GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER I and II

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC101/201** Course Title: **Basic Electronics Engineering**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester: **Autumn/Spring**
7. Subject Area: **Core Course**
8. Pre-requisite: **Basic semiconductor Physics.**

9. **Course Outcome:**	• Identify the terminology associated with electronics and explain the basic concepts of PN junction diode. • To apply the basics of diode to analyze the rectifier circuits and DC power supply • Understand transistor (BJT) basics and analyze biasing circuits. • Analysis of different mathematical operations using Operational amplifiers. • Understanding and implementation of concepts of digital electronics. • After successful completion of the course the students will be able to analyze and design simple electronics circuits.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**SEMICONDUCTORS AND JUNCTION DIODE CHARACTERISTICS:** Classification of solids based on energy band theory, Intrinsic semiconductors, Extrinsic Semiconductors– P-type and N-type, Electrons and Holes in intrinsic and Extrinsic semiconductors, Mobility and conductivity, Mass Action Law, charge densities in semiconductors, Drift and Diffusion current, Open circuited PN Junction diode, Current components and V- I Characteristics of PN Junction Diodes.	8
2	**RECTIFYING CIRCUITS AND D.C. POWER SUPPLY:**	6

	Introduction to power supply, Rectifiers circuit: Half wave, Center tapped full wave and Bridge rectifier circuits. Rectifier performance parameter analysis, Filter circuits: L, C and Pi filters, Zener Diode: Concept of Zener and Avalanche Breakdown. Analysis and Design of Zener Regulator circuits.	
3	**TRANSISTOR BIASING AND BIAS STABILIZATION:** Construction and characteristics of bipolar junction, transistors (BJT's)-Common Base, Common Emitter, Common Collector configuration, Transistor biasing and bias stabilization: - the operating point, stability factor analysis of fixed base bias, collector to base bias, Emitter resistance bias circuit and self-bias circuit.	10
4	**INTRODUCTION TO OPERATIONAL AMPLIFIERS** Introduction to Integrated Circuits- Advantages and Limitations. Characteristics of an Ideal op-amp, Introduction of 741 IC. Inverting and Non-inverting op-amp circuits, Adder or Summing Amplifier, Difference Amplifier, Voltage follower. Op Amp as Integrator and Differentiator.	6
5	**NUMBER SYSTEMS & BOOLEAN ALGEBRA:** Number systems and their conversion, Addition & Subtraction of binary, octal and hexadecimal numbers , multiplication & division of binary numbers, fractional numbers, Boolean algebra, logic gates , De-Morgan's theorem, implementation of basic gates using universal gates, implementation of logic functions using basic gates & universal gates, SOP & POS form of logic expression, canonical form, conversion from SOP &POS form to canonical form, simplification of Boolean function: Algebraic method, Karnaugh map method(two, three &four variable K-map with don't care condition.	10
	Total	**40**

11**. Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Jacob Millmann & Halkias, *Integrated Electronics*, TMH, 2nd Edition	2010
2.	Mano M. Morris and Ciletti M. D., *Digital Design,* Pearson Education, 4th Edition.	2004
	Reference Books	
1.	Kalsi H. S., '*Electronics Instrumentation*', TMH	2004
2.	Boylestad and L. Robert and Nashelsky Louis, '*Electronics Devices and Circuits Theory* ', PHI/Pearson Education, 9th Edition.	2010

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **PEC 151/251** Course Title: **Basic Electronics Lab**
2. Contact Hours: **L:** 0 **T:** 0 **P:** 2
3. Examination Duration (Hrs): **Theory** 0 **Practical** 3
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 1
6. Semester: **Autumn/Spring**
7. Subject Area: **Core Course**
8. Pre-requisite: **Physics.**

9. **Course Outcomes:**	• An in-depth understanding of basic active and passive components. • Characteristics of diode and transistors. • Implementation of electronic circuits on the bread board. • An in-depth understanding of basic logic gates.

10. **Details of the Course:**

Sl. No.	Contents
1.	Familiarization of Electronics measuring instrument and components.
2.	Measure the Voltage and frequency using a CRO.
3.	Measurement of Resistance, Capacitance, Voltage and Current using Digital Multimeter.
4.	Study V-I characteristics of PN junction diode.
5.	Study of logic gates
6.	Study V-I characteristics of PN junction diode and determine the static and dynamic resistance from the characteristic curve.
7.	Study V-I characteristics of Zener diode and determine its voltage regulation.
8.	Study of a Half Wave rectifier circuit with and without capacitor filter.
9.	Study of a Full Wave rectifier circuit with and without capacitor filter.
10.	Study the input and output characteristics of common base (CB) transistor.
Innovative	
1.	Study of summer using Op-Amp IC.

2.	Study of subtractor using Op-Amp IC.
3.	Study of half adder using logic gates.
4.	As suggested by the concerned faculty/lab in charge.

11.	**Mode of Evaluation**	Viva / Mid Term Lab Exam / End Term Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER III

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 301** Course Title: **Electronics Devices and Circuits**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs.): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester: **Autumn (Odd)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Basic Electronics Engineering**

9. **Course Outcomes:**	• Understanding of Bias stabilization, Operating point and Device Characteristics in different regions. • Analysis of multistage amplifier and frequency response of CE amplifier. • Analysis of MOSFET small signal model and frequency response. • Understanding genesis of feedback structures with application of negative and positive feedback in different types of circuits • Analysis of power amplifiers and their classification with crossover distortion and its removal. • Successful completion of this course enables students to design BJT and MOSFET based amplifier and oscillator circuits.

10. Details of the Course: -

Sl. No.	Contents	Contact Hours
1	**Diode Review and its Applications** **Bipolar Junction Transistor** Construction and characteristics of bipolar junction, transistors (BJT's)-Comm. Base, Comm. emitter, Comm. Collector configuration, Transistor biasing and bias stabilization: - the operating point, stability factor, analysis of fixed base bias, collector to base bias, Emitter resistance bias circuit and self-bias circuit.	13

2	**BJT Circuits:** BJT as an amplifier and switch, small signal models and analysis (CB, CE, CC). Multistage amplifier: RC coupled, Darlington pair, Cascode configuration. Frequency response of CE amplifier, calculation of cutoff frequency.	6
3	**MOSFET:** MOSFET biasing, MOSFET as an amplifier and switch, biasing in MOSFET amplifier circuits, small signal models and analysis (CG, CS, CD). Frequency response of CS amplifier, calculation of cutoff frequency.	9
4	**Feedback and Oscillators:** General feedback structure, properties of negative feedback, four basic feedback topologies and their analysis. Principle of sinusoidal oscillators, Types of oscillators: RC phase shift, Wein bridge, Hartley, Colpitts.	8
5	**Power Amplifiers:** Classification of power amplifiers, Operation and efficiency of: Series fed class A Transformer coupled class A, Class B push pull. Crossover distortion, methods to remove it	6
	Total	**42**

11. **Suggested Books:**

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Millman Halkias, “Integrated electronics”, TMH, 2nd edition.	2001
2.	Boylestad L Robert, “Electronic devices and circuit theory”, Pearson, 10th edition.	2005
	Reference Books	
1.	Neaman A Donald, “Electronics circuits”, TMH, 3rd edition.	2008
2.	S. Sedra and KC Smith, “Microelectronic Circuits”, Oxford university press.5th edition.	2009
3.	Jacob Millman and Arvin Grabel, “Microelectronics”, TMH, 2nd edition	2001

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 302** Course Title: **Digital Electronics**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 3
6. Semester: **Autumn (Odd)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Basic Electronics**

9. **Course Outcomes:**	• Learning of Boolean algebra, Minimization and Gate level implementation. • Designing of Combinational logic circuit. • Analysis and Design of Sequential circuits. • Design of various Synchronous and Asynchronous sequential circuits • Implementing various characteristics of Logic families. • To make student able to investigate digital design problems in real time.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Review of Number System:** Digital Signals and Waveforms, Binary, Octal, Hexadecimal; Complements, Signed Binary Numbers, Arithmetic Operation, Binary Codes, Error Detection and Correction. **Boolean Algebra and Gate Level Minimization:** Basic Definition, Boolean Logic, postulates, Theorems and Properties. Digital Logic Gates, K-Map Method for Minimization up to 6-Variables, Quine-McClusky Method for Minimization, NAND and NOR Gate Implementation.	8
2	**Combinational Logic Circuits:** Combinational circuits, Analysis Procedure, Design Procedure, Binary Adder & Subtractor, Decimal Adder, Binary Multiplier, Magnitude Comparator, Multiplexer, Demultiplexer, Decoder, Encoder, Parity Generator & Checker, Programmable ROMs, Programmable Logic Array,	8

	Programmable Array Logic, Code Convertors (BCD, Gray and Seven Segment Code etc.	
3	**Sequential Logic Circuits:** Triggering, Latches **Flip Flops:** RS, JK, D and T (Characteristics Table, Equation and Excitation Table), Flip Flop Conversion, Race around Condition, JK Master Slave Flip Flop. **Counter:** Asynchronous Counter, Decoding Gates, Synchronous Counters, Changing the Counter Modulus, Decade Counter, Presettable Counter, Designing of Asynchronous and Synchronous Counters. **Register:** Types of Register, Serial In-Serial Out, Serial In-Parallel Out, Parallel In- Parallel Out, Parallel In- Serial Out, Universal Shift Register, Bidirectional Shift Register, Application of Shift Registers.	10
4	**Design of Synchronous and Asynchronous Sequential Circuit:** Model Selection, State Transition Diagram, State Synthesis Table, Design Equations and Circuit Diagram, State Reduction Table, Design and Analysis of Asynchronous Sequential Circuit, Problems with Asynchronous Sequential Circuit.	8
5	**Logic Family:** Introduction, Various Characteristics, Register Transistor Logic (RTL), Diode-Transistor Logic (DTL), Transistor-Transistor Logic (TTL), Emitter Coupled Logic (ECL), NMOS and PMOS Logic, CMOS Logic Family, CMOS Transmission Gate Circuits, Semiconductor Memory.	8
	Total	**42**

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Mano M. Morris and Ciletti M.D., 'Digital Design', 4th Edition, Pearson Education.	2006
2.	Charles H. Roth: Fundamentals of Logic Design, Jr., 5th Edition, Thomson.	2004
	Reference Books	
1.	Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss: Digital Systems Principles and Applications, 10th Edition, Pearson Education.	2007
2.	Donald P Leach, Albert Paul Malvino & Goutam Saha: Digital Principle and Application, 7th Edition, Tata McGraw Hill.	2010

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 303** Course Title: **Network Analysis and Synthesis**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester: **Autumn (Odd)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Basic Electrical Engineering**

9. Course Outcomes:	• Applying various network theorems to solve electrical networks. • Using Graph theory approach to solve electrical networks. • Analyze transient response and time domain analysis. • Understanding the concepts of two port network in electrical systems. • Formulate and analyze driving point impedance and network function of one and two port networks. • Analyzing the concepts of filters.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Network concepts and theorems:** Elements and sources, node and mesh analysis, Kirchhoff's laws, Thevenin's, Norton's, Maximum power transfer, Tellegen's, reciprocity and superposition theorems, study of basic waveforms.	10
2	**Graph Theory:** Concept of graphs, definitions, trees, co-tree, chords and links, matrices associated with graphs, incidence matrix, circuit matrix, tie-set matrix, cut-set matrix and their KVL and KCL analysis.	6
3	**Network transients:** Steady state sinusoidal analysis, Transient response, time domain analysis of simple RC, RL and RLC circuits, network analysis using	10

	Laplace transform, driving point and transfer function, resonance in electrical circuits.	
4	**Two Port Network and Coupling Circuit:** Different two port parameters, condition of reciprocity and symmetry for different two port parameters, inter relationship between different two port parameters, interconnection of two port networks. Coupled Circuits: Self-inductance and Mutual inductance, Coefficient of coupling, dot convention, Analysis of Magnetic Coupling Circuits.	8
5	**Network function and synthesis:** Driving point function, transfer function, Positive real function; definition and properties, poles and zeroes of network functions, Hurwitz polynomials, properties of LC, RC and RL driving point functions, synthesis of LC, RC and RL driving point admittance functions using Foster and Cauer first and second forms, passive filter fundamentals.	8
	Total	**42**

11. **Suggested Books:**

SL. No.	**Name of Authors/Books/Publishers**	**Year of Publication/Reprint**
	Text Books	
1.	Kemmerly, Hayt and Durbin, 'Engineering Circuit Analysis', TMH 7th Edition	2010
2.	Van Valkenburg, M.E., 'Network Analysis & Synthesis', PHI/ Pearson education, 3rd Edition.	2002
	Reference Books	
1.	Alexander, Charles K., Sadiku, Matthew N. O., 'Fundamentals of Electric Circuits', 5th Edition, Mc-Graw Hill.	2004
2.	Irwin David J./ R.Mark Nelms, 'Basic Engineering Circuit Analysis', John Wiley 8th Edition.	2013

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 304** Course Title: **Signals and Systems**
2. Contact Hours: **L:** 3 **T:** 0 **P:** 0
3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 3
6. Semester: **Autumn (Odd)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Basic Electrical Engineering**

9.**Course Outcomes:**	• Introduction to various types of signals and its operations. • Analyzing various types of LTI systems responses. • Applying Continuous time Signals using Fourier series. • Applying Continuous time Signals using Fourier Transform. • Analyzing Continuous time Signals using Laplace Transform. • Successful completion of this course enables students to understand test signals and its response to systems.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Signals:** Introduction to Signal, Classification of Signals: continuous /discrete-time, Analog/ Digital signal, periodic/ aperiodic, Even/odd, Energy/power, Deterministic/random, Commonly used Continuous-Time Signals and Discrete-Time Signals: Unit step, Unit ramp, exponential, rectangular pulse, unit impulse, Operation on continuous –time and discrete time signals: Addition, Multiplication, differentiation/Difference, Integration/ Accumulation, Shifting, Scaling, Folding and Convolution.	08
2	**Systems:** Introduction to System, Classification of systems for both continuous time and discrete time: Linear/ Non-linear, Time varying/ time invariant, Causal/non-causal, Dynamic/ static, Stable/unstable and Invertible/ Non-invertible, continuous time and discrete time LTI system, Response of LTI system and convolution Integral/	09

	convolution Sum, properties of LTI system and Eigen functions of LTI system.	
3	**Fourier series analysis for continuous time signals:** Introduction, Vector space representation by ortho-normal vectors and Signal space representation by orthogonal signal set, Fourier series representation of periodic signals, convergence of Fourier series, Trigonometric Fourier series and exponential Fourier series, properties of the continuous time Fourier series. Power content of a periodic Signal.	06
4	**Continuous time Signal representation and Analysis by Fourier Transform:** Continuous time Fourier Transform, Fourier-Transform pair, Fourier Spectra, convergence of the Fourier transforms, Fourier transform of some useful signals, properties of the Continuous time Fourier transform, Convolution, signal transmission through distortion- less transmission line, group delay and phase delay and Parseval's theorem: energy spectral density, power spectral density.	08
5	**Continuous –time signal analysis using the Laplace transform:** Introduction to Laplace transform, region of convergence for Laplace transform, and properties of ROC, Laplace transform of some common signals, properties of the Laplace transform, Convolution, The inverse Laplace transform and Unilateral Laplace Transform and their properties, Initial value and final value theorem, solution of differential equation using Laplace transform.	09
	Total	40

11**. Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	B.P.Lathi , Signal processing & linear systems, Oxford University Press.1998	1998
2.	A. V. Oppenheim, A. S Willsky, Signals and Systems (2/e), Pearson 2003	2003
	Reference Books	
1.	Simon Haykin, Barry Van Veen, Signals and Systems 2/e, John Wiley	2007
2.	HWEI P.HSU ,Signal and system, schaum outlines, McGraw hill, 3/e	2010

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TMA 310** Course Title: **Advanced Engineering Mathematics**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester: **Autumn (Odd)**
7. Subject Area: **Basic Science**
8. Pre-requisite:

9. **Course Outcomes:**	• Understanding of Analytic function and power series expansion. • Analysis different order of moments. • Understanding different numerical methods and their applications. • Analysis of differential and integral equations. • Understanding of conditional probability and Baye's theorem. • Successful completion of this course will be helpful in applying these theorems in Electronics and Communication problems.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Complex variable:** Analytic Function, Complex integration, Cauchy Integral formula, Cauchy Integral formula for derivatives, Power series, Taylor series, and Laurent series, Zeros, Singularities and Residues. Conformal mapping, Bilinear Transformation,	8
2	**Moments:** Kurtosis, Skewness, Curve fitting (all curves), Correlation and Regression, Multiple Regression. Definition and Examples of Vector Space .	8
3	**Solution of Algebraic and Transcendental Equations:** Bisection, Iteration method, Newton Raphson method, Interpolation: Finite Differences, Newton's forward and backward formula, Central difference Bessel's formula, Interpolation with unequal intervals Lagrange's interpolation formula.	8

4	**Numerical Integration:** Trapezoidal rule, Simpson's 1/3 and 3/8 rule, Weddle's rule and Boole's rule Solution of differential equation: Euler's method and Runge-Kutta method**.**	10
5	**Random variables:** Random variables, Baye's Theorem, Function of Random variables, probability distribution functions, moments, Mean, Correlation and Covariance function: Principles of autocorrelation function, cross – correlation functions, Central limit theorem, Properties of Gaussian process.	8
	Total	**42**

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Higher Engineering Mathematics by B. S. Grewal, Khanna Publications, 43/e	2013
2.	Higher Engineering Mathematics by B.V. Ramanna (Tata-McGraw Hill), 6/e	2006
	Reference Books	
1.	Kreyszig, Erwin. "Advanced Engineering Mathematics Wiley Publications, 10/e.	2010
2.	Mattuck, A., Introduction to Analysis, Prentice-Hall, 3/e.	1999
3.	Jain, R K; Iyengar, S R K; Advanced Engineering Mathematics, Narosa Publication, 2/e	2002

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **XCS 300** Course Title: **Career Skills**
2. Contact Hours: L: **3** T: **0** P: **0**
3. Examination Duration (Hrs): Theory **3** Practical **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester: **Autumn (Odd)**
7. Subject Area: **HUSS**
8. Pre-Requisite: **Communication**

9.**Course Outcomes:**	• Have a logical approach to the problems and at the same time they will be able to differentiate between the strong and the week arguments and validity of the statement. • It covers the various approaches to improve the reasoning ability of the students by using the different methods. • Student would have learned the different types of problems may it be related to the coding or other complex types of problems which are related to the sequence detection etc. • A basic knowledge of the data interpretation. • Along with it the knowledge of puzzles and different methods to solve the puzzles in an easier way is also included. • Successful completion of this course will provide the foundation for the students to develop the basic skills of aptitude and logical reasoning.

