Group Creative Techniques: Brain Storming, off The Wall Thinking.

MODULE 4: (06 HRS)

Evaluation of Effectiveness of Innovation- Legal Aspects like IPR, patent filing, copyright, Patenting Procedures, Design patents etc.

MODULE 5: (06 HRS)

Concept, Scope, Characteristics, Evolution of Innovation Management, Significance, Factors Influencing Innovation. Organizational Aspects- Economic Aspects like venture capital, angel investors.

Case Studies on Innovation business ideas i.e. RedBus, Flipcart, Ola, Big Basket, Patented products, Chemical products and Materials, special patents of procedures.

Course Outcomes:

After completion of the course the student will be able to

1. Analyze creativity concepts and principles & process for problem solving.
2. Understand innovation & apply creativity for innovation.
3. Understand innovative products or services.
4. Apply design thinking tools techniques for IPR.
5. Understand the concept of Innovation Management.

Text /Reference Books:

1. S.Salivahanan, S.Suresh Kumar, D.Praveen Sam, “Introduction to Design Thinking”, TataMc Graw Hill, First Edition,2019.
2. Kathryn McElroy, “Prototyping for Designers: Developing the best Digital and Physical Products”, O’Reilly, 2017.
3. Michael G. Luchs, Scott Swan, Abbie Griffin, “Design Thinking – New Product Essentials from PDMA”, Wiley, 2015

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Scheme & Syllabus Based on AICTE Flexible Curricula

B. Tech, Chemical Engineering Department

Course Code	Semester	Course Title	Load	Credit
LC-CH02	III	Fluid Mechanics	0L:0T:2P (04hours)	Credits:01

List of experiments-

1. Determine the local point pressure with the help of pitot tube.
2. Calculate the terminal velocity of a spherical body in water.
3. Calibration of venturi meter.
4. Determination of C_C, C_V,C_D of orifices.
5. Calibration of orifice meter.
6. Calibration of nozzle meter and mouth piece.
7. Reynolds experiment for demonstration of stream lines & turbulent flow.
8. Calculate the metacentric height.
9. Measure the friction factor of a pipe.
10. Study the characteristics of a centrifugal pump.
11. Verification of impulse momentum principle.

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Course Code	Semester	Course Title	Load	Credit
LC-CH04	III	Fluid Particle Mechanics	0L:0T:2P (04hours)	Credits:01

List of experiments-

1. Analyze the given sample by differential, cumulative methods using standard screen.
2. Determination of size and surface area of irregular particles using a measuring gauge.
3. Calculate the crushing efficiency and to determine the Rittinger's and Bond's constantof the given solid in a jaw crusher.
4. Determine the efficiency of a ball mill for grinding a material of known.
5. Calculate the power consumption of the hammer mill.
6. Find out the specific cake resistance for the given slurry by leaf filter.
7. Calculate the efficiency of a given cyclone separator.
8. Evaluate the efficiency of fluidized characteristic bed.
9. Perform the analysis of the dorr type of thickener.
10. Study the plate & frame filter press.

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Course Code	Semester	Course Title	Load	Credit
SBC-CS01	III	Computer Programming (Programming in Python)	0L:0T:2P (04 Hours)	Credits:01

Course Objective:

The course is designed to provide Basic knowledge of Python. Python programming is intended for software engineers, system analysts, program managers and user support personnel who wish to learn the Python programming language. Learning Outcomes: Problem solving and programming capability.

MODULE I: **(08 Hours)**

Introduction, History, Features, Python –Environment Setup Local Environment Setup, Getting Python, Installation of Python, Use of IDE

MODULE II: **(08 Hours)**

Python –Basic Syntax Python Identifiers,Reserved Words, Lines & Indentation, Multiline Statements, Quotation in Python, Comments & other useful constructs, Python –Variables Assigning Values to Variables, Multiple Assignment, Standard Data Types

MODULE III: **(08 hrs)**

Python –Variables, Assigning Values to Variables, Multiple Assignment, Standard DataTypes; Python Numbers, Python Strings, Python Lists, Python Tuples, Dictionary, Data Type Conversion

MODULE IV: **(08 Hours)**

Python –Basic Operators, Types of Operators, Arithmetic Operators, Comparison Operators, Assignment Operators, Bitwise Operators, Logical Operators, Operator Precedence, Python – Decision Making & Loops, Flowchart, If statement Syntax

MODULE V: **(08 Hours)**

Python-Functions, Syntax for defining a function, Calling a Function, Function Arguments, Anonymous Functions Python-Applications & Further Extensions.

