Second Semester (Common to All Branches)					
Theory					
Sl. No.	**Category**	**Subject Code**	**Subject Name**	**L-T-P**	**Credit**
1	BSC	19FY2BS01T/ 19FY2BS02T	Physics/ Chemistry	3-0-0	3
2	BSC	19FY2BS03T	Mathematics-II	3-0-0	3
3	ESC	19FY2ES01T/ 19FY2ES02T	Basic Electrical Engineering/ Basic Electronics Engineering	2-0-0	2
4	ESC	19FY2ES03T/ 19FY2ES04T	Basic Mechanical Engineering/ Basic Civil Engineering	2-0-0	2
5	ESC	19FY2ES05T	Problem Solving using C	3-0-0	3
Total Credit (Theory)					**13**
Practical					
1	BSC	19FY2BS01L/ 19FY2BS02L	Physics Lab/ Chemistry Lab	0-0-2	1
2	ESC	19FY2ES01L/ 19FY2ES02L	Basic Electrical Engineering Lab / Basic Electronics Engineering Lab	0-0-2	1
3	ESC	19FY2ES03L/ 19FY2ES04L	Basic Mechanical Engineering Lab/ Basic Civil Engineering Lab	0-0-2	1
4	ESC	19FY2ES05L	Programming Lab	0-0-2	1
5	ESC	19FY2ES06L/ 19FY2ES07L	Engineering Graphics & Design / Workshop or Manufacturing	0-0-2	1
6	MC	19FY2MC01L	NCC/NSS/Yoga/Professional Ethics	0-0-2	0
Total Credit (Practical)					**5**
Total Semester Credit					**18**

19FY2BS01T	Physics (3-0-0)	3 Credits

Course Objective:

6. Understand and apply the knowledge to analyze the fundamental physics behind their courses in higher semester.
7. Do project works based on theoretical as well as experimental research.
8. Use the knowledge of Physics for Industrial development.
9. Generate fundamental knowledge needed for the future technological advances that will continue to drive the economic engines of the society.
10. Create an exciting intellectual adventure that inspires young mass and expands the frontiers of their knowledge about Nature.

Module I: **[8 Hrs]**

Oscillation & Waves

Simple Harmonic Oscillation: velocity of motion, acceleration, time period, frequency, phase; damped harmonic oscillation: Wave equation of damped vibration, logarithmic decrement, quality factor, relaxation time; Forced oscillation, resonance, velocity resonance and amplitude resonance, coupled oscillation, Normal coordinates and normal frequencies, In-phase and out-of-Phase Oscillation, Concept of wave and wave equation, reflection and transmission of longitudinal waves at boundaries (Concepts).

Module II: **[10 Hrs]**

OPTICS

Concept of interference, two sources interference pattern, Bi-prism, Fringe width, uses of biprism, Newton's ring; measurement of wavelength and refractive index. Diffraction: Huygen's principle, Fresnel's Diffraction and Fraunhoffer's diffraction, Half period zone, Zone plate, construction, principle, multiple foci, comparison of zone plate with convex lens, Fraunhofer's diffraction of Single slit, intensity distribution.

Module III:

LASER and Fiber Optics **[6 Hrs]**

Atomic excitation and energy states, Interaction of external energy with atomic energy states, Absorption, spontaneous emission and stimulated emission, Population inversion, Pumping mechanism, optical pumping, Electrical Pumping, Components of laser system, active medium, population inversion (All concepts only, not details), Ruby laser, Helium-Neon laser, Semiconductor laser (basic concepts, and Engineering application only, mechanism not required), Structure of optical fibre, Principle of propagation and numerical aperture (concept only, derivation not required), Acceptance angle, classification of optical fibre (Single mode and Multi mode, SIN and GRIN), FOCL (Fiber Optic Communication Link)

Solid State Physics **[4 Hrs]**

Crystalline and Amorphous solid, unit cell, lattice parameter, Miller Indices, Reciprocal Lattice (Only concept), Bragg's law, Concept of fermions and Bosons and their distribution Functions, Band theory of Solids (Qualitative), Classification of materials: metals, semiconductor and insulator in terms of band theory.

Module IV: **[8 Hrs]**

Electromagnetism

(Student will be familiarized with some basic used in vector calculus prior to Development of Maxwell's electromagnetic wave equations. No proof of theorems and laws included in this unit **expected- statement and interpretation should sufficient**.)Introduction; Scalar and vector fields, Gradient of Scalar Field, divergence and curl ofVector Field, Gauss divergence theorem, Stokes theorem (Only statements, no proof), Gauss's law of electrostatics in free space and in a medium (Only statements), Faraday's law of electromagnetic induction (Only statements), Displacement current, Ampere's circuital law, Maxwell's equation in Differential and Integral form, Electromagnetic wave equation in E and B, Electromagnetic Energy, Poynting theorem and Poynting vector (no derivation).