10. **Details of the Course:**

SI.NO	CONTENT	CONTACT HOURS
1.	**Meeting Etiquette:** Introductions - the Handshake– Exchange of Visiting Cards Personal Etiquette – Hygiene, Grooming, and Good sense Travel Etiquette, Sharing Apartments Behavior at Work – Formal behavior with seniors and Colleagues – Etiquette with Women/men – Adherence to Office Rules – Discipline Table Manners and Small Talk (unit 1) **Group Discussions:**	6

	Group Discussion Techniques/ Do's and Dont's/ body language/mock sessions.	
2.	**Logical Reasoning:** Series completion, Coding decoding, direction sense test, logical Venn diagram.	6
3.	**Logical Reasoning:** Mathematical operation, number ranking, time sequence test, arithmetical reasoning.	6
4.	**Job application:** Importance of Business Communication in today's world, Designing Business Letters, Types of Letters. Writing Effective Emails, Report Writing Essential parts - Cover Letter and the 'resume'. Types of 'resumes ' (*Curriculum Vitae*) Chronological 'resume', functional 'resume'	6
	Total	**24**

11. **Suggested Books:**

Sl. No.	**Name Of Authors/Books/Publishers**	**Year Of Publication/Reprint**
	For Verbal Section:	
1.	Spoken English for India by R.K.Bansal and J.B. Harrison- Orient Longman	
2.	A practical English Grammar by Thomson and Martinet-Oxford University Press	
3.	Professional Communication by Malti Aggarwal	
4.	English grammar, composition and correspondence by M.A.Pink and A.E.Thomas –S.Chand and Sons.Word Power by Blum Rosen-Cambridge University Press	
5.	A Dictionary of Modern Usage-Oxford University Press	
	For Aptitude Section:	
1.	Quantitative aptitude by R.S Agarwal	
2.	Verbal and Non Verbal Reasoning by R.S Agarwal	
3.	All books of puzzles to puzzle to puzzle you by Shakuntala Devi.	
4.	Question Bank on the practice exercise (Created for internal use)	

12.	**Mode Of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **PEC 301** Course Title: **Electronics Circuits Lab**
2. Contact Hours: **L:** 0 **T:** 0 **P:** 2
3. Examination Duration (Hrs): **Theory** 0 **Practical** 3
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 1
6. Semester: **Autumn (Odd)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Basic Electronics Lab**

9.**Course Outcomes:**	• Understanding different electronic components and testing their waveforms. • Analysis of HWR, FWR, amplifier and oscillator circuits with simulation in ORCAD. • Applying amplifier circuits to compute gain and frequency response. • Designing and implementation of hardware PCBs followed by soldering and testing.

10. **Details of the Course: -**

Sl. No.	Contents
1.	Identification & study of different electronic components and compute the value of different resistors and capacitors using Millimeter.
2.	To study of CRO and measure the amplitude/frequency of different signals using CRO.
3.	Simulation of half wave and full wave center tapped rectifiers through ORCAD software.
4.	Simulation of DC regulated power supply (+5V) through ORCAD software.
5.	To implement the circuits of Half wave and Full wave center tapped rectifiers on the bread board and draw/measure the outputs with and without filter.
6.	Simulation of CE Amplifier using PSPICE ORCAD.
7.	Simulation of two stage RC Coupled Amplifier using PSPICE ORCAD.

8.	To implement the circuit of single stage common emitter (CE) amplifier on the bread board and draw its output and frequency response curve.
9.	Simulation of FET amplifier circuit using ORCAD and compute the gain and bandwidth.
10.	To test the given Hartley Oscillator and determine its frequency of oscillation.
11.	To test the given Wein Bridge Oscillator and determine its frequency of oscillation.
12.	To test the given RC Phase Shift Oscillator and determine its frequency of oscillation.
13.	To test the given COLPITTS Oscillator and determine its frequency of oscillation.
14.	To develop the negative of full wave center tapped rectifier/DC regulated power supply.
15.	To make the PCB of full wave center tapped rectifier/DC regulated power supply.
16.	To drill and solder the components on the PCB of full wave center Tapped rectifier/DC regulated power supply.
17.	To test the PCB of full wave center tapped rectifier/DC regulated power supply.
Innovative	
1.	To make the Layout of Center tapped full wave rectifier through ORCAD software.
2.	To make the Layout of DC regulated power supply through ORCAD software.
3.	Simulate Hartley Oscillator and determine its frequency of oscillation.
4.	Simulate Wein Bridge Oscillator and determine its frequency of oscillation.
5.	Simulate RC Phase Shift Oscillator and determine its frequency of oscillation.
6.	Simulate COLPITTS Oscillator and determine its frequency of oscillation.

11.	**Mode of Evaluation**.	Viva / Quiz / Mid Term Lab Exam / End Term Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **PEC 302** Course Title: **Digital Electronics Lab**
2. Contact Hours: **L:** 0 **T:** 0 **P:** 2
3. Examination Duration (Hrs): **Theory** 0 **Practical** 3
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 1
6. Semester: **Autumn (Odd)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Basic Electronics Lab**

9.**Course Outcomes:**	• Understanding in depth of various digital ICs and circuit on bread board. • Apply the concept of combinational and sequential logic to create the circuits on bread board. • Analysis and design of digital circuits in ORCAD. • Implementation and testing of any digital Circuit on Bread board and its software simulation.

10. **Details of the Course**:

Sl. No.	**Contents**
1.	To verify the truth table of basic logic gates (AND, OR, NOT, NAND, NOR, XOR). To realize basic two input Boolean AND, OR logic functions using discrete components.
2.	To verify the Consensus Theorem (Boolean algebra functions) using universal digital IC Gates
3.	To design and test a half/full adder circuit using digital IC gates.
4.	To design and test a half/full subtractor circuit using IC gates.
5.	To design, implement and test the function F(A,B,C,D)=m(1,3,5,7,9,15)+d(4,6,12,13) using a NOR-OR implementation.
6.	To design and test RS, JK, D and T flip flops using logic gates.
7.	To design and test shift registers using flip-flops.
8.	To design and test an asynchronous up/down counter
9.	To design, implement and test half/full adder/subtractor functions using a multiplexer.
10.	To design and simulate the implementation of BCD TO EXCESS 3-CODE CONVERTER using ORCAD/PSPICE.

11.	To design and simulate the implementation of a Ring Counter using ORCAD/PSPICE.
Innovative	
1.	To design, implement and simulate half & full adders using ORCAD/PSPICE.
2.	To design, implement and simulate half & full subtractors using ORCAD/PSPICE.

11.	**Mode of Evaluation**	Viva / Quiz / Mid Term Lab Exam / End Term Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **PEC 303** Course Title: **Network Lab**
2. Contact Hours: **L:** 0 **T:** 0 **P:** 2
3. Examination Duration (Hrs): **Theory** 0 **Practical** 3
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 1
6. Semester: **Autumn (Odd)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Basic Electrical Lab**

9.Course Outcomes:	• Verification of various theorems to solve electric networks. • Analysis of transient behavior and frequency response of electric circuits. • Assessment of different parameters of two port network in electrical systems. • Evaluation of image impedance and characteristic impedance of electric network.

10. **Details of the Course:-**

Sl. No.	Contents
1.	Verification of principle of superposition with dc and ac sources.
2.	Verification of Thevenin, Norton and Maximum power transfer theorems in ac circuits.
3.	Verification of Tellegen's theorem for two networks of the same topology.
4.	Determination of transient response of current in RL and RC circuits with step voltage input.
5.	Determination of transient response of current in RLC circuit with step voltage input for under damped, critically damped and over damped cases.
6.	Determination of frequency response of current in RLC circuit with sinusoidal ac input.
7.	Determination of z and h parameters (dc only) for a network and computation of Y and ABCD parameters.
8.	Determination of driving point and transfer functions of a two port ladder network and verify with theoretical values.

9.	Determination of image impedance and characteristic impedance of T and ∏ networks, using O.C. and S.C. tests.
10.	Verification of parameter properties in inter-connected two port networks: series, parallel and cascade also study loading effect in cascade.
11.	Determination of frequency response of a Twin – T notch filter.

11.	**Mode of Evaluation**	Viva / Quiz / Mid Term Lab Exam / End Term Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER IV

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 401** Course Title: **Communication Systems- I**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester: **Spring (Even)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Signals and Systems**

9. **Course Outcomes:**	• Analyze and compare different analog modulation schemes for their efficiency and bandwidth. • Analyze and compare the performances of AM and FM receiver. • Random variable, random process and their application for Noise analysis. • Analyze the behavior of a communication system in presence of noise. • Investigate Analog pulsed modulation systems and analyze their system Performances. • Successful completion of this course enables students to apply the concepts of Analog modulation and demodulation for radio & TV receivers.

10. **Details of the Course:**

S. No.	Contents	Contact Hours
1	**Amplitude Modulation Systems:** Modulation, Need of modulation, Model of communication system, Amplitude Modulation: Equation for AM wave, Modulation Index, Power and current relationships, transmission and power efficiency, Generation and Demodulation of DSB-FC, DSB-SC, SSB-SC and VSB Signals, Spectral characteristics of amplitude modulated signals, Comparison of Amplitude Modulation Systems; AM receiver and its characteristic.	12
2	**Angle Modulation Systems:**	12

	Phase and Frequency Modulation: Narrow Band and Wideband FM & PM, Spectral characteristics of angle modulated signals, Generation and Demodulation of FM Signal, PLL, Communication Receiver.	
3	**Noise:** Introduction – internal and external noise, noise equivalent bandwidth, S/N ratio, Noise Figure, Equivalent Noise temperature, Cascade connection of two port network.	6
4	**Performance of Continuous Wave Modulation Systems:** Introduction: Review of probability and random process. Gaussian and white noise characteristics, Analog communication model, SNR Calculation in DSB-SC,SSB-SC, DSB-FC & FM systems, FM threshold effect; Pre-emphasis and De-emphasis in FM, Comparison of performances.	8
5	**Pulse Modulation System:** Sampling process, Generation and detection of PAM, PWM, and PPM and its SNR performances.	5
	Total	**43**

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	B. P. Lathi, 'Modern Digital and Analog Communication', Oxford Publication, 3/e	2005
2.	Simon Haykin, 'Communication Systems', John Willey, 4/e	2001
3.	Taub and Schilling, 'Principles of Communication System', Tata McGraw-Hill, 4/e	1995
4.	HWEI HSU, Analog and Digital Communications, Schaum Outline Series, 2/e.	2003
	Reference Books	
1.	Roddy and Coolen, ' Electronic Communication', Prentice Hall of India, 4/e.	1998
2.	Singh and Sapre, 'Communication system', TMH, 2/e.	2007
3.	A. Papoulis, " Probability, Random variables and Stochastic processes", MGH, 4/e.	2002

12	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 402** Course Title: **Analog Integrated Circuits**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 3
6. Semester: **Spring (Even)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Electronics Devices and Circuits.**

9. **Course Outcomes:**	• Analysis of various characteristics of differential amplifier configurations • Understanding of characteristic and operation of op-amps • Design and implementation of linear applications of op-amp • Design and implementation of non-linear applications of op-amp • Evaluation of active filter transfer function with frequency response and voltage regulator implementation. • After completion of this course student will be able to design and evaluate op amp output.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Brief review of differential amplifier (DC and AC analysis) OP-AMP Fundamentals:** Input stage, intermediate stage circuits, constant current bias circuits, current mirror, active load, level shifter, output stage, DC and AC characteristics.	10
2	**IC OP-AMP Applications:** Basic building blocks using OP-AMPS. Inverting/Non-inverting amplifier, (gain, input and output resistance, bandwidth), Summer and difference amplifier, Integrators, Differentiators, VCVS, CCVS and VCCS, Instrumentation Amplifiers.	8
3	**Non-linear Circuits:** Logarithmic Amplifiers, Log/Antilog Modules, Precision Rectifier, OP-AMP as Comparator, Schmitt Trigger, Square and Triangular Wave	10

	Generator, Multivibrator, 555 Timer and applications, Oscillators (Hartley, Colpitts, RC phase shift), PLL & Capture range.	
4	**Active Filters:** Frequency response, Characteristics and terminology, Active versus passive filters **Low Pass Filter:** First order low pass active filter, second order active filter model, second order low pass filter characteristics, Sallen-Key unity gain filter, Sallen-Key equal component filter. High pass active filter, Band pass filter: single op-amp band pass filter, State variable filter	8
5	**Voltage Regulators:** OP-AMP Regulators, IC Regulators, Fixed Voltage, Regulators (78/79, XX).	6
	Total	**42**

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Sedra and Smith, 'Microelectronic Circuits', Oxford University press, 5th Edition.	2005
2.	J. Michael Jacob, 'Applications and design with Analog Integrated Circuits', PHI, 2nd Edition.	2004
	Reference Books	
1.	Razavi, B, 'RF Microelectronics', Second Edition, Prentice Hall	2007
2.	B.P. Singh and Rekha Singh, 'Electronic Devices and Integrated Circuits; Pearson Education, 1st Edition.	2006

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **TEC 403** Course Title: **Microprocessor and its Applications**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 3
6. Semester: **Spring (Even)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Digital Electronics**

9. **Course Outcomes:**	• Understanding of microprocessor 8085 hardware. • Understand 8085 instruction set and ability to utilize it in assembly language programming. • Understand 8086 instruction set and ability to utilize it in assembly language programming. • Interfacing of memory and devices with 8085/8086. • Apply the concept of 8085/8086 programming to program real time applications. • Successful completion of this course will act as foundation for Microcontroller and Embedded system courses.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Introduction to Microprocessors**: Evolution of Microprocessors, Microprocessor Internal Architecture, hardware model of 8085, Pin diagram and function of each pin, memory interfacing.	8
2	**Programming with 8085**: Instruction set, programming model of 8085, addressing modes, assembly language programming, peripheral I/O, memory mapped I/O, 8085 Interrupts, Stack and subroutines.	8
3	**16 Bit Processor**: 16-bit Microprocessors (8086): Architecture, pin diagram, Physical address, segmentation, memory organization, Addressing modes, Instruction set ,Assembly Language Programming of 8086, comparison of 8086 & 8088	10

4	**Interfacing (Data Transfer) with Microprocessor**: Data Transfer Schemes: Introduction, handshaking signals, Types of transmission, 8255 (PPI), Serial Data transfer (USART 8251), memory interfacing, 8257 (DMA), programmable interrupt Controller (8259).	8
5	**Interfacing of Microprocessor with Timing Devices**: Programmable Interval Timer/ Counter (8253/8254): Introduction, modes, Interfacing of 8253, applications. Introduction to DAC & ADC, ADC & DAC Interfacing (0808, 0809).	7
	Total	**41**

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Ramesh Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", 5th Edition, Penram International Publication (India) Pvt. Ltd.	2006
2.	A.K.Ray & K.M.Bhurchandi, Advanced Microprocessors and peripherals , Tata McGraw Hill, 2000.2nd edition	2000
	Reference Books	
1.	Douglas V. Hall, "Microprocessors and Interfacing", 2nd Edition, TMH.	2006
2.	YU-Cheng Liu & Glenn A Gibson, Microprocessor System, Architecture Programming & Design,PrenticeHall,Inc., 2 nd edition.	2010

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 404** Course Title: **Electromagnetic Field Theory**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester: **Spring (Even)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Physics.**

9.**Course Outcomes:**	• Understanding the concept of vector algebra, gradient, divergence and curl. • Analyzing the electric field and magnetic field for various structure. • Evaluation of E-M wave parameter in different medium. • Applying the boundary concept for wave guide structure. • Modeling of Transmission line and its various parameter. • After completion of this course student will be able to analyze the behavior of E and H filed in various medium.

