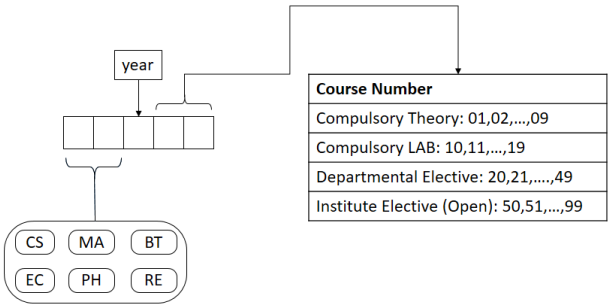
INDIAN INSTITUTE OF INFORMATION TECHNOLOGY BHAGALPUR

B.Tech. Course Structure (1st and 2nd year)

Computer Science and Engineering (CSE)

Course Code	Course name	L	T	P	C	Year	Semester	semester total credit	
CS101	**Computer Programming**	**3**	**1**	**0**	**8**	1	1	42	APPROVED IN THE 1ST ACADEMIC COMMITTEE MEETING
CS110	**Computer Programming LAB**	**0**	**0**	**3**	**3**				
EC101	**Digital Design**	**3**	**1**	**0**	**8**				
EC102	**Electrical Circuit Analysis**	**3**	**1**	**0**	**8**				
EC110	**Digital Design LAB**	**0**	**0**	**3**	**3**				
HS101	**English**	**2**	**0**	**0**	**4**				
MA101	**Mathematics I**	**3**	**1**	**0**	**8**				
	NCC/NSO/NSS	**0**	**0**	**2**	**0**				
CS103	**Data Structures**	**3**	**1**	**0**	**8**	1	2	44	
CS104	**Computer Organization**	**3**	**1**	**0**	**8**				
CS111	**Data Structures LAB**	**0**	**0**	**3**	**3**				
EC103	**Basic Electronic Circuits**	**3**	**1**	**0**	**8**				
EC111	**Basic Electronics LAB**	**0**	**0**	**3**	**3**				
HS102	**Economics**	**3**	**0**	**0**	**6**				
MA102	**Mathematics II**	**3**	**1**	**0**	**8**				
	NCC/NSO/NSS	**0**	**0**	**2**	**0**				
BT201	Engineering Biology	3	0	0	6	2	3	46	APPROVED IN THE 2nd ACADEMIC COMMITTEE MEETING
CS201	Design and Analysis of Algorithms	3	0	0	6				
CS202	Discrete Mathematics	3	1	0	8				
CS203	Object Oriented Programming	3	0	0	6				
CS210	IT Workshop	0	0	3	3				
CS211	Object Oriented Programming Lab	0	0	3	3				
MA201	Mathematics III	3	1	0	8				
PH201	Engineering Physics	3	0	0	6				
CS204	Database Management System	3	0	0	6	2	4	40	
CS205	Formal Language and Automata	3	1	0	8				
CS206	Operating System	3	0	0	6				
CS212	Database Management System Lab	0	0	3	3				
CS213	Operating System Lab	0	0	3	3				
MA202	Probability and Random Process	3	1	0	8				
RE201	Renewable Energy and Applications	3	0	0	6				

Course Code Nomenclature Schem



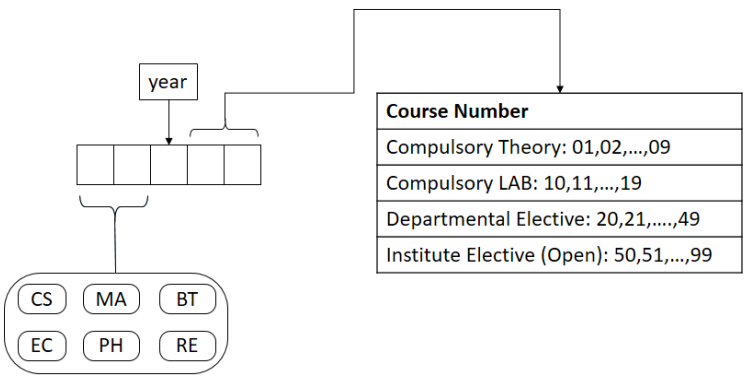
INDIAN INSTITUTE OF INFORMATION TECHNOLOGY BHAGALPUR

B.Tech. Course Structure (1st and 2nd year)

Electronics and Communication Engineering (ECE)

Course Code	Course name	L	T	P	C	Year	Semester	semester total credit	
CS101	**Computer Programming**	**3**	**1**	**0**	**8**	1	1	42	APPROVED IN THE 1ST ACADEMIC COMMITTEE MEETING
CS110	**Computer Programming LAB**	**0**	**0**	**3**	**3**				
EC101	**Digital Design**	**3**	**1**	**0**	**8**				
EC102	**Electrical Circuit Analysis**	**3**	**1**	**0**	**8**				
EC110	**Digital Design LAB**	**0**	**0**	**3**	**3**				
HS101	**English**	**2**	**0**	**0**	**4**				
MA101	**Mathematics I**	**3**	**1**	**0**	**8**				
	NCC/NSO/NSS	**0**	**0**	**2**	**0**				
CS103	**Data Structures**	**3**	**1**	**0**	**8**	1	2	44	
CS104	**Computer Organization**	**3**	**1**	**0**	**8**				
CS111	**Data Structures LAB**	**0**	**0**	**3**	**3**				
EC103	**Basic Electronic Circuits**	**3**	**1**	**0**	**8**				
EC111	**Basic Electronics LAB**	**0**	**0**	**3**	**3**				
HS102	**Economics**	**3**	**0**	**0**	**6**				
MA102	**Mathematics II**	**3**	**1**	**0**	**8**				
	NCC/NSO/NSS	**0**	**0**	**2**	**0**				
BT201	Engineering Biology	3	0	0	6	2	3	46	APPROVED IN THE 2nd ACADEMIC COMMITTEE MEETING
CS203	Object Oriented Programming	3	0	0	6				
CS211	Object Oriented Programming Lab	0	0	3	3				
EC201	Control Systems	3	1	0	8				
EC202	Signals and Systems	3	0	0	6				
EC210	Signals and Systems LAB	0	0	3	3				
MA201	Mathematics III	3	1	0	8				
PH201	Engineering Physics	3	0	0	6				
EC203	Analog Circuits	3	0	0	6	2	4	42	
EC204	Principles of Communications	3	1	0	8				
EC205	Semiconductor Devices	3	1	0	8				
EC211	Analog Circuits LAB	0	0	3	3				
EC212	Communication LAB	0	0	3	3				
MA202	Probability and Random Process	3	1	0	8				
RE201	Renewable Energy and Applications	3	0	0	6				

Course Code Nomenclature Scheme:



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY BHAGALPUR

B.Tech. Course Structure

CSE Core Courses:

CS101: Computer Programming 3-1-0-8

Procedural programming through Language 'C': Basic Syntax and Semantics; Variables; Types; Expressions; Assignment statements; Conditional and Iterative Control Structures; Simple I/O; Functions and parameter passing; Strings and string processing; Pointers and References; Structures; Recursion.
Algorithm development: Techniques of problem solving; Stepwise Refinement; Simple numerical examples; algorithms for searching and sorting; merging order lists. Examples taken from real-world applications involving data manipulation.