Module V: **[10 Hrs]**

Quantum Physics

Elementary concepts of quantum physics formulation to deal with physical systems.

Need for Quantum physics- historical overviews (For concept), Einstein equation, de-Broglie Hypothesis of matter waves, Compton Scattering, Pair production (no derivation), Uncertainty Principle, Application of Uncertainty Principle, Non-existence of electrons in the Nucleus, Ground state energy of a harmonic oscillator. Basic features of Quantum Mechanics: Transition from deterministic to Probabilistic, Wave function, probability density, Normalization of wave function (Simple problem), observables and operators, expectation values (Simple problem), Schrodinger equation-Time dependent and time independent equation.

Course Outcome:

1. Memorize the Definitions, statements of physics.
2. Understand and explain different laws of physics governing our physical world.
3. Analyze the theoretical concepts mathematically as well as graphically.
4. Apply and interpret the knowledge to experimental application.

Text Book:

1. Engineering Physics by Malik and Singh (Mc Graw Hill).
2. Practical of physics, Chattopadhay, & Rakshit
3. Practical Physics, C L. Arora.

Reference Books:

1. Optics - A. K. Ghatak
2. Introduction to Electrodynamics - David J. Griffiths, PHI Publication
3. Concepts of Modern Physics – Arthur Beiser.
4. Physics-I for engineering degree students - B.B. Swain and P.K.Jena.
5. Principle of Physics Vol. I & Vol. II by Md. M. Khan; S. Panigrahi (Cambridge Univ. Press).
6. Physics for Scientists and Engineers, Serway and Jewett,

7. Digital Learning Resources

Course Name	Foundation Engineering
Course Link	https://nptel.ac.in/courses/105/105/105105176/

Course Instructor	Prof. Koushik Deb, Department of Civil Engineering, IIT Kharagpur

19FY2BS02T	Chemistry (3-0-0)	3 Credits

Course Objective:

1. To understand the basics of quantum mechanical concepts and spectroscopy.
2. To predict the bulk properties and processes using thermodynamic considerations.
3. To understand the fundamental concepts on fuels and corrosion chemistry.
4. To know the Basic concepts of electro-chemistry

Module I: **[10 Hrs]**

Quantum Chemistry and Spectroscopy: Introductory concepts of wave-mechanical model for atom, Electromagnetic radiation, dual nature of matter, Uncertainty principle. Operators in quantum mechanics, Postulates of quantum mechanics, Schrodinger Wave Equation, Particle in a box model (1D), Energy levels.

Spectroscopy: Introductory idea on rotational and vibrational Spectroscopy: Principle and applications to diatomic molecules. Beer's-Lambert Law: Principles and applications of UV-Visible Molecular Absorption Spectroscopy; Chromophores, Auxochrome, applications on quantitative analysis. Effect of conjugation on chromophores, solvent effect, Absorption by aromatic systems.

Module II: **[8 Hrs]**

The phase rule: Introduction to free energy and Claussius Clapeyron equation. Statement of Gibb's phase rule(derivation not required) and explanation of the terms involved, Phase diagram of one component system – water and sulfur system, Condensed phase rule, Eutectic system, Phase diagram of two component system –Bi-Cd, and Fe-C system.

Module III: **[8 Hrs]**

Fuels: Classification of fuels, calorific value. (Determination by Dulong's formula), G.C.V. and N.C.V., Solid fuels: Analysis of coal. Liquid fuels: Classification of petroleum, Refining of petroleum, Cracking (Mechanism not required), Knocking in IC engines, cetane and octane numbers. unleaded petrol, synthetic petrol, power alcohol. Gaseous Fuel: Producer gas, Water gas, LPG, CNG. Combustion calculation.

Module IV: **[8 Hrs]**

Electrochemistry: Electrochemical cells, Electrode potentials, Reference electrode (Hydrogen, Calomel), EMF, Relation between EMF and Thermodynamic parameter, Nernst's Equation and it's applications: EMF, pH measurement (using Hydrogen and calomel electrode), Solubility product. Concentration cell, Lead storage cell, H_2-O_2 Fuel cell.

Module V: **[6 Hrs]**

Corrosion: Chemical and Electrochemical corrosion, galvanic series, Types of corrosion: Galvanic corrosion, Differential aeration corrosion (Pitting, Crevice water line corrosion), Stress corrosion (caustic embrittlement in boilers), Factors affecting corrosion, Corrosion control: metal coatings (Galvanizing and Tinning) Corrosion inhibitors, cathodic protection

Course Outcome:

1. Understand the basics of quantum mechanical concepts and spectroscopy.
2. Understand and analyze phase transition and know the conditions of different stable and metastable phase equilibria for both single and binary system.
3. Analyze the quantitative aspects of different kinds of fuel and their combustion and know the properties of different natural and synthetic fuels.
4. To know the basic principles electrochemistry and mechanism of corrosion

Text Books:

1. Wiley Engineering Chemistry, Willey publication
2. Engineering Chemistry, Jain and Jain, Dhanpat Rai Publication.

Reference Books

1. Fundamentals of Molecular Spectroscopy by Banwell, Tata McGraw Hill Education.
2. Textbook on Applied Chemistry by A.N. Acharya and B. Samantaray, Pearson
3. Introductory to Quantum Chemistry by A. K. Chandra, 4th Ed., Mcgraw Hill.
4. Principles of Physical Chemistry by Puri, Sharma &Pathania, Vishal Publishing Co.
5. Engineering Chemistry (NPTEL web-book) by B. L. Tembe, Kamaludddin and M. S. Krishan.
6. Engineering Chemistry by Payal B. Joshi and Shashank Deep, Oxford University Press.