10. **Details of the Course: -**

Sl. No.	Contents	Contact Hours
1	**Introduction to Electromagnetic:** Vector Algebra, Co-ordinate Systems, Scalar and Vector fields, Line integral, Surface integral, Volume integral, Gradient of a Scalar field, Divergence of a vector field, Curl of a Vector Field, Divergence Theorem, and Stoke's theorem.	8
2	**Static Fields:** Coulomb's law, Electric field intensity, Electric flux density, Gauss' Law & its application, Electrostatic Potential, Poisson's & Laplace equation, Energy density in electrostatics field, Dielectric Constant, Continuity equation, Boundary Condition in electrostatics, Biot- Savart Law, Ampere's law & its application, Magnetic flux density, Force due to magnetic field, Magnetic energy, Boundary Condition in Magnetostatics.	12
3	**Maxwell's Equation and Electromagnetic Wave Propagation:**	8

	Uniform plane waves, Poynting theorem, Wave polarization, Reflection & Refraction of a plane wave at normal incidence & oblique incidence.	
4	**Parallel Plate Waveguide**: Analysis of TE, TM and TEM waves.	6
5	**Introduction to Transmission Lines:** Transmission Line Parameters, Transmission Line Equations, Input Impedance, Reflection Coefficient & Standing Wave Ratio, Power, Quarter wave transformer and impedance matching through single stub using smith chart.	8
	Total	**42**

11. **Suggested Books:**

SL. No.	**Name of Authors/Books/Publishers**	**Year of Publication/Reprint**
	Text Books	
1.	Mathew N.O. Sadiku, 'Elements of Electromagnetics', Third Edition, Oxford University Press	2011
2.	Hyatt, William, 'Engineering Electromagnetics', Seventh Edition, McGraw Hill	2011
	Reference Books	
1.	Griffiths D.J., 'Introduction to Electrodynamics' 3rd Edition, PHI.	2010
2.	Krauss, J.D., 'Electromagnetics with Applications'5th edition, TMH	2012
3.	Jordan & Balmain, 'Electromagnetic Wave & Radiating Systems,' 2nd edition, PHI.	2010

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TOE 410** Course Title: **Data Structure**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester: **Spring (Even)**
7. Subject Area: **Open Elective**
8. Pre-requisite:

9. **Course Outcomes:**	• Familiarity with major algorithms and data structures. • Identify the strengths and weaknesses of different data structures. • Selection of appropriate data structure and algorithm design method for a specified application. • Using various data structures effectively in application programs. • Evaluate algorithm efficiency. • Possess the knowledge of various existing algorithms.

10. **Details of the Course:**

SL. No.	Contents	Contact Hours
1	**Introduction:** Basic Terminology, Pointer and dynamic memory allocation, Elementary Data Organization, Data Structure operations, Algorithm Complexity and Time-Space trade-off Arrays**:** Array Definition, Representation and Analysis, Single and Multidimensional Arrays, address calculation, application of arrays, Array as Parameters, Ordered List, Sparse Matrices. Stacks: Array. Representation and Implementation of stack, Operations on Stacks: Push & Pop, Array Representation of Stack, Linked Representation of Stack, Operations Associated with Stacks, and Application of stack: Conversion of Infix to Prefix and Postfix Expressions, Evaluation of postfix expression using stack. Recursion: Recursive definition and processes, recursion in C, example of recursion, Tower of Hanoi Problem, tail recursion.	8
2	**Queues:** Array and linked representation and implementation of queues, Operations on Queue: Create, Add, Delete, Full and Empty. Circular queue, Dequeue, and Priority Queue.	8

	Linked list: Representation and Implementation of Singly Linked Lists, Two-way Header List, Traversing and Searching of Linked List, Overflow and Underflow, Insertion and deletion to/from Linked Lists, Insertion and deletion Algorithms, Doubly linked list, Linked List in Array, Polynomial representation and addition, Generalized linked list.	
3	**Trees:** Basic terminology, Binary Trees, Binary tree representation, algebraic Expressions, Complete Binary Tree. Extended Binary Trees, Array and Linked Representation of Binary trees, Traversing Binary trees, Threaded Binary Trees. Traversing Threaded Binary trees, Huffman algorithm & Huffman tree. **Searching and Hashing:** Sequential search, binary search, comparison and analysis, Hash Table, Hash Functions, Collision Resolution Strategies, Hash Table Implementation.	8
4	**Sorting:** Insertion Sort, Bubble Sorting, Quick Sort, Two Way Merge Sort, Heap Sort, Sorting on Different Keys, Practical consideration for Internal Sorting. **Binary Search Trees:** Binary Search Tree (BST), Insertion and Deletion in BST, Complexity of Search Algorithm, Path Length, AVL Trees.	8
5	**File Structures**: Physical Storage Media File Organization, Organization of records into Blocks, Sequential Files, Indexing and Hashing, Primary indices, Secondary indices, B+ Tree index Files, B Tree index Files, Indexing and Hashing Comparisons, Graph, Traversal(DFS,BFS) ,Minimum spanning tree.	8
	Total	**40**

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Horowitz and Sahani, “Fundamentals of data Structures”, Galgotia	
2.	R. Kruse et al, “Data Structures and Program Design in C” Pearson Education.2nd edition.	
3.	A M Tenenbaum et al, “Data Structures using C & C++”, PHI	
4	Lipschutz, “Data Structure”, TMH	

5	K Loudon, “Mastering Algorithms With C”, Shroff Publisher & Distributors	
6	Bruno R Preiss, “Data Structures and Algorithms with Object Oriented Design Pattern in C++”, Jhon Wiley & Sons, Inc.	

12	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **XCS 400** Course Title: **Career Skills**
2. Contact Hours: L: **3** T: **0** P: **0**
3. Examination Duration (Hrs): Theory **3** Practical **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester: **Spring (Even)**
7. Subject Area: **HUSS**
8. Pre-Requisite: **Communication**

9. **Course Outcomes:**	• Have a logical approach to the problems and at the same time they will be able to differentiate between the strong and the week arguments and validity of the statement. • It covers the various approaches to improve the reasoning ability of the students by using the different methods. • Student would have learned the different types of problems may it be related to the coding or other complex types of problems which are related to the sequence detection etc. • A basic Knowledge of the data interpretation. • Along with it the knowledge of puzzles and different methods to solve the puzzles in an easier way is also included. • This course will provide the foundation for the students to develop the basic skills of aptitude and logical reasoning.

10. **Details of the Course:**

S.NO	CONTENT	CONTACT HOURS
1.	**Functional Grammar:** Parts of speech, articles, parallel construction, subject verb agreement.	6
2.	**Logical Reasoning :** Blood relation, puzzle test, syllogism, classification, seating/placing arrangements,	6
3.	**Logical Reasoning:** Ranking and comparison, sequential order and things, selection based on conditions, data interpretation	6
4.	**Building Vocabulary:**	6

	Analogy, Para jumbles, antonyms and synonyms.	
	Total	**24**

11. **Suggested Books:**

Sl. No.	**Name Of Authors/Books/Publishers**	**Year Of Publication/Reprint**
	For Verbal Section:	
1.	Spoken English for India by R.K.Bansal and J.B. Harrison- Orient Longman	
2.	A practical English Grammar by Thomson and Martinet-Oxford University Press	
3.	Professional Communication by Malti Aggarwal	
4.	English grammar, composition and correspondence by M.A.Pink and A.E.Thomas –S.Chand and Sons.Word Power by Blum Rosen-Cambridge University Press	
5.	A Dictionary of Modern Usage-Oxford University Press	
	For Aptitude Section:	
1.	Quantitative aptitude by R.S Agarwal	
2.	Verbal and Non Verbal Reasoning by R.S Agarwal	
3.	All books of puzzles to puzzle to puzzle you by Shakuntala Devi.	
4.	Question Bank on the practice exercise (Created for internal use)	

12.	**Mode Of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **PEC 401** Course Title: **Communication Systems- I Lab**
2. Contact Hours: **L:** 0 **T:** 0 **P:** 2
3. Examination Duration (Hrs): **Theory** 0 **Practical** 3
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 1
6. Semester: **Spring (Even)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Knowledge of CRO and fundamentals of MATLAB.**

9. **Course Outcomes:**	• Demonstrate understanding and analyzing the waveforms of DSB-FC, DSB-SC, SSB-SC. • Analyzing different amplitude modulation techniques (DSB-FC, DSB-SC) angle modulation techniques (FM & PM) using MATLAB.. • Understanding and analyzing of different angle modulation techniques (FM & PM). • Understanding and analyzing of Pulse amplitude modulated & demodulated waveforms.

10. **Details of the Course:**

Sl. No.	Contents
1.	Generation of amplitude modulated (DSB-FC) waveform and determines the modulation indices.
2.	Generation of double sideband suppressed carrier (DSB-SC) waveform using balanced modulator.
3.	Generation of single sideband suppressed carrier (SSB-SC) signal.
4.	Generation of frequency modulated (FM) signal using voltage controlled oscillator.
5.	Demodulation of FM signal using phase locked loop (PLL).
6.	Understanding the pulse amplitude modulation (PAM) and demodulation circuit and draw the waveform for the same.
7.	Simulation of double sideband suppressed carrier (DSB-SC) signal using MATLAB.
8.	Simulation of amplitude modulated (DSB-FC) signal using MATLAB
9.	Simulation of frequency modulated (FM) signal using MATLAB.
10.	Simulation of phase modulated (PM) signal using MATLAB.
Innovative Experiments	

1.	To analyze the radiation pattern of Yagi-Uda antenna.
2.	Getting familiar with the features and basic operations of the spectrum analyzer and investigating signals in frequency domain.
3.	To plot the frequency domain representation of DSB-FC, DSB-SC and SSB-SC using MATLAB.
4.	To plot the frequency domain representation of FM, and PM using MATLAB.
5.	To study the effect of Sampling on the spectrum of analog, Discrete time signal using MATLAB.
6.	To demonstrate the effect of AWGN in DSB-FC, DSB-SC and SSB-SC using MATLAB.
7.	Simulation of frequency modulation and demodulation in noisy condition using MATLAB.
8.	To plot the frequency domain representation of PWM using MATLAB.

11.	**Mode of Evaluation**	Viva / Quiz / Mid Term Lab Exam / End Term Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **PEC 402** Course Title: **Analog integrated Circuits Lab**
2. Contact Hours: **L:** 0 **T:** 0 **P:** 2
3. Examination Duration (Hrs): **Theory** 0 **Practical** 3
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 1
6. Semester: **Fourth**
7. Subject Area: **Core Course**
8. Pre-requisite: **Electronics Circuits Lab**

9. **Course Outcomes:**	• To design, test and implement open loop and closed loop linear application. • To design and implement RC Active filters. • To design and test positive feedback based circuits. • To analyze CMRR of differential amplifier.

10. **Details of the Course:**

Sl. No.	Contents
1.	To Design and Test open loop & closed loop inverting and non-inverting op-amp.
2.	To Design and Test op-amp based Adder and Subtractor circuits.
3.	To Design and Test op-amp based integrator and differentiator circuits.
4.	To Design and Test op-amp based Active RC low pass filters.
5.	To Design and Test op-amp based Active RC high pass filters.
6.	To Design and Test op-amp based Active Band pass & Band reject filters.
7.	To Design and Test op-amp based comparator circuits.
8.	To realize op-amp based triangular wave generator.
9.	To find CMRR of a differential amplifier.
10.	To design and test monostable multivibrator using 555 timer.
Innovative	
1.	To design op-amp based cascaded circuits.

2.	To design a state variable filter.
3.	To design and Test Op-amp based PLL.
4.	As suggested by lab in charge.

11.	**Mode of Evaluation**	Viva / Quiz / Mid Term Lab Exam / End Term Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **PEC 403** Course Title: **Microprocessor Lab**
2. Contact Hours: **L:** 0 **T:** 0 **P:** 2
3. Examination Duration (Hrs): **Theory** 0 **Practical** 3
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 1
6. Semester: **Spring (Even)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Digital Electronics Lab**

9.**Course Outcomes:**	• Understanding of 8085 and 8086 microprocessor Kit &its associated peripherals. • Implementation of different assembly language programs on microprocessor based microcomputer kit. • Ability to test and debug assembly language program in the laboratory. • Understand real mode Memory addressing and ability to interface various devices to the microprocessor.

10. **Details of the Course:**

Sl. No.	Contents
1.	Write program in 8085 to swap two 8 bit numbers.
2.	Write a program in 8085 to move a block of data bytes from one location to another location.
3.	Write programs in 8085 to perform addition & subtraction of 8 bit number with carry / borrow.
4.	Write a program in 8085 for addition of 16 bits numbers with carry.
5.	(a) Write an ALP in 8085 to find one's complement of 8 /16bit data. (b) Write an ALP in 8085 to find two's complement of 8/16 bit data.
6.	Write an ALP in 8085 to add two 8 bit BCD data.
7.	(a) Write an ALP in 8085 to find larger number between two numbers. (b) Write an ALP in 8085 to find smaller number between two numbers.
8.	Write an ALP in 8085 to find largest /smallest in a series of n number.
9.	Write an ALP in 8085 to find multiplication of 8 bit number.
10.	(a) Write a program in 8086 to add two 16 bit numbers given by the user.

	(b) Write a program in 8086 to subtract two 16 bit numbers given by the user
11.	(a) Write a program in 8086 to multiply two 16 bit data. (b) Write a program in 8086 to divide: 32 bit data by 16 bit data.
12.	(a) Write a program in 8086 to find the largest no. from an array of n numbers stored in an array. (b) Write a program in 8086 to perform sorting of given set of numbers
13.	Write a program in 8086 to add and subtract two 8 bit BCD numbers.
14.	(a) Write a program in 8086 to convert a BCD number to its ASCII code equivalent. (b) Write a program in 8086 to convert a BCD number to its grey code equivalent

Innovative	
1.	Write an ALP for Traffic light controller using 8085.
2.	Write an ALP for interfacing of PPI 8255 with microprocessor 8085.
3.	A data string of no. of bytes is converted to its equivalent 2's complement using 8086 string instruction.

11.	**Mode of Evaluation**	Viva / Quiz / Mid Term Lab Exam / End Term Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **POE 410** Course Title: **Data Structure Lab**
2. Contact Hours: **L:** 0 **T:** 0 **P:** 2
3. Examination Duration (Hrs): **Theory** 0 **Practical** 3
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 1
6. Semester: **Spring (Even)**
7. Subject Area: **Open Elective**
8. Pre-requisite:

9. **Course Outcomes:**	• This will boost the basic programming skills of the student in C and C++ programming. • Better understanding to the concept of the stacks and queue and their use with dynamic memory allocation. • Learning and understanding in a better way to sort the arrays and lists. • Implementation of various algorithms.

10. **Details of the Course:**

Sl. No.	Contents
1.	Write Program in C or C++ for Array implementation of Stack, Queue, Circular Queue, List.
2.	Write Program in C or C++ for Implementation of Stack, Queue, Circular Queue, List using Dynamic memory Allocation.
3.	Write Program in C or C++ for Implementation of Tree Structures, Binary Tree, Tree Traversal, Binary Search Tree, Insertion and Deletion in BST.
4.	Write Program in C or C++ for Implementation of Searching and Sorting Algorithms.
5.	Write Program in C or C++ for Graph Implementation, BFS, DFS, Min. cost spanning tree, shortest path algorithm.

11.	**Mode of Evaluation.**	Viva / Quiz / Mid Term Lab Exam / End Term Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER V

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 501** Course Title: **Digital Signal Processing**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 3
6. Semester: **Autumn (Odd)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Signals and Systems.**

9**. Course Outcomes:**	• Understanding of Discrete Time signals & systems and various transforms. • Implementation of the DFT and FFT algorithm and its applications. • Analysis and implementation of digital filter structures. • Design methods of IIR digital filter. • Design techniques of FIR digital filters. • Successful completion of this course enables students to design and analyze various digital processing systems.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Introduction of Discrete –Time Signals and Systems and Other Transforms:** Elements of Digital Signal Processor, Discrete time sinusoids, Discrete time signals and systems, Correlation (Cross and Auto correlation). Z Transform and its properties, ROC properties, Inverse Z Transform. Introduction to Discrete time Fourier series (DTFS) and Discrete Time Fourier Transform (DTFT) and their properties.	8
2	**DFT and FFT Algorithms:** Discrete Fourier Transform (DFT), DFT as linear transformation, DFT properties, Circular Convolution, Fast Fourier Transform (FFT):	9

	Decimation –in- Time Fast Fourier Transform (DITFFT), Decimation –in- Frequency Fast Fourier Transform (DIFFFT), Applications of FFT, Goertzel Algorithm.	
3	**Structures of Digital Filters:** Structure for realization of Digital Filters: Direct Form I, Direct Form II, Cascade and Parallel Form, Transversal Structure Linear Phase FIR Filter structure, Lattice Structure, Signal Flow Graph and Transposed Structure.	9
4	**Design of Infinite Impulse Response (IIR) Digital Filters:** Design of IIR digital filters using impulse invariance technique, Bilinear transformation technique, Approximation of derivatives technique, Design of low pass Butterworth filter and Chebyshev Filter.	9
5	**Design Of Finite Impulse Response (FIR) Digital Filters:** Symmetric and Anti-symmetric FIR filters, Linear phase FIR filters, Design using Frequency sampling technique , Design of FIR filter using Window techniques- Hamming, Hanning and Blackman, Rectangle, Bartlett and Kaiser Windows, Concept of optimum equi-ripple approximations, Effect of finite word length, Fixed point and binary floating point number representations, Comparison, Overflow error, truncation error**.**	7
	Total	**42**