Texts:

1. Bryon Gottfried, Programming with C, 3rd edition, McGraw Hill, 2010.

References:

1. Horowitz, Sahni, and Anderson-Freed, Fundamentals of Data Structures in C, 2nd edition, Universities Press, 2011.
2. Kernighan and Ritchie, The C Programming Language, 2nd edition, PHI, 2012.

CS103: Data Structures 3-1-0-8

Performance of algorithms: space and time complexity, asymptotics; Fundamental Data structures: linked lists, arrays, matrices, stacks, queues, binary trees, tree traversals; Algorithms for sorting and searching: linear search, binary search, insertion-sort, selection sort, bubble-sort, quicksort, mergesort, heapsort, shellsort; Priority Queues: lists, heaps, binomial heaps, Fibonacci heaps; Graphs: representations, depth first search, breadth first search; Hashing: separate chaining, linear probing, quadratic probing; Search Trees: binary search trees, red-black trees, AVL trees, splay trees, B-trees; Strings: suffix arrays, tries; Randomized data structures: skip lists.

Texts:

1. Seymour Lipschutz, Data Structures with C, SCHAUM SERIES, 1st edition, Tata McGraw-Hill, 2010.

References:

1. M. A. Weiss, Data Structures and Problem Solving Using Java, 4th edition, Addison-Wesley, 2009.
2. A. M. Tannenbaum, Y. Langsam and M. J. Augenstein, Data Structures Using C++, 2nd edition, Prentice Hall India, 2007.
3. A. H. Aho, J. E. Hopcroft and J. Ullman, Data Structures and Algorithms,1st edition, Addison-Wesley, 2002.
4. Robert Sedgewick, Algorithms in C++ Parts 1-4, 3rd edition, Pearson Education, 1998.
5. Robert Sedgewick, Algorithms in C++ Part 5, 3rd edition, Pearson Education, 2002.

CS104: Computer Organization 3-1-0-8

Basic Computer Architecture; ARM Instruction Set and Assembly Language Programming; Computer Arithmetic: integer addition (carry look-ahead), multiply (booth's algorithm), division (restoring and non-restoring), floating point arithmetic; Processor Design – single cycle, multi-cycle; pipelined design; memory architecture (static and Dynamic RAM; row and column addressing; interleaving, banks), cache memory (direct, set-associative, multi-level); storage basics: disks, tapes, printers, displays, flash memory; Buses (daisy chaining; synchronous and asynchronous; point-to-point; PCI, PCIe); Intel Sandy Bridge Archtecture; Intel X86 instruction set introduction.

Texts:

1. David A. Patterson and John L. Hennesy, Computer Organization and Design: The Hardware Software Interface, ARM Edition, 4th edition, Elesevier India, 2010.

CS201: Design and Analysis of Algorithms 3-0-0-6

Models of Computation: space and time complexity measures, lower and upper bounds; Design techniques: the greedy method, divide-and-conquer, dynamic programming, backtracking, branch and bound; Lower bound for sorting; Selection; Graph Algorithms: connectivity, topological sort, shortest paths, minimum spanning trees, network flow; The disjoint set union problem; String matching; NP-completeness; Introduction to approximate algorithms and Randomized algorithms.

Text Books:

1. Cormen, Thomas H. Introduction to algorithms. MIT press, Third Edition, 2009.

Reference Books:

1. Kleinberg, Jon, and Eva Tardos. Algorithm design. Pearson Education India, First Edition, 2013.
2. Sahni, Sartaj. Data structures, algorithms, and applications in C++. Universities Press, Second Edition, 2005.

CS202: Discrete Mathematics(CSE) 3-1-0-8

Set Theory: Set, Relation, Mapping, Bijections, Countable-Uncountable Sets, Partial Orders, Lattices;

Logic: Propositional Logic, Predicate Logic; Counting Principles: Pigeonhole Principle, Principle of Inclusion and Exclusion, Generation Functions, Recurrence Relation;

Number Theory: Division Algorithm, Euclid's Algorithm, Fundamental Theorem of Arithmetic, and Chinese Remainder Theorem;

Graphs: Graphs, Sub graphs, Adjacency Matrix, Isomorphism, Connectedness, Trees, Eulerian and Hamiltonian Graphs, Bipartite Graphs, Matching, Planer Graph, Vertex Coloring.

Text Books:

1. Kenneth H. Rosen, Discrete Mathematics and Its Applications, Tata McGraw-Hill Education, 7th Edition, 2012.

Referenc Books:

1. Joe L. Mott, Abraham Kandel and Theodore P. Baker, Discrete Mathematics for Computer Scientists and Mathematicians, PHI Learning, 2nd Edition, 2009.

2. Jean-Paul Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw-Hill Education, 1st Edition, 2001.

CS203: Object Oriented Programming 3-0-0-6

Introduction: Introduction to object oriented programming, Characteristics of Object-Oriented Languages; Basic terms and ideas: Abstraction, Encapsulation, Information hiding, Inheritance, Polymorphism, Difference between C and C++, cin, cout, new, delete operators; Classes and Objects: Abstract data types, Object & classes, attributes, methods, C++ class declaration, State identity and behavior of an object, Constructors and destructors, instantiation of objects, Default parameter value, Copy Constructor, Static Class Data, Constant and Classes, C++ garbage collection, dynamic memory allocation; Inheritance and Polymorphism: Inheritance, Types of Inheritance, Class hierarchy, derivation – public, private & protected, Aggregation, composition vs classification hierarchies, Polymorphism, Type of Polymorphism – Compile time and runtime, Method polymorphism, Polymorphism by parameter, Operator overloading, Parametric polymorphism, Generic function – template function, function name overloading, Overriding inheritance methods; Files and Exception Handling: Persistant objects, Streams and files, Namespaces, Exception handling, Generic Classes; Standard Template Library: Standard Template Library, Overview of Standard Template Library, Containers, Algorithms, Iterators, Other STL Elements, The Container Classes, General Theory of Operation, Vectors.