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Course Name	Foundation Engineering
Course Link	https://nptel.ac.in/courses/105/105/105105176/
Course Instructor	Prof. Koushik Deb, Department of Civil Engineering, IIT Kharagpur

19FY2BS03T	Mathematics-II (3-0-0)	3 Credits

Course Objectives:

1. To familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables.
2. To equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Module- I: **[10 Hrs]**

First order ordinary differential equations

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x, Clairat's type, Laplace Transformation.

Module- II: **[10 Hrs]**

Ordinary differential equations of second orders

Second order equations with constant and variable co-efficients, Cauchy-Euler equation, operator method, method of variation of parameters, solutions by power series method.

Module- III: **[6 Hrs]**

Multivariable Calculus (Integration

Line integrals, Double integrals, Green's theorem (without Proof), Surface integrals, Gauss theorem and Stokes Theorem (without Proof).

Module- IV: **[8 Hrs]**

Complex Variable (Differentiation)

Functions of one complex variable, differentiation, Analytic function, Cauchy-Riemann equations, harmonic function, finding harmonic conjugate, Milne-Thomson's method.

Module- V: **[8 Hrs]**

Complex Variable (Integration)

Contour integrals, Cauchy's integral theorem (without proof), Cauchy's integral formula (without proof), Taylor's series, Singularities and zeros, Laurent's series, Residues, Cauchy-Residue Theorem.

Course Outcome:

1. Upon the successful completion of the course, students will be able to:
2. The mathematical tools needed in evaluating multiple integrals and their usage.
3. The effective mathematical tools for the solutions of differential equations that model physical processes.
4. The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

Text Books:

1. Advanced Engineering Mathematics by E. Kreyszig, Tenth Edition, Willey.
2. Higher Engineering Mathematics by B.V. Raman, Mc-Graw Hills Education.
3. Engineering Mathematics by Rohit Khurana, Kanti B. Datta, Cengage Publications.

Reference Books:

1. Ordinary Differential Equations by Purna Chandra Biswal, PHI.
2. A Textbook of Vector Calculus by Shanti Narayan and P.K. Mittal, S. Chand.

Complex Variables and Applications by J.W. Brown and R.V. Churchill, 7th d., Mc-Graw Hill, 2004.

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Course Instructor	Prof. Koushik Deb, Department of Civil Engineering, IIT Kharagpur

19FY2ES01T	Basic Electrical Engineering (2-0-0)	2 Credits

Course Objective:

4. Understand the basics of the Electrical Engineering
5. Able to identify design and solve the engineering problems.
6. Acquire the knowledge and use the concepts in the practical field of Electrical Engineering , Research as well as in project

Module I: **[8 Hrs]**

DC Circuits

Circuit laws: Fundamentals of electrical circuit, Ohm's law, Kirchoff's laws, series and parallel connections, analysis of circuits using node voltage, mesh current, Superposition, Thevenin, Maximum power transfer theorem and Norton theorems to solve simple circuits with dc excitation, Star-Delta Conversion.

DC transient analysis

Analysis of DC transient circuits by consisting of RL & RC combinations, writing differential equations for circuits.

Module II: **[8 Hrs]**

AC Circuits

Single phase AC circuit: Single phase emf generation, representation of sinusoidal waveforms, average, effective, peak and rms values, j operator, impedance and admittance calculation, rectangular and polar representation of phasors.

Power in AC Circuit

Real power, reactive power, apparent power, power factor, analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel).

Module III: **[8 Hrs]**

Three Phase Circuits

Three phase circuit: Three phase emf generation, delta-star and star-delta conversions, and voltage and current relations in star and delta connections.

Three phase interconnections: Solution of the three phase circuits with balanced voltage and balanced load conditions, phasor diagram, measurement of power in three phase circuits.

Module IV: **[8 Hrs]**

Magnetic Circuits

Magnetic Circuits: MMF, flux, reluctance, inductance, review of Ampere Law, Biot Savart Law, magnetic field, B-H characteristics and hysteresis loss, series and parallel magnetic circuits.

Module V: **[6 Hrs]**

Electrical Machines

Transformers (Single Phase): Construction, operation, impedance reflection, phasor diagram, transformer on no-load & on load and performance testing.