11**. Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Proakis, John G. and Manolakis, Dimitris G., 'Digital Signal Processing, Algorithms and Applications', PHI of India Ltd., New Delhi, 5rd Edition.	2007
2.	Oppenheim, A.V. Schafer, R.W., 'Discrete Time Signal Processing', Englewood Cliffs, NJ: Prentice Hall.	1989
	Reference Books	
1.	Mitra, K.Sanjit, 'Digital Signal Processing A Computer Based Approach', Tata McGraw-Hill, New Delhi.	1998
2.	Jhonson,J..R., 'Introduction to Digital Signal Processing', Prentice-Hall.	1989
3.	Salivahanan, S.; Vallavaraj, A., Gnanapriya C., 'Digital Signal Processing', Tata McGraw-Hill, New Delhi.	2008

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 502** Course Title: **Communication Systems- II**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 3
6. Semester: **Autumn (Odd)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Signals and systems, Communication systems-I**

9. **Course Outcomes:**	• Understanding of analog to digital conversion and transmission of digital base band signals. • Analyze the effect of ISI and their mitigation. • Design of optimum receiver for AWGN channel. • Analyze different digital modulation schemes and compute their bit error performances. • Understanding of measurement of Information and source coding techniques. • Successful completion of this course enables students to apply the concepts of digital communications for reliable communication with high data rate. This course is foundation course to the wireless communication.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Sampling and Baseband Transmission:** Model of digital communication system, Sampling of Low pass and Band pass signals, Distortion due to sampling, Uniform and Non-uniform Quantization, Quantization error, Pulse Code Modulation, Differential PCM and Delta Modulation, Adaptive Delta Modulation, linear prediction filters.	10
2	**Band Limited Signaling:** Line Coding and its properties, Power Spectra of PAM signals, Inter symbol Interference, Ideal Nyquist filter, Raised Cosine filter, Eye Diagram, Introduction to Equalization Techniques and Zero Forcing Equalizer.	8
3	**Digital Pass Band Transmission:**	10

	Represent of Bandpass Signals and Systems, Gram Schmidt Procedures, Representation of Digitally Modulated Signals; Amplitude Shift Keying, Phase Shift Keying, Differential PSK, Quadrature PSK, Frequency Shift Keying, Minimum Shift Keying, Quadrature Amplitude Modulation (QAM).	
4	**Optimum Receivers for AWGN Channel:** Model for Received Signal passed through an AWGN Channel, Matched Filter Receiver and Correlation Receiver, Detector: MAP Detector, ML Detector, Likelihood function, minimum square distance detector and maximum correlation Detector. Probability of Error Calculation for BASK, BPSK, QPSK, BFSK, and QAM.	7
5	**Information Theory And Error Control Coding:** Information Measure; Entropy and Information rate, Discrete Memory less source, Mutual Information, Binary symmetric channel, Discrete channel capacity, Continuous information source, Continuous channel capacity, Source coding Theorem, Shannon-Fano coding, Huffman coding, Channel Capacity Theorem, Linear block codes, Coding Gain, Hamming codes, Convolution Coding.	7
	Total	**42**

11**. Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	B.P.Lathi, 'Modern Digital and Analog Communicatoin', Oxford Publication, 3/e	2005
2.	Simon Haykins, 'Digital Communications', John Wiley, 4/e	2001
3	Taub and Schilling, ' Principles of Communication System ', Tata McGraw-Hill, New Delhi,4/e	1995
	Reference Books	
1.	Proakis,John G., 'Digital Communication', McGraw-Hill Inc., Third edition	1995
2.	K. Vasudevan, 'Digital Communications and Signal Processing', Universities Press, Second edition.	2010
3.	A.Bruce Carlson, 'Communication Systems', McGraw-Hill Inc., Fourth Edition	2002

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 503** Course Title: **Microcontroller and Embedded System**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester: **Autumn (Odd)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Microprocessor.**

9. **Course Outcomes:**	• Understanding the concept of embedded system. • Assembly language programming of 8051. • Understanding of 8051 microcontroller as I/O, timer and counter. • Study of Arduino IDE • Interfacing of different IC with 8051. • Successful completion of this course will act as foundation for Advanced embedded system course.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**MICROCONTROLLER*:*** Difference between Microprocessors and Micro-controllers, Types of Micro-controllers, ARM Processor, Memory structure of 8051, Processor Architecture – Harvard v/s Von Neumann, CISC v/s RISC, 8051 Architecture , control storage, variable area, stack, hardware register space, SFR,8051 pin diagram..	9
2	**8051 Instruction Set:** Addressing modes, external addressing, Instruction execution, Instruction set – data movement, arithmetic, bit operators, branch, Software development tools like assemblers, simulators, O/P file formats. Assembling and running an 8051 program, 8051 data types, 8051 flag bits and the PSW register, 8051 register banks and stack	9

3	**PROGRAMMING OF 8051 and INTERRUPTS:** Programming of 8051, I/O bit manipulation. Timer, counter, programming of timer, 8051 interrupts, Interrupts priority in the 8051, and interrupts programming.	8
4	**INTRODUCTION TO ARDUINO IDE PLATFORM** Introduction to ATMEGA328 microcontroller and to Arduino IDE, Instruction Set, Hardware, Characteristics, Interfacing with different peripheral devices, Debugging hardware errors, Using PWM I/O pins, Interfacing Arduino hardware with Internet of Things	8
5	**INTERFACING:** Interfacing with 8051: LCD, Keyboard, ADC, DAC interfacing, Sensor interfacing and Signal Conditioning, Stepper motor and DC motor, Basics of serial communications, 8051 connection to RS-232, 8051 serial port programming assembly.	8
	Total	**42**

11**. Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Mazidi, The 8051 Microcontrollers & Embedded Systems, Pearson Education.	2007
2.	Programming and Customizing the 8051 Micro-controller, Myke Predko, Tata McGraw-Hill edition.	2003
3.	Brad Kendall, Arduino Make use of A complete beginner guide,	2013
	Reference Books	
1.	Kenneth Ayala, The 8051 Microcontroller, West Publishing Company.	1193
2.	Julien Bayle, C-Programming for Arduino	2013

12.	**Mode of Evaluation.**	Viva / Quiz / Mid Term Lab Exam / End Term Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 504** Course Title: **Control System**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester: **Autumn (Odd)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Network Analysis and Synthesis.**

9. **Course Outcomes:**	• Understanding basic concepts of control systems, related terminologies, modeling and transfer function. • Analysing and understanding the concepts of time domain analysis. • Analyzing stability concepts using various techniques. • Understanding the concept of frequency domain analysis. • Design of control system through compensation techniques • State variable analysis of systems and understanding the concepts of nonlinear systems.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1	**Introduction:** Introduction to open loop and closed loop control systems, feedback characteristics of control systems, Mathematical Representation of physical systems, control hardware and their models: dc and ac servomotors, Electrical and Mechanical analogy, Block diagram algebra and signal flow graphs, Mason's gain formula.	8
2	**Time Domain Analysis:** Standard Test Signals, Time response of First and Second systems, Performance Indices. Error Analysis: Static and Dynamic Error Coefficients, Effect of adding poles and zeroes to the system, response of P, PI, and PID controllers.	8
3	**Concept of Stability:** Concept of stability, Asymptotic and conditional stability, Routh Hurwitz Criterion, Root Locus technique (Concept and construction). **Frequency Response Analysis:**	10

	Correlation between time and frequency response, polar and inverse polar plots, Nyquist stability criterion, Bode plots, M and N circle.	
4	**Design through compensation techniques:** Realization of lag, lead and lag-lead compensators, Design of closed loop control system using root locus and Bode plot Compensation.	8
5	**State Variable Analysis:** Introduction, State space representation, State modes of linear systems, State equations, transfer matrices, diagonalization solution of state equations, controllability and observability. Introduction to non Linear systems.	8
	Total	**42**

11. Suggested Books:

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Nagrath I. J. & Gopal M. ,' Control System Engineering', New Age International Publishers.4/e.	2005
	Reference Books	
1.	Kuo B. C. ,' Automatic Control Systems', PHI.10 edition	2005
2.	Ogata K.,' Modern Control Engineering,' PHI.5th edition.	2010
3.	Nise S. Norman,' Control System Engineering' John Wiley & Sons, Singapore.6th edition	2010
4.	A K Jairath ,Problems And Solutions Of Control Systems With Essential Theory ,5th Edition	2012

12.	**Mode of Evaluation**	Test / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **XCS 500** Course Title: **Career Skills**

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

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

4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**

5. Credits: **3**

6. Semester: **Autumn (Odd)**

7. Subject Area: **HUSS**

8. Pre-requisite:

9.**Course Outcomes:**	• The basic concept of the marketing related to the profit, loss and the interest. • It Along with it one would have the understanding of time, distance and concept of work etc. • It covers the various approaches to improve the reasoning ability of the students by using the different methods. • A basic knowledge of the data interpretation. • It will enhance the numerical ability of the student related to computation and estimation, and other concepts like ratio, clock and time and probability concept etc. • Successful completion of this course will provide the foundation for the students to develop the basic skills of aptitude and logical reasoning.

10. **Details of the Course:**

S.NO	CONTENT	CONTACT HOURS
1.	**Effective Reading Skills:** Reading Comprehension Purpose of reading, skimming and scanning. Tips for improving comprehension skills. (For effective reading skills practice papers on Reading Comprehension will be provided to students).	4
2.	**Aptitude section**: Clocks, Calendar, Profit/loss, Percentage, Average.	4
3.	**Aptitude Section:** Ages, Trains & Boats, Simplification, Ratio & proportion, Partnership	12
4.	**Critical Reasoning**: Analyze logical arguments.	4
	Total	**24**

11. **Suggested Books:**

Sl. No.	Name Of Authors/Books/Publishers	Year Of Publication/Reprint
	For Verbal Section:	
1.	Spoken English for India by R.K.Bansal and J.B. Harrison- Orient Longman	
2.	A practical English Grammar by Thomson and Martinet-Oxford University Press	
3.	Professional Communication by Malti Aggarwal	
4.	English grammar, composition and correspondence by M.A.Pink and A.E.Thomas –S.Chand and Sons.Word Power by Blum Rosen-Cambridge University Press	
5.	A Dictionary of Modern Usage-Oxford University Press	
	For Aptitude Section:	
1.	Quantitative aptitude by R.S Agarwal	
2.	Verbal and Non Verbal Reasoning by R.S Agarwal	
3.	All books of puzzles to puzzle to puzzle you by Shakuntala Devi.	
4.	Question Bank on the practice exercise (Created for internal use)	

12.	**Mode of Evaluation.**	Test / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: Electronics and Communication Engineering

1. Subject Code: **PEC 501** Course Title: **Digital Signal Processing Lab**
2. Contact Hours: **L:** 0 **T:** 0 **P:** 2
3. Examination Duration (Hrs): **Theory** 0 **Practical** 3
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 1
6. Semester: **Autumn (Odd)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Fundamentals of MATLAB**.

9.**Course Outcomes:**	• Understanding and implementing and analyzing various basic signals and convolution and correlation functions. • Analyzing DFT and IDFT functions. • Analyzing and verifying FFT algorithm. • Implementing FIR and IIR digital filter.

10. **Details of the Course:**

Sl. No.	Contents
1.	Generation of various signals Functions (Unit Impulse, Unit Step, Unit Ramp Signals, Sinc & Signum) through MATLAB. Sampling of the signal using different sampling techniques and reconstruction of the sampled signals.
2.	To convolve sequence (i) Linear (ii) Circular, and their characteristics using MATLAB. (By given problems, verify it by mathematically as well as experimental ways).
3.	To correlate of Sequences using MATLAB. (By given problems, verify it by mathematically as well as experimental ways and plot them). .
4.	DFT and IDFT Computation for a sequence N points using MATLAB. .
5.	Development of FFT Algorithm using MATLAB, validate the result through mathematically as well as experimentally.
6.	Generation of Gaussian distributed numbers using MATLAB.
7.	To simulate 2nd order IIR Filter using MATLAB.
8.	To simulate FIR filter using MATLAB.

Innovative Experiments	
1.	Circular Convolution of two Sequences by using FFT method.
2.	Write a MATLAB Program to implement Radix2 Decimation In Time (DIT) FFT algorithm.

11.	**Mode of Evaluation**.	Viva / Quiz / Mid Term Lab Exam / End Term Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **PEC 502** Course Title: **Communication Systems-II Lab**
2. Contact Hours: **L:** 0 **T:** 0 **P:** 2
3. Examination Duration (Hrs): **Theory** 0 **Practical** 3
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 1
6. Semester: **Autumn (Odd)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Knowledge of CRO and fundamentals of MATLAB.**

9. **Course Outcomes:**	• Understanding and analyzing of different Sampling techniques waveforms. • Understanding and analyzing of different digital pulse modulation (PCM, DM) and demodulation waveforms. • Analyzing the different line coding waveforms. • Understanding and analyzing of different digital passband transmission waveforms using MATLAB.

10. **Details of the Course:**

Sl. No.	Contents
1.	Sampling of the signal using different sampling techniques and reconstruction of the sampled signals.
2.	Analog to digital and digital to analog conversion using Pulse Code Modulation and demodulation.
3.	Transmission of an analog signal using Delta modulator and recover back the original analog signal at receiver using Delta demodulator.
4.	Mapping of binary data in to baseband pulses using different data formatting techniques.
5.	Mapping of binary data in to pass band signal using binary amplitude shift keying (BASK).
6.	Mapping of binary data in to pass band signal using binary frequency shift keying (BFSK).
7.	Mapping of binary data in to pass band signal using binary phase shift keying (BPSK).
8.	Simulation of Binary Amplitude shift keying (BASK) Modulated Signal using MATLAB.
9.	Simulation of Binary Frequency shift keying (BFSK) Modulated Signal using MATLAB.
10.	Simulation of Binary Phase shift keying (BPSK) Modulated Signal using MATLAB.

Innovative Experiments	
11.	To plot and analyze the waveform for Quadrature Phase Shift Keying (QPSK) signal using MATLAB for a given bit stream.
12.	Analysis of QPSK signals subjected to AWGN using MATLAB.

11.	**Mode of Evaluation**.	Viva / Quiz / Mid Term Lab Exam / End Term Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **PEC 503** Course Title: **Microcontroller & Embedded Lab**
2. Contact Hours: **L:** 0 **T:** 0 **P:** 2
3. Examination Duration (Hrs): **Theory** 0 **Practical** 3
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 1
6. Semester: **Autumn (Odd)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Microprocessor Lab**

9. **Course Outcomes:**	• Understanding of 8051 microcontroller Kit &its associated peripherals. • Implementation of different assembly language programs on microprocessor based microcomputer kit. • Ability to test and debug assembly language program in the laboratory. • Understand real mode Memory addressing and ability to interface various devices to the microprocessor.

10. **Details of the Course:**

Sl. No.	Contents
1.	a) Write a program in 8051 to add two 8 bit numbers. b) Write a program in 8051 to subtract two 8 bit numbers.
2.	a) Write a program in 8051 to add two 16 bit numbers. b) Write a program in 8051 to subtract two 16 bit numbers.
3.	a) Write a program in 8051 to find the largest no. from an array of n numbers stored in an array. b) Write a program in 8051 to perform smallest no. from an array of n numbers stored
4.	Write a program in 8051 to add two 8 bit BCD numbers.
5.	a) Write a program in 8051 to multiply two 8 bit data. b) Write a program in 8051 to divide two 8 bit data.
6.	Write a program in 8051 to convert a BCD number to its ASCII code equivalent.
7.	Write a program in 8051 which move a block of data.

8.	Write a program in 8051 which sort a block of data.
9.	Write a program in 8051 which convert a binary number to its grey code equivalent
10.	Write a program in 8051 which determines average of n numbers.
11.	Write a program in 8051 to convert a BCD number to its binary code equivalent
12.	Write a program in Arduino to I/O interface with putty.sh.
13.	Write a program in Arduino to interface LED and create a burglar alarm.
14.	Write a program in Arduino to interface with a dc motor.
Innovative	
1.	8255 Interface to 8051.
2.	Traffic Light Controller interface to 8051.
3.	Interfacing Arduino IDE to create an IOT data log.