Text Books:

1. Schildt, Herbert. C++: the complete reference. Tata McGraw-Hill, 4th Edition, 2003.

Reference Books:

1. Stroustrup, Bjarne. The C++ programming language. Pearson Education India, 4th Edition, 2013.

2. Balagurusamy, E. Object Oriented Programming with C++, Tata McGraw-Hill Education, 6th Edition, 2016.

CS204: Database Management System 3-0-0-6

Databases: Introduction, Introduction to the Relational Model, Introduction to SQL, Intermediate SQL, Advanced SQL, Formal Relational Query Languages; Database Design: ER Model, Functional Dependencies, Schema Design, Normal Forms; Data Storage and Querying: Storage and File Structure, Indexing and Hashing, Query Processing, Query Optimization, Stored procedure; Transaction Management: Transactions, Concurrency Control, Recovery System; System Architecture: Database System Architecture, Parallel Databases, Distributed Databases; Advanced Topics: Data Warehousing and Mining, Information Retrieval, XML.

Text Books:

1. Silberschatz, Abraham, Henry F. Korth, and Shashank Sudarshan. Database system concepts. Tata McGraw-Hill, 6th Edition, 2013.

References:

1. Date, Christopher John. An introduction to database systems. Pearson Education India, 8th Edition, 2004.

2. Elmasri, Ramez, and Shamkant B. Navathe. Fundamentals of database systems. Pearson, 7th Edition, 2016.

CS205: Formal Language and Automata 3-1-0-8

Alphabets, language, grammars; Finite Automata, regular language, regular expression; Context free grammars, Push Down Automata; Context Sensitive grammars, Linear Bounded Automata; Turing Machines, design of Turing Machine, Universal Turing Machine, Halting Problem; Operations on formal language and their properties; Chomsky hierarchy.

Text Book:

1. J. E. Hopcroft, R. Motwani, and J. D. Ullman, Introduction to Automata Theory, Languages and computation, Pearson Education, 3rd Edition, 2007.

References:

1. Linz, Peter. An introduction to formal languages and automata. Jones & Bartlett Publishers, 6th Edition, 2017.
2. M. Sipser, Theory of Computation, Cengage Learning, 3rd Edition, 2012.

CS206: Operating System 3-0-0-6

Process Management: process, thread, scheduling; Concurrency: mutual exclusion, synchronization, semaphores, deadlocks; Memory Management: allocation, protection, hardware support, paging, segmentation; Virtual Memory: demand paging, allocation, replacement, swapping, segmentation, TLBs; File Management: naming, file operations and their implementation; File Systems: allocation, free space management, directory management, mounting; I/O Management: device drivers, disk scheduling, Basics of Security, Basic introduction to Cloud computing.

Text Book:

1. Silberschatz, Abraham, James Lyle Peterson, and Peter B. Galvin. Operating system concepts. Reading, Wiley, 9th Edition, 2012.

References:

1. Stallings, William. "Operating Systems: Internals and Design Principles.", Pearson Education, 9th Edition, 2017.
2. Tanenbaum, Andrew S. Modern operating system. Pearson Education, 4th Edition, 2015.
3. Hurwitz, Judith, et al. Cloud computing for dummies, John Wiley & Sons, 1st edition, 2009.

CSE Lab Courses:

CS110: Computer Programming Lab 0-0-0-3

Programming assignments on: Basic Assignment Statement; Conditional and Iterative Control Structures; Some Numerical Examples; Functions and parameter passing; Array and String; Pointer; Structure; Recursion; Dynamic Memory Allocation; File Handling; Linked List; Sorting; Command Line Arguments.

CS111: Data Structures Lab 0-0-3-3

Programming assignments on: Using C Programming Language, Implementation of linked lists, stacks, queues, binary trees, tree traversals.
Implementation of algorithms for sorting: Insertion-sort, selection sort, bubble-sort, quicksort, mergesort, heapsort, shellsort; Implementation of algorithms for searching: linear search, binary search.
Assignments on Priority Queues: lists, heaps, binomial heaps, Fibonacci heaps; Graphs: representations, depth first search, breadth first search; Hashing: separate chaining, linear probing, quadratic probing.
Assignments on search Trees: binary search trees, red-black trees, AVL trees, splay trees, B-trees; Strings: suffix arrays, tries; Randomized data structures: skip lists.

CS 210: IT Workshop 0-0-3-3

Linux Operating System: Overview of Linux System and basic commands, Basic Linux Administration, Linux File System; Shell Programming Using Bash; Introduction to Web Development: HTML Basics, Cascading Style Sheet (CSS), JavaScript, Basics of HTML5 elements, Basic introduction to XML, Basic introduction to PHP.

Text:

1. Das, Sumitabha. UNIX System V. 4: Concepts and Applications. Tata McGraw-Hill, 4th Edition, 2006.
2. Jennifer Niederst Robbins. Learning Web design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics. " O'Reilly Media, Inc.", 4th Edition, 2012.
3. Kogent Learning Solutions, Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, ASP.NET, XML and Ajax, Black Book, Dreamtech Press, 1st edition, 2012

CS211: Object Oriented Programming 0-0-3-3

Practical will be based on Object Oriented Programming using C++: Concepts of classes and objects, Inheritance and Polymorphism, Files and Exception Handling, Overview of Standard Template Library.

Text/Reference:

1. Schildt, Herbert. C++: the complete reference. Tata McGraw-Hill, 4th Edition, 2003.

2. Balagurusamy, E. Object Oriented Programming with C++, Tata McGraw-Hill Education, 6th Edition, 2016.

CS212: Database Management System Lab 0-0-3-3

Exercise to create simple tables and table with constraints, insert data into tables
Exercise on different forms of select statement.
Exercise on updating and deleting data using different conditions.
Exercise on group by and having clause.
Exercise on queries based joining different tables.
Exercise on nested queries and correlated Queries.
Exercise on data functions, group and scalar functions.
Exercise on Indexes, views and sequences.
Exercises on creation of PL/SQL blocks.
Exercises on cursor management in PL/SQL.
Exercise on trigger statement.

Exercise to write C program to create own database based on file, parse different basic queries and output them.

Text/Reference:

1. Silberschatz, Abraham, Henry F. Korth, and Shashank Sudarshan. Database system concepts. Tata McGraw-Hill, 6th Edition, 2013.
2. James R Groff, Paul N. Weinberg and Andy Oppel, The Complete Reference SQL, TMG Publication, 3rd Edition, 2011.