DC machines: EMF Equation, torque equation, types of D.C. machine, methods of Excitation, speed control.

Induction Motors (Three Phase): Basic Principles, rotating magnetic field, torque-speed characteristics.

Course Outcome:

1. Analysis of Resistive Circuits and Solution of resistive circuits with independent sources.
2. Two Terminal Element Relationships for inductors and capacitors and analysis of the magnetic circuit.
3. Analysis of Single Phase & Three Phase AC Circuits, the representation of alternating quantities and determining the power in these circuits.
4. Analysis of construction, connection and testing of single-phase transformer.
5. Acquire knowledge about the constructional details and principle of operation of dc machines.
6. Acquire knowledge about the working of dc & AC machines as generators and motors.

Text Books:

1. Giorgio Rizzoni, "Principles and Applications of Electrical Engineering", McGrawHill.
2. N. K. De, D. Sarkar, "Basic Electrical Engineering", University Press.
3. Leonard S. Bobrow , "Foundations of Electrical Engineering", Oxford University Press.

Reference Books:

1. Edward Hughes, "Electrical & Electronics Technology", Pearson Education Limited.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.

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Course Link	https://nptel.ac.in/courses/105/105/105105176/
Course Instructor	Prof. Koushik Deb, Department of Civil Engineering, IIT Kharagpur

19FY2ES02T	Basic Electronics Engineering (2-0-0)	2 Credits

Course Objectives:

1. Develop an understanding of the characteristics and operation of modern semiconductor devices and their applications.
2. Understand the basics of operational amplifier and its applications.
3. Acquire the knowledge of basic logic gates and analyze its application to different combinational logic circuits.

Module I: **[6 Hrs]**

Introduction to Semiconductors, Principle of operation of Junction Diodes, V-I characteristics of Junction Diode, Diode Current Equation, AC and DC Resistance of Diode, Equivalent circuit of Diode, Applications of Diode-Clipper and Rectifier circuits.

Module II: **[6 Hrs]**

Bipolar Junction Transistors (BJTs): Types and Basic Principle of Operation, Modes of Operation and Configurations, Common Emitter Characteristics, Requirement of Biasing, DC Biasing (Fixed bias and Voltage Divider), Load line Analysis, Basic characteristics of a voltage amplifier.

Module III: **[6 Hrs]**

Field Effect Transistors (FETs): JFET-types, Operations and their Characteristics; MOSFET-types, Operations and their Characteristics; Concept of transconductance g_m and channel resistance r_d, Current Equations in FETs.

Module IV: **[4 Hrs]**

Operational Amplifiers (OP-AMP): The Ideal OP-AMP, Common Mode Rejection ratio (CMRR), Inverting and Non-Inverting configurations as amplifiers.

Module V: **[5 Hrs]**

Digital Electronic Principles: Binary digits, Logic levels, Basic Logic Operations, Laws and Rules of Boolean algebra, Logic Gates - AND, OR, NOT, NAND, NOR, XOR and XNOR gate, De Morgan's theorem, Minterms and Maxterms, Standard forms of Boolean expressions, Universal properties of NAND and NOR gates, Function implementation using different Gates.

Course Outcomes:

1. Understand the basic characteristics of semiconductor materials, principle of operation of a p-n junction diode and its use in different circuit design.
2. Understand the construction, operation and characteristics of different types of transistors and learn to solve basic BJT DC circuits.
3. Analyze the basic operational amplifier circuits by understanding its characteristics and configuration details.
4. Gain the knowledge of basic logic gates and its application in functional implementation using Boolean algebra.

Text books:

1. Electronic Devices Circuit Theory - by Robert L. Boylestad 11th Edition, Pearson Publication, 2014. (Modules 1, 2, 3 and 4)
2. Digital Design by M. Morris Mano, 5th Edition, Pearson Publication, 2016. (Module 5)

Reference Books:

1. Microelectronic circuits by Adel S. Sedra and Kenneth C. Smith, 7th Edition, Oxford University Press
2. Electronic Devices and Circuits by David A. Bell, 5th Edition, Oxford University Press
3. Digital Fundamentals by Thomas L. Floyd, 11th Edition, Pearson

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Course Link	https://nptel.ac.in/courses/105/105/105105176/
Course Instructor	Prof. Koushik Deb, Department of Civil Engineering, IIT Kharagpur

19FY2ES03T	Basic Mechanical Engineering(2-0-0)	2 Credits

Course Objective:

1. To understand basic terminologies associated with thermodynamics
2. To understand basic working principle of power plant, IC engine, refrigerator, heat pump, and air compressor.
3. To study the measurement of the fluid characteristics.
4. To give complete knowledge about power transmission.
5. To accustom with various methods of mechanical measurement

Module-I: **[12 Hrs]**

Thermodynamics: Systems, Properties, Process, State, Cycle, Internal energy, Enthalpy, Zeroth Law, Properties of ideal gas., First law of Thermodynamics, and Second Law of Thermodynamics, Properties of pure substances. (Only introduction).