11.	**Mode of Evaluation.**	Viva / Quiz / Mid Term Lab Exam / End Term Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER VI

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 601** Course Title: **Wireless Communication**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester: **Spring (Even)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Communication Systems-II.**

9. **Course Outcomes:**	• Understanding of wireless systems and standards • Analysis and design of cellular system and mobile radio propagation models • Applying the concepts of radio propagation models to small scale fading. • Analysis and design of diversity combining techniques. • Apply the concepts of spread spectrum for designing wireless Communication Systems. • Successful completion of this course enables students to apply concepts of Wireless Communications for secured high data rate communication

10. **Details of the Course**:-

Sl. No.	Contents	Contact Hours
1	**Wireless System and standards**: 1G, 2G, 3G, 4G and standards & GSM system architecture **System design fundamental:** Frequency reuse, channel assignment strategies, handoff strategies, interference and system capacity, improving coverage and capacity in cellular systems.	10
2	**Evolution of mobile radio Propagation fundamentals**: **Large scale path loss:** Introduction to Radio wave propagation, Free space	9

	propagation Model, Basic propagation Mechanisms, Ground Reflection (Two-Ray) Model, Practical link Budget Design Using Path loss Models, Indoor Propagation Models.	
3	**Small Scale Fading & Multipath**: Small-Scale Multipath propagation, Impulse Response Model of Multipath Channel, Parameters influencing small scale fading, Types of small scale fading, Diversity mechanisms,	9
4	**Diversity Combining Techniques**: Rayleigh & Rician fading models, Selection Combining(SC), Equal Gain Combining(EGC), and Maximal Ratio Combining(MRC), Derivation of SC, EGC, and MRC improvement, RAKE Receiver	8
5	**Spread spectrum:** Multiple Access Techniques, Pseudo-noise sequence, Direct sequence spread spectrum (DS-SS), Frequency hopped spread spectrum (FHSS). Time Hopping.	6
	Total	**42**

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	T.S. Rappaport, "Wireless Communication-Principles and practice", PHI, Second edition.	2006
2.	Sanjay Kumar, "Wireless Communication: The Fundamental and Advanced Concepts", River Publishers Series in Communications.	2015
	Reference Books	
1.	Willium C. Y. Lee, "Mobile communication Design and fundamentals" 4 edition,	2006
2.	D. R. Kamilo Fehar, "Wireless digital communication",	2004
3.	Haykin S & Moher M., "Modern wireless communication", Pearson,	2005
4.	R. Pandya, " Mobile and personal communication system", PHI,	2008

12.	**Mode of Evaluation**.	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 602** Course Title: **Microwave Engineering**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester: **Spring (Even)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Communication Systems, Electromagnetic Field Theory.**

9. **Course Outcomes:**	• Understanding of waveguides characteristics, cavity resonators and its field expressions • Analysis of different microwave components based on network parameters • Understanding of microwave sources and their characteristics • Design of microwave components and measurement of performance • Implementation of Microstrip filters used in RF transmitter and receiver. • Successful completion of this course will be helpful in designing RF component, transmitter, receiver and RF communication link

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Waveguides and Transmission Line:** Rectangular and Circular waveguide, Excitation of waveguides, Rectangular cavity resonators, Introduction to Microstrip line.	10
2	**Passive microwave devices:** Network parameter of microwave circuit, Scattering matrix Microwave T junctions, E plane TEE, H plane TEE, Magic TEE, Hybrid TEE, Hybrid ring, terminations, attenuators & phase changers, Isolator & circulators, directional couplers and power divider.	8

3	**Microwave Sources:** Klystron, Reflex Klystron, Magnetron (Conventional, linear), TWT, Gunn Diode, IMPATT, TRAPATT, Tunnel Diode –Operation & Characteristics, Basics of GaAs, FET.	8
4	**Microwave measurements:** Measurement of frequency, wavelength, Power, VSWR, Impedance determination, S-Parameter measurements, Spectrum analyzer, Network analyzer.	6
5	**Microwave Systems:** Types of filter designing, Low-pass prototype filter design, filter transformations, filter implementation Richard transformation, Kuroda identities, Stepped-Impedance Low Pass Filters. Introduction to RFID, MMIC, RFMEMS, and Effect of microwave on human body.	8
	Total	**40**

11. **Suggested Books:**

SL. No.	**Name of Authors/Books/Publishers**	**Year of Publication/Reprint**
	Text Books	
1.	Liao, Samuelf, 'Microwave Devices & Circuits', PHI, Third edition.	2003
2.	Pozar, D.M., 'Microwave Engineering' John Wiley & sons, fourth edition.	2013
	Reference Books	
1.	Collins, R.E., 'Foundations for Microwave Engineering', John Wiley & sons, 2nd edition.	2009
2.	Bhal, I.J. Bhal & Bhartia, P., 'Microwave Solid state Circuit Design', John Wiley & sons, Inc. New York.	2003

12.	**Mode of Evaluation**.	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 603** Course Title: **VLSI Technology and Design**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 3
6. Semester: **Spring (Even)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Electronic Devices and Circuits**

9. **Course Outcomes:**	• Understanding of fabrication techniques • Design steps of complete manufacturing flow for the MOS transistor. • Understand the features and characteristics of MOS transistor • Designing and analysis of Inverter circuits in terms of switching Characteristics and noise margin. • Implementation of stick diagram and layout for NMOS, PMOS and CMOS circuits. • Successful completion of this course will create a base for semiconductor device fabrication processes for VLSI Technology.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**VLSI Technology:** Clean Room Technology, Crystal Growth and Wafer Preparation, Electronic Grade Silicon, CZ crystal growth technique, Silicon Shaping. Epitaxy: Vapor-Phase Epitaxy, Doping and Auto-doping, Buried Layers. Oxidation: Importance, Deal and Grove's Model.	8
2	**Diffusion:** Models of diffusion in Solids, Fick's Law. Ion Implantation: Range Theory, Ion Stopping, Implantation Equipment, Annealing. Lithography: Types, Photoresist. Etching: Wet Etching, Ion Milling, Liftoff. Metallization: Applications, Choices, Deposition.	8

3	**Era of VLSI Design:** Introduction to VLSI Design, Front End and Back End Design, Computer Aided Design Technology. **MOS Transistor:** MOS Structure, MOS system under external Bias, Threshold voltage, Structure and operation of MOS transistor, MOSFET device design equation, MOSFET scaling, MOSFET capacitances.	8
4	**MOS Inverters:** Static Characteristics, Resistive – Load Inverter, Inverters with n-type MOSFET Load, CMOS Inverter, Switching Characteristics of MOS Inverters, Delay-Time Definitions, Switching Power Dissipation of CMOS Inverters.	10
5	**Layout Design:** Design rules, Stick Diagram, parasitic effects, Layout Design prospects, CMOS Basic Circuits Layout Design: NAND, NOR, AND, OR, AOI circuits.	8
	Total	42

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	S. Kang and Y. Leblebici, CMOS Digital Integrated Circuits, Analysis and Design, 3rd Ed., Tata McGraw-Hill.	2003
2.	S. M. Sze, VLSI Technology (2/e) , McGraw Hill,.2nd edition	1988
3.	James D. Plummer , Michael Deal , Peter D. Griffin, Silicon VLSI Technology: Fundamentals, Practice, and Modeling, 1e, Pearson Edition	2003
4.	VLSI Fabrication Principles Silicon And Gallium Arsenide, SorabK.Ghandi, A Wiley Inderscience Publications,2e.	1994
	Reference Books	
1.	D. A. Pucknell and K. Eshraghian, Basic VLSI Design, 3 rd Ed., Prentice-Hall of India..	1994
2.	Stephen A. Campbell, The Science and Engineering of Microelectronic Fabrication, 2nd Ed., Oxford University Press.	2008

12.	**Mode of Evaluation.**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 604** Course Title: **Data Communication Networks**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester: **Spring (Even)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Communication Theory**

9. **Course Outcomes:**	• Understanding of OSI and TCP/IP network models and designing of physical layer. • Understanding functions of data link layer and its protocols • Understanding channel access techniques and IEEE LAN and MAN standards • Analyzing performance of routing protocols and understanding of congestion control techniques, IPV4, TCP • Understanding functions of presentation, session and application layer. • Successful completion of this course will enable student to analyze the heterogeneous packet switched network.

10. **Details of the Course: -**

Sl. No.	Contents	Contact Hours
1	**Introduction to Data Communication:** Goals and Applications of Networks, LAN, WAN, MAN, Wireless network. Reference Model: OSI, TCP/IP. **Physical Layer:** Data and signals, digital transmission, analog transmission, Bandwidth utilization- multiplexing and spreading, Wireless transmission, Circuit switching, Packet switching.	8

2	**Data Link Layer:** Data link layer design issues, services provided to network layers, Framing, Error control, Flow control, Error detection and correction, Elementary data link protocols, An unrestricted Simplex protocol, A Simplex Stop-and-Wait protocol, Simplex Protocol for a noisy channel, Sliding Window protocols, A protocol using go-back-N, A protocol using selective repeat, Example data link protocol-HDLC and PPP.	8
3	**Medium Access Sub layer:** Channel Allocations, Static and dynamic allocation in LAN, Multiple Access protocols, ALOHA, Carrier Sense multiple access protocols, Collision free protocols, Limited contention protocols, IEEE standard 802.3-Ethernet, IEEE standard 802.4- Token bus, IEEE standard 802.5-Token Ring, IEEE standard 802.6- FDDI, bridges.	**7**
4	**Network and Transport Layer:** Network Layer design issues, Concept of virtual circuit and datagram subnet, Routing algorithms, Congestion Control Algorithms, Internetworking, IP protocol and addressing. Transport services, Design issues, elements of transport protocols, simple transport protocols, Connection management, TCP, UDP.	7
5	**Presentation and Application Layer & Security:** **Presentation Layer:** Design issues, Data compression techniques, cryptography. **Application Layer:** Domain Name System (DNS), File Transfer (FTP), Access and Management, Electronic mail (SMTP), Virtual Terminals, **Network Security:** Security services, message confidentiality, integrity And Authentication. Other topics: Integrated and differentiated services internet model, Multi-protocol label switching (MPLS).	**12**
	Total	**42**

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	A.S. Tanenbaum, Computer Networks, 3rd Edition, Prentice Hall India.	2010
2.	Forouzen, Data Communications and Networking, TMH.	2007
	Reference Books	
1.	S. Keshav, An Engineering Approach on Computer Networking, Addison Wesley.	2008
2.	W. Stallings, Data and Computer Communication, Macmillan Press.	2009

12.	**Mode of Evaluation.**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **XCS 600** Course Title: **Career Skills**

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

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

4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**

5. Credits: **3**

6. Semester: **Spring (Even)**

7. Subject Area: **HUSS**

8. Pre-requisite: **Communication.**

9. **Course Outcomes:**	• It will enhance the numerical ability of the student related to computation and estimation, and other concepts like ratio, clock and time and probability concept etc. • It will enhance the knowledge of the students related to the quadratic equation concepts. • Along with it the knowledge of puzzles and different methods to solve the puzzles in an easier way is also included. • It also includes the methods to solve the complicate puzzle and problems and improve the technical skills of the students. • It covers the various approaches to improve the reasoning ability of the students by using the different methods. • Successful completion of this course will provide the foundation for the students to develop the basic skills of aptitude and logical reasoning.

10. **Details of the Course:**

SI.NO	CONTENT	CONTACT HOURS
1.	**Building Advanced Vocabulary:** Sentence completion: Single and double vocabulary **Job Application**: Personal Interviews and C.V Writing Essential parts - Cover Letter and the 'resume'. Types of 'resumes' (*Curriculum Vitae*) Chronological 'resume', functional 'resume'.	5
2.	**Aptitude Section:**	8

	Number system, P& C, Probability, Log,	
3.	**Aptitude Section**: Time & Work, S.I & C.I, Time & Distance, Mixture, Chain Rule, Pipes & Cisterns	6
4.	**Advanced Grammar:** Spotting errors, subject verb agreement based errors.	5
	Total	**24**

11. **Suggested Books:**

Sl. No.	**Name Of Authors/Books/Publishers**	**Year Of Publication/Reprint**
	For Verbal Section:	
1.	Spoken English for India by R.K.Bansal and J.B. Harrison- Orient Longman	
2.	A practical English Grammar by Thomson and Martinet-Oxford University Press	
3.	Professional Communication by Malti Aggarwal	
4.	English grammar, composition and correspondence by M.A.Pink and A.E.Thomas –S.Chand and Sons.Word Power by Blum Rosen-Cambridge University Press	
5.	A Dictionary of Modern Usage-Oxford University Press	
	For Aptitude Section:	
1.	Quantitative aptitude by R.S Agarwal	
2.	Verbal and Non Verbal Reasoning by R.S Agarwal	
3.	All books of puzzles to puzzle to puzzle you by Shakuntala Devi.	
4.	Question Bank on the practice exercise (Created for internal use)	

12.	**Mode of Evaluation**	Test / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **PEC 601** Course Title: **CAD using CADENCE Tool**
2. Contact Hours: **L:** **0** **T:** **0** **P:** **2**
3. Examination Duration (Hrs): **Theory** **0** **Practical** **3**
4. Relative Weight**: CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **1**
6. Semester: **Autumn (Odd)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Digital Electronics lab.**

9. **Course Outcomes:**	• Student will have a thorough knowledge about the Cadence tool to create the library and schematic. • Knowledge of basic combinational and sequential programming. • Knowledge about designing the combinational and sequential circuits. • Successful completion of this lab will provide performance analysis of digital circuits and implementation in FPGA kit.

10. **Details of the Course: -**

Sl. No.	**Contents**
1.	Design and simulation of various gates.
2.	Design and simulation of XOR gate using NAND gate only.
3.	Design and simulation of comparator.
4.	Design and simulation of Full Adder and Full Substractor.
5.	Design and simulation of Multiplexer and Demultiplexer.
6.	Design and simulation of Encoder and Decoder.
7.	Design and simulation of Flip-Flops.
8.	Design and simulation of UP-DOWN counter/Decade counter.

9.	FPGA Implementation of Full Adder and Full Substractor.
10.	FPGA Implementation of Flip-Flops.
Innovative Experiment:	
1.	FPGA Implementation of Binary Multiplier.
2.	As suggested by lab in charge.

11.	**Mode of Evaluation**	Viva / Quiz / Mid Term Lab Exam / End Term Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **PEC 602** Course Title: **Microwave Lab**
2. Contact Hours: **L:** **0** **T:** **0** **P:** **2**
3. Examination Duration (Hrs): **Theory** **0** **Practical** **3**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **1**
6. Semester: **Spring (Even)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Knowledge of EMFT and Microwave**

9. **Course Outcomes:**	• Understanding of microwave bench and related component. • Measurement of basic parameters of microwaves and analysis of S-parameters for various microwave devices. • Understanding of different microwave sources. • Successful completion of this lab will provide good understanding of microwave devices and its measurement.

10. **Details of the Course:**

Sl. No.	Contents
1.	To measure the Guide Wavelength and Frequency of the signal in a rectangular waveguide, working on TE_{10} mode.
2.	Measurement of VSWR using slotted line, introduced by the wave guide in dominant mode.
3.	To measure the S-Parameters of given Magic TEE.
4.	Measurement of characteristics of a given Circulators.
5.	To measure the characteristics of given directional coupler.
6.	To draw the mode characteristic of Reflex Klystron.
7.	To draw the characteristic of Gunn Oscillator.
8.	Measurement of Microwave Power using power meter.
9.	To draw the Polar pattern and measure the Gain of waveguide Horn Antenna.
10.	To verify the characteristic of Low Pass filter (S-Band and C-Band).
11.	To measure the impedance using Smith Chart.
Innovative	
1.	To measure the characteristics of given E, H-TEE.
2.	To measure the characteristic of Power Divider and Power Combiner (S-Band and C-Band).

11	**Mode of Evaluation**	Viva / Quiz / Mid Term Lab Exam / End Term Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER VII

Name of Department: Electronics and Communication Engineering

1. Subject Code: **TEC 701** Course Title: **Principles of Management**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester: **Autumn (Odd)**
7. Subject Area: **HUSS**
8. Pre-requisite: **None**

9**. Course Objectives:**	• Understanding theories of principle of management. • Analysing the elements and steps of planning. • Analysing the structure, design and principle of organising. • Understanding principle and elements of direction and control. • Understanding functional domain of management. • Successful completion of this course enables students to apply practical concepts of scientific management in their respective work domain. Students will be able to manage ethical issues involved in management decision making

10. **Details of the Course: -**

Sl. No.	Contents	Contact Hours
1	**Theories and Principles of Management:** Introduction to management, evolution of management thought: Classical, Neo-Classical and Contemporary approaches like MBO, MBE, MBWA etc, Definitions of Management, Management as Science, Art and Profession, Goals, Roles and Functions of Managers, Managerial Pyramid.	10
2	**Function of Planning:** Objectives and Significance of Planning-Elements and Steps in Planning- Types of planning- Environmental scanning - SWOT and PEST analysis- Vision, Mission, Objectives, Goals & other components of Planning.	8

3	**Function of Organizing:** Organization Structure & Design, Principles of organizing - Elements and process of organizing; Grouping of activities: Departmentalization; Line and staff – Power vs. authority; Delegation - centralization and decentralization-Empowerment-Organization chart	8
4	**Function of Directing and Controlling:** Principles and elements of direction: Motivation, Leadership, Communication. Essence of Management – Coordination, Decision Making. Process of Controlling**,** Dimensions of control, Limitations, Requirements for effective control.	8
5	**Introduction to Functional domains:** Marketing - Core concepts of marketing - Demand, value, customer satisfaction. Marketing mix- product, price, place, promotion. Financial Economics - scope and significance, objectives, opportunity cost principle, marginal and incremental principle, time-perspective principle, Break – even analysis. Human Resource – concept, scope, challenges and importance, overview of recruitment, selection, placement, training and development. Overview of Operations & Supply Chain.	8
	Total	**42**

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	L.M.Prasad, Priciples and Practice of Management, S. Chand & Sons,3/e.	2008
2.	Koontz H. and Heinz Weihrich, Elements of Management. TMH. New Delhi, 11/e	2005
	Reference Books	
1.	Heinz Weihrich, Mark V. Cannice and Harold Koontz, (2009). Management: A Global Perspective, 12/e, TMH., New Delhi.	2009
2.	Drucker, F. Peter, Management - Tasks, Responsibilities & Practices, New Delhi, 18/e	2007

12.	**Mode of Evaluation**	Viva / Quiz / Mid Term Lab Exam / End Term Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER VIII

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 801** Course Title: **Computer Architecture**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 3
6. Semester: **Spring (Even)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Digital Electronics, Microprocessor Fundamentals**

9. **Course Objectives:**	• Understanding and design of CPU and its components. • Implementation of parallelism in computing. • Understanding the design of main memory, cache memory, virtual memory and I/O devices. • Understanding of multiprocessing system and interfacing. • Analyze input/output devices. • Successful completion of this course enables students to design components of microprocessor/microcontroller unit and integrating them to form a computing system

