Department of Electronics & Communication Engineering.

1.	MAN-001	Mathematics-1	BSC	4
2.	PHN-005	Electrodynamics and Optics	BSC	4
3.	CEN-105	Introduction to Environmental Studies	GSC	3
4.	HS-001A	Communication Skills (Basic)	HSSC	2
5.	HS-001B	Communication Skills (Advance)	HSSC	2
6.	HSN-002	Ethics and General Awareness	HSSC	2
7.	ECN-101	Introduction to Electronics & Communication Engineering	DCC	2
8.	CSN-103	Fundamentals of Object Oriented Programming	ESC	4
9.	MAN-010	Optimization Techniques	BSC	4
10.	PHN-006	Quantum Mechanics and Statistical Mechanics	BSC	4
11.	CSN-102	Data Structures	DCC	4
12.	ECN-104	Digital Logic Design	DCC	4
13.	ECN-142	Semiconductor Devices	DCC	4
14.	EEN-112	Electrical Science	ESC	4
15.	MIN-108	Mechanical Engineering Drawing	DCC/ESC	4
16.	ECN-203	Signals and Systems	DCC	4
17.	ECN-205	Analog Circuits	DCC	4
18.	CSN-221	Computer Architecture and Microprocessors	DCC	4
19.	ECN-291	Electronic Network Theory	DCC	4
20.	MTN-105 *	Electrical and Electronic Material	ESC	4
21.	MAN-006	Probability and Statistics	BSC	4
22.	ECN-212	Principles of Digital Communication	DCC	4
23.	ECN-222	Automatic Control Systems	DCC	4
24.	ECN-232	Engineering Electromagnetics	DCC	4
25.	ECN-252	Digital Electronic Circuits Laboratory	DCC	2
26.	ECN-311	Comunication Systems and Techniques	DCC	4
27.	ECN-331	Antenna Theory	DCC	3

1.	ECN-333	Microwave Engineering	DCC	3
2.	ECN-341*	Microelectronic Devices, Technology and Circuits	DCC	2
3.	ECN-351	IC Application Laboratory	DCC	2
4.	ECN-312	Digital Signal Processing	DCC	3
5.	ECN-342	RF and Mixed Signals Circuits	DCC	3
6.	ECN-352	Communication Systems Laboratory	DCC	2
7.	ECN-354	Microwave Laboratory	DCC	2

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Department of Computer Science and Engineering**

1. Subject Code: **CSN-102** Course Title: **Data Structures**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory: 3** **Practical : 0**

4. Relative Weight: **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**

5. Credits: **4** 6. Semester: **Spring** 7. Subject Area: **DCC**

8. Pre-requisite: **CSN-103**

9. Objective: To provide basic data structure concepts in an object-oriented setting for design, implementation, testing and maintenance of software systems.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	**Complexity A nalysis:** Time and Space com plexity of algorithms, asymptotic a nalysis, bi g O and ot her not ations, i mportance of efficient al gorithms, program pe rformance m easurement, data structures and algorithms.	3
2.	**Linear L ists:** Abstract da ta t ype, s equential a nd l inked representations, c omparison of i nsertion, de letion and search operations f or s equential a nd l inked l ists, l ist and c hain c lasses, exception a nd i terator c lasses f or l ists, doubl y l inked l ists, c ircular lists, linked lists thr ough simulated pointers, lists in STL, skip lists, applications of lists in bin sort, radix sort, sparse tables.	8
3.	**Stacks an d Q ueues: A** bstract d ata t ypes, s equential and linked implementations, e xception ha ndling i n c lasses, r epresentative applications s uch as p arenthesis m atching, t owers of H anoi, w ire routing i n a c ircuit, f inding pa th i n a m aze, s imulation of que uing systems, equivalence problem.	6
4.	**Hashing:** Search efficiency in lists and skip lists, hashing as a search structure, ha sh t able, collision a voidance, l inear ope n a ddressing, chains, uses of hash tables in text compression, LZW algorithm.	4
5.	**Trees:** Binary trees and their properties, terminology, sequential and linked implementations, tree traversal methods and algorithms, heaps as pr iority que ues, he ap i mplementation, i nsertion a nd de letion operations, heapsort, h eaps i n H uffman coding, l eftist t rees, tournament t rees, use o f w inner t rees i n mergesort as an external	8

	sorting algorithm, bin packing.	
6.	**Search T rees**: Binary s earch t rees, search efficiency, insertion and deletion ope rations, i mportance of ba lancing, AVL t rees, searching insertion a nd d eletions in A VL t rees, red-black t rees, com parison with AVL trees, search insert and delete operations.	**4**
7.	**Multiway Trees:** Issues in large dictionaries, m-way search trees, B-trees, search insert and delete operations, height of B-tree, 2-3 trees, sets and multisets in STL.	**5**
8.	**Graphs:** Definition, t erminology, di rected and undi rected graphs, properties, c onnectivity i n g raphs, a pplications, i mplementation – adjacency m atrix and linked adjacency ch ains, g raph traversal – breadth first and depth first, spanning trees.	**4**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Sahni, S., "Data Structures, Algorithms, and Applications in C++", WCB/McGraw-Hill.	2001
2.	Sahni, S., "Data Structures, Algorithms, and Applications in Java", WCB/McGraw-Hill.	2001
3.	Drozdek, A ., " Data S tructures a nd Algorithms i n C ++", V ikas Publishing House.	2002
4.	Wirth, N ., " Algorithms a nd D ata S tructures", P rentice-Hall of India.	1985
5.	Lafore, R ., " Data S tructures a nd A lgorithms i n J ava", 2 nd Ed., Dorling Kindersley.	2007

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Computer Science and Engineering**

1. Subject Code: **CSN-103** Course Title: **Fundamentals of Object Oriented Programming**

2. Contact Hours: **L: 3** **T: 0** **P: 2**

3. Examination Duration (Hrs.): **Theory** **3** **Practical** **0**

4. Relative Weightage**:** **CWS** **15** **PRS** **15** **MTE** **30** **ETE** **40** **PRE** **0**

5. Credits**:** **4** 6. Semester**: Autumn** 7. Subject Area**: ESC**

8. Pre-requisite**:** **NIL**

9. Objective: To introduce the concepts of Object Oriented Programming through Java.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction:** Introduction to computer systems, computer as a programmed machine; machine language, assembly language, high level languages; concept of flow chart and algorithms, algorithms to programs, object oriented programming concept, difference in approach from procedural programming,	**3**
2.	**Introduction t o Java Programming E nvironment:** Java compiler and virtual machine, Structure of a Java program, stand-alone programs and applets; concepts of portability.	**3**
3.	**Programming E lements i n Java:** Data types, variables and array operators, assignment and selection statements, iterative structures, nested loops, string handling in Java, I/O mechanism, command line arguments.	**6**
4.	**Classes i n Java:** General form of a class, creating objects, access control in classes; Constructors, methods, parameters, method overloading, recursive methods, returning objects, static members, finalization, final qualifier, nested and inner classes.	**10**
5.	**Dynamic M emory:** Pointers, references and dynamic memory handling in C++, Objects as references in Java, dynamic memory allocation and garbage collection in Java	**5**

6.	**Inheritance:** Basics, super classes and subclasses, the keyword extends, multilevel hierarchy, method overriding; run time polymorphism, abstract classes, final in inheritance, the object class.	**5**
7.	**Packages an d I nterfaces:** Defining package, access protection, importing classes and packages, defining and implementing interfaces, nested interfaces, use of interfaces, variables in interfaces.	**3**
8.	**Exception H andling:** Fundamentals, types of exceptions, catching exceptions, multiple catching, nested try statements, uncaught exceptions, throw and throws, finally mechanism, built-in exceptions, creating exception subclasses, using exceptions.	**4**
9.	**Applets:** Applet fundamentals, native methods, static import, the applet class, applet display method, requesting repainting, a banner applet, passing parameters to applets, uses of applets.	**3**
	Total	**42**

11. Suggested Books:

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Dietel H.M., Dietel P.J., "Java: How to Program", Prentice-Hall, 7th Edition.	**2006**
2.	Flanagan D., "Java in a Nutshell", O'Reilly Media, Inc., 5th Edition.	**2005**
3.	Eckel B., "Thinking in Java", Prentice-Hall.	**1998**
4.	Gosling J., Joy B., Steele G., Bracha G., "The Java Language Specification", Prentice-Hall, 2nd Edition.	**2000**
5.	Xavier C., "Java Programming – A Practical Approach", Tata McGraw-Hill.	**2011**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE**: Department of Computer Science and Engineering**

1. Subject Code**: CSN-221** Course Title**: Computer Architecture and Microprocessors**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical :0**

4. Relative Weight**:** **CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits**:4** 6. Semester**: Autumn** 7. Pre-requisite**: ECN-104**

8. Subject Area**: DCC**

9. Objective: To familiarize students with the architecture of a processor and machine level programming.

10. Details of the Course:

Sl.No.	Contents	Contact Hours
1.	CPU structure and functions, processor organization, ALU, data paths, internal registers, status flags; System bus structure: Data, address and control buses.	5
2.	Processor control, micro-operations, instruction fetch, hardwired control, microprogrammed control, microinstruction sequencing and execution.	6
3.	Instruction set principles, machine instructions, types of operations and operands, encoding an instruction set, assembly language programming, addressing modes and formats.	8
4.	Memory system, internal and external memory, memory hierarchy, cache memory and its working, virtual memory concept.	5
5.	I/O organization; I/O techniques: interrupts, polling, DMA; Synchronous vs. asynchronous I/O.	4
6.	8085 microprocessor architecture; Instruction set, instruction types and formats; Instruction execution, instruction cycles, different types of machine cycles and timing diagram.	8
7.	16-bit microprocessors, 8086 architecture, registers, memory segmentation and addressing, 32-bit/64-bit microprocessor families.	6
	Total	**42**

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication / Reprint
1.	Mano, M.M., "Computer System Architecture" 3rd Ed., Prentice-Hall of India.	2004
2.	Rajaraman, V. and Radhakrishnan, T., "Computer Organization and Architecture", Prentice-Hall of India.	2007
3.	Govindrajalu, B., "Computer Architecture and Organization", Tata McGraw-Hill.	2004
4.	Stallings, W., "Computer Organization and Architecture", 5th Ed., Pearson Education.	2001
5.	Hall, D.V., "Microprocessors and Interfacing", 2nd Ed., Tata McGraw-Hill.	2006
6.	Brey, B.B., "The Intel Microprocessors", 6th Ed., Pearson Education.	2003