Module-II: **[7 Hrs]**

Application of Thermodynamics: Air compressors, Steam Power Plant, Refrigerators, Heat pump, I.C. Engines and heat exchangers (basics). (Brief description of different components of above mentioned systems and working principles with Schematic diagram only).

Module-III: **[8 Hrs]**

Introduction to Fluid Mechanics: Fluid properties, Pascal's law, Buoyancy and Archimedes principle, Bernoulli's theorem and its application, Hydraulic turbines and pumps.

Module-IV: **[8 Hrs]**

Engineering materials: Classification of engineering materials. Mechanical properties of Steel, Aluminium and Plastics; Production processes: Casting and forming (Drawing, Forging, Extrusion) (working principles with Schematic diagram only).

Module-V: **[8 Hrs]**

Power transmission devices: Belt, Rope, Gear drives. Coupling, clutch, brakes. (Basics, applications, advantages and limitations only); Mechanical Measurements: Temperature, pressure, velocity, flow, strain, force, torque measurements. (Working principle only).

Course Outcome:

1. Understand basics of thermodynamics, heat transfer, refrigeration and internal combustion engines, and components of a thermal power plant.
2. Solve the numeric related to Laws of thermodynamics and pure substances.
3. Understand basics and application of the fluid.
4. Identify engineering materials, their properties, manufacturing methods encountered in engineering practice.
5. Understand mechanism of power transfer through belt, rope, gear drives, coupling, clutch, brakes.
6. Understand functions and operations of the measurement devices.

Suggested Books:

1. Basic Mechanical Engineering by Pravin Kumar, Pearson

2. Basic Mechanical Engineering by Dr. Sadhu Singh, S.Chand Publications
3. Basic Mechanical Engineering by Basant Agrawal, C M Agrawal, Willey
4. Basic Mechanical Engineering by K. Mylsamy, Jonathan Wicket, Cenage publication
5. Text book of Elements of Mechanical Engineering, S T Murthy, Universities press
6. Basic and applied Thermodynamics by P. K. Nag, Tata McGraw Hill
7. https://nptel.ac.in/downloads/112108148/

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Course Link	https://nptel.ac.in/courses/105/105/105105176/
Course Instructor	Prof. Koushik Deb, Department of Civil Engineering, IIT Kharagpur

19FY2ES04T	Basic Civil Engineering (2-0-0)	2 Credits

Course Objective:

1. To understand the properties of common building materials.
2. To learn functional planning of building
3. To Understand the concepts of stress and strain of structural members
4. To learn the various methods of surveying
5. To understand public water supply system

Module-I: **[8 Hrs]**

Basics of Civil Engineering; Broad disciplines of Civil Engineering;Structural Engineering, Geotechnical Engineering,Water Resources Engineering,Transportation Engineering.
Construction materials:Bricks: Qualities of a good brick, Classification of bricks. Types of cement and their uses, Various field and laboratory tests on cement, Ingredients of cement concrete, Grades of concrete,workability of concrete.

Module-II: **[6 Hrs]**

Functional planning of building:General principles of site selection, site plan, principles of planning ofbuildings, open air spaces, floor area ratio, requirement of parts of buildings, lighting and ventilation,functional aspects various rooms, Building bye laws. orientation of building.

Module-III **[8 Hrs]**

Structural mechanics: Stress, Strain, Hookes' Law, Stress-Strain diagram, Young's modulus , Bulkmodulus, Shear modulus of rigidity, Poisson's ratio.
Parallel forces in a plane- General case of parallel forces, Center of parallel forces in a plane

Module-IV **[8 Hrs]**

Surveying: Linear measurement and chain survey: Use of chains and tapes for measurement of correctlength of lines. Prismatic Compass; Bearing Systems and Conversions ,Local Attraction.

Module-V **[6 Hrs]**

Water resources engineering: Necessity and objectives of public water supply schemes; populationgrowth and forecast –estimating the quantity of water required.

Course Outcomes:

At the end of the course, the student will be able to:

1. Compare the properties of building materials.
2. Planning and design of building
3. Understand the concepts of stress and strain of structural members
4. use of various surveying instruments and mapping
5. estimate the quantity of water required for a project

Text Books:

1. Basic Civil Engineering and Engg mechanics, S.Ramamurtham Dhanpatrai pub.
2. Basic Civil Engineering, M.S. Palanichamy, McGraw Hill
3. Basic Civil Engineering, S.S.Bhavikatti,New age international
4. Basic Civil Engineering, S. Gopi, Pearson

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Course Link	https://nptel.ac.in/courses/105/105/105105176/
Course Instructor	Prof. Koushik Deb, Department of Civil Engineering, IIT Kharagpur

19FY2ES05T	Problem Solving Using C (3-0-0)	3 Credits

Course Objective:
The course aims to provide exposure to problem-solving through programming. It aims to train the student to the basic concepts of the C-programming language. This course involves a lab component which is designed to give the student hands-on experience with the concepts.