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	Basic Structure of Computers, Functional units, software, performance issues software, machine instructions and programs	8
2	Processor organization, Information representation, number formats. Multiplication & division, ALU design, Floating Point arithmetic, IEEE 754 floating point formats standards	8
3	Control Design, Instruction sequencing, Interpretation, Hard wired control - Design methods, and CPU control unit. 4 Microprogrammed Control - Basic concepts, minimizing microinstruction size, multiplier control unit. Microprogrammed computers - CPU control unit	10
4	Memory organization, device characteristics, RAM, ROM, Memory management, Concept of Cache & associative memories, Virtual memory	8

5	System organization, Input - Output systems, Interrupt, DMA, Standard I/O interfaces,Concept of parallel processing, Pipelining, Forms of parallel processing, interconnect network	8
	Total	**42**

11**. Suggested Books:**

SL. No.	**Name of Authors/Books/Publishers**	**Year of Publication/Reprint**
	Text Books	
1.	M. Morris Mano: Computer System Architecture, 3rd Edition, Pearson Education.	2013
2.	Linda Null, Julia Lobur: Essentials of Computer Organization and Architecture, 4th Edition, Jones and Bartlett Publishers.	2003
	Reference Books	
1.	David A. Patterson, John L. Hennessy: Computer Organization and Design – The Hardware / Software Interface, 3rd Edition, Morgan Kaufman.	2005
2.	William Stallings: Computer Organization & Architecture, 8th Edition, PHI.	2010

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Detailed Syllabus of Electives

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TPE 001** Course Title: **Antenna & Wave Propagation**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 3
6. Semester:
7. Subject Area: **Program Elective**
8. Pre-requisite: **Communication System, EMFT**

9. **Course Outcomes:**	• Understanding the concept of radiation. • Evaluation of fundamental parameters of antenna and different antenna characteristics. • Analysis of uniform and non-uniform antenna array • Designing of microstrip patch antenna • Understanding the concept of wave propagation through free space • Successful completion of this course will be helpful in designing antenna for different application.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Radiation Fundamentals:** Potential theory, Helmholtz integrals, Radiation from a current element, Basic antenna parameters, Radiation field of an arbitrary current distribution, Small loop antennas**.**	8
2	**Receiving Antenna:** Reciprocity relations, Receiving cross section, and its relation to gain, Reception of completely polarized waves, Linear antennas, Current distribution, Radiation field of a thin dipole, Folded dipole, Feeding methods, Radiation from helical antenna.	10
3	**Antenna Arrays:** Array factorization. Array parameters. Broad side and end fire arrays. Yagi-Uda arrays Log-periodic arrays, Broadband antennas, helical antenna, spiral antenna.	8
4	**Aperture Antennas:**	8

	Fields as sources of radiation, Horn antennas, Babinet's principle, Parabolic reflector antenna, Feeding systems, Microstrip antennas, metamaterial antenna.	
5	**Wave Propagation:** Propagation in free space, Propagation around the earth, surface wave propagation, structure of the ionosphere, propagation of plane waves in ionized medium, Determination of critical frequency, MUF, Fading, troposphere propagation, Super refraction.	8
	Total	**42**

11. **Suggested Books:**

SL. No.	**Name of Authors/Books/Publishers**	**Year of Publication/Reprint**
	Text Books	
1.	Antennas: J.D. Kraus, TMH, 4th edition, TMH Publication	2017
2.	Antenna analysis & Design: C.A. Balanis, John Wiley, 3rd edition	2016
3.	Antennas and Radio Wave Propagation: R.E. Collin, McGraw–Hill, 1st edition	2013
	Reference Books	
1.	Antennas and Wave Propagation, A R Harish and M Sachidananda, 1st Ed., Oxford Publication	2007
2.	Structure and Applications of Microstrip Antennas, Joe Myers, Clanrye International Publication	2015

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **TPE 002** Course Title: **Optical Fiber Communication**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 3
6. Semester:
7. Subject Area: **Program Elective**

8. Pre-requisite: **Communication System**

9**. Course Outcomes:**	• Understanding Block diagram and different types of optical waveguides and merits of OFC, types and propagation mechanism. • Analysis of attenuation, losses and polarization for different types of optical fiber. • Analysing different optical transmitter sources. • Understanding genesis of optical detectors with noise considerations. • Analysis of optical fiber link by integrating optical transmitter and receiver circuits with application in multiplexing and optical networking. • Successful completion of this course enables students to apply concepts of optical communication to build optical networks.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Introduction:** Block diagram of optical fiber communication system, Advantages of optical fiber communication, Optical fiber waveguides: Structure of optical wave guide, Step Index fiber, Graded Index Fiber, Single mode, Multimode, light propagation in optical fiber using ray theory, acceptance angle, numerical aperture, skew rays, wave theory for optical propagation, modes in a planar and cylindrical guide, mode volume, single mode fibers, cutoff wavelength, mode field diameter, effective refractive index and group and mode delay factor for single mode fiber.	10
2	**Attenuation in optical fibers:** Intrinsic and extrinsic absorption, linear and nonlinear scattering losses, fiber bend losses. Dispersion and pulse broadening, intramodal and intermodal dispersion for step and graded index fibers, modal	12

	noise, over all fiber dispersion for multimode and monomode fiber, modal birefringence and polarization maintaining fibers.	
3	**Optical Sources:** LED structures and Characteristics, LASER, Nd:YAG LASER, He Ne Laser, CO_2 Laser, Distributed Feedback Laser.	8
4	**Optical detectors:** Requirement for photo detections p-n photodiode, characteristics of photo detections, p-i-n and avalanche photodiodes, phototransistors & photoconductors. Direct detection receivers. Performance considerations: Noise sources in optical fiber communication, noise in p-n, p-i-n and APD receivers.	6
5	**Receiver structure Optical fiber communication systems:** Principal components of an optical fiber communication system, optical transmitter circuits, LED and laser drive circuits, optical receiver block diagram, simple circuits for pre-amplifier, automatic gain control and equalization, optical system design, Multiplexing, Coherent and non-coherent detection, WDM, OTDM, Introduction to Optical Network.	6
	Total	**42**

11. **Suggested Books:**

SL. No.	**Name of Authors/Books/Publishers**	**Year of Publication/Reprint**
	Text Books	
1.	Optical fiber Communication: John M.S Senior PHI, 3rd Ed.	2009
	Reference Books	
1.	Optical Communication: J. Gowar PHI, 2nd Ed	2002
2.	Optical fiber Communication: G.E. Keiser Mc Graw-Hill, 4rd Ed.	2010
3.	Optoelectronics: Wilson & Hawkes PHI, 3rd Ed.	2001

12.	**Mode of Evaluation.**	Viva / Quiz / Mid Term Lab Exam / End Term Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TPE 003** Course Title: **High Speed Communication Circuits**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester:
7. Subject Area: **Program Elective**
8. Pre-requisite: **Electronics Devices and Circuits, Analog Integrated Circuit, Communication System-I.**

9. **Course Outcomes:**	• Understanding the concept of RF design and different communication Transceiver modules. • Understanding of LNA, Mixer and Converters. • Analysis of power amplifiers and modulation of power amplifiers • Implementation of circuits for modulation and demodulation of AM and FM • Analyse the application of frequency synthesizers • Successful completion of this course enables students to design and analyse various communication Transceiver modules and design of LNA Mixer and Frequency synthesizers.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Noise in Communication subsystems:** Internal and external noise, noise performance**,** high frequency amplifier design, shunt – series amplifier, bandwidth enhancement, neutralization and unilateralization, cascaded amplifiers.	8
2	**LNA Design:** Problem of input matching, LNA topologies, LNA with resistive load and complete LNA design, Mixer design: Mixer noise figure, design of passive and active up-conversion, design of passive and active down conversion.	10
3	**RF Power Amplifiers:** Design of class A, B, AB, C, D, E and F power amplifiers, modulation of power amplifiers.	10

4	**Modulators and Demodulators:** Circuits for generation and detection of AM, DSBSC, SSBSC, FM and FSK signal, PLL application, AGC circuits.	10
5	**Frequency synthesizers:** Coherent synthesizers using PLL, direct digital synthesis, phase noise in oscillators.	8
	Total	**46**

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	J. Smith, Modern Communication Circuits (2/e), McGraw – Hill	1998
	Reference Books	
1.	T. H. Lee, The Design of CMOS Radio – Frequency Integrated Circuits (2/e), Cambridge.	2004
2.	J. S. Beasley & G. M. Miller, Modern Electronic Communication (9/e), Pearson.	2004
3.	T.L. Floyd, Electronic Devices, (7/e), Pearson.	2007

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TPE 004** Course Title: **Digital System using Verilog**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 3
6. Semester:
7. Subject Area: **Program Elective**
8. Pre-requisite:

9. **Course Outcomes:**	• Understanding the basic concept of data types, system tasks and compiler directives. • Analysis of Verilog modules and ports, along with the different types of modeling. • Understanding the concept of tasks and function along with timing and delays • Understanding the concept of Switch-Level Modeling, User-Defined Primitives**.** • Designing the concept of test benches and object-oriented programming. • Successful completion of this course enables the designing of digital circuits in hardware descriptive language.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Basic Concepts:** Lexical conventions, Data types, System tasks and compiler directives. **Modules and ports:** Modules, Ports, Hierarchical Names. **Gate-Level Modeling:** Gate types, Gate delays.	8
2	**Dataflow Modeling:** Continuous Assignments, Delays, Expressions, operators, and Operands. Operator types, Examples. **Behavioral Modeling:**	10

	Structured Procedures, Procedural Assignments, Timing Controls, Conditional Statements, Multiway Branching, Loops, Sequential and Parallel blocks, Generate Blocks, Examples.	
3	**Task and Functions:** Differences between Tasks and Functions, Tasks, Functions. **Useful Modeling Techniques:** Procedural Continuous Assignments, Overriding Parameters, Conditional Compilation and Execution.	8
4	**Switch-Level Modeling:** Switch-Modeling Elements, Examples. **User-Defined Primitives:** UDP basics, Combinational UDPs, Sequential UDPs, UDP Table shorthand symbols, Guidelines for UDP Design.	8
5	**Writing Test benches:** Basic test benches, test bench structure, constrained random stimulus generation, object-oriented programming, and Assertion-based verification.	8
	Total	**42**

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/ Reprint
	Text Books	
1.	Samir Palnitkar, Verilog HDL 2/e, Pearson Education.	2004
2.	Mark Zwolinski, Digital System Design with System Verilog 1/e, Pearson Education.	2010
	Reference Books	
1.	J.bhasker, Verilog Synthesis Primer 1/e, B.S.Publications.	1998
2.	J.bhasker, Verilog HDL Primer 3/e, Pearson Education.	2005
3.	M.Ciletti, Advanced Digital Design with Verilog HDL 2/e, Pearson Education.	2010

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TPE 005** Course Title: **Digital Image Processing**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 3
6. Semester:
7. Subject Area: **Program Elective**
8. Pre-requisite: **Signals and Systems, Digital Signal Processing**

9. **Course Objectives:**	• Understanding the basics of images formation • Analyse the different image transformation technique • Understand the image restoration and reconstruction • Implementation of morphological operation • Analysis of different image segmentation techniques • On the completion of the course student will be able to design their own algorithm for image processing

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Introduction to the Digital Image Processing**: Areas and Applications, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationships between Pixels: Neighborhoods, Adjacency and Distances.	8
2	**Image Enhancement**: Intensity Transformations, Histogram modeling; equalization and modification, Spatial Filtering: Smoothing Spatial Filters and Sharpening Spatial Filters, Image Smoothing Using Frequency Domain Filters.	8
3	**Image Restoration and Reconstruction**:	8

	Model of the Image Degradation/Restoration Process, Noise Models, Restoration by Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering.	
4	**Morphological Image Processing**: Erosion and Dilation, Duality, Opening and Closing, the Hit-or-Miss Transformation, Boundary Extraction, Hole Filling, Extraction of Connected Components.	8
5	**Image Segmentation, Representation and Description**: Detection of Isolated Points, Line Detection, Edge Models, Edge Detection, Thresholding, Region-Based Segmentation, Chain Codes, Shape Numbers, Fourier Descriptors, and Statistical Moments.	8
	Total	**40**

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Rafael C. Gonzalez, Richard E. Woods, ``Digital Image Processing,'' 3rd Edition, Prentice Hall; ISBN: 013168728X;	2007
2.	Al Bovik editor, Handbook of Image & Video Processing, ISBN 0-12-119790-5, Academic Press, San Diego.	2000
	Reference Books	
1.	Rafael C. Gonzalez, Richard E. Woods, and S. L. Eddins, ``Digital Image Processing Using MATLAB,'' Prentice Hall, ISBN 0130085197	2004
2.	Anil K. Jain, ``Fundamentals of digital image processing,'' Englewood Cliffs, NJ : Prentice Hall	1989

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TPE 006** Course Title: **Telecommunication Switching**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester:
7. Subject Area: **Program Elective**
8. Pre-requisite: **Communication System-II, Data Communication & Networking.**

9. **Course Outcomes:**	• Understanding of modern telecommunication network and its heterogeneous switching • Analysis of Single stage and Multistage switch networks & single and dual processor systems • Applying the concepts of traffic engineering to telecommunication network. • Understanding genesis of digitization of telecommunication network-ISDN • Analysis of design of integration of circuit switched network with packet switched network. • Successful completion of this course enables students to apply concepts of network engineering and traffic engineering to telecommunication network.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Introduction:** Evolution of public switched telecommunication, Simple telephone communication, Basic of switching system, Concept of Strowger and crossbar switching.	6
2	**Electronic Space Division Switching:** Stored program control, Centralized and distributed SPC, Software architecture, Application software, Enhanced software, Two and three stage networks. **Time Division Switching:**	12

	Sampling, quantization, encoding, basic time division space switching, Basic time division time switching, Time multiplexed space and time switching, Combination switching.	
3	**Traffic Engineering:** Network traffic load and parameters, Grade of service, Modeling Switching, Incoming traffic, Common channel signaling, SS7 signaling protocols. **Telephone Networks:** Subscriber loop system, Switching hierarchy and routing, Transmission plan, Transmission system, Signaling techniques.	**10**
4	**Integrated Digital Network:** Digital multiplexing techniques-(Time division multiplexing, frequency division multiplexing), TDMA, FDMA and CDMA, Concept of ISDN, ISDN standards, Cellular mobile communication.	6
5	**Data Networks:** Data transmission in PSTN, Switching techniques, Data communication architecture, Link to link layers, end to end layers, OSI Architecture , satellite based data networks, LAN,MAN standards, TCP/IP, Internet, Principle of ATM networks.	**8**
	Total	**42**

11. **Suggested Books:**

SL. No.	**Name of Authors/Books/Publishers**	**Year of Publication/Reprint**
	Text Books	
1.	Thiagarajan Viswanathan, "Telecommunication switching systems and Networks '', Prentice hall of India LTD.	
2.	Forouzen, Data Communications and Networking, TMH.	
	Reference Books	
1.	Syed R. Ali, "Digital switching system", McGraw Hill Inc.	