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electronics & Communication Engineering**

1. Subject Code: **ECN-101** Course Title: **Introduction to Electronics & Communication Engineering**

2. Contact Hours: **L: 2** **T: 0** **P: 0**

3. Examination Duration (Hrs.): **Theory** **2** **Practical** **0**

4. Relative Weightage**:** **CWS** **15** **PRS** **0** **MTE** **35** **ETE** **50** **PRE** **0**

5. Credits**:** **2** 6. Semester**: Autumn** 7. Subject Area**: DCC**

8. Pre-requisite**:** **NIL**

9. Objective: To acquaint the students of Electronics and Communication Engineering with the fundamental concepts of their discipline of study, basic understanding of semiconductor devices, electronic circuits and communication systems.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction t o Electronics Engineering:** Overview, scope and objective of studying Electronics Engineering.	**1**
2.	**Introduction t o semiconductor devices:** Bond structure of semiconductors, intrinsic and extrinsic semiconductors; Basic principle and operation of semiconductor devices – diode, bipolar junction transistor, field effect transistors; Introduction to VLSI.	**6**
3.	**Applications of semiconductor devices:** Basic concepts of rectifiers, voltage regulators, amplifiers and oscillators; Basic concepts of operational amplifier and their applications; Introduction to digital systems	**5**
4.	**Introduction t o Communication Sys tems:** Elements of a communication system – transmitter and receiver; Signal types in communication; FDM and TDM; Processing of signals for transmission – basic concepts of amplitude and frequency modulation; Examples of telecommunication systems – telephone, radio, television, mobile communication and satellite communication.	**8**

5.	**Introduction t o High F requency Engineering:** RF sources, components, transmission lines, radiating elements; Radio waves transmission; Applications in industrial-scientific-medical and communication systems.	**8**
	Total	**28**

11. Suggested Books:

S. No.	**Name of Books / Authors/ Publishers**	**Year of Publication/ Reprint**
1.	Boylstead R.L., Nashelsky L., "Electronic Devices and Circuit Theory", Pearson, 10th Edition.	**2009**
2.	Millman J., Halkias C.C., Jit S., "Electronic Devices and Circuits", Tata McGraw-Hill, 2nd Edition.	**2007**
3.	Mano M.M., "Digital Design", Prentice-Hall, 3rd Edition.	**2002**
4.	Kennedy G., Davis B., "Electronic Communication Systems", Tata McGraw-Hill, 4th Edition.	**2008**
5.	Tomasi W., "Advanced Electronic Communication Systems", Pearson/Prentice-Hall, 6th Edition.	**2004**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electronics and Communication Engineering**

1. Subject Code: **ECN-102** Course Title: **Fundamentals of Electronics**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**

4. Relative Weightage**: CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**

5. Credits**: 4** 6. Semester**: Spring** 7. Subject Area**: ESC**

8. Pre-requisite**: Nil**

9. Objective: To impart knowledge of basic principles of electronics to UG students from other disciplines of engineering and science.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Review of properties of metals, dielectrics and semiconductors.	**1**
2.	**Diodes**: Working principle and characteristics and diode applications (rectification with capacitive filter and zener regulation).	**4**
3.	**BJT**: Operation and characteristics, brief overview of DC biasing, 're' model, Amplifier (CE, CB and CC).	**6**
4.	**MOSFET**: Introduction to MOSFET operation and characteristics.	**1**
5.	**Operational Amplifiers**: Input modes and parameters, introduction to concept of negative feedback, negative feedback in OPAMP, bias currents and offsets, open and closed loop responses.	**5**
6.	**Op-Amp A pplications**: Comparator, summing, integrator, differentiator, instrumentation amplifiers, isolation amplifiers, Operational Transconductance Amplifiers, Log and Antilog amplifiers, Converters, Introduction to OPAMP based active filters, Brief description of OPAMP based oscillators.	**8**
7.	**Basic D igital E lectronics**: Binary number system, Boolean algebra, Logic gates, adders, one-bit memory, flip-flops (SR, JK), shift registers, Asynchronous counter.	**8**
8.	**Introduction t o microprocessor**: Four-bit microprocessor architecture, stored program computer, instruction set and basic assembly language programming.	**9**
	Total	**42**

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Boylstead R.L., Nashelsky L., "Electronic Devices and Circuit Theory", Pearson, 10th Edition.	2009
2.	Floyd T.L., Buchla D.L., "Electronics Fundamentals: Circuits, Devices and Applications", 8th Edition	2010
3.	Millman J., Halkias C.C., Jit S., "Electronic Devices and Circuits", Tata McGraw-Hill, 2nd Edition.	2007
4.	Dorf R.C., Smith R.J., "Circuits, Devices and Systems: A First Course in Electrical Engineering", 5th Edition	1991

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electronics and Communication Engineering**

1. Subject Code: **ECN-104** Course Title: **Digital Logic Design**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory : 3** **Practical : 0**

4. Relative Weightage**: CWS : 25** **PRS: 0** **MTE: 25** **ETE : 50** **PRE: 0**

5. Credits**: 4** 6. Semester**: Spring** 7. Subject Area**: DCC**

8. Pre-requisite**: NIL**

9. Objective: To acquaint the students with the fundamental principles of Digital Logic Circuits and their design.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Number s ystems and B oolean a lgebra**: Introduction to number system and Boolean algebra; Boolean identities, basic logic functions, standard forms of logic expressions, simplification of logic expressions.	**5**
2.	**Logic families:** Brief overview of Transistor as a switch; Logic gate characteristics – propagation delay, speed, noise margin, fan-out and power dissipation; Standard TTL and static CMOS gates.	**4**
3.	**Combinational l ogic**: Arithmetic circuits, decoders, encoders, multiplexers, de-multiplexers, and their use in logic synthesis; Hazards in combinational circuits.	**6**
4.	**Introduction to VHDL**: Behavioral – data flow, and algorithmic and structural description, lexical elements, data objects types, attributes, operators; VHDL coding examples, combinational circuit design examples in VHDL and simulation.	**6**
5.	**Sequential l ogic ci rcuits**: Latches and Flip Flops (SR, D, JK, T); Timing in sequential circuits; Shift register; Counters – synchronous, asynchronous; Sequential circuit design examples in VHDL and simulation.	**6**
6.	**Finite s tate machines**: Basic concepts and design; Moore and Mealy machines examples; State minimization/reduction, state assignment; Finite state machine design case studies and FSM circuit design examples in VHDL and simulation.	**7**
7.	ROM and RAM, PLA, PAL and FPGA; RTL based design projects and their implementation in FPGA using VHDL.	**5**

8.	Astable and monostable multivibrator circuits using basic logic gates; Internal structure of 555 and its applications, clock circuits.	**3**
	Total	**42**

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Mano M.M., Ciletti M.D., "Digital Design", Pearson India, 4th Edition.	2006
2.	Katz R.H., Borriello G., "Contemporary Logic Desing", Prentice Hall India, 2nd Edition.	2008
3.	Kohavi Z., Jha N.K., "Switching and Finite Automata Theory", Cambridge University Press, India, 2nd Edition.	2011
4.	Wakerly J.F., "Digital Design: Principles and Practices," Pearson India, 4th Edition.	2008
5.	Harris D., Harris S., "Digital Design and Computer Architecture", Elsevier Publications, 2nd Edition.	2007
6.	Pedroni V.A., "Digital Circuit Design with VHDL", Prentice Hall India, 2nd Edition.	2001

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electronics & Communication Engineering**

1. Subject Code: **ECN-142** Course Title: **Semiconductor Devices**

2. Contact Hours: **L: 3** **T: 1** **P: 2/2**

3. Examination Duration (Hrs.): **Theory : 3** **Practical: 0**

4. Relative Weightage**: CWS: 15** **PRS: 15** **MTE : 30** **ETE: 40** **PRE: 0**

5. Credits**: 4** 6. Semester**: Spring** 7. Subject Area**: DCC**

8. Pre-requisite**: NIL**

9. Objective: To impart knowledge about the principles of semiconductor devices.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Review of semiconductor materials – Si, Ge, III-V material properties and band structure.	**2**
2.	**Energy b and d iagrams**: Intrinsic and extrinsic semiconductors, carrier statistics, and thermal equilibrium carrier concentration.	**4**
3.	**Excess car riers i n s emiconductors**: Excess carriers, lifetime, and carrier transport by drift and diffusion; Continuity equation and its solution under different injections; Solution of diffusion equation in uniformly doped base long and short base limits.	**6**
4.	**Theory of P N j unctions**: Steady state I-V characteristics under forward bias, reverse bias and illumination; Dynamic behavior under small and large signals; Breakdown mechanisms (qualitative); Metal-semiconductor junctions, ohmic and rectifying contacts.	**8**
5.	**Theory of b ipolar j unction t ransistors**: Static I-V characteristics in active and saturation regions; Emitter efficiency, transport factor, transit time, switching, ac small signal model and frequency limitations.	**6**
6.	**Theory of field effect transistors**: Static characteristics of JFETs and MESFETs; Analysis of MOS structure and C-V characteristics; Calculation of threshold voltage; Static I-V characteristics of MOSFETs; Nanoscale MOSFETs and short channel effects – SS, DIBL, surface mobility, CLM – qualitative; FET ac small signal model and its frequency limitations.	**10**
7.	**Special d evices**: Introduction to light emitting diodes, semiconductor laser, gunn effect and related devices.	**6**
	Total	**42**

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Streetman B.G., Banerjee, S.K, "Solid State Electronic Devices", Pearson Education, 6th Edition.	2006
2.	Tyagi M.S., "Introduction to Semiconductor Materials and Devices", John Wiley & Sons.	1993
3.	Sze S.M., "Semiconductor Devices Physics and Technology" John Wiley & Sons, 2nd Edition.	2002
4.	"Advanced Semiconductor Fundamentals," Prentice Hall India, 2nd Edition.	2002

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE**:** **Electronics and Computer Engineering**

1. Subject Code**: ECN-203** Course Title**: Signals and Systems**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory3** **Practical0**

4. Relative Weight**: CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits**:4** 6. Semester Autumn 7. Pre-requisite**: MA – xxx (Maths 1 + Maths 2)**

8. Subject Area**: DCC**

9. Objective: To provide a thorough understanding of the fundamentals of signals and systems required in the study of signal processing, communication systems and control systems.