Course Outcomes:

After completion of this course, the students are able to:

CO1: Install Python and have knowledge of syntax of Python.

CO2: Describe the Numbers, Math functions, Strings, List, Tuples and Dictionaries in Python.

CO3: Express different Decision Making statements and Functions.

CO4: Develop code in Python using functions, loops etc.

CO5: Design GUI Applications in Python and evaluate different database operations.

Text/Reference Book-

1. Python Crash Course: A Hands-On, Project-Based Introduction to Programming, by Eric Matthes, No Starch Press.
2. Learn Python the Hard Way' by ZedA. Shaw (3rdEdition),Addison Wesley.
3. Head-First Python, by Paul Barry,O'Reilly.
4. Python Programming' by John Zelle, Franklin, Beedle& AssociatesInc;

List of Experiments:

1. To write a Python program to find GCD of two numbers.
2. To write a Python Program to find the square root of a number by Newton's Method.
3. To write a Python program to find the exponentiation of a number.
4. To write a Python Program to find the maximum from a list of numbers.
5. To write a Python Program to perform Linear Search
6. To write a Python Program to perform binary search.
7. To write a Python Program to perform selection sort.
8. To write a Python Program to perform insertion sort.
9. To write a Python Program to perform Merge sort.
10. To write a Python program to find first n prime numbers.
11. To write a Python program to multiply matrices.
12. To write a Python program for command line arguments.
13. To write a Python program to find the most frequent words in a text read from a file.
14. To write a Python program to simulate elliptical orbits in Pygame.
15. To write a Python program to bouncing ball in Pygame.

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Course Code	Semester	Course Title	Load	Credit
MLC-ML01	III	Energy & Environmental Engineering	2L:0T:0P (02 Hours)	Credit:00

Course objective-To provide an introduction to energy resources and an emphasis on alternative energy sources and their application. To study the interrelationship between the living organism and environment. To understand the transformation and degradation of organic pollutants in the environment

Course content-

MODULE 1: (06 Hours)

Energy: Introduction, conventional and non-conventional energy resources - coal, oil, gas, solar energy, wind energy, geothermal energy, Hydropower, Bio-energy, Nuclear energy. Energy survey in India. Current and future energy requirements in India and across the world including associated environmental problems.

MODULE 2: (08 Hours)

Ecosystem and Biodiversity: Introduction of an ecosystem, Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, rivers, oceans),Biodiversity at global, national and local levels. Threats to biodiversity, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic adoption values; Endangered and endemic species of India. Conservation of biodiversity: In-Situ and Ex-Situ.

MODULE 3: (08 Hours)

Air pollution and Water Pollution: Definition, Cause, effects and control measures of Air pollution; Mobile and stationary sources of air pollutants, effective stack height concept, CO, CO_2, H_2S, SO_x, NO_x emissions, and its control. Definition, Classification, Cause, effects and control measures of water pollution, Measurement of levels of pollution such as DO, BOD, COD.

MODULE 4: (06 Hours)

E-Waste: Definition, Classification, Cause, effects and control measures of e-waste, global trade issues of e-waste, Recycling method of e-waste & its benefit.

MODULE 5: (08 Hours)

Environment Impact & Protection Act Environment: Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation; Public awareness. Environmental Impact Assessment. Measuring environmental impacts and policies for the regulation of environmental impacts.

Course Outcomes:

After completion of this course, the students are able to:

1: Ability to understand basic concepts conventional and non-conventional energy resources.

2: Ability to understand Ecosystem& Biodiversity.

3: To provide knowledge about Air pollution & Water Pollution.

4: To provide knowledge & reuse of E-Waste.

5: Ability to understand basic concepts of Environment Impact & Protection Act.

Text/Reference Book-

1. H. Peavy, D. Rowe & G. Tchobanoglous. Environmental Engineering, McGraw HillEducation. 2017.
2. A. K. De, Environmental Chemistry, 1st Edition New Age Publisher Int. Pvt. Ltd. 2016.
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, EnvironmentalEncyclopedia, Jaico Publ. House, Mumbai.

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