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TPE 007** Course Title: **Semiconductor Devices and Modeling**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 3
6. Semester:
7. Subject Area: **Program Elective**
8. Pre-requisite: **Electronics devices & Circuit.**

9. **Course Outcomes**:	• Understanding the concept of semiconductor device physics. • Analyse the different models of MOSFET and its scaling. • Analysis of SOI devices and technology development in VLSI. • Understanding the simulation and SPICE modelling • Understanding the extraction of parameter of different semiconductor devices. Students will be able to analyse and design the different solid state devices. • On successful completion of this course, students will be able to analyse and model the different semiconductor devices

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Core Basic Device Physics:** Semiconductor Properties, Band Structure of Semiconductors, Two & Three Terminal MOS Structure, MOS System under External Bias, Four Terminal MOS Transistor: Structure and Operation, Threshold Voltage, MOSFET Current Voltage (I-V) Characteristics, Channel Length Modulation, Body Effect, Measurement of Parameters.	10
2	**MOSFET Models and Device Scaling:** MOSFET Models: DC, Small Signal, High Frequency and Noise Models of MOSFETS. MOS Capacitors. Short and Narrow Channel Effects, MOSFET Channel Mobility Model, DIBL, Charge Sharing and Other Non-Linear Effects, Device Scaling.	8
3	**SOI Devices :**	8

	Structure of SOI Devices, Advantage of SOI Devices, Partially Depleted and Fully Depleted SOI Devices, Fin-FET, and Recent Development in Microelectronics.	
4	**Simulation and SPICE Modeling:** Principle of Circuit Simulation and its Objectives, SPICE Modeling: SPICE MOSFET Models-Level 1, 2, 3 and 4 Models and their Comparison, Circuit Description, AC, DC, Transient, Noise, Temperature Extra Analysis, Semiconductor Diode, BJT Parameters.	8
5	**Modeling and Parameters Extraction:** JFET, MOSFETS and MESFETS: Modeling of JFET, MOSFET, MESFETS and Parameters Extraction. HBTS: Principles of Hetero-Junction Devices, HBTS, HEMT	8
	Total	**42**

11**. Suggested Books:**

SL. No.	**Name of Authors/Books/Publishers**	**Year of Publication/Reprint**
	Text Books	
1.	S. M. Sze, and K. K. Ng, *Physics of Semiconductor Devices*, 3rd Ed., Wiley-Interscience.	2006
2.	Tsividis, Yannis, and Colin McAndrew, *Operation and Modeling of the MOS Transistor*, Oxford: Oxford university press, Vol. 2.	1999
	Reference Books	
1.	M. H. Rashid, Introduction to PSPICE using OrCAD for circuits and electronics, PHI, Ed. 2008	2008
2.	N. Arora, MOSFET Models for VLSI Circuit Simulation: Theory and Practice, 4th Ed., Springer-Verilog. 1993	1993

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TPE 008** Course Title: **Neural Networks and Machine**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester:
7. Subject Area: **Program Elective**
8. Pre-requisite: **Basic probability theory and basic linear algebra**

9. **Course Outcomes:**	• Understanding the basics of Neural Network and its parameters. • Analyse the feed forward network and its implementation • Understanding the concept of pattern analysis and implementation of support vector machine • Analyses of self-organizing map and pattern clustering. • Understanding different feedback network such as Hopfield, Boltzmann machine. • Student will be able to develop the neural network for their specific problems

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Introduction to Artificial Neural Networks**: Biological Neural Networks, ANN Application Overview, Pattern Analysis Tasks: Classification, Regression and Clustering, Computational Models of Neurons, Structures of Neural Networks, Learning Principles, Supervised, Unsupervised and Reinforcement Learning. **Linear Models of Learning and Classification**: Polynomial Curve Fitting, Bayesian Curve Fitting, Linear Basis Function Models, Bias-variance decomposition, Bayesian Linear Regression, Least Squares for Classification, Logistic Regression for Classification, Bayesian Logistic Regression for Classification.	12
2	**Feed Forward Neural Networks**: Pattern Classification using Perceptron, Multilayer Feed forward Neural Networks (MLFNNs), Pattern Classification using MLFNNs, Error and Back Propagation Learning, Fast Learning Methods: Conjugate Gradient Method, Auto-associative Neural Networks, Bayesian Neural Networks.	8

3	**Radial Basis Function Networks**: Regularization Theory, RBF networks for Function approximation, RBF networks for pattern classification. **Kernel Methods for Pattern Analysis**: Statistical Learning Theory, Support Vector Machines for Pattern Classification, Support Vector Regression for Function Approximation, Relevance Vector Machines for Classification and Regression.	8
4	**Self Organizing Maps**: Pattern Clustering, Topological mapping, Kohonen's Self Organizing Map, Competitive Learning, Learning Vector Quantizers, Counter Propagation Networks, Adaptive Resonance Theory(ART).	6
5	**Feedback Neural Networks**: Pattern Storage and Retrieval, Hopfield Model, Boltzmann Machine, Recurrent Neural Networks. **Applications of Neural Networks and Machine Learning**: Case Studies.	6
	Total	**40**

11**. Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	B. Yegnanarayana, Artificial Neural Networks, Prentice Hall of India.	2009
2.	Satish Kumar, Neural Networks – A Classroom Approach, Tata McGraw-Hill.	2004
	Reference Books	
1.	S. Haykin, Neural Networks – A Comprehensive Foundation, Prentice Hall, 2E	1999
2.	C.M. Bishop, Pattern Recognition and Machine Learning, Springer, 2E	2011

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TPE 009** Course Title: **Mobile Ad hoc Networks**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 3
6. Semester:
7. Subject Area: **Program Elective**
8. Pre-requisite: **Wireless Communication & Data Communication & Networking**

9. **Course Objectives:**	• Learning the concept of adhoc wireless networking,802.11(Wi-Fi), 802.16 (Wi-Max) Bluetooth, IrDA, RF home , design and operation of adhoc network, their design issues and available solution • Understanding of MAC layer protocols and design issues of MAC protocols. • Implementation of proactive, reactive and hybrid routing protocols and routing mechanism • Analysis of energy management in adhoc network • Analysis of Security attacks and QoS provisioning in adhoc network • Successful completion of this course enables students to be familiar with infrastructure less network, design and, implementation, MAC protocols, routing protocols, energy management, security attacks and QoS in adhoc network

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Introduction:** Ad hoc Networking: An Introduction. Model of operation, Symmetric links, Fundamental of wireless networks, Bluetooth, IrDA, Comparison of Bluetooth and IrDA, Home RF, 802.11(Wi-Fi), 802.16(Wi-Max), Hotspot, Difference between cellular and ad hoc networks, Technical and research challenges. DoD perspective.	8

2	**MAC Layer Protocols for Ad hoc wireless Networks:** Need for Medium Access Control(MAC) Protocols, Issues and design goals of MAC protocols, Classification of MAC protocols: Contention Based Mac protocols, Contention Based Mac protocols with reservation mechanism, Multiple Access Collision Avoidance (MACA), Media Access Protocol for wireless (MACAW), Floor Acquisition Multiple Access Protocols (FAMA), Busy Tone Multiple Access Protocols (BTMA), Multiple Access Collision Avoidance – by Invitation(MACA-BI), Dual Busy Tone Multiple Access Protocols (DBTMA), Multichannel Carrier sense Multiple access (CSMA) MAC Protocol.	10
3	**Routing Protocols:** Design Issues of Routing Protocols, Ideal characteristics of Routing, Classification of Routing Protocols: Proactive, Reactive, Hybrid. Overview of DSDV (Destination Sequenced Distance Vector) Routing protocol, Link state, Distance vector, DSDV Properties and its Merits demerits, Damping Fluctuations. Clustering, Hierarchical Routing. Overview of DSR (Dynamic Source Routing) Protocols: DSR Properties, Additional Route Discovery and Maintenance Features. Overview of AODV (Ad Hoc On Demand Distance vector) Protocols, Unicasting, Multicasting, Unicast Route Establishment, Multicasting Route Establishment, Expanding Ring Search. Overview of ZRP (Zone Routing Protocol), Reconfigurable Wireless Networks, Intrazone, Interzone Routing Protocols. Overview of OLSR (Optimized Link State Routing) Protocol, Multipoint Relays (MPRs), Protocol Functioning, Core Functioning.	12
4	**Energy management** Energy management System in Ad Hoc networks, Power Issues, Smart Batteries, and Associatively based Routing, Effects of Beaconing of Battery Life, Maximum life Time Routing.	5
5	**Network Security Attacks and Quality of Service** Security in Ad Hoc wireless networks, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks. QoS in Ad Hoc wireless networks, Issues and Challenges, Classification of QoS solutions. Wireless Sensor Networks, Issues and Challenges, Sensor Network Architecture, Flooding Gossiping, **Rumor** Routing, Quality of Sensor Networks, Evolving Standards.	7
	Total	**42**

11. **Suggested Books**:

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Perkins, C., '*Ad Hoc Networking*', Addison Wesley.	2000

2.	Murthy, C. Siva Ram, and Manoj, B. S., '*Ad Hoc Wireless Networks Architecture and Protocols*', Pearson Education 2nd Edition.	2004
	Reference Books	
1.	Basagni, S. And Conti M., '*Mobile Ad Hoc Networking*', Wiley,	2004

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TPE 010** Course Title: **Radar and Navigation Aids**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 3
6. Semester:
7. Subject Area: **Program Elective**
8. Pre-requisite: **Wireless Communication**

9. **Course Outcomes:**	• Understanding the concept RADAR and its application. • Analyse MTI and Pulsed Doppler radar. • Analysis of detection of signal and noise in it. • Understanding the concept of navigation. • Analysis of Doppler navigation system and its accuracy. • Students will be able to analyse different radar systems.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Introduction to Radar Basics:** The simple form of the Radar Equation, Radar Block Diagram, Radar Frequencies, Applications of Radar, Detection of Signals in Noise, Receiver Noise and the Signal-to-Noise Ratio, Probability Density Functions, Probabilities of detection and False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets, Radar cross Section Fluctuations, Transmitter Power, Pulse Repetition Frequency, Antenna Parameters, System losses.	8
2	**MTI and Pulse Doppler Radar:** Introduction to Doppler and MTI Radar, Delay Line Cancelers, Staggered Pulse Repetition Frequencies, Moving Target Detector, Limitations to MTI Performance, Pulse Doppler Radar, Doppler Filters, Tracking with Radar, Monopulse Tracking, Conical Scan, Sequential Lobing, Tracking in Range.	9
3	**Radar Transmission and Detection of Signals in Noise :** Radar Transmitters, Linear Beam Power Tubes, Solid State RF Power Sources, Magnetron, Crossed Field Amplifiers. The Radar Receiver, Receiver noise Figure, Super heterodyne Receiver,	8

	Duplexers and Receiver Protectors, Matched Filter Receiver, Detection Criteria, Detectors, Automatic Detector, Constant False Alarm Rate Receivers, Propagation of Waves, Atmospheric Refraction, Standard propagation, Nonstandard Propagation, Radar Clutter, land and sea clutter, Detection of target in precipitation, The Radar Antenna, Reflector Antennas, Electronically Steered Phased Array Antennas, Phase Shifters, Frequency-Scan Arrays.	
4	**Introduction to Navigation:** Radio Direction Finding, The Loop Antenna, Loop Input/output Circuits, An Aural Null Direction Finder, The Goniometer, Errors in Direction Finding, Adcock Direction Finder, Automatic Direction Finders, The Commutated Aerial Direction Finder, Range and Accuracy of Direction Finders, The LF/MF Four course Radio Range, VHF Omni Directional Range Finder (VOR), VOR Receive ring Equipment, Range and Accuracy of VOR.	8
5	**Distance Measuring Equipment (DME) and Tactical Air Navigation (TACAN):** Operation of DME and TACAN, Instrument Landing System, Ground Controlled Approach System, Microwave Landing System (MLS), Doppler Navigation, Beam Configurations, Track Stabilization, Doppler Spectrum, Components of the Doppler Navigation System, Accuracy of Doppler Navigation Systems, Inertial Navigation, Principles of Operation, Navigation Over the Earth, Components of an Inertial Navigation System, Earth Coordinate Mechanization, Strapped-Down Systems, Accuracy of Inertial Navigation Systems, Global Positioning System (GPS).	9
	Total	**42**

11. **Suggested Books**:

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Merrill I. Skolnik ," Introduction to Radar Systems", Tata McGraw-Hill (3rd Edition)	2003
2.	Nagaraja N. S., "Elements of Electronics Navigation " Tata McGraw-Hill (2nd Edition)	2017
	Reference Books	
1.	Peyton Z. Peebles:, "Radar Principles", John wiley.	2004
2.	J.C Toomay, “Principles of Radar", 2nd Edition –PHI.	2004

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TPE 011** Course Title: **Digital Video Processing**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester:
7. Subject Area: **Program Elective**
8. Pre-requisite:

9. **Course Objectives:**	• Understanding the concept of colour video system. • Analysis the motion estimation technique and various block matching algorithm. • Analysis of various video coding schemes • Understanding the content dependent video coding. • Understanding the object based video coding. • Students will be able to analyse and design various video coding algorithms.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Introduction to Video Processing**: Principles of Color Video system, Video Display, Composite versus Component Video, Progressive and Interlaced Scan, Sampling of Video Signals, DVI technology.	8
2	**Motion Estimation Techniques**: General Methodologies, Pixel based Motion Estimation, Block Matching Algorithm, Deformable Block Matching Algorithm, Mesh Based Motion Estimation, Global Motion Estimation, Region Based Motion Estimation, Multi-resolution Motion Estimation, and Feature Based Motion Estimation.	8
3	**Basic of Video Coding**: Categorization of Video Coding Schemes, Information Theory for Source Coding, Binary Encoding, Scalar Quantization, Vector Quantization, Wave form based Coding, Block-based Transform Coding, Predictive Coding, Temporal Prediction and Transform Coding.	8

4	**Content dependent Video Coding**: Two Dimensional Shape Coding, Texture Coding for Arbitrarily Shaped Region, Joint Shape and Texture Coding, Region Based Video Coding.	8
5	**Object based Video Coding:** Knowledge based Video Coding, Semantic Video Coding, Layered Coding System **Video Compression Standard:** standards, H.261 Family of Standards.	8
	Total	**40**

11. **Suggested Books**:

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Y. Wang, J. Ostermann, and Y.Q.Zhang, Video Processing and Communications, Prentice Hall.	2002
	Reference Books	
1	M. Tekalp ,"Digital video Processing", Prentice Hall International	

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TPE 012** Course Title: **Electromagnetic Interference and Compatibility**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 3
6. Semester:
7. Subject Area: **Program Elective**
8. Pre-requisite: **Communication System, EMFT & Antenna and wave propagation.**

9. **Course Outcomes:**	• Understanding the concept electromagnetic interference. • Analysing the measurement techniques of electromagnetic interference. • Understanding the EMC standards. • Understanding EMI control and filtering. • Analysis of EMC design and interconnection. • Students will be able to analyse EMC techniques.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Basic Concept:** Definition of EMI and EMC, Classification of EMI/EMC - CE, RE, CS, RS, Units of Parameters, Sources of EMI, EMI coupling modes - CM and DM, ESD Phenomena and effects, Transient phenomena and suppression.	8
2	**EMI Measurement:** Basic principles of RE, CE, RS and CS measurements, EMI measuring instruments- Antennas, LISN, Feed through capacitor, current probe, EMC analyzer and detection technique open area site, shielded anechoic chamber, TEM cell.	8
3	**EMC Standard and Regularization:** National and Intentional standardizing organizations, FCC, CISPR, ANSI, DOD, IEC, CENEEC, FCC CE and RE standards, CISPR, CE and RE Standards, IEC/EN, CS standards, Frequency assignment - spectrum conversation.	8
4	**EMI Control and Method Fixes:** Shielding, Grounding, Bonding, Filtering, EMI gasket, Isolation transformer, Opto-isolator.	8

5	**EMC Design and Interconnection Technique:** Cable routing and connection, Component selection and mounting, PCB design- Trace routing, Impedance control, decoupling, Zoning and grounding	8
	Total	**40**

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Prasad Kodali.V – Engineering Electromagnetic Compatibility – S. Chand & Co – New Delhi.	2000
2.	Clayton R.Paul – Introduction to Electromagnetic compatibility – Wiley & Sons .	1992
	Reference Books	
1.	Keiser – Principles of Electromagnetic Compatibility – Artech House – 3rd Edition –	1994
2.	Donwhite Consultant Incorporate – Handbook of EMI / EMC – Vol I.	1985

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TPE 013** Course Title: **Satellite Communication**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester:
7. Subject Area: **Program Elective**
8. Pre-requisite: **Communication System-I, Communication System-II, Wireless Communication.**

9. **Course Outcomes:**	• Understanding of basic concepts of satellite communication orbital mechanism and launch vehicle analysis • Analysis of satellite and earth station architecture, technologies used for specific applications • Satellite link design and analysis for optimum link performance • implementation of modulation and coding schemes for a given satellite communication link design • Implementation of knowledge in the development of prototype satellite communication link for given specifications • Learning of various satellite systems - worldwide and Indian scenario

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Overview of Satellite Systems, Orbits and Launching Methods:** General features, frequency allocation, properties of satellite communication systems, LEO, MEO and GEO orbits, Kepler's laws, orbital dynamics, orbital elements, Sub-satellite point, orbital perturbations, orbital effects on communication system performance. Launching and positioning of satellite. Antenna look angle determination, Sub-satellite point, limits of visibility.	8
2	**Space Segment (satellite subsystems) and Earth Station:** Attitude and orbit control system; Telemetry, tracking, command and monitoring (TTC & M); communication subsystems, antenna	9

	subsystem, power system, equipment reliability and space qualification. Different types of earth stations.	
3	**Satellite Link Design:** Basic transmission theory, General link design equation, system noise temperature, uplink/down link design, C/N ratio, saturation flux density, input/output back off, Effect of rain (attenuation and depolarization).	12
4	**Satellite Multiple Access Techniques:** Multiplexing and multiple access, Preassigned, demand assigned multiple access, FDMA- bandwidth-limited and power limited TWT amplifier operation; TDMA- TDMA frame structure, frame efficiency, Comparison of uplink power requirements for FDMA and TDMA. CDMA- Direct-sequence spread spectrum, m-sequence codes, spectrum spreading and dispreading	8
5	**Introduction of various Satellite systems:** VSAT systems, DBS, DTH; LEO and non-Geosystems- RADARSAT, IRIDIUM, INMARSAT, ORBCOMM, Global Positioning System (GPS), IRNSS	5
	Total	42

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books:	
1.	Satellite Communications/ Pratt, Bostian/ John Wiley & Sons.	2003
2.	Satellite Communications/ Dennis Roddy/ McGraw-Hill.	2010
3.	Digital Satellite Communications/ Tri T. Ha./McGraw Hill.	2009

12.	**Mode of Evaluation**	Viva / Quiz / Mid Term Lab Exam / End Term Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TPE 014** Course Title: **Testing of VLSI Circuits**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester:
7. Subject Area: **Program Elective**
8. Pre-requisite

9. **Course Outcomes:**	• Understanding the role of testing of digital and analog VLSI circuit • Analysis of SCOAP controllability and observability • Understanding memory density and defect trends • Understanding fundamental technique of logic testing • Analysis of embedded core testing. • Students will be able to analyse testing techniques of various VLSI circuits.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Introduction:** Role of Testing, Digital and Analog VLSI Testing, VLSI Technology Trends Affecting Testing. **Fault Molding:** Defects, Errors, and Faults, Functional Versus Structural Testing, Levels of Fault Models, A Glossary of Fault Models, Single Stuck-at Fault. **Logic and Fault Simulation:** Simulation for Design Verification, Simulation for Test Evaluation, Modeling Circuits for Simulation	9
2	**Testability Measures:** SCOAP Controllability and Observability, High-Level Testability Measures. **Combinational Circuit Test Generation:** Algorithms and Representations, Redundancy Identification (RID), Testing as a Global Problem , Definitions, Test Generation Systems,	8