Module-I: **[8 Hrs]**
Introduction to Programming
Computers Fundamentals: Recap of Classification of Computers, Application of Computers, Basic organization of computer, Input and Output Devices, Binary Number System, Computer memory, Computer Software, operating system, compilers etc. Idea of Algorithm: Steps to solve logical and numerical problems. Representation of Algorithm: Algorithm/Flowcharts/Pseudocode, Generation of Programming Languages. Introduction to Language: Structure of C Program, Life Cycle of Program from Source code to Executable, Compiling and Executing C Code, Keywords, Identifiers, Primitive Data types in C, variables, constants, input/output statements in C. Operators and Expressions: Expression evaluation: Operator Precedence and Associativity.

Module-II: **[10 Hrs]**
Control Structure and Array
Conditional Branching: One (simple if), two (if else) and multi way selection(else if ladder and switch and nested selection), Iteration and loops: Iterative statements, nested loops, break and continue statements. Arrays & Strings:One-dimensional, Two-dimensional and Multi-dimensional arrays, operations on array: traversal, insertion, deletion, merging and searching, Character arrays and Strings and String Operations (with and without library functions).

Module-III: **[10 Hrs]**
Function & Pointer
Function: Declaration, Definition, Call and return, Call by value, Call by reference, showcase stack usage with help of debugger, Scope of variables, Storage classes, Recursive functions, Recursion vs Iteration. Example programs, such as Finding Factorial, Fibonacci series. Pointers: Idea of pointers, Defining pointers, Use of Pointers in Inter-function communication via arrays, matrices. Reading, writing and manipulating Strings, Understanding computer memory, accessing via pointers, pointers to arrays, dynamic allocation, drawback of pointers. Dynamic memory allocation: Memory Layout Implicit vs. Explicit Allocation; Static vs. Dynamic Allocation; Motivation for Dynamic Allocation.

Module-IV: **[8 Hrs]**
Structure & File
Structures, Defining structures and Array of Structures, Structure vs Union, self-referential structures, nested structures, notion of linked list (no implementation)Pre-processor and Storage classes, File handling: ASCII and binary Files, command line arguments.

Module-V: **[4 Hrs]**
Searching and Sorting
Introduction to searching and sorting, Linear search, Binary search, selection sort, Bubble sort.

Course Outcomes:

Upon the successful completion of the course, students will be able to:
Describe the basics of programming language and its syntax and understand the problem solving aspect.

1. Design and develop C program to solve different real life problems efficiently.
2. Analyse and compare different possible solutions.

Text Books:

2. Behrouz A. Forouzan & Richard F. Gilberg, "A structured Programming Approach Using C", 3rd Edition, Cengage Publication, ISBN: 9788131503638, 2007.
3. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, 2nd Edition, Prentice Hall of India, 2015.
4. Byron Gottfried, Schaum's Outline of Programming with C, 3rd Edition, McGraw-HillBook, 1st July 2017.

1. https://nptel.ac.in/courses/106105085/4 [Last accessed on: 08/05/2019]

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Course Link	https://nptel.ac.in/courses/105/105/105105176/
Course Instructor	Prof. Koushik Deb, Department of Civil Engineering, IIT Kharagpur

19FY2BS01L	Physics Lab (0-0-2)	1 Credit

A student is expected to perform ten experiments form the list given below.

16. Determination of Young's modulus by Searle's method.
17. Determination of Young's modulus by bending of beams.
18. Determination of Rigidity modulus by static method.
19. Determination of surface tension by capillary rise method.
20. Determination of acceleration due to gravity by Bar pendulum.
21. Verification of laws of vibration of string using sonometer.
22. Determination of wave length of light by Newton's ring apparatus.
23. Determination of wavelength of laser source by diffraction rating method.
24. Determination of grating element of a diffraction grating.
25. Plotting of characteristic curve of a PN junction diode.
26. Plotting of characteristic curves of BJT.
27. Study of Hall Effect.
28. Study of RC circuit.
29. Determination of unknown resistance using Meter Bridge.
30. Energy gap determination by Four-Probe method.

Books:

1. Engineering Practical Physics, by S. Panigrahi and B. Mallick, (CENGAGE learning)

19FY2BS02L	Chemistry Lab (0-0-2)	1 Credit

Course Objective:

4. To understand the water quality parameter
5. Quantitative analysis of some standard compound
6. Instrumental methods for quantitative analysis

Experiments (for all branches):