10. Details of the Course:

Sl.No.	Contents	Contact Hours
1.	Classification and representation of signals and systems, examples; Impulse response and step response of a system.	6
2.	Review of Fourier series and its exponential representation; Review of Fourier transform and its properties, relationship between Fourier transform and Fourier series; Generalized Fourier transform; Amplitude and phase spectra, energy and power spectral density, signal bandwidth.	6
3.	Relationship of Laplace and Fourier transforms; Transfer function and its block diagram representation, convolution integral and the Fourier transfer function; System properties, linearity and time invariance, bandwidth.	6
4.	Review of z-transform and its properties, geometric evaluation of Fourier transform from pole-zero plot; Discrete time Fourier transform and its properties; Discrete convolution and duality; Discrete Fourier transform and its properties; Computation of discrete time Fourier transform and discrete Fourier transform, approximation of Fourier transform and discrete convolution using discrete Fourier transform.	10
5.	Difference equation, impulse response, convolution sum and transfer function representation of discrete time linear time invariant systems; Transform analysis and networks structures for discrete-time systems.	8
6.	Distortionless transmission, ideal and non-ideal filters, Butterworth and Chebyshev filters; Time and frequency domain analysis of continuous time LTI systems.	6
	Total	**42**

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Oppenheim, A.V., Willsky, A.S. and Nawab, S.H., "Signals & Systems", 2nd Ed., Prentice-Hall of India.	1997
2.	Haykin, S. and Van Been, B., "Signals and Systems" 2nd Ed., John Wiley & Sons.	2003
3.	Roberts, M.J., "Fundamentals of Signals & Systems", Tata McGraw-Hill.	2007
4.	Ziemer, R.E., Tranter, W.H. and Fannin, D.R., "Signals and Systems: Continuous and Discrete", 4th Ed., Pearson Education.	2001
5.	Lathi, B. P., "Linear Systems and Signals", 2nd Ed., Oxford University Press.	2006

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT. /CENTRE: **Department of Electronics and Computer Engineering**

1. Subject Code**: ECN-205** Course Title**: Analog Circuits**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weight**:** **CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits**:4** 6. Semester **: Autumn** 7. Pre-requisite**: EC142, EC101**

8. Subject Area**: DCC**

9. Objective: To acquaint the students with the fundamental principles of operation and design of analog circuit building blocks and their use in analog circuit design

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	**Basic Diode Circuits and MOSFET and BJT models**: Equivalent circuit of pn junction diode, half and full wave rectifiers, voltage regulation, limiting circuits, level shifters, Review of large signal I-V relations, transconductance, output resistance, device capacitances, small-signal equivalent circuit, transit frequency	5
2.	**Single-stage Amplifiers and Current Mirrors**: Brief overview of biasing of MOS and BJT amplifiers, Common Source (CS) amplifiers, CS amplifier with source degeneration, common gate amplifers, common drain amplifiers, Brief overview of BJT amplifiers (Common emitter, common base, common collector), MOS and BJT cascode amplifiers, MOS and BJT current mirrors, cascode current mirrors.	7
3.	**Differential Amplifiers**: MOS and BJT differential pair's large signal analysis, small signal analysis of differential pairs, cascode differential amplifiers, common-mode rejection, and differential amplifiers with active load.	6
4.	**Frequency Response**: Brief overview of poles and zeroes in transfer functions and Bode's rules, association of poles with nodes in multi-stage amplifiers, frequency response of single-stage amplifiers (common source, common emitter, common gate, common base, source follower, emitter follower), frequency response of cascode and differential amplifiers, input and output impedances of amplifiers.	6

5.	**Feedback and O scillators**: Impact of negative feedback on properties of amplifiers (Gain, linearity, bandwidth and I/O impedances), feedback topologies (voltage-voltage, voltage-current, current-voltage and current-current), examples circuits for each feedback topology, stability in feedback amplifiers (stability condition, phase and gain margins, frequency compensation), Ring oscillators, LC Oscillators (LC tanks, cross-coupled), phase shift oscillators, wien-bridge oscillators, brief discussion on crystal oscillators.	9
6.	**CMOS D esign E xamples an d SP ICE Projects**: Two-stage OPAMP, Gilbert cell, phase shift oscillator.	3
7.	**OPAMP B asics an d A pplications**: Basic OPAMP configurations and characteristics, OPAMP non-idealities, digital to analog and analog to digital converters - basic conversion techniques and errors, precision amplifier, logarithmic amplifier, square-root amplifier.	6
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication / Reprint
1.	Behzad Razavi, "Fundamentals of Microelectronics", 2nd Ed., Wiley India.	2013
2.	Paul R. Gray, P. J. Hurst, S. H. Lewis and R. G. Meyer, "Analysis and Design of Analog Integrated Circuits," 5th Ed, Wiley India.	2009
3.	Adel S. Sedra and K. C. Smith, "Microelectronic Circuits," 6th Ed. Oxford University Press India.	2010
4.	Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw-Hill.	2002

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electronics & Communication Engineering**

1. Subject Code: **ECN-212** Course Title: **Principles of Digital Communication**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weight**:** **CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits**:4** 6. Semester**: Spring** 7. Subject Area**: DCC**

8. Pre-requisite**:** **EC-203 Signals & Systems**

9. Objective: **T**o provide a detailed treatment of the techniques used in digital communication and to introduce the students to the basics of information theory and coding techniques.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction:** Digital communication system model, modulation process, analog vs. digital communication; Fundamental limitations of communication systems.	**3**
2.	**Probability and random variables:** Concept of probability, random variable and its characterization, probability density functions, transformations of random variables, statistical averages.	**6**
3.	**Waveform sampling and coding:** Sampling theorem for low-pass and band-pass signals, practical difficulties in signal reconstruction; Instantaneous, natural and flat-top sampling; PAM and TDM; Uniform quantization and its noise analysis, non-uniform quantization, A-law, μ-law; PCM, DM, and DPCM, performance comparison; Adaptive quantization and prediction, low bit rate coding and compression standards for speech signals; Emerging digital communication techniques including video compression and HDTV.	**12**
4.	**Baseband data transmission:** Baseband transmission; Matched filter; Nyquist rate and wave shaping techniques; ISI and adaptive equalization.	**6**
5.	**Digital modulation techniques:** Passband transmission; Coherent and	**10**

	non-coherent detection of signals in noise; Generation and detection of PSK, DPSK, QPSK, OOK, FSK, QAM and MSK; Probability of error analysis of digital modulation techniques.	
6.	**Introduction t o I nformation t heory:** Measure of information, entropy; Channel capacity and Shannon's theorems; Introduction to source coding and channel coding techniques.	**5**
	Total	**42**

11. Suggested Books:

S. No.	**Name of Books / Authors/ Publishers**	**Year of Publication/ Reprint**
1.	Haykin, S., "Communication Systems", 4th Ed., John Wiley & Sons.	2001
2.	Lathi, B.P., "Modern Digital and Analog Communication Systems", 3rd Ed., Oxford University Press.	1998
3.	Proakis, J.G., Salehi, M., "Digital Communications", 5th Ed., McGraw-Hill International.	2008
4.	Roden, M.S., "Analog and Digital Communication Systems", 5th Ed., Discovery Press.	2005
5.	Couch II, L.W., "Modern Communication Systems: Principles and Applications", Prentice-Hall.	1998
6.	Couch II, L.W., "Digital and Analog Communication Systems", 7th Ed., Pearson.	2009
7.	Carlson, A.B., Crilly, P.B. and Rutledge, J.C., "Communication Systems: An Introduction to Signals and Noise in Electrical Communication", 4th Ed., McGraw-Hill.	2002
8.	Sklar, B., "Digital Communications", 2nd Ed., Pearson.	2001

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Department of Electronics and Computer Engineering**

1. Subject Code: **ECN-232** Course Title: **Engineering Electromagnetics**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weight: **CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits: **4** 6. Semester : **Spring** 7. Pre-requisite: **PH - 101 (OR) EQUIVALENT**

8. Subject Area: **DCC**

9. Objective: To introduce to the students the theory of electromagnetic wave propagation in free space and in various types of guiding structures.

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10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	**Fundamental Concepts:** Scalar and vector fields; Physical interpretation of gradient, divergence and curl; Coordinate systems; Review of static fields; Current continuity equation; Displacement current; Maxwell's equations.	4
2.	**Plane Waves:** Wave equation in an isotropic homogeneous medium and its solution, phasor notation, polarization of waves, reflection and refraction of plane waves at plane boundaries, Poynting vector.	10
3.	**Transmission Lines:** Time-domain analysis of transmission lines; Bounce diagrams; Frequency-domain analysis of transmission lines; Standing waves; Smith chart; Transmission line matching: Single and double-stub matching, quarter-wave transformers.	12
4.	**Waveguides and Planar Transmission Lines:** Electromagnetic fields in parallel-plate, rectangular, and circular waveguides, TE and TM modes, wave impedance, wave velocities, attenuation in waveguides, Electromagnetic fields in striplines, microstriplines, and co-planar waveguides.	8
5.	**Cavity Resonators:** Elecromagnetic fields in rectangular and cylindrical resonators, degeneracy of modes, quality factor.	4
6.	**Introduction to Computational Electromagnetics**: Solution of Laplace/Poisson and Helmotz Wave equations using Finite Difference Method, and introduction to Finite Difference Time Domain (FDTD) scheme.	4
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Narayana Rao, N., "Elements of Engineering Electromagnetics", 5th Ed., Prentice-Hall of India.	2002
2.	Sadiku, M.N.O., "Elements of Electromagnetics", 3rd Ed., Oxford University Press.	2001
3.	Jordan, E.C. and Balmain, K.G., "Electromagnetic Waves and Radiating Systems", 2nd Ed., Prentice-Hall of India.	1993
4.	Hayt, W.H. and Buck, J.A., "Engineering Electromagnetics", 7th Ed., Tata McGraw-Hill.	2006
5.	Shen L. C., Kong J. A., Patniak A., "Engineering Electromagnetics", Cengage Learning.	2011
6.	Ramo, S.A., Whinnery, J.R. and Van Duzer, T., "Fields and Waves in Communication Electronics", 3rd Ed., John Wiley & Sons.	1994

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: **Department of Electronics and Computer Engineering**