CS213: Operating System Lab 0-0-3-3

Programming assignments on:

1. Linux Programming with System Calls
2. Critical Section Problems
3. Scheduling
4. Memory Management
5. File Systems

Alternative, to build parts of an OS kernel. Use of a teaching package such as Nachos, Pintos.

Text/Reference:

1. Silberschatz, Abraham, James Lyle Peterson, and Peter B. Galvin. Operating system concepts. Reading, Wiley, 9th Edition, 2012.
2. Das, Sumitabha. UNIX System V. 4: Concepts and Applications. Tata McGraw-Hill, 4th Edition, 2006.

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY BHAGALPUR

B.Tech. Course Structure

ELECTRONIS AND COMMUNICATION ENGINEERING (ECE)

ECE Core Courses:

EC101: Digital Design 3-1-0-8

Binary Arithmetic: Representation of integers, fractions and signed numbers in different codes; Addition and subtraction operations on binary-coded numbers; Algorithms for performing multiplication and division.

Combinational Circuits: Boolean expressions and their minimization using algebraic identities; Karnaugh map representation and minimization of Boolean functions using K-map; Two-level realizations using gates -- AND-OR, OR-AND, NAND-NAND and NOR-NOR structures.

Combinational Circuits using MSI Modules: Multifunction gates, Multi-bit adder, Multiplexers, Demultiplexers, Decoders, Programmable ALU; Multiplexer-based realization of K-maps; Combinational circuit design using multiplexers and gates.

Sequential Circuits: Latches and Flip-flops; Ripple counters using T flip-flops; Synchronous counters; Shift Registers; Ring and MLS counters; Sequence generator using J-K / D flip-flops.

Memories, Microprocessors and Microcomputer Organization: RAM, ROM, PAL, PLA, Introduction to microprocessor and microcomputer organization; Central processing unit (CPU), memory and input/output devices.

Texts:

1. M. Morris Mano, Digital Logic and Computer Design, 11th edition, Pearson Education, 2009.

2. R. S. Gaonkar, Microprocessor Architecture, Programming, and Applications with the 8085, 6th edition, Penram International Publishing, 2013.

References:

1. Ronald J Tocci, Neal S Wisdmer and Gregory L. Moss, Digital Systems: Principle and Applications, 10th edition, Pearson Education, 2011.

2. Albert Paul Malvino, Donald P Leach and Gautam Saha, Digital Principles and Applications, 7th edition, Tata McGraw - Hill Education, 2011.

3. C. H. Roth Jr., Fundamentals of Logic Design, 4th edition, Jaico Publishers, 2002.

4. J. F. Wakerly, Digital Design - principles and practices, 4th edition, Pearson Education; 2006.

EC102: Electrical Circuit Analysis 3-1-0-8

Basic components and electric circuits: charge, current, voltage and power, voltage and current sources, Ohm's law;

Voltage and current laws: nodes, paths, loops and branches, Kirchoff's current law, Kirchoff's voltage law, dependent and independent sources, voltage and current division;

Basic nodal and mesh analysis: nodal analysis, supernode, mesh analysis, supermesh;
Network theorems: linearity and superposition, source transformations, Thevenin and Norton equivalent circuits, maximum power transfer;
RL and RC circuits: source-free RL circuit, source-free RC circuit, unit-step function, driven RL circuits, natural and forced response, driven RC circuits;
RLC circuit: source-free parallel circuit, overdamped parallel RLC circuit, critical damping, underdamped parallel RLC circuit, source-free series RLC circuit, complete response of the RLC circuit;
Sinusoidal steady-state analysis: forced response to sinusoidal functions, complex forcing function, phasor, phasor relationship for R, L and C, impedance, admittance, phasor diagrams, instantaneous power, average power, apparent power and power factor, complex power;
Polyphase circuits: polyphase systems, single-phase three-wire systems, three-phase Y-Y connection, delta connection, power measurement in three-phase systems; Magnetically coupled circuits: mutual inductance, energy considerations, linear transformer, ideal transformer;
Frequency response: parallel and series resonance, Bode plots, Filters;
Two-port networks: one-port networks, admittance parameters, impedance parameters, hybrid parameters, transmission parameters.

Texts:

1. W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, 7th / 8th edition, Tata-McGraw-Hill Publishing Company Limited, 2010/ 2012.

References:

1. Bruce Carlson, Circuits: Engineering Concepts and Analysis of Linear Electric Circuits, 2nd Reprint, Thomson Asia Pvt. Ltd., 2006.
2. R. A. De Carlo and P. M. Lin, Linear Circuit Analysis, 2nd edition, Oxford University Press, 2001.
3. Nagrath I.J. and D. P. Kothari, Basic Electrical Engineering, 3rd edition, Tata McGraw Hill, 2009.
4. Ae Fitzgerald David E Higginbotham Arvin Grabel , Basic Electrical Engineering, 5th edition, Tata McGraw Hill Publishing Co Ltd., 2009.

EC103: Basic Electronic Circuits 3-1-0-8

D-C power supply: Diode characteristics, half-wave and full wave rectifiers, shunt capacitor filter, voltage regulator, regulated D-C power supply.
Amplifier: Amplifier parameters, controlled source models, classification, the operational amplifier (OP-AMP) as a linear active device, the VCVS model of an op-amp, different amplifier configurations using op-amp, frequency response of op-amp and op-amp based amplifiers.
Filter: Concepts of low-pass, high-pass and band-pass filters, ideal (brick-wall) filter response, frequency response of simple RC filters, active RC filters using Op-amp.
Oscillator: Effects of negative and positive feedback of an amplifier, condition of harmonic oscillation, RC and LC oscillator circuits.
Comparator: Op-amp as a comparator, digital inverters (TTL/CMOS) as comparators, comparator with hysteresis, Schmitt trigger using Op-amp, 555 timer as a two dimensional comparator.

Waveform generators: Concept of bistable, monostable and astable circuits, timer and relaxation oscillator based on comparator and RC timing circuit, square wave generator using 555 timer, crystal clock generator.
Analog-Digital conversion: Digital to Analog Converter (DAC) using binary resistor scheme, R-2R ladder DAC, DAC using switched current resources, Analog to Digital converter (ADC) using capacitor charge/discharge: single-slope and dual-slope ADCs, ADC using counter and DAC, ADC using successive approximation.
Outcome - As a result of this course students become acquainted with basics of electronic circuits at least at the system integration level.

Texts:

1. Adel S. Sedra, Kenneth C. Smith & Arun N. Chandorkar, Microelectronic Circuits, International Version 6th Edition, Oxford University Press India, 2013.