16. Determination molecular weight of polymer by viscosity method.
17. Determination of partition coefficients of iodine between Toluene and water.
18. Determination of rate constant of acid catalyzed hydrolysis reaction.
19. Determination of dissolved oxygen in a sample of water.
20. Determination of Viscosity of a supplied sample(s) by Ostwald's Viscometer.
21. Determination of Flash point of given oil by Pensky-Marten's flash point approach.
22. Determination of critical solution temperature of Phenol-Water system.
23. Determination of Calorific value of a fuel using Bomb calorimeter.
24. Determination of percentage of available chlorine in a sample of bleaching powder.
25. Acid-Base Titration using pH meter
26. Estimation of acid mixture using Conductance Bridge.
27. Determination of total hardness of water by EDTA method.
28. Determination of amount of sodium hydroxide and sodium carbonate in a mixture.
29. Kinetic study of ester hydrolysis.
30. Determination of surface tension of given sample using Stalagnometer

Course Outcome:

4. Analyze the water quality parameter including dissolved oxygen, Hardness, and chlorine content.
5. Analyze qualitatively different compounds using analytical equipments like, pH meter, Conductivity meter, Colorimeter etc.
6. Qualitative analysis of liquid sample through viscosity and surface tension measurement

Suggested Books:

3. Laboratory manual on Engineering Chemistry, S.K. Bhasin, Sudha Rani, Dhanpat Rai Publishing company.
4. Experiments in Applied Chemistry By Dr. Sunita Ratan, S.K. Kataria and sons.

19FY2ES01L	Basic Electrical Engineering Lab(0-0-2)	1 Credit

Course Objective:

5. To enhance understanding of electrical engineering circuit analysis concepts including: Thevenin's theorem, Norton's theorem, Superposition Theorem
6. To get the knowledge of phasor representation, power and power factor measurement of electrical circuit
7. To know the concept of B-H Curve of the magnetic materials and to know the functionality of the transformer with their losses by conducting suitable tests on it.
8. To Apply knowledge of DC generators and motors in various applications and able to know the uses of starter

List of Experiments:

11. V-I Characteristics of Incandescent (Filament) Lamp
12. Voltage and Power measurement of a Fluorescent Lamp
13. Verification of DC Network Theorems (Superposition, Thevenin's & Norton's Theorem)
14. Calculation of current, voltage and power in series R-L-C circuit excited by single phase AC supply and calculation of power factor
15. Measurement of power and power factor in a three phase AC circuit by using Two-Wattmeter method
16. Connection and testing of a Single Phase Energy Meter
17. O.C & S.C Test on Single phase Transformer
18. Starting and Speed Control of a D.C. Shunt Motor
19. Study of B-H curve by using by using CRO
20. House Wiring

Course Outcome:

After completion of this course the students will be able to:

5. Determination of DC network analysis with the use of theorems and their applicability for the practical application.
6. Know the fundamentals magnetic field theory, able to apply the laws of magnetic field for the transformer and also determination of its losses by conducting suitable tests
7. Understand the concept of Phasor representation and Power factor measurement of AC circuit
8. Analyze the performance of D.C machines and it various practical applications.

19FY2ES02L	Basic Electronics Engineering Lab(0-0-2)	1 Credit

Course Objective:

5. Understand the measurement techniques using basic measuring instruments.
6. Expose to characteristics and testing of various electronics components.
7. Assemble and test different circuits using diode and op-amps.
8. Verify the truth table of basic logic gates.

Any ten Experiments out of 12 should be performed

12. Study of digital multi-meters, CROs and function generators.
13. Familiarization and testing of different electronic components (Active & Passive).
14. Study of the V-I characteristics of P-N junction diode and calculation of DC & AC resistance.
15. Construction of half-wave rectifier with & without capacitive Filter and verify the output waveforms using CRO and calculation of efficiency and ripple factor.
16. Constructions of full wave rectifier circuits with & without capacitive Filter and verify the output waveforms using CRO and calculation of efficiency and ripple factor.
17. Design a Zener based voltage regulator to verify the load regulation.
18. Construction of positive and negative clipper circuits and study of their output waveforms by CRO.
19. Study of both input and output V-I characteristics of a Common Emitter configuration.
20. Study of output V-I characteristics of an n-channel JFET and define the pinch off voltage from it.
21. Design of inverting and non-inverting amplifiers using Op-Amp and compare the theoretical and practical gain values.
22. Truth table verification of logic gates.

Verification of universal properties of NAND and NOR gates.

Course Outcome:

5. Identify and test basic electronics components using test and measuring instruments.
6. Design, assemble and test of diode characteristics and its application in circuits.
7. Design and testing of op-amp based configurations.
8. Familiarization and testing of basic logic gates.

19FY2ES03L	Basic Mechanical Engineering Lab(0-0-2)	1 Credit

List of Experiments:

12. Model study of Fire Tube Boilers and Water Tube Boilers.
13. Model study of Two stroke I.C. Engine.
14. Model study of Four stroke I.C. Engine.
15. Model study of Refrigerator
16. Model study of Water Turbines.
17. Model study of Water pumps.
18. Study of Gears and Gear trains.
19. Verification of Bernoulli's Theorem and its application to Venturimeter.
20. Calibration of Bourdon Tube Pressure gauge and measurement of pressure using manometers.
21. Model study of Automobile Parts.
22. Determination of velocity ratio of belt drive.