1. Subject Code: **ECN-252** Course Title: **Digital Electronic Circuits Laboratory**

2. Contact Hours: **L: 0** **T: 0** **P: 3**

3. Examination Duration (Hrs.): **Theory:0** **Practical :3**

4. Relative Weight: **CWS:0** **PRS:50** **MTE:0** **ETE:0** **PRE:50**

5. Credits: **2** 6. Semester : **Spring** 7. Pre-requisite: **EC - 203**

8. Subject Area: **DCC**

9. Objective: To provide hands-on experience on the various building blocks of digital circuits.

10. Details of the Course:

Sl.No.	Contents	ContactHours
1 2	**Hardware based** Design of binary adders. Design and testing of switch debouncers. Design of TTL- and 555-based multivibrators, timers and clock circuits. Basic programming of 8085 microprocessor. Simple I/O exercises using 8255. **VHDL and FPGA kit based** Design of a 'last-in, first-out'(LIFO) stack or a FIFO queue. (i) Design of a 'rising edge detector' circuit using an FSM. (ii) Design of a debouncing circuit. Design of a UART receiver and transmitter. Design of various types of memory Interfacing of a PS/2 keyboard (Controlling the stopwatch through a PS/2 keyboard) Interfacing of a VGA monitor (A simple animation) Design of a simple single-cycle 'reduced instruction set computer (RISC)' based on the MIPS design Design of a pipelined RISC processor with various enhancements like forwarding, hazard detection	14 x 4
	Total	**56**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Mano, M.M. and Ciletti, M.D., "Digital Design", 4th Ed., Prentice-Hall.	2006
2.	Gaonkar, R.S., "Microprocessor Architecture, Programming and Applications", 5th Ed., Penram International.	2007
3.	Pong P. Chu, "FPGA Prototyping by VHDL Examples: Xilinx Spartan-3 Version" Wiley.	2008
4.	Bhasker, J., "A VHDL Primer," Pearson India.	2005
5.	Volnei A. Pedroni , "Circuit Design and Simulation with VHDL," 2nd Ed. PHI India	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE **:** **Department of Electronics and Computer Engineering**

1. Subject Code**: ECN-291** Course Title**: Electronic Network Theory**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**

4. Relative Weight**: CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **RE: 0**

5. Credits**:4** 6. Semester Autumn 7. Pre-requisite**: Electrical Science**

8. Subject Area**: DCC**

9. Objective: To acquaint the students with the fundamental principles of circuit theory and network synthesis

10. Details of Course:

Sl. No.	Particulars	Contact Hours
1.	**Network T heorems**: Basic nodal and mesh analysis, linearity, superposition and source transformation, Thevinin's, Norton's and maximum power transfer theorem and useful circuit analysis techniques, network topology, introduction to SPICE in circuit analysis.	6
2.	**Transient A nalysis**: Source free RL and RC circuits, unit step forcing function, source free parallel and series RLC circuit, complete response of the RLC circuit, lossless LC circuit.	7
3.	**Frequency Domain A nalysis**: The phasor concept, sinusoidal steady state analysis; AC circuit power analysis.	6
4.	**Laplace t ransform and i ts c ircuit app lications**: Laplace transform, initial and final value theorem, circuit analysis in s-domain, frequency response.	6
5.	**Two Port Networks**: Z, Y, h and ABCD parameters, analysis of interconnected (magnetically coupled) two port, three terminal networks.	6
6.	**State Variable Analysis**: State variables and normal-form equations, matrix-based solution of the circuit equations.	3
7.	**RL & RC Network Synthesis**: Synthesis of one-port networks, transfer function synthesis, basics of filter design.	8
	Total	42

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Hayt, Kemmerley and Durbin, "Engineering Circuit Analysis", 8th Ed., Tata McGraw-Hill	2012
2.	DeCarlo, R.A. and Lin, P.M., "Linear Circuit Analysis: Time Domain, Phasor and Laplace Transform Approaches", Oxford University Press.	2003
3.	M.E. Van Valkenburg, "Network Analysis", 3rd ed., Pearson	2006
4.	M.E. Van Valkenburg, "Network Synthesis," PHI	2007
5.	Kuo, F.F., " Network Analysis and Synthesis", 2nd Ed., Wiley India.	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EEN-112** Course Title: **Electrical Science**

2. Contact Hours: **L: 3** **T: 1** **P: 2/2**

3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**

4. Relative Weight**:** **CWS: 15** **PRS: 15** **MTE: 30** **ETE: 40** **PRE: 0**

5. Credits**: 4** 6. Semester**: Both** 7. Subject Area**: ESC**

8. Pre-requisite**: NIL**

9. Objective: To introduce the students to the fundamentals of Electrical Engineering concepts of network analysis, principles of electrical machines, basics of electrical measurement and measuring instruments.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Energy Resources an d U tilization:** Conventional and non-conventional energy resources; Introduction to electrical energy generation from different resources, transmission, distribution and utilization.	**5**
2.	**Network F undamentals**: Types of Sources and elements, Kirchoff's Laws, Mesh and Node Analysis of D.C. Networks, Network Theorems: Thevenin's Theorem, Norton's Theorem, Superposition Theorem, Maximum Power Theorem, Star-Delta Transformation.	**5**
3.	**A.C. F undamentals**: Concept of phasor, impedance and admittance; Mesh and Node analysis of AC networks; Network theorems in AC networks; Active and reactive power in AC circuits; Resonance in series AC circuits; Power factor correction.	**4**
4.	**Three-phase A.C . Circuits**: Analysis of 3-phase balanced start-delta circuits, Power in 3-phase Circuits.	**2**
5.	**Measurement of E lectrical Qu antities**: Measurement of Voltage, Current, and Power; Measurement of 3 phase power; Energy meters.	**5**
6.	**Single P hase T ransformer**: Introduction to magnetic circuit concepts, Basic constructional features, operating principle, phasor diagram, equivalent circuit, voltage regulation; Eddy current and Hysteresis losses, efficiency; Open circuit and Short Circuit tests.	**5**

7.	**D.C. Machines**: Principle of operation, constructional features; Emf and torque equations; Types of excitation; Generator characteristics; Starting and speed control of D.C. motors.	**5**
8.	**AC Machines**: Three-phase Induction Motor - Operating principle, constructional features, torque-speed characteristics, starting and speed control; Single-phase Induction Motor - Operating principle, constructional features, torque-speed characteristics, starting methods.	**5**
9.	**Industrial A pplications an d C ontrol: V** arious industrial loads, traction, heating, lighting; Concept of power electronic control of AC and DC motors.	**6**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Mukhopadhyaya P., Pant A.K., Kumar V. and Chittore D.S., "Elements of Electrical Science", M/s Nem Chand & Brothers.	1997
2.	Vincent Del Toro, "Electrical Engineering Fundamentals", Prentice Hall of India.	2002
3.	Dubey G. K., "Fundamentals of Electric Drives", 2nd Ed., Narosa Publishing House.	2007
4.	Alexander C.K., Sadiku M.N.O., "Fundamentals of Electric Circuits", McGraw Hill, 5th Edition.	2012
5.	Chapman, Stephen, J., "Electric Machinery Fundamentals", McGraw Hill Book Company.	1985
6.	Hughes Edward, "Electrical & Electronic Technology", Pearson Publishing, 8th edition.	2002

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Mathematics**

1. Subject Code: **MAN-006** Course Title: **Probability and Statistics**

2. Contact Hours: **L: 3** **T: 1** **P : 0**

3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**

4. Relative Weightage**:** **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**

5. Credits**: 4** 6. Semester**: Spring** 7. Subject Area**: BSC**

8. Pre-requisite**: Nil**

9. Objective: To impart techniques of Probability and Statistics.

10. Details of Course:

S.No.	Contents	Contact Hours
1	Concept of probability, random variable and distribution function: discrete and continuous, moments and moment generating functions.	**9**
2	Special distributions (discrete): Binomial, Poisson, Negative binomial, Geometric. (continuous): Uniform, Exponential, Gamma, Beta, Normal, Lognormal.	**9**
4	Bivariate random variables: joint, marginal, conditional distribution. Statistical independence, product moment.	**3**
5	Random sample, law of large numbers, central limit theorem, correlation, regression.	**7**
6	Estimation: maximum likelihood estimation, unbiasedness and efficiency, interval estimation for normal population with normal, t, χ^2 distribution.	**7**
7	Testing of Hypothesis: Simple and composite hypothesis, Type I and type II errors. Power of test. Some tests for normal population parameters based on normal, t, χ^2 distribution.	**7**
	TOTAL	**42**

11. Suggested Books:

S.No.	Title/Authors/Publishers	Year of Publication
1.	Rohatgi, V K. and Saleh , A. K. Md. Ehsanes, "An Introduction to Probability and Statistics", (John Wiley and Sons) , (2^{nd} edition)	2000
2.	Hogg, R. V. and Craig, A., "Probability and Statistical Inference", (Pearson Education), (6^{th} Edition)	2006
3.	Johnson, R. A., Miller, I. and Freund, J. E., "Miller & Freund's probability and statistics for engineers", (Prentice Hall PTR), (8^{th} edition)	2011
4.	Hines, W. W., Montgomery, D. C., Goldsman, D. M. and Borror, C. M.,	2003

	"Probability and Statistics in Engineering", (John Wiley & sons), (4^{th} Edition)	
5.	Papoulis, A. and Pillai, S. U., "Probability, Random Variables and Stochastic Processes", (Tata McGraw-Hill), (4^{th} edition)	2002

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Mathematics**

1. Subject Code: **MAN-010** Course Title: **Optimization Techniques**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory: 3** **Practical : 0**

4. Relative Weightage**:** **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**

5. Credits**: 4** 6. Semester**: Spring** 7. Subject Area**: BSC**

8. Pre-requisite**: Nil**

9. Objective: To acquaint the students with the basic concepts of Optimization.

10. Details of Course

S. No.	Contents	Contact Hours
1	Different Types of OR Models, Case studies in Engineering applications	**2**
2	Convex Sets, Graphical Method, Simplex Method, Big – M Method, Two Phase Method, Revised Simplex Method	**10**
3	Duality Theory, Dual Simplex Method, Sensitivity Analysis	**7**
4	Cutting Plane and Branch and Bound Techniques for all Integer and Mixed Integer Programming Problems, 0-1 Integer Problems, Travelling Salesman Problem, Cargo Loading Problem	**9**
5	Transportation Problems and Assignment Problems	**4**
6	Game Theory: Rectangular Games, Minmax Theorem, Graphical Solution of 2 X n and m X 2 games, Reduction to Linear Programming Problems	**5**
7	Sequencing and Scheduling: Processing of Jobs through Machines, CPM and PERT	**5**
	TOTAL	**42**

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1	Taha, H.A., "Operations Research: An Introduction", MacMillan Pub Co., NY, Ninth Edition (Reprint).	2013
2.	Ravindran, A., Phillips, D.T. and Solberg, J.J., "Operations Research: Principles and Practice", John Wiley and Sons, NY, Second Edition (Reprint).	2012
3.	Pant, J.C., "Introduction to Optimization", Jain Brothers,	2012
4.	Hillier, F. S. and Lieberman, G. J., "Introduction to Operations Research," 9th Edition, McGraw-Hill	2009
5.	Mittal, K.V. and Mohan, C., "Optimization Methods in System Analysis and Operations Research"	1996
6.	Mohan C. and Deep K., "Optimization Techniques"	2009

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT. /CENTRE: **Department of Mechanical and Industrial Engineering**

1. Subject Code: **MIN-108** Course Title: **Mechanical Engineering Drawing**

2. Contact Hours: L**: 2** T: **0** P**: 4**

3. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**

4. Relative Weightage: **CWS: 0** **PRS: 25** **MTE: 25** **ETE: 50** **PRE: 0**

5. Credits: **4** 6. Semester: **Both** 7. Subject Area: **DCC/ESC**

8. Pre-requisite: **Nil**

9. Objective: The course objective is to teach the basic concepts of Mechanical Engineering Drawing to the students. The emphasis is on to improve their power of imagination.