EC201: Control Systems 3-1-0-8

Basic Concepts of Control Systems, Open loop and closed loop systems, Mathematical Models of Physical Systems, Differential Equations of Physical Systems, Derivation of Transfer functions, Signal flow Graphs, Mason's Gain Formula;
Feedback characteristics of Control Systems: Effect of negative feedback on sensitivity, bandwidth, Disturbance, linearizing effect of feedback, Regenerative feedback;
Time response of first order systems to unit step and unit ramp inputs, Time Response of Second order systems to unit step input, Steady State Errors and Static Error Constants of different types of systems. Generalised error series and Generalised error coefficients, Stability and Algebraic Criteria;
Concept of stability, Routh-Hurwitz stability criterion, Application of the Routh stability criterion to linear feedback system, Relative stability by shifting the origin in s-plane;
Root locus concepts, Root contours, Systems with transportation lag. Effect of adding open loop poles and zeros on Root locus;
Frequency domain specifications, correlation between Time and Frequency Response with respect to second order system, Polar plots, Bode plot, Determination of Gain Margin and Phase Margin from Bode plot;
Stability in frequency domain: Principle of argument, Nyquist stability criterion, Application of Nyquist stability criterion for linear feedback system. Constant M-circles, Constant N-Circles, Nichol's chart; Controllers: Concept of Proportional, Derivative and Integral Control actions, P, PD, PI, PID controllers. Zeigler-Nichols method of tuning PID controllers.

Text Books:

1. K. Ogata, Modern Control Engineering, Pearson Education India; 5th Edition, 2015.
2. M. Gopal, Control Systems, 3rd Edition, McGraw Hill Education; 4th Edition, 2012.

Reference Books:

1. B. C. Kuo, Automatic Control Systems, McGraw-Hill Education; 10th edition, 2017.

EC202: Signals and Systems 3-0-0-6

Some Elementary Continuous-Time signals, Classification of Continuous-Time Signals, Cross-correlation, Autocorrelation and Properties; Continuous-Time Input-Output Systems, Classification of Continuous-time systems, Causal and Non-causal, BIBO stability;
Analysis of Continuous-Time LTI Systems: Impulse Response, Properties of unit impulse function, Properties of Convolution, Causal LTI Systems, Stability of LTI Systems, Review of Fourier Transform,

Laplace transform: Properties, Continuous-Time Systems Described by Differential Equations, Solving Differential equation by Laplace transform, Laplace transform of unit impulse and unit step functions; Discrete-Time Signals and Systems: Nyquist Sampling Theorem, Discrete-Time Signals, Classification of Discrete-Time Signals; Discrete Input-Output Time Systems, Classification of Discrete-time systems; Analysis of Discrete-Time LTI Systems: Impulse Response, Properties of Convolution, Stability of LTI Systems; Discrete-Time Systems Described by Difference Equations; Implementation of Discrete-Time Systems;
The Direct Z-Transform, Properties of the Z-Transform, Rational Z-Transforms: Poles and Zeros, Analysis of LTI Systems in the Z-Domain: Transient and Steady-State Responses, Causality and Stability, Pole-Zero Cancellations; The Inversion of the Z-Transform: Power Series Expansion, Partial-Fraction Expansion; The One-sided Z-Transform, Solution of Difference Equations; The Discrete Time Fourier Series: Parseval's theorem, Power Spectral Density; Discrete Time Fourier Transform, Relation between Continuous time Fourier transform and Discrete-time Fourier Transform of a signal, Autocorrelation and Energy Spectral Density, Wiener Khinchin Theorem.

Text Books:

1. Oppenheim and Schafer, Signals and Systems, Pearson Education India; 2nd Edition , 2015.
2. S. Haykin and B. Van Been, Signals and Systems, John Wiley & Sons., , 2nd Edition, 2007.

Reference Books:

1. B. P. Lathi, Linear Systems and Signals, Oxford University Press, 2nd Edition, 2006.

EC203: Analog Circuits 3-0-0-6

Low and High Frequency Response of BJTs and MOSFETs, Unit gain-frequency, Frequency Response of Amplifier for different configurations using BJT and MOSFET, Multistage Frequency Effects, Miller Effect Capacitance;
Differential Amplifier, passive and active current mirror circuits, differential amplifier as a building block for operational amplifier; Ideal Op-Amp,Op-Amp Characteristics: Slew rate, CMRR, Inverting and non-inverting configurations, General feedback structure, Properties and advantages of negative feedback, Four Basic Feedback Topologies, Stability and compensation; Practical Feedback Circuits, Feedback Amplifier Stability using Nyquist Plot, The Barkhausen criterion;
Sinusoidal oscillators-RC, LC, and crystal oscillators, Schmitt trigger; Analog subsystems: analog switches, voltage comparator, voltage regulator, switching regulator, bandgap reference voltage source, analog multiplier, filter approximations: Butterworth, Chebyshev and elliptic, first order and second order passive/active filter realizations;
Power amplifiers: class A, B, AB, C, D, E stages, output stages, short circuit protection, power transistors and thermal design considerations.

Text Books:

1. A. S. Sedra, K. C. Smith and A. N. Chandorkar, Microelectronics circuits, Oxford university Press India, 7th Edition, 2017.

2. B. Razavi, Design of Analog CMOS Integrated Circuits, Tata McGraw-Hill, 2nd Edition,2017.

Reference Books:

1. B R. Gayakwad, Op-amp and Linear Integrated Circuits, Pearson Education, 4th Edition 2015.

EC204: Principle of Communication 3-1-0-8

Basic blocks in a communication system: transmitter, channel and receiver, baseband and passband signals and their representations, concept of modulation and demodulation, Continuous wave (CW) modulation: amplitude modulation (AM)-double sideband (DSB), double sideband suppressed carrier (DSBSC), single sideband suppressed carrier (SSBSC) and vestigial sideband (VSB) modulation; angle modulation-phase modulation (PM) & frequency modulation (FM), narrow and wideband FM;

Pulse Modulation: sampling process, pulse amplitude modulation (PAM), pulse width modulation (PWM), pulse position modulation (PPM), pulse code modulation (PCM), line coding, differential pulse code modulation, delta modulation, adaptive delta modulation;
Noise in CW and pulse modulation systems: Receiver model, signal to noise ratio (SNR), noise figure, noise temperature, noise in DSB-SC, SSB, AM & FM receivers, pre-emphasis and de-emphasis, noise consideration in PAM and PCM systems;
Basic digital modulation schemes: Phase shift keying (PSK), amplitude shift keying (ASK), frequency shift keying (FSK) and Quadrature amplitude modulation (QAM), coherent demodulation and detection; probability of error in PSK, ASK, FSK & QAM schemes;
Multiplexing schemes: frequency division multiplexing, time division multiplexing, Code division multiplexing and error correction & Detection Theory.