19FY2ES04L	Basic Civil Engineering Lab(0-0-2)	1 Credit

List of Experiments:

11. Shape, size and compressive strength test of brick
12. Consistency Test of Cement
13. Setting time of cement
14. Workability test of concrete: Slump test
15. Line plan of a two BHK building in a plot.
16. Plan, section and elevation of a building.
17. Cube test of concrete (nominal mix)
18. Experiment on calculation of support Reactions of a simply supported beam.
19. Experiment on calculation of support Reactions of a overhanging beam.
20. Chain traversing through obstacles

19FY2ES05L	Programming Lab	1 Credit

Course Objective:
This course is aimed at concepts of programming and software code development of moderate complexity using C programming language within the framework of structural and procedural programming paradigms.

List of Suggested Programs

1. Familiarity with basic LINUX command, vi editor.
2. Programs on arithmetic expressions, data type limits, operators and precedence.
3. Programs on Conditional Branching.
4. Programs on Loops.
5. Programs on single dimensional array.
6. Programs on two-dimensional array.
7. Programs on String operations (with and without library functions)
8. Programs on Functions (searching and sorting).
9. Programs on Recursive Functions.
10. Programs on Pointers.
11. Programs on Dynamic Memory Allocation.
12. Programs on Structure & Union.
13. Programs on File Handling.

Course Outcomes:

Upon the successful completion of the sessional course, students will be able to:

1. Understand problem solving approach of moderate complexity in Linux environment.
2. Design and develop C program to solve different real life problems efficiently.
3. Analyse and compare different possible solutions.

19FY2ES06L	Engineering Graphics & Design (0-0-2)	1 Credit

Module- I: **[6 Hrs]**

Importance of graphics in engineering applications – Use of drafting instruments. BIS conventions and specifications. Size, layout and folding of drawing sheets – Lettering and dimensioning; Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle. Drawing of tangents and normal to the above curves.

Module- II: **[8 Hrs]**

Orthographic Projections

Introduction, Definitions - Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only),True and apparent lengths, True and apparent inclinations to reference planes **2 – Sheets**

Module- III: **[8 Hrs]**

Orthographic Projections of Plane Surfaces (First Angle Projection Only)

Introduction, Definitions–projections of plane surfaces–triangle, square, rectangle, rhombus, pentagon, hexagon and circle, planes in different positions by change of position method only **1-Sheet**

Module- IV: **[10 Hrs]**

Projections of Solids (First Angle Projection Only)

Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, pyramids, cylinders and cones in different positions. **2-Sheets**

Sections and Development of Lateral Surfaces of Solids

Introduction, Section planes, Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP. **2 – Sheet**

Module- V: **[8 Hrs]**

Isometric Projection (Using Isometric Scale Only)

Introduction, Isometric scale, Isometric projection of simple plane figures, Isometric projection of tetrahedron, hexahedron(cube), right regular prisms, pyramids, cylinders, cones, spheres, cut spheres. **2-Sheets**

Suggested Books:

6. Engineering Drawing - N.D. Bhatt & V.M. Panchal, Charotar Publishing House, Gujarat.
7. Computer Aided Engineering Drawing - S. Trymbaka Murthy, -I.K. International Publishing House Pvt. Ltd., New Delhi.
8. Engineering Drawing by N.S.Parthasarathy and Vela Murali Oxford University Press.
9. Engineering Graphics - K.R. Gopalakrishna, Subash Publishers Bangalore.

10. Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production-Luzadder Warren J., Duff John M., Eastern Economy Edition, Prentice-Hall of India Pvt. Ltd., New Delhi.

19FY2ES07L	Workshop (0-0-2)	1 Credit

Topic	Hour
Safety: Workplace safety: Safety rules for workplace organization. Survival techniques and evacuation procedure in case of hazard at workplace.	1
Personal safety: Personal protection equipment, safe workplace behaviour; First aid techniques: General first aid, resuscitation.	2
Tooling: Introduction to different tools used in engineering fabrication; Tool organization: Tool board, tool box.	3
Fitting practice (Any one experiment): 3. Preparing a male and female joint; 4. Making a hexagonal paper weight. (Material: MS);	6
Joining practice: Gas welding, electric arc welding, Gas brazing Prepare any two: 1. Lap joint 2. Butt joint 3. T-joint using appropriate joining technique	6
Carpentry: Engineering description of wood: composition, type, texture, grains. Any one experiment- Male female T-joint (or) Male female elbow joint.	3
Plumbing practice: Plumbing elements (Demonstration), Threading and assembly, Introduction to PVC fittings, quick joining (Demonstration), Leakage prevention with cementing components (Demonstration).	3
Machining practice: All experiments - Stepped cylindrical turning from a bar stock using 3-jaw chuck; Making rectangular and trapezoidal slots using shaping operation; Gear cutting using milling machine; Cutting rectangular slot using dremel;	12