10. Details of Course:

S. No.	Contents	Contact Hours
1	General Instructions : Sheet Layout, Line Symbols and Groups, Preferred Scales, Technical Sketching	**1**
2	Types of projections: Reference Planes and Quadrants, Orthographic Projection	**2**
3	Projection of point and lines	**3**
4	Projection of plane figures	**2**
5	Projection of solids	**2**
6	Section of solid and development	**2**
7	Shape Description(External): Multiplanar Representation, Systems of Projection, Sketching of Orthographic Views from Pictorial Views, Conventional Practices, Precedence of Views , Precedence of Lines	**2**
8	Uniplaner Representation: Sketching of Pictorial Views (Isometric and Oblique) from Multiplaner Orthographic Views	**2**
9	Shape Description (Internal): Sectioning as an Aid to Understanding internal features, Principles of Sectioning, Types of Sections, Section Lines, Cutting Plane Lines and Conventional Practices	**3**
10	Size Description: Dimensioning, Tools of Dimensioning, Size and Position Dimensions, Unidirectional and Aligned Systems, Principle and Practices of Dimensioning,	**4**
11	Conventional Representation: Representation and	**1**

	Identification of Common Machine Elements and Features	
12	Introduction to Solid Modeling	**4**
	Total	**28**

Practical Exercises:

Topics	**Practice Classes of Two Hour Duration**
Projection of points and lines	04
Projection of plane figures	02
Projection of solids	03
Section and development	02
Sketching of Orthographic Views from Pictorial Views	04
Sketching of Pictorial Views (Isometric and Oblique) from Multiplanar Orthographic Views, Missing Lines Exercise, Missing Views Exercise	04
Sectioning Exercise	02
Dimensioning exercise	02
Identification Exercise	01
Solid Modeling, orthographic views from solid models	04

11. Suggested Books:

S.No.	**Name of Authors / Books / Publishers**	**Year of Publication/ Reprint**
1.	Technical Drawing, Giesecke, Mitchell, Spencer, Hill, Dygdon and Novak, Macmillan Publishing Company	2003
2.	Engineering Graphics, A. M. Chandra and Satish Chandra, Narosa Publishing House, New Delhi	2003
3.	Engineering Drawing and Graphics Technology, T.E. French, C.J. Vierck and R.J. Foster, McGraw-Hill Inc	1993
4.	Fundamentals of Engineering Drawing, W.J. Luzadder, J. Warren and J.M. Duff, Prentice Hall International Editions	1989
5.	SP 46:1988 Engineering Drawing Practice for Schools and Colleges, Bureau of Indian standards	-------

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE **:** **Department of Physics**

1. Subject Code**:** **PHN-006** Course Title**: Quantum Mechanics and Statistical Mechanics**

2. Contact Hours: **L: 3** **T: 0** **P: 2**

3. Examination Duration (Hrs.): **Theory: 3** **Practical : 0**

4. Relative Weightage**:** **CWS: 15** **PRS: 15** **MTE: 30** **ETE: 40** **PRE: 0**

5. Credits**: 4** 6. Semester**: Spring** 7. Subject Area**: BSC**

8. Pre-requisite**: None**

9. Objective: To provide basic knowledge and applications of Statistical Mechanics and Quantum Mechanics.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Postulates of classical statistical mechanics, the three ensembles: micro canonical, canonical and grand canonical; Micro canonical: Definition of entropy from microstates, Derivation of the laws of thermodynamics, concept of temperature from the derivative of entropy.	**8**
2	Statistical distributions: Maxwell-Boltzmann, Bose-Einstein, Fermi-Dirac distributions; Applications: equipartition of energy, Bose-Einstein Condensation, Black body radiation: Classical Rayleigh-Jeans law, Wien's law, Planck's Quantum radiation law, Stefan's law, Wien's displacement law, Stimulated emission, Einstein's A and B coefficients, Specific heat of solids, free electrons in a metal.	**10**
3	Photoelectric effect, Compton effect, Frank-Hertz experiment, wave particle duality and wave packets, de Broglie waves, phase and group velocities, Davisson-Germer experiment and gamma ray scattering from electrons, uncertainty principle (single slit thought experiment), applications of the uncertainty principle.	**7**
4	Basic postulates of quantum mechanics and physical meaning of the wave function, Schrödinger wave equation, stationary states, expectation values, probability current density; Applications: Particle in a 1-D box, 1-D step potential, reflection and transmission by a barrier and tunneling and their applications in electronics, electron in periodic potential, energy band gap, qualitative discussion of Kronig-Penney model, 1-D linear harmonic oscillator.	**11**
5	H-atom and the related quantum numbers *(n,l,m)*, normal and anomalous Zeeman effect, Anomalous Zeeman effect (Na D1 and D2 lines), Stern-Gerlach experiment, Fine structure of $H_{\square}$ line.	**6**

	Total	**42**

List of experiments:

1. Study of magnetic field of a pair of coils in Helmholtz arrangement
2. Determination of e/m
3. Determination of first excitation potential of a gas by Frank-Hertz experiment
4. Determination of Stefan's constant
5. Determination of Planck's constant by radiation
6. To study and verify Malus' law
7. Study of polarization of light using quarter wave plate
8. Determination of Brewster's angle at glass-air interface
9. Determination of width of a slit by single-slit diffraction pattern
10. Four probe method of finding resistivity of semiconductor
11. Quincke's Method for determining mass susceptibility
12. Wavelength of Na light by Newton's ring method

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	A. Beiser, "Concepts of Modern Physics", Tata McGraw Hill	2009
2.	F. Reif," Fundamentals of Statistical and Thermal Physics", Sarat	2010
3.	R.P. Feynman, "The Feynman Lectures On Physics (Vol. 1-3)", Narosa	2008
4.	I.S. Tyagi, "Principles of Quantum Mechanics", Pearson Education	2013
5.	D.J. Griffiths," Introduction to Quantum Mechanics", Pearson Education	2005

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT/CENTRE: **DEPARTMENT OF CIVIL ENGINEERING**

1. Subject code: **CEN-105** Course Title: **Introduction to Environmental Studies**
2. Contact Hours: **L: 3 T: 0 P: 0**
3. Examination Duration (Hrs): **Theory:** 3 **Practical:** 0
4. Relative Weightage: **CWS:** 15 **PRS:** 0 **MTE:** 35 **ETE:** 50 **PRE:** 00
5. Credits: **3** 6. Semester: **Autumn** 7. Subject Area: **GSC**
8. Pre-requisite: **Nil**
9. Objective: To introduce fundamentals of environmental pollution and its control.
10. Details of Course:

S. No.	Contents	Contact Hours
1.	Overview: Environment and Natural Processes; Development (Resource Utilization & Waste G eneration); Environmental issues; Concept of Sustainable D evelopment; Issues affecting f uture development (population, urbanization, health, water scarcity, energy, climate change, toxic chemicals, finite resources etc.); Environmental units	6
2.	Air –Water i nteraction: (Liquid ph ase-gas pha se e quilibrium) H enry's Law Constant with units, Dimensionless Henry's Law Constant	3
3.	Water –Soil I nteraction: Carbonate S ystem (Alkalinity a nd buffering capacity); Major ions in water; Natural Organic Matter (NOMs); Water quality parameters; Physical processes (Mass Balance): Spatio-temporal variation i n qua lity of r iver w ater, l ake w ater, gr ound water; Water quality standards	9
4.	Wetlands, water treatment and wastewater treatment .	6
5.	Air resources: Atmosphere; Air pollutants; Emissions and control of air pollutants; Atmospheric meteorology and dispersion; Transport of air (global, r egional, lo cal); A ir/ a tmospheric stability; P lume sha pe; Gaussian modeling; Air quality standards	9
6.	Land pollution and solid waste management	3
7.	Ecosystem: Structure and function; Energy flow in ecosystem; Material flow in ecosystem; Biodiversity and ecosystem health; Bio-amplification and bio-magnification	3
8.	Hazardous Waste: Definition; Classification; Storage and management; Site remediation; Environmental Risk: assessment, and management	3
Total		**42**

11. Suggested Books:

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Davis M . L . a nd C ornwell D . A ., " Introduction to E nvironmental Engineering", McGraw Hill, New York 4/e	2008
2.	Masters G . M., Joseph K . a nd N agendran R . "Introduction t o Environmental E ngineering a nd S cience", P earson E ducation, New Delhi. 2/e	2007
3.	Peavy H. S., R owe D.R. and T chobanoglous G., "Environmental Engineering", McGraw Hill, New York	1986
4.	Mines R . O. and L ackey L . W. "" Introduction t o Environmental Engineering", Prentice Hall, New Yark	2009
5.	Miheicic J. R . a nd Z immerman J . B . " E nvironmental E ngineering: Fundamentals, Sustainability, Design" John Wiley and Sons, Inc.	2010

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Humanities & Social Sciences**

1. Subject Code: **HS-001A** Course Title: **Communication Skills (Basic)**

2. Contact Hours: **L: 1** **T: 0** **P: 2**

3. Examination Duration (Hrs.): **Theory** 2 **Practical** 0

4. Relative Weight: **CWS** 25 **PRS** 00 **MTE** 25 **ETE** 50 **PRE** 0

5. Credits: 2 6. Semester: **Autumn/Spring** 7. Subject Area: **HSS**

8. Pre-requisite: **NIL**

9. Objective:
The course intends to build the required communication skills of the students having limited communicative abilities, so that they may communicate effectively in real-life situations