Text Books:

1. J. G. Proakis and M. Salehi, Communication system engineering, Pearson Education Asia, 2nd Edition, 2015.
2. R. E. Ziemer, W. H. Tranter, Principles of Communications: Systems, Modulation, and Noise, John Wiley & Sons, 7th Edition, 2015.

Reference Books:

1. H Taub and D. L. schilling, Principle of communication system, Tata McGraw-Hill, 3rd Edition, 2007.

EC205: Semiconductor Devices 3-1-0-8

Energy band in Semiconductor: charge carriers: electrons and holes, effective mass, doping. Carrier concentration: Fermi level, temperature dependence of carrier concentration. Drift and diffusion of carriers: excess carriers; recombination and life time, Five equations of carrier transport;
Semiconductor Diodes: Physical operation of p-n junction diodes, depletion region, forward and reverse-bias, Characteristics of p-n junction diodes, Zener diode, Tunnel diode, depletion and diffusion capacitances, switching characteristics; breakdown mechanisms; SPICE model;
Bipolar Junction Transistors (BJTs): Simplified structure and physical operation of n-p-n and p-n-p transistors in the active region, Current-voltage characteristics of BJT, carrier distribution; current gain, transit time, secondary effects; SPICE model. BJT as an amplifier and as a switch;
Metal-semiconductor junctions: rectifying and ohmic contacts. The MOS structure, Energy band diagrams, Flat-band condition and flat-band voltage, Surface accumulation, surface depletion, Threshold condition and threshold voltage, MOS C-V characteristics, Introduction to the MOSFET, Complementary MOS (CMOS) technology, V-I Characteristics, Surface mobilities and high-mobility, Threshold voltage, Body effect and steep retrograde doping, pinch-off voltage.

Text Books:

1. B. G. Streetman and S. K. Banerjee, Solid State Electronic Devices, Pearson Education, 7th Edition, 2015.
2 R. F. Pierret, Semiconductor Device Fundamentals, PHI, 1st Edition, 2006.

Lab Courses:

EC110: Digital Design Lab 3-1-0-8

Familiarization with digital IC family 74LS00 and 74HS00; Familiarization with laboratory equipments – voltage generator, function generator, oscilloscope; Study of digital IC characteristics – input voltage, input current, output voltage, output current, fan out, noise margin and propagation delay. Combinational logic circuits: Implementation of Boolean functions using logic gates; Arithmetic operations using logic gates; Implementation of Multiplexers, Demultiplexers, Encoders, Decoders; Implementation of Boolean functions

using Multiplexers/Decoders. Study of sequential logic circuits: Implementation of flip flops; Implementation of counters; Implementation of sequence generators. Microprocessor: Programming in 8085 microprocessor.

EC111: Basic Electronics Lab 0-0-3-3

Experiments using diodes: diode characteristics, design and analysis of half-wave and full-wave rectifier circuits without and with filter, clipping circuits, clamper circuits, experiments using operational amplifier: inverting amplifier, non-inverting amplifier, voltage follower, integrator, differentiator, comparators, Multivibrators, Wien's Bridge Oscillator, first-order filters, D/A and A/D converters.

EC210: Signals and Systems LAB 0-0-3-3

Analysis of Continuous -Time LTI Systems: Impulse Response, Properties of unit impulse function: sifting, replication, area within the unit impulse function, multiplication property (sampling property). Properties of Convolution, Causal LTI Systems, Stability of LTI Systems. Analysis of Discrete-Time LTI Systems: Impulse Response, Properties of Convolution, Causal LTI Systems, Stability of LTI Systems; Discrete-Time Systems Described by Difference Equations; Implementation of Discrete-Time Systems. The Z-Transform and Its Application to the Analysis of LTI Systems.

Text/Reference:

1. Oppenheim and Schafer, Signals and Systems, Pearson Education India; 2nd Edition, 2015.

2. S. Haykin and B. Van Been, Signals and Systems, John Wiley & Sons., 2nd Edition, 2007.

3. B. P. Lathi, Linear Systems and Signals, Oxford University Press, 2nd Edition, 2006.

EC211: Analog Circuits LAB 0-0-3-3

Experiments using BJTs, FETs, op-amps and other integrated circuits: Multistage amplifiers, automatic gain controlled amplifiers, programmable gain amplifiers; frequency response of amplifiers; voltage regulator with short circuit protection; phase locked loop; waveform generators; filters.

Text/Reference:

1. A. P. Malvino, Electronic Principles, Tata McGraw-Hill, 5th Edition, 2007.

2. A. S. Sedra, K. C. Smith and A. N. Chandorkar, Microelectronics circuits, Oxford university Press India, 7th Edition, 2017.

3. B R. Gayakwad, Op-amp and Linear Integrated Circuits, Pearson Education, 4th Edition 2015.

EC212: Communication LAB 0-0-3-3

Amplitude modulation and demodulation (AM with carrier & DSBSC AM); frequency modulation and demodulation (using VCO & PLL); automatic gain control (AGC); pulse width modulation (PWM); pulse code modulation (PCM); pseudo-random (PN) sequence generation; binary phase shift keying (BPSK); binary frequency shift keying (BFSK).

Text/Reference:

1. J. G. Proakis and M. Salehi, Communication system engineering, Pearson Education Asia, 2nd Edition, 2015.

2. R. E. Ziemer, W. H. Tranter, Principles of Communications: Systems, Modulation, and Noise, John Wiley & Sons, 7th Edition, 2015.

3. H Taub and D. L. schilling, Principle of communication system, Tata McGraw-Hill, 3rd Edition, 2007.

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY BHAGALPUR

B.Tech. Course Structure

Mathematics Courses:

MA101: Mathematics I 3-1-0-8

Linear Algebra: Systems of linear equations and their solutions; vector space $\mathbb{R}^n$ and its subspaces; spanning set and linear independence; matrices, inverse and determinant; range space and rank, null space and nullity, eigenvalues and eigenvectors; diagonalization of matrices; similarity; inner product, Gram-Schmidt process; vector spaces (over the field of real and complex numbers), linear transformations.
Single Variable Calculus: Convergence of sequences and series of real numbers; continuity of functions; differentiability, Rolle's theorem, mean value theorem, Taylor's theorem; power series; Riemann integration, fundamental theorem of calculus, improper integrals; application to length, area, volume and surface area of revolution.

Texts:

1. D. Poole, Linear Algebra: A Modern Introduction, 4th Edition, Brooks Cole, 2014.
2. S. R. Ghorpade and B. V. Limaye, A Course in Calculus and Real Analysis, 1st Edition, Springer India, 2006.