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Understanding the Basics of Communication Skills: Listening, Speaking, Reading & Writing, Scope and Importance	**01**
2.	Grammar & Composition: Time and Tense, Agreement, Active-Passive, Narration, Use of Determiners, Prepositions & Phrasal Verbs	**05**
3.	Vocabulary Building & Writing: Word-formation, Synonyms, Antonyms, Homonyms, One-word Substitutes, Idioms and Phrases, Collocations, Abbreviations of Scientific and Technical Words	**02**
4.	Introduction to Sounds (Vowels & Consonants) Organs of Speech, Place and Manner of Articulation, Stress & Intonation, Listening Comprehension (Practical Sessions in Language Laboratory)	**02**

5.	Speaking, Countering Stage-fright and Related Barriers to Communication.	**02**
6.	Reading and Comprehension: Two lessons to be identified by the department.	**02**
	Total	**14**

List of Practicals:

1. Ice-breaking Exercises
2. Assignments on Time and Tense, Agreement, Active-Passive
3. Laboratory Session on Narration, Use of Determiners, Prepositions & Phrasal Verbs, Revisionary Exercises & Quiz
4. Laboratory Session on Synonyms, Antonyms, Homonyms
5. Assignments and Practice Sheets on One-word Substitutes, Idioms and Phrases, Collocations, Abbreviations of Scientific and Technical Words
6. Laboratory Session on Practice of sounds, Intonation and Stress, Listening Comprehension
7. Individual presentation, debates, Extempore & Turncoats
8. Exercises in Composition and Comprehension

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Murphy, Raymond. *Intermediate English Grammar*, New Delhi, Cambridge University Press.	**2009**
2.	Quirk, Randolph & Sidney Greenbaum. *A University Grammar of English*, New Delhi, Pearson.	**2009**
3.	McCarthy, Michael & Felicity O' Dell. *English Vocabulary in Use*, New Delhi, Cambridge University Press	**2010**
4.	Jones, Daniel. *The Pronunciation of English*, New Delhi, Universal Book Stall.	**2010**
5.	Birchfield, Susan M. *Fowler's Modern English Usage*, New Delhi, OUP.	**2004**
6.	Llyod, Susan M. *Roget's Thesaurus of English Words and Phrases.* New Delhi: Penguin.	**2010**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Humanities & Social Sciences**

1. Subject Code: **HS-001B** Course Title: **Communication Skills (Advanced)**

2. Contact Hours: **L: 1** **T: 0** **P: 2**

3. Examination Duration (Hrs.): **Theory** 2 **Practical** 0

4. Relative Weight: **CWS** 25 **PRS** 00 **MTE** 25 **ETE** 50 **PRE** 0

5. Credits: 2 6. Semester: **Autumn/Spring** 7. Subject Area: **HSS**

8. Pre-requisite: **NIL**

9. Objective: The course intends to train the learners in using both verbal and non-verbal communication effectively.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Advanced Communication Skills: Scope, Relevance, & Importance	01
2.	Soft Skills: Interpersonal Communication; Verbal & Non-verbal, Persuasion, Negotiation, Neuro-Linguistic Programming	03
3.	Communication and Media (Social and Popular), The Social and Political Context of Communication, Recent Developments and Current Debates in Media	04
4.	Cross-cultural and Global Issues in Communication: Race, Ethnicity, Gender & Diaspora	03
5.	Rhetoric and Public Communication, Audience Awareness, Emotionality	03
	Total	14

List of Experiments:

1. Discussion on the Process of Communication in Personal and Professional Life
2. Group Discussion, Case Studies and Role-Play
3. Assignments on E-mail Etiquette, Social Networking, Blog Writing, Discussions on Current Issues
4. Non-Verbal Communication in Cross-Cultural Situations, Case Studies, Group Discussions and Readings on Topics Related to Race, Ethnicity , Gender and Diaspora
5. Individual Presentations (Audience Awareness, Delivery and Content of Presentation)

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Rentz, Kathryn, Marie E. Flatley & Paula Lentz. *Lesikar's Business Communication CONNECTING IH A DIGITAL WORLD*, McGraw-Hill, Irwin	**2012**
2.	Bovee, Courtland L & John V. Thill. *Business Communication Today*. New Delhi, Pearson Education	**2010**
3.	McMurrey, David A. & Joanne Buckley. *Handbook for Technical Writing*, New Delhi, Cengage Learning.	**2009**
4.	Jones, Daniel. *The Pronunciation of English*, New Delhi, Universal Book Stall.	**2010**
5.	Allan & Barbara Pease. *The Definitive Book of Body Language,* New York, Bantam	**2004**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Humanities and Social Sciences**

1. Subject Code: **HSN-002** Course Title: **Ethics and Self-awareness**

2. Contact Hours: **L: 01** **T: 0 1** **P: 0**

3. Examination Duration (Hrs.): **Theory 2** **Practical 0**

4.Relative Weight**: CWS:25 PRS:0 MTE:25 ETE:50 PRE:0**

5. Credit **02** 6. Semester**: Autumn** 7. Subject Area**: HSSC**

8. Pre-requisite**: NIL**

9. Objective: To introduce the concepts pertaining to ethical and moral reasoning and action and to develop self - awareness.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Introduction**: Definition of Ethics; Approaches to Ethics: Psychological, Philosophical, Social.	**1**
2	**Psycho-social theories of moral development**: View of Kohlberg; Morality and Ideology, Culture and Morality, Morality in everyday context.	**3**
3	**Ethical Concerns**: Work Ethics and Work Values, Business Ethics, Human values in organizations.	**3**
4	**Self-Awareness**: Self Concept: Johari Window, Self and Culture, Self Knowledge, Self-Esteem; Perceived Self-control, Self-serving bias, Self-presentation, Self-growth: Transactional Analysis and Life Scripts.	**4**
5.	**Self Development**: Character strengths and virtues, Emotional intelligence, Social intelligence, Positive cognitive states and processes (Self-efficacy, Empathy, Gratitude, Compassion, and Forgiveness).	**3**
	Total	**14**

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication
1.	Hall, Calvin S., Lindzey, Dardner., & Cambell, John B.,"Theories of Personality",Hamilton Printing Company.	1998
2.	Car Alan, "Positive Psychology: The Science of Happiness and Human Strengths", Brunner-Routledge.	2004
3.	Leary M.R., "The Curse of Self: Self-awareness, Egotism and the Quality of Human Life", Oxford University Press.	2004
4.	Louis P. P., "The Moral Life: An Introductory Reader in Ethics and Literature", Oxford University Press.	2007
5.	Corey, G., Schneider Corey, M., & Callanan, P., "Issues and Ethics in the Helping Professions", Brooks/Cole.	2011
6.	Snyder, C.R., Lopez, Shane, J., & Pedrotti, J.T., "Positive Psychology" Sage, 2nd edition.	2011

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Mathematics Department**

1. Subject Code: **MAN-001** Course Title: **Mathematics I**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weightage**:** **CWS** 25 **PRS** 00 25 50 0

5. Credits**:** 4 6. Semester**: Autumn** 7. Subject Area**: BSC**

8. Pre-requisite**:** **None**

9. Objective: **To provide essential knowledge of basic tools of Differential Calculus, Integral Calculus , Vector Calculus and Matrix Algebra for degree students.**

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Matrix Algebra:** Elementary operations and their use in getting the Rank, Inverse of a matrix and solution of linear simultaneous equations. Orthogonal, Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian, Normal & Unitary matrices and their elementary properties. Eigen-values and Eigenvectors of a matrix, Cayley-Hamilton theorem, Diagonalization of a matrix.	8
2.	**Differential Calculus:** Limit, Continuity and differentiability of functions of two variables, Euler's theorem for homogeneous equations, Tangent plane and normal. Change of variables, chain rule, Jacobians, Taylor's Theorem for two variables, Error approximations. Extrema of functions of two or more variables, Lagrange's method of undetermined multipliers	12
3.	**Integral Calculus:** Review of curve tracing and quadric surfaces, Double and Triple integrals, Change of order of integration. Change of variables. Gamma and Beta functions. Dirichlet's integral. Applications of Multiple integrals such as surface area, volumes, centre of gravity and moment of inertia..	12
4.	**Vector Calculus:** Differentiation of vectors, gradient, divergence, curl and their physical meaning. Identities involving gradient, divergence and curl. Line and surface integrals. Green's, Gauss and Stroke's theorem and their applications.	10
	Total	42

11. Suggested Books:

S. No.	Name of Authors/ Books/Publishers	Year of Publication/Reprint
1.	E. Kreyszig, Advanced Engineering Mathematics, 9th edition, John Wiley and Sons, Inc., U.K.	2011
2.	R.K. Jain and S.R.K. Iyenger, Advanced Engineering Mathematics, 2nd Edition, Narosa Publishing House.	2005
3.	M.D. Weir, J. Hass, F.R. Giordano, Thomas' Calculus, 11th Edition, Pearson Education.	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Physics Department**

1. Subject Code: **PHN-005** Course Title: **Electrodynamics and Optics**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weightage**:** **CWS** 25 **PRS** 0 25 50 0

5. Credits**:** 4 6. Semester**: Autumn** 7. Subject Area**: BSC**

8. Pre-requisite**:** **None**

9. Objective: **To familiarize students with the basic principles of electrodynamics and optics and extend its applications to interference, diffraction, and lasers.**

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Basic principles of electrostatics and magnetostatics, Maxwell's equations in differential form, physical significance of Maxwell's equations., wave equation and its solution for a dielectric medium, plane waves in a dielectric, concept of polarization, linear, circular and elliptical polarization, the Poynting vector, energy density and intensity of an e-m wave, reflection and refraction at the interface of two dielectrics	**14**
2.	Interference of light waves, Young's double slit experiment, interference pattern, intensity distribution, interference with white light, displacement of fringes, phase change on reflection. Interference by division of amplitude, interference by a plane parallel film when illuminated by a plane wave, interference by a film with two non-parallel reflecting surfaces (wedge shaped films), colours of thin films, Newton's rings, the Michelson interferometer. Coherence, Young's double slit and Michelson interferometer to explain coherence, the line width, spatial coherence, optical beats.	**10**
3.	Fraunhofer diffraction, single-slit diffraction pattern, diffraction by a circular aperture, directionality of laser beams, focusing of laser beams, limit of resolution, resolving power of a microscope, two-slit Fraunhofer diffraction, N-slit Fraunhofer diffraction, diffraction grating, grating spectrum and resolving power.	**6**
4.	Polarization and double refraction, wire grid polarizer, polarization by reflection and double refraction, Malus law, Brewster's law, superposition	**6**

	of t wo di sturbances, t he m athematical a nalysis. P henomenon of doub le refraction, nor mal and obl ique i ncidence, i nterference of pol arized lig ht, quarter-wave an d h alf-wave p lates, a nalysis o f p olarized l ight, o ptical activity.	
5.	Basic p roperties o f l asers, sp ontaneous an d st imulated e missions, main components of a laser, ruby and He-Ne laser, semiconductor diode laser	**6**
	Total	**42**

11. Suggested Books:

S. No.	**Name of Authors/ Books/Publishers**	**Year of Publication/Reprint**
1.	D. J. Griffiths, "Introduction of Electrodynamics," PHI Learning Pvt. Ltd.	2009
2.	M. N. O. Sadiku, " Elements of Electromagnetics," Oxford Univ. Press	2009
3.	A. Ghatak, "Optics," 6th Ed., Tata McGraw-Hill Publishing Co. Ltd.	2012
4.	E. Hecht, "Optics," 4th Ed., Pearson Education Pvt. Ltd.	2003
5.	F. Jenkins and H. White, "Fundamentals of Optics," 4th Ed. McGraw Hill	2001

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE**:** **Electronics and Communication Engineering**

1. Subject Code**:** **ECN-222** Course Title**: Automatic Control Systems**

2. Contact Hours: **L: 3** **T: 0** **P: 3**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weight**:** **CWS:15** **PRS:15** **MTE:30** **ETE:40** **PRE:0**

5. Credits**: 4** 6. Semester: **Spring** 7. Pre-requisite**: ECN-203**

8. Subject Area**: DCC**

9. Objective: To introduce the concepts of modeling, analysis and design of simple linear and non-linear dynamic systems.

10. Details of the Course:

Sl.No.	Contents	Contact Hours
1.	**Control System Concepts and Classification:** Open loop, closed loop, continuous, discrete, linear and non-linear control systems.	2
2.	**Mathematical Models of Systems:** Impulse response and transfer function, block-diagram model and signal flow graphs.	4
3.	**Time Domain Analysis:** Transient and steady state responses of first and second order systems, steady state errors, control of transient response; Basic control actions and their effects on transient and steady state responses.	7
4.	**Root Locus Technique:** Root loci, properties and construction of root loci, effects of adding and moving poles and zeros, root locus of conditionally stable systems, generalized root contour.	7
5.	**Frequency Domain Analysis:** Routh Hurwitz criterion, Bode and Nyquist diagrams, gain magnitude and phase shift plots, frequency domain specifications, peak resonance and resonant frequency of a second order system, gain margin and phase margin, conditionally stable system.	6
6.	**Compensation Design in s and ω Planes:** Introduction, phase lead compensation, phase lag compensation; Design of phase-lead and phase-lag compensation by Bode plot and root locus methods.	6
7.	**State Variable Technique:** Derivation of state model of LTI continuous time systems, state equations, state transition matrix, solution of state equations.	5
8.	**Basic Non-linear Analysis:** Linearization, describing function and phase plane methods, stability concepts and Lyapunov functions.	5
	Total	**42**

11. Suggested Books:

Sl. No.	Name of books/ Authors	Year of Publication
1.	Gopal, M., "Control Systems: Principle and Design", 2nd Ed., Tata McGraw-Hill.	2002
2.	Kuo, B.C., "Automatic Control Systems", 8th Ed., Wiley India.	2008
3.	Ogata, K., "Modern Control Engineering", 4th Ed., Pearson Education.	2008
4.	Dorf, R.C. and Bishop, R.H., "Modern Control Systems", 11th Ed., Prentice-Hall of India.	2007
5.	Nise, N. S., "Control Systems Engineering", 4th Ed., Wiley India.	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Electronics & Communication Engineering**

1. Subject Code: **ECN-311** Course Title: **Communication Systems and Techniques**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weightage**: CWS:25** **PRS:0** **MTE:25** **ETE:50** **PRE:0**

5. Credits**: 4** 6. Semester**: Autumn** 7. Subject Area**: DCC**

8. Pre-requisite**: ECN-212**

9. Objective: To provide a detailed treatment of techniques used for implementation and performance analysis of transceivers for general communication applications; basic concepts of TV and satellite communication systems.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction:** Introduction to modern communication systems and frequency band allocation	**2**
2.	**Random processes and Noise models:** Random process, correlation and power spectrum of random signals, random signals through linear systems, Gaussian random process and white noise; Shot noise and thermal noise; Noise figure and noise temperature of a two-port network, system noise calculations	**8**
3.	**Continuous-wave modulation techniques:** Characteristics of AM and FM; Generation and detection techniques for AM-FC, AM-DSB, SSB, NBFM, WBFM and PM; PLL and its applications in carrier acquisition and FM demodulation; Effect of noise on AM and FM systems, evaluation of SNR at detector output	**12**
4.	**Elements of Radio Receiver and Transmitter:** Super heterodyne receivers and their characteristics; Different receiver architectures; RF and IF amplifiers, mixers	**8**
5.	**Basic concept of Television System:** Image characteristics; Interlaced scanning, horizontal and vertical resolution, video bandwidth; Luminance and chrominance signals, composite video signal; Digital TV and video compression; TV camera; Transceiver architecture for TV; HDTV	**6**
6.	**Basic concept of Satellite Communication System:** Introduction to satellite systems; Orbital period and velocity; Coverage angle and slant range; Satellite link design; Multiple access techniques used in satellite systems	**6**
	Total	**42**

11. Suggested Books:

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Haykin, S., "Communication Systems", 4th Edition, John Wiley & Sons.	**2001**
2.	Kennedy G., Davis B., "Electronic Communication Systems", Tata McGraw-Hill, 4th Edition.	**2008**
3.	Tomasi W., "Advanced Electronic Communication Systems", Pearson/Prentice-Hall, 6th Edition.	**2004**
4.	Proakias, J.G., and Salehi, M., "Communication Systems Engineering", 2nd Edition, Pearson Education.	**2002**
5.	Roddy, D. and Coolen, V., "Electronic Communications", 4th Edition, Prentice-Hall of India	**1997**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Electronics and Communication Engineering**

1. Subject Code: **ECN-312** Course Title: **Digital Signal Processing**

2. Contact Hours: **L: 3** **T: 0** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weightage**: CWS:15** **PRS:0** **MTE:35** **ETE:50** **PRE:0**

5. Credits**:3** 6. Semester**: Spring** 7. Subject Area**: DCC**

8. Pre-requisite**:** **ECN-203**

9. Objective: To provide a detailed treatment of principles and algorithms of Digital Signal Processing (DSP), and implementation and applications of DSP algorithms.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction:** Review of discrete-time signal and system analysis; Advantages and typical applications of DSP	**2**
2.	**Sampling and Quantization:** Sampling and discrete-time processing of continuous time signals, Sampling of low-pass and band-pass signals; Uniform and non-uniform quantization, Lloyd-Max algorithm, Log-companding, A-law, μ-law; Adaptive quantization and prediction	**6**
3.	**Orthogonal transforms:** Properties and applications of DFT, implementing linear time invariant systems using DFT, circular convolution, linear convolution using DFT; Fast Fourier Transform, FFT algorithms: Decimation in time, decimation in frequency; Goertzel algorithm; Application of transform in speech, audio, image and video coding, Karhunen-Loeve Transform, DCT, JPEG and MPEG coding standards	**12**
4.	**Digital Filter design techniques:** IIR and FIR filters, filter design specifications; Design of digital IIR filters: Impulse invariant, and bilinear transformation techniques for Butterworth and Chebyshev filters; Design of FIR filters: Windowing, frequency sampling filter design, optimum approximations of FIR filters	**8**
5.	**Multi-rate Signal Processing:** Fundamentals of multirate systems, Decimation and interpolation, application of Multirate DSP in sampling rate conversion; Filter banks; Polyphase structures; Quadrature-mirror filter bank; Wavelet transform and its relation to multi-rate filter banks; applications to speech and audio coding.	**10**
6.	**Basic concept of Adaptive Digital Signal Processing:** Adaptive Wiener filter and LMS algorithm; Applications of adaptive filtering to echo cancellation and equalization	**4**
	Total	**42**

11. Suggested Books:

S. No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	Mitra, S.K., "Digital Signal Processing-A Computer Based Appraoach", 3rd Ed., Tata Mcgraw-Hill.	**2005**
2.	Oppenheim, A.V. and Schafer, R.W. with Buck, J.R., "Discrete Time Signal Processing", 2nd Ed., Prentice-Hall of India.	**2002**
3.	Proakis, J.G. and Manolakis, D.G., "Digital Signal Processing: Principles, Algorithm and Applications", 4th Ed., Pearson Education.	**2007**
4.	Vaidyanathan, P.P., "Multirate Systems and Filter Banks", Pearson Education.	**1993**
5.	Ifeachor, E.C. and Jervis, B.W., "Digital Signal Processing: A Practical Approach", 2nd Ed., Pearson Education.	**2002**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE**:** **Electronics and Communication Engineering**

1. Subject Code**: ECN-331** Course Title**: Antenna Theory**

2. Contact Hours: **L: 3** **T: 0** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weight**:** **CWS:15** **PRS:0** **MTE:35** **ETE:50** **PRE:0**

5. Credits**:3** 6. Semester**: Autumn** 7. Pre-requisite**: ECN-232**

8. Subject Area**: DCC**

9. Objective: To explain the theory of different types of antennas used in communication systems.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	**Fundamental Concepts:** Physical concept of radiation, retarded potentials, Hertzian dipole; Antenna parameters: Radiation pattern, gain, directivity, effective aperture, and reciprocity; Radiation from dipoles of arbitrary length.	10
2.	**Antenna Arrays:** Arrays of point sources, endfire and broadside arrays, pattern multiplication, synthesis of binomial and Dolph-Chebyshev arrays.	10
3.	**Broadband Antennas:** Log-periodic and Yagi antennas, frequency-independent antennas, broadcast antennas.	7
4.	**Aperture and Reflector Antennas:** Huygens' principle, radiation from apertures in an infinite ground plane, slot and horn antennas, parabolic reflector antennas.	10
5.	**Printed Antennas:** Radiation from rectangular and circular patches, feeding techniques.	5
	Total	**42**

11. Suggested Books:

Sl.No.	Name of Books / Authors	Year of Publication
1.	Balanis, C.A., "Antenna Theory and Design", 3rd Ed., John Wiley & Sons.	2005
2.	Kraus, J.D. and Fleisch, D.A., "Electromagnetics with Applications", McGraw-Hill.	1999
3.	Stutzman, W.L. and Thiele, H.A., "Antenna Theory and Design", 2nd Ed., John Wiley & Sons.	1998
4.	Elliot, R.S., "Antenna Theory and Design", Revised edition, Wiley-IEEE Press.	2003

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE**:** **Electronics and Communication Engineering**

1. Subject Code**: ECN-333** Course Title**: Microwave Techniques**

2. Contact Hours: **L: 3** **T: 0** **P: 0**

3. Examination Duration (Hrs.): **Theory:3** **Practical:0**

4. Relative Weight**:** **CWS:15** **PRS:0** **MTE:35** **ETE:50** **PRE:0**

5. Credits**:3** 6. Semester**: Autumn** 7. Pre-requisite**: ECN-232**

8. Subject Area**: DCC**

9. Objective: To provide a comprehensive introduction to various devices and passive components used at microwave frequencies.