References:

1. G. Strang, Linear Algebra and Its Applications, 4th Edition, Brooks Cole, 2006.
2. R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 4th Edition, Wiley India, 2011.

MA102: Mathematics II 3-1-0-8

Multivariable Calculus: Vector functions of one variable – continuity, differentiation and integration; functions of several variables - continuity, partial derivatives, directional derivatives, gradient, differentiability, chain rule; tangent planes and normals, maxima and minima, Lagrange multiplier method; repeated and multiple integrals with applications to volume, surface area, moments of inertia, change of variables; vector fields, line and surface integrals; Green's, Gauss' and Stokes' theorems and their applications.
Ordinary Differential Equation: First order differential equations - exact differential equations, integrating factors, Bernoulli equations, existence and uniqueness theorem, applications; higher-order linear differential equations - solutions of homogeneous and non-homogeneous equations, method of variation of parameters, series solutions of linear differential equations, Legendre equation and Legendre polynomials, Bessel equation and Bessel functions of first and second kinds. Laplace and inverse Laplace transforms; properties, convolutions; solution of ODE by Laplace transform. Systems of first-order equations, two-dimensional linear autonomous system, phase plane, critical points, stability.

Texts:

1. G. B. Thomas, Jr. and R. L. Finney, Calculus and Analytic Geometry, 12th edition, Pearson Education India, 2010.

2. S. L. Ross, Differential Equations, 3rd edition, Wiley India, 2007.

References:

1. H. Anton, I. C. Bivens and S. Davis, Calculus: Early Transcendentals, 11th edition, Wiley, 2016.
2. T. M. Apostol, Calculus, Volume 2, 2nd edition, Wiley India, 2007.
3. W. E. Boyce and R. C. Di Prima, Elementary Differential Equations and Boundary Value Problems, 10th edition, Wiley India, 2012.

MA201: Mathematics-III 3-1-0-8

Complex Analysis: Complex numbers and elementary properties. Complex functions - limits, continuity and differentiation. Cauchy-Riemann equations. Analytic and harmonic functions. Elementary functions. Anti-derivatives and path (contour) integrals. Cauchy-Goursat Theorem. Cauchy's integral formula, Morera's Theorem. Liouville's Theorem, Fundamental Theorem of Algebra and Maximum Modulus Principle. Taylor series. Power series. Singularities and Laurent series. Cauchy's Residue Theorem and applications. Mobius transformations.

Partial Differential Equations: First order PDEs; solutions of linear and nonlinear first order PDEs; classification of second-order PDEs; method of characteristics; boundary and initial value problems (Dirichlet and Neumann type) involving wave equation, heat conduction equation, Laplace's equations and solutions by method of separation of variables; initial boundary value problems.

Solution of PDE by Laplace transform; Fourier series, Fourier integrals; Fourier transforms, sine and cosine transforms; solution of PDE by Fourier transform.

Text Books:

1. J. W. Brown and R. V. Churchill, Complex Variables and Applications, Tata McGraw-Hill, 9th Edition, 2014.
2. I. N. Sneddon, Elements of Partial Differential Equations, Dover Publications, 2006.
3. S. L. Ross, Differential Equations, Wiley India, 3rd Edition, 2007.

Reference:

1. J. H. Mathews and R. W. Howell, Complex Analysis: for Mathematics and Engineers, Narosa, 5th Edition, 2013.
2. E. Kreyszig, Advanced Engineering Mathematics, Wiley India, 10th Edition, 2011.
3. R. Haberman, Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem, Prentice Hall, 3rd Edition, 1998.

MA202: Probability and Random Process 3-1-0-8

Basic Probability: Sample Space and Events, Algebra of Sets, the Notion and Axioms of Probability, Equally Likely Events, Conditional Probability, Total Probability, Independent Events

Random Variables: Discrete and Continuous; Moments, Moment generating Function; Distributions: Binomial-Poisson-Geometric-Uniform-Exponential-Gamma.

Two dimensional Random Variables: Joint Distribution, Marginal and Conditional Distribution, Covariance, Correlation Coefficient; Linear Regression, Transformation of Random variables.

Random Process: Classification, Stationary-Markov-Poisson-Random telegraph; Autocorrelation function and WSS process, Cross correlation functions Properties Power spectral density, Cross spectral density; Continuity and Differentiation of Random Processes; White noise processes; Linear time invariant system. Bandpass Random Processes.

Text Book:

1. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2000.

2. J. Medhi, Stochastic Processes, New Age International, 4th Edition, 2017.

Reference:

1. G. R. Cooper and C. D. McGillem, Probabilistic Methods of Signal and System Analysis, Oxford University Press, 3rd Edition, 2012.

2. R. D. Yates and D. J. Goodman, Probability and Stochastic Processes, Wiley India, 2nd Edition, 2012.

3. S. L. Miller and D. G. Childers, Probability and Random Processes with Applications to Signal Processing and Communications, Academic Press, 2004.

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY BHAGALPUR

B.Tech. Course Structure

Other Common Courses:

HS101: English 2-0-0-4

Prose:

- "Letter to my Daughter" by Jawaharlal Nehru.
- "An Astrologer's Day" by R.K. Narayan.

Poem :

- "Pied Beauty" by Gerard Manley Hopkins
- "Sonnet CXVI" by William Shakespeare.
- "The Charge of the light Brigade" by Alfred Tennyson.

Remedial grammar:

Articles, Subject-verb Agreement, Preposition, Time and tense, Active and Passive Voice, Phrasal Verbs, Degree of Comparison.

Technical Writing:

Notice, agenda, minutes of a meeting, memo, cv/resume, report writing, circular, business letters, technical description, brochures, newsletter, banners, job interviews: purpose and process, how to prepare for interviews, language and style to be used in interview, type of interview questions and how to answer them, group discussion: structure and dynamics, techniques of effective participation discussion, preparing for group discussion.

Texts:

1. Menon, Madhavi, ed. Prose for Our Times, 2004, Kolkata: Orient BlackSwan, 2004.
2. Sriraman, T., and N. Krishnaswami, eds. Verses for a Multiverse: Poems for the New Generation.
Hyderabad: The English and Foreign Languages University; Orient BlackSwan, 2011.
3. Wood, F.T. A Remedial English Grammer for Foreign Students, New Delhi; Macmillan, 2014.
4. Arora, V.N., and Lakshmi Chandra. Improve Your Writing, Oxford University Press, New Delhi, 2013.
5. Anderson, Marilyn, Pramod K. Nayar, and Madhucchanda Sen. Critical Reasoning, Academic Writing and Presentation Skills. Rev. ed. New Delhi: Longman-Pearson, 2010.