10. Details of the Course:

Sl.No.	Contents	Contact Hours
1.	**Microwave Tubes:** Design considerations for microwave tubes, current status of microwave tubes, principle of operation of multi-cavity and reflex klystron, magnetron and traveling wave tube.	8
2.	**Microwave Network Analysis**: Equivalent voltages and currents, concept of impedance, impedance and admittance matrices of microwave junctions, scattering matrix representation of microwave networks, ABCD parameters, excitation techniques for waveguides.	10
3.	**Power Dividers and Couplers:** Scattering matrix of 3- and 4-port junctions, T-junction power divider, Wilkinson power divider, qualitative description of two-hole and multi-hole waveguide couplers, hybrid junctions.	8
4.	**Ferrimagnetic Components:** Permeability tensor of ferrites, plane wave propagation in ferrites, Faraday rotation, ferrite circulators, isolators and phase shifters.	6
5.	**Microwave Semiconductor Devices:** Operation and circuit applications of Gunn diode, IMPATT diode, PIN Diode, and Schottky barrier diode; Microwave BJT, MESFET, HEMT and their applications.	10
	Total	**42**

11. Suggested Books:

Sl.No.	Name of Books / Authors	Year of Publication
1.	Pozar, D.M., "Microwave Engineering", 3rd Ed., John Wiley & Sons.	2004
2.	Liao, S.Y., "Microwave Devices and Circuits", Prentice-Hall of India.	1991
3.	Collin, R.E., "Foundations for Microwave Engineering", 2nd Ed., John Wiley & Sons.	2000
4.	Streetman, B.G. and Banerjee, S.K., "Solid-state Electronic Devices", 6th Ed., Prentice-Hall of India.	2006
5.	Sze, S.M. and Ng, K.K., "Physics of Semiconductor Devices", 3rd Ed., John Wiley & Sons.	2006
6.	Bahl, I. and Bhartia, P., "Microwave Solid State Circuit Design", 2nd Ed., John Wiley & Sons.	2003

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT. /CENTRE: **Electronics and Communication Engineering**

1. Subject Code**: ECN- 342** Course Title**: RF and Mixed Signal Circuits**

2. Contact Hours: **L: 3 T: 0 P: 0**

3. Examination Duration (Hrs.): **Theory:3 Practical:0**

4. Relative Weight**: CWS:15 PRS:0 MTE:35 ETE:50 PRE:0**

5. Credits**: 3** 6. Semester **: Spring** 7. Pre-requisite**: ECN-142, ECN-205**

8. Subject Area**: DCC**

9. Objective: To acquaint the students with the fundamental principles of operation and design of mixed-signal and RF circuit building blocks and their use in circuit design

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	**Introduction:** Basic concepts of wireless communication systems design; Transceiver architectures; VLSI design issues and layout techniques in wireless transceiver design, Low voltage low power design techniques and design flow for RF and mixed signal circuits and systems, Properties of CMOS substrates and technological issues related to CMOS based RF circuits.	6
2.	**Passive On-chip Circuits:** On chip transmission lines and their properties, Modeling of Lumped and Distributed Radio Frequency circuits such as inductors, capacitors, resonators and filters.	8
3.	**Linear and Nonlinear On chip Circuits**: Design of on chip CMOS low noise amplifiers, power amplifiers Gilbert cell mixers, detectors and switches for RF and mixed signal applications	10
4.	**Data Converters**: Brief review of S/H characteristics and Quantization noise, ADC and DAC specifications, ADC and DAC architectures, brief review of OP-AMP based ADC and DAC	8
5.	**Voltage Controlled Oscillators and PLL**: Ring-oscillators, LC Oscillators, Ring and LC oscillator based Voltage Controlled Oscillators (VCOs), Simple PLLs, Charge pump based PLLs, Delay Locked Loops (DLLs).	10
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books/ Authors	Year of Publication
1.	Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, Tata McGraw-Hill.	2002
2	R. Caverly, "CMOS RFIC Design Principles", Artech House	2007
3.	B. Razavi, "RF Microelectronics", 2nd Edition, Prentice Hall	2014
4.	J. Rogers and C. Plett, "Radio Frequency Integrated Circuit Design", 2nd Edition, Artech House	2010
5.	R. Chi-His Li, "RF Circuit Design", John Wiley & Sons	2009
6.	R. Jacob Baker, “CMOS Mixed-Signal Circuit Design,” Wiley India Pvt. Ltd.	2009

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE**:** **Electronics and Communication Engineering**

1.Subject Code**: ECN-351** Course Title**: IC Applications Laboratory**

2. Contact Hours: **L: 0** **T: 0** **P: 3**

3. Examination Duration (Hrs.): **Theory:0** **Practical:3**

4. Relative Weight**:** **CWS:0** **PRS:50** **MTE:0** **ETE;0** **PRE:50**

5. Credits**:2** 6. Semester: **Autumn** 7. Pre-requisite**: ECN-104, ECN-205, ECN-252**

8. Subject Area**: DCC**

9. Objective: To provide hands-on experience on the various building blocks of digital circuits.

10. Details of the Course:

Sl.No.	Contents	ContactHours
1	**Introductory experiments for important ICs** Introduction to an OP-AMPICof 74x family Introduction to an ADC using 0800ICs Introduction to DAC using 080x family ICs Introduction to VCO 566 IC family OPAMP Applications	14 x 3
2	**Lab based mini-projects (any one from the list for each group)** PLL using VCO and other ICs Temperature/sound/light sensing and digital display MP3 player	
	Total	**42**

11. Suggested Books:

Sl. No	Name of Books/ Authors	Year of Publication
1.	Paul Horowitz, "Art of Electronics", 2nd Ed., Cambridge University Press.	1989
2.	Bruce Carter, "Op Amps for Everyone," 4th Ed., Elsevier.	2013
3.	BehzadRazavi, "Fundamentals of Microelectronics", 2nd Ed., Wiley India.	2013

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT. /CENTRE**:** **Electronics and Communication Engineering**

1. Subject Code**:** **ECN-352** Course Title**:** **Communication Systems Lab**

2. Contact Hours: **L: 0** **T: 0** **P: 3**

3. Examination Duration (Hrs.): **Theory:0** **Practical:0**

4. Relative Weight**:** **CWS:0** **PRS:50** **MTE:0** **ETE:0** **PRE:50**

5. Credits**: 2** 6. Semester: **Spring** 7. Pre-requisite**: ECN-311**

8. Subject Area**: DCC**

9.Objective: To expose students to the techniques of communication hardware design through fabrication and testing of simple communication subsystems.

10. Details of Course:

Sl. No.	Contents	Contact Hours
	Design and fabrication of Full- and suppressed-carrier AM DSB modulator using 633. Demodulator for full-carrier AM DSB signal. ASK and PSK modulator using 633. Integrate and dump filter. PCM system using LM 398, ADC 0809 and DAC 0800. Encoder and decoder for Hamming code. Delta modulator and demodulator. Frequency modulator using 8038. FM demodulator using 565. Frequency multiplier by a given factor N and demonstrate carrier recovery using 565. FSK generator using 566 and FSK demodulator using 565. PPM and PWM circuits.	14 x 3
	Total	**42**

11. Suggested Books:

Sl. No.	Name of Books/ Authors	Year of Publication
1.	Gayakwad, R.A., "Op-Amps and Linear Integrated Circuits", 3rd Ed., Prentice-Hall of India.	2002
2.	Lathi, B.P., "Modern Digital and Analog Communication Systems", 3rd Ed., Oxford University Press.	1998
3.	Soclof, S., "Applications of Analog Integrated Circuits", Prentice-Hall of India.	1990
4.	Smith, J.R., "Modern Communication Circuits", McGraw-Hill.	1998
5.	Roddy, D. and Coolen, V., "Electronic Communications", 4th Ed., Prentice-Hall of India.	1997

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT. /CENTRE**:** **Electronics and Communication Engineering**

1. Subject Code**:** **ECN-354** Course Title**: Microwave Lab**

2. Contact Hours: **L: 0** **T: 0** **P: 3**

3. Examination Duration (Hrs.): **Theory:0** **Practical:3**

4. Relative Weight**:** **CWS:0** **PRS:50** **MTE:0** **ETE:0** **PRE:50**

5. Credits**:2** 6. Semester: **Spring** 7. Pre-requisite**: ECN-331 , ECN-333**

8. Subject Area**: DCC**

9.Objective: To introduce the students to various microwave sources, components, and equipments and the measurement of their performance characteristics.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
	Study of microwave sources and components. Study of crystal detector characteristics. Measurement of VSWR, impedance and frequency. Measurement of attenuation and dielectric constant. Measurement of phase shift. Measurement of Q of a cavity resonator. Measurement of directional coupler characteristics. Study of tee junctions. Study and measurement of transmission line characteristics. Measurement of antenna characteristics. Study of Spectrum Analyzer. Study of Network Analyzer.	14x3
	Total	**42**

11. Suggested Books:

Sl.No.	Name of Books / Authors	Year of Publication
1.	Pozar, D.M., “Microwave Engineering”, 3rd Ed., John Wiley & Sons.	2004
2.	Collin, R.E., “Foundations for Microwave Engineering”, 2nd Ed., John Wiley & Sons.	2000
3.	Laverghetta, T.S., "Microwave Measurements and Techniques", Artech House.	1984
4.	Laverghetta, T.S., "Practical Microwaves", H.W. Sams & Co.	1984