References:

1. Mukherjee, Meenakshi. Let's Go Home and Other Stories. New ed. Hyderabad: Orient BlackSwan, 2009.
2. Krishnaswami, N., and T. Sriaman, Current English for Colleges, Trinity Press, 2014.
3. Krishnaswami, N., and T. Sriraman. Creative English for Commination 2nd edition, Macmillan India Limited, 2000.
4. Swan, Michael, Practical English Usage, 3rd ed. Oxford University Press, 2005

HS102: Economics 3-0-0-6

Definition of economics, subject matter, scope and nature of economics; Microeconomic theory: consumer behaviour: preference, utility, indifference curve and its properties, income and prices, budget line; Derivation of demand: effects of price and income, demand elasticities, income and substitution effects, consumer's surplus; Production: output and inputs, short run and long run, law of variable proportions, returns to scale, different costs and revenues, profit maximisation and supply function, supply elasticities, opportunity cost; Markets: perfect competition, monopoly; Macroeconomic theory: national income: different aggregative concepts, methods of estimation of national income, circular flow of income; Money: definition and its function; Banking: role of central and commercial banks, money creation; Public finance: public vs. private finance, public revenue and expenditure, taxes- direct and indirect, progressive and regressive; Policy implications.

Text:

1. P. A. Samuelson and W. D. Nordhaus, Economics, 19th edition, McGraw Hill Inc., 2010.

References:

1. R. S. Pindyck, D. L. Rubinfeld and P. L. Mehta, Microeconomics, 7th edition, Pearson Education, 2009.

2. N. G. Mankiw, Principles of Macroeconomics, 6th edition, South-Western Cengage Learning, 2011. 3. S. B.Gupta, Monetary Economics: Institutions, theory and policy, 1st edition, S. Chand & Co. Ltd., 2010

BT201: Engineering Biology 3-0-0-6

Diversity in biological systems; cell biology and cell structure; biological membranes; bioenergetics; genetics: DNA as genetic material; structure of DNA; DNA replication; transcription; translation; genes to proteins and to protein function; gene expression and regulation; recombinant DNA technology. Human physiology: biological axons and neurons, neuromuscular and synaptic junctions; sensory systems - hearing, taste, smell and visual receptors; Applications to engineering.

Text Book:

1. J. L. Tymoczko, J. M. Berg and L. Stryer, Biochemistry, W. H. Freeman & Co, 5th Edition, 2002.

2. D. L. Nelson and M. M. Cox, Lehninger Principles of Biochemistry, Macmillan Worth, 2000.

1. N. Hopkins, J. W. Roberts, J. A. Steitz, J. Watson and A. M. Weiner, Molecular Biology of the Gene, 4th Ed, Benjamin Cummings, 1987.

Reference:

2. C. R. Cantor and P. R. Schimmel, Biophysical Chemistry (Parts I, II and III), W.H. Freeman & Co., 1980.

3. C. C. Chatterjee, Human Physiology, Vol 1 & 2, 11th Ed, Medical Allied Agency, 1987.

PH201: Engineering Physics 3-0-0-6

Thermal Physics: Laws of thermodynamics- Statement, Discussion and Significance of Zeroth, First and Second law, Isothermal and Adiabatic change & Carnot cycle, Concept of Entropy- Clausius inequality and physical significance of Entropy;

Optics: Review of wave front and Huygen's principle; Interference by the division of wave front- Young's double slit, Fresnel biprism, Lloyd's mirror arrangement; interference by division of amplitude-plane parallel film illuminated by plane wave, non-reflecting films, plane film illuminated

by a point source, colour of thin films, Newton's Rings, Michelson interferometer, Single slit and two slits Fraunhoffer diffraction; diffraction grating;

Basic ideas of Quantum Mechanics: Matter Waves, Wave and Group Velocities, Heisenberg Uncertainty Principle, Wave Function, its Interpretation and Normalization, Superposition of Amplitudes, Dynamical Variables as Operators, Expectation Values, Schrodinger Equation and its Simple Applications like Particle in a Box, Quantum Well, Potential Barrier Problem;

Electronic Properties of Materials: Semiconductor materials, insulators, intrinsic and extrinsic semiconductor, Carrier transport in semiconductor: diffusion current, drift current, mobility and resistivity. Generation and recombination of carriers in semiconductors. Electrons and Holes in semiconductors: Silicon crystal structure, Donors and acceptors in the band model, electron effective mass, Density of states, Thermal equilibrium, Fermi-Dirac distribution function for electrons and holes, Fermi energy. Equilibrium distribution of electrons & holes. Dielectric Properties, Piezo-electricity.

Text Book:

1. D. R Joshi, Engineering Physics, Tata McGraw-Hill, 2017.
2. D. K. Bhattacharya and P. Tandon, Engineering Physics, Oxford University Press, 2015.

Reference:

1. A. Beiser, Concept on Modern Physics, Tata McGraw-Hill, 7th Edition, 2017.
2. A. Ghatak, Optics, Tata McGraw-Hill, 6th Edition, 2015.

RE201: Renewable Energy and Applications 3-0-0-6

Overview of Global and Indian energy scenario, Sources of Energy and its classifications, Renewable energy sources, classification and systems, Overview of 1st, 2nd and 3rd law of thermodynamics, Thermodynamic processes and basic cycles; Bio-Energy: Introduction to bio-fuels, Feedstock for bio-fuel production, Biodiesel, bioethanol, bio butanol, bio hydrogen, Biochemical and thermochemical conversions of biomass, Concept of bio refinery; Fuel cell: importance, classification, basic principle design, materials used for developing fuel cell, application and future aspects; Solar Energy Conversion: Solar thermal energy conversion devices, Solar energy storage and, applications, Solar cell fundamentals, Solar cell technologies and PV systems, Solar energy assisted heating and cooling systems; Wind Energy Conversion: Fundamentals of wind energy conversion, Types of wind energy, conversion devices, Mathematical derivation of Betz limit; Non-conventional method of energy conversion: Magneto hydrodynamics (MHD), Thermoelectric generator, Thermionic generator, Wave and ocean thermal energy conversion, Energy storage systems.

Text Book:

1. H. P. Garg and S. Prakash, Solar Energy: Fundamental and Application, Tata McGraw-Hill Education, 1st Edition, 2017.
2. C. S. N. Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, PHI, 3rd Edition, 2015.

Reference:

1. P.K. Nag, Power Plant Engineering, Tata McGraw-Hill Education, 4th Edition, 2017.