	Test Compaction, Significant Combinational ATPG Algorithms and sequential circuit test generation.	
3	**Memory Test:** Memory Density and Defect Trends, Faults, Memory Test Levels, March Test Notation, Fault Modeling, Memory Testing. Analog and Mixed Signal Test, Delay Test and IDDQ test.	9
4	**Fundamental Techniques for Logic Testing:** Design For Test fundamentals, ATPQ fundamental, scan architecture and technique.	8
5	**Embedded Core Test Fundamentals:** Introduction to Embedded Core Testing, Core, Core-Based Design, Core DFT Development, Chip Design with a Core, User Defined Logic Chip-Level DFT Concerns, Memory Testing with BIST.	8
	Total	**42**

11**. Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Viswani D. Agarval Michael L. Bushnell, *Essentials of electronic testing for digital memory & mixed signal VLSI circuit*, Kluwer Academic Publications.	1999
2.	Alfred L. Crouch, *Design for test for digital IC's and embedded core systems*, PHI.	1999
	Reference Books	
1.	Parag. K. Lala, *Digital circuit testing and testability*, Academic Press.	1997

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TPE 015** Course Title: **Wireless Sensor Networks**
2. Contact Hours: **L:** 3 **T**: 0 **P**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CWS** 25 **PRS** 0 **MTE** **ETE** **PRE** 0
5. Credits: 3
6. Semester:
7. Subject Area: **Program Elective**
8. Pre-requisite: **Wireless communication, Data Communication & Networking.**

9. **Course Outcomes:**	• Understanding the basic concepts and applications of wireless sensor networks (WSN). • Learning technologies for WSN. • Analyzing different routing protocols of WSN. • Analyzing dissemination protocols of WSN. • Understanding and analyzing design principles of wireless sensor network. • After the completion of this course the student will be able to carry out research work in the area of WSN.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks	7
2	Classification of WSNs Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks	8
3	Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee,	9
4	Dissemination protocol for large sensor network. Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.	8

5	Design Principles for WSNs, Gateway Concepts & Need for gateway, WSN to Internet Communication, and Internet to WSN Communication. Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC.	10
	Total	**42**

11. **Suggested Books:**

SL. No.	**Name of Authors/Books/Publishers**	**Year of Publication/Reprint**
	Text Books	
1.	Wireless Sensor Networks: F. ZHAO, C GUIBAS, Elsevier, Morgan Kaufmann, 2004 .	2004
2.	Hand book of Sensor Networks, MOHAMMAD ILYAS, IMAD MAHGOUB, CRC Press.	2005
	Reference Books	
1.	KAZEM SOHRABY DANIEL MINOLI TAIEB ZNATI : Wireless sensor networks Technology, Protocols, and Applications, A John Wiley and sons, INC Publication.	2007
2.	Jun Zheng, Abbas Jamalipour :Wireless Sensor Networks: A Networking Perspective, A John Wiley and sons, INC Publication.	2009

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TPE 016** Course Title: **CMOS Analog Circuit Design**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester:
7. Subject Area: **Program Elective**
8. Pre-requisite: **Electronic Devices and Circuits**

9. **Course Outcome:**	• Understanding the characteristics and parameters of MOS transistor. • Extraction of performance parameters for common source amplifier with different load conditions. • Understanding the characteristics of differential amplifier and operational amplifier. • Designing and analysis of current mirrors using MOS transistor. • Determination of frequency response for CS amplifier and feedback configurations. • Successful completion of this course will bring forward several aspects of designing CMOS analog circuits.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**MOS structure and operation:** Threshold voltage, current voltage characteristics, second order effects, MOS device capacitance, DC and small signal models of MOS transistor.	8
2	**Single-stage Amplifier:** Common source stage with Resistive Load, CS stage with diode connected load, CS stage with current source load, CS stage with source degeneration, source follower and common gate configuration.	10
3	**Differential Amplifier:** Single ended and differential operation, Basic differential pair, common mode response, Operational Amplifier: General considerations, one stage op-amp and two stage op-amp, introduction to low power amplifier.	8

4	**Current Mirrors:** Simple current mirror, cascode current mirror, Frequency response of Single stage Amplifier: Common Source stage, Source follower, Common Gate stage.	8
5	**Feedback:** General consideration, properties of feedback circuits, feedback configuration. **Switched capacitor:** MOS as a switch, Unity gain buffer.	8
	Total	**42**

11. **Suggested Books:**

SL. No.	**Name of Authors/Books/Publishers**	**Year of Publication/Reprint**
	Text Books	
1.	B. Razavi, Design of analog CMOS integrated circuits, McGraw-Hill Edition.	2001
2.	Paul R. Gray and R. G. Meyer, Analysis and design of analog integrated circuits John Wiley and Sons, USA, (4th Edition).	2001
	Reference Books	
1.	Mohammed Ismail and Terri Faiz, Analog VLSI signal and information process, McGraw-Hill Book Company.	2001

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA UNIVERSITY DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TPE 017** Course Title: **Probability and Stochastic Processes**
2. Contact Hours: **L**: **3** **T**: **0** **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: **3**
6. Semester:
7. Subject Area: **Program Elective**
8. Pre-requisite: **Engineering Mathematics**

9. **Course Outcomes:**	• Understanding the basic concepts of Random Variable & Random Processes. • Analysis of various probability distribution functions. • Analysis of operation of two random variables. • Understanding and analyzing the measurement of correlation functions. • Analysis of PSD & autocorrelation function. • After the completion of this course the student will be able to carry out research work in the area Wireless Communications.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Introduction to Theory of Probability:** Axioms of Probability, Review of set theory, Joint & conditional probability, Independent events, Combined Experiments.	6
2	**Random variables and random vectors:** Distributions and densities. Some useful probability distributions (Uniform, Gaussian, Exponential, Gamma, Rayleigh, Rician**,** Binomial, Poisson), Conditional distribution & density function, Functions of one RV, Statistical independence. Operations on One Random Variable - Expectations, moments, Chebycheff inequality, Characteristic functions and moment generating functions.	10
3	**Functions of two Random Variables:** Operation on Two random variables, correlation, covariance, vector space of random variables, Multiple random variables, operation on multiple random variable, central limit theorem, Infinite sequences of	10

	random variables. Convergence concepts. Laws of large numbers, Tchebycheffinequality and estimation of unknown parameters.	
4	**Stochastic processes:** Stationarity& independence, Stationarity in the strict and wide senses, Ergodicity, Widesense stationary processes.Correlation functions & their properties, Gaussian random process, Covariance functions and their properties, Measurement of correlation functions.	10
5	**Spectral characteristic of random process:** Power spectral density &their properties, relation between PSD & autocorrelation function, Wiener-Khintchine relations, cross power spectrum density and its properties.	6
	Total	**42**

11**. Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Peyton Z. Peebles, Probability, random variable, and random signal principle, 4th Edition, McGraw-Hill.	2001
2.	Athanasios Papoulis, S. UnnikrishnaPillai, "Probability, Random Variables and Stochastic Processes," 4th Edition, McGraw-Hill.	2002
	Reference Books	
1.	R.B.Ash&C.DoleansDade, Probability and Measure Theory (2/e), Elsevier, 2005	2005
2.	E.Wong&B.Hajek, Stochastic Processes in Engineering systems, Springer.	1985
3	R.B.Ash and W.A.Gardner, Topics in stochastic processes, Academic Press.	1975

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **TPE 018** Course Title: **Speech Processing**
2. Contact Hours: **L**: **3** **T**: **0** **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: **3**
6. Semester:
7. Subject Area: **Program Elective**
8. Pre-requisite: **Digital Signal processing**

9. **Course Outcomes:**	• Understanding the basic concepts of speech production. • Analysis of predictive coding. • Understanding of homomorphic systems. • Analysis of speech enhancement techniques. • Analysis of several statistical model for speech recognition. • After the completion of this course the student will be able to carry out research work in the area Smart Communications.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Fundamentals of the Speech Production mechanism and Digital Speech Processing:** Anatomy & Physiology of Speech Organs, The process of Speech Production, Acoustic phonetics, The Acoustic Theory of Speech Production, Lossless Tube models, Digital models for speech signals. Time Domain Models For Speech Processing: Introduction, Window considerations, Short time energy and average magnitude Short time average zero crossing rate, Speech vs. silence discrimination using energy and zero crossing, Pitch period estimation using a parallel processing approach, The short time autocorrelation function, The short time average magnitude difference function, Pitch period estimation using the autocorrelation function.	10
2	**Linear Predictive Coding (LPC):** Basic principles of Linear Predictive Analysis: The Autocorrelation Method, The Covariance Method, Solution of LPC Equations: Cholesky Decomposition Solution for Covariance Method, Durbin's	8

	Recursive Solution for the Autocorrelation Equations, Pitch Detection and using LPC Parameters.	
3	**Homomorphic Speech Processing:** Introduction, Homomorphic Systems for Convolution: Properties of the Complex Cepstrum, Computational Considerations, The Complex Cepstrum of Speech, Pitch Detection, Formant Estimation, Mel frequency cepstrum computation, Mel frequency cepstral co-efficients (MFCC) feature extraction.	8
4	**Speech Enhancement:** Nature of interfering sounds, Speech enhancement techniques: spectral subtraction, Enhancement by re-synthesis, Comb filter, Wiener filter.	6
5	**Statistical models for speech recognition:** Introduction to speaker recognition and speech recognition. Vector quantization model and Gaussian mixture model for speaker and speech recognition. Discrete and Continuous Hidden Markov modeling for isolated word and continuous speech recognition.	10
	Total	**42**

11. **Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Lawrence R. Rabiner, Ronald W. Schafer, Introduction to Digital Speech Processing, pearson.	2007
2.	Thomas F. Quatieri, Discrete-Time Speech Signal Processing: Principles And Practice, Pearson Education India	2002
	Reference Books	
1.	Sadaoki Furui, Digital Speech Processing: Synthesis, and Recognition, Second Edition	1995

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TGRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 359** itle: **Fundamentals of Computer Organization**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester: **Autumn**
7. Subject Area: **Core Course**
8. Pre-requisite: **Basic Electronics**

9. **Course Outcome:**	• Understanding the fundamental organization of computer system. • Understanding the addressing modes, instruction formats. • Understanding of Computer Arithmetic operations and algorithms. • Analysis of fundamental units of processor and control unit. • Understanding of memory organization, cache memory and paging. • Successful completion of this course will provide the foundation for the students to analyze the structure of computer system

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**INTRODUCTION:** Structure of a computer system, Functional components of a computer, Historical Development: First through Fourth Generation Computers, Moore's Law, The Von Neumann and Non von Neumann Model.	8
2	**MACHINE INSTRUCTIONS:** Memory location and addresses, Operands, addressing modes, Instruction formats, Instruction Sequencing, Addressing Modes, Execution of a complete Instruction, Instruction set architectures - CISC and RISC architectures.	8

3	**COMPUTER ARITHMETIC:** Addition and subtraction, Arithmetic circuit, multiplication Algorithms, Division Algorithms, Floating-point representation, floating point Arithmetic operations, BCD Adder.	8
4	**PROCESSING UNIT:** Organization of a processor - Registers, ALU and Control unit, Data path in a CPU, Instruction cycle, Organization of a control unit - Operations of a control unit, Hardwired control unit, Microprogrammed control unit.	8
5	**MEMORY SUBSYSTEM:** Semiconductor memories, Memory cells - SRAM and DRAM cells, Internal Organization of a memory chip, Cache memory unit - Concept of cache memory, Mapping methods, Organization of a cache memory unit, Effective Access Time and Hit Ratio, Virtual Memory, Paging, Advantages and Disadvantages of Paging.	10
	Total	**42**

11**. Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	William Stallings, *Computer Organization & Architecture*, PHI, 8th Edition.	2010
2.	Carl Hamacher, ZvonkoVranesic, SafwatZaky, *Computer Organization*, TMH, 5th Edition.	2002
	Reference Books	
1.	David A. Patterson, John L. Hennessy: "*Computer Organization and Design – The Hardware / Software Interface ARM Edition*", Elsevier, 4th Edition	2016
2.	John P. Hayes,*Computer Architecture and Organization*, TMH, 3rd Edition.	2012

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 491** Course Title: **Sensors and Signal Conditioning**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester: **Spring**
7. Subject Area: **Core Course**
8. Pre-requisite: **Basic Electronics**

9. **Course Outcome:**	• Understanding the basics of measurement system. • Analyzing different sensors based on their functionality. • Understanding sensors and signal conditioning system. • Analyzing op-amp based instrumentation. • Designing suitable signal conditioning circuits for sensors • Successful completion of this course will provide the foundation for the students to analyze signal condition system for different sensors.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Introduction to sensor bases Measurement System:** Sensor classification, Input-Output configuration: Interfering and modifying inputs, configuration techniques, Static characteristics: of measurement system, Accuracy, Precision and sensitivity, Linearity and resolution, Systematic errors, Dynamic characteristics: Zero-order, First order and second order measurement	8
2	**Sensors:** Temperature sensors, Flow sensors, Pressure sensors, Level sensors, Force sensors, Torque sensors, Acceleration sensors, Velocity sensors, Materials for sensors: Conductors, semiconductors and dielectrics; Magnetic materials	8
3	**Interfacing of Sensors and Signal Conditioning:**	7

	Change of bios and level of signals, Loading effects on Sensor's output, Potential divider, Low-Pass RC filter, High-Pass RC filter, Band pass filter, Band rejection filter.	
4	**Op-amp based Instrumentation:** Op-Amp Fundamentals, Basic op-amp configurations, Ideal op-amp circuit analysis, Negative feedback, Feedback in op amp circuits, Loop gain, Op amp powering. Resistance bias circuit and self-bias circuit. I/V and V/I converters, Current amplifiers, Difference amplifiers, Instrumentation amplifiers, Instrumentation applications, Transducer bridge amplifiers.	9
5	**Active Filters:** Transfer function, First order active filters, Standard second order responses, KRC filters, Multiple feedback filters, Sensitivity, Filter approximations, Cascade design, Direct design, Switched capacitor, Switched capacitor filter.	8
	Total	**40**

11**. Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Ramon-Pallas Areny and John G. Webster, 'Sensors and Signal Conditioning', John Wiley & Sons Ltd.	**2001**
2.	Franco S., 'Operational Amplifiers and Analog Integrated Circuits', McGraw Hill International Edition	**1988**
	Reference Books	
1.	E.O. Doebelinand D.N. Manic, 'Measurement Systems: Applications and Design', McGraw Hill	**2004**

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 591** Course Title: **Transducers, Actuators and Display Devices**

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

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

4. Relative Weight: **CWA** 25 **PRS** 0 **ESE** 25 **PRE** 50 0

5. Credits: 3

6. Semester: **Autumn (Odd)**

7. Subject Area: **Core Course**

8. Pre-requisite: **Physics, Basic Electronics Engineering**

9. **Course Outcomes:**	• Understanding basic concepts of sensor's characteristics and its physical effect • Understanding the concepts of different transducers • Analysing the working of various MEMS actuators. • Understanding the concept of different optoelectronic devices. • Design and analysis of different types of display systems. • On successful completion of this course, students will be able to utilize various transducers and optoelectronic devices for several applications

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1	**Sensor Characteristics and Physical Effects:** Active and Passive sensors, Static and dynamic characteristics, Accuracy, offset and linearity, Physical effects involved in signal transduction, Photoelectriceffect, Photoluminescence, Electroluminescence, chemiluminescence effect, Hall effect, Thermoelectric effect, Peizoresistive effect, Piezoelectric effect, Pyroelectric effect, Magneto-mechanical effect (magnetostriction), Magneto resistive effect.	10
2	**Transducers:** Conductometric and capacitive transducers, Interferometric optical transducer, Electrochemical transducer, p-n diode based transducer, Schottky diode-based transducer, BJT based transducers, FET based transducers, cantilever based transducers.	8
3	**MEMS Actuators and Sensors**	8

	Electromechanical transducers: Piezoelectric transducers, Electrostrictive transducers, Magnetostrictive transducers, Electrostatic actuators, Electromagnetic transducers, Electrodynamic transducers, Electrothermal actuators, Micro sensing for MEMS: Piezoresistive sensing, Capacitive sensing, Piezoelectric sensing.	
4	**Optoelectronic Devices:** Photovoltaic devices, Solar Radiation, PN-Homo junction solar cells, Antireflection coatings, Ideal conversion efficiency, Spectral response, I-V Characteristics, Temperature and radiation effects, Heterojunction solar cells, Schottky barrier solar cell.	8
5	**Display Devices:** Characterization of displays, drawbacks of cathode ray tube, Flat panel display: Electroluminescence displays, Plasma display, LED, LCD.	8
	Total	**42**

11. Suggested Books:

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Kourosh Kalantar – Zadeh, Benjamin Fry, "Nanotechnology-Enabled Sensors", Springer Publication	2008
2.	Vijay K. Varadan, K. J. Vinoy and K. A. Jose., 'RF MEMS & Their Applications', John Wiley & Sons.	2003
	Reference Books	
1.	S. M. Sze, and K. K. Ng, Physics of Semiconductor Devices, 3rd Ed., Wiley-Interscience.	2006
2.	J. Wilson & JFB Hawkers, Optoelectronics: An introduction, PHI, New Delhi.	1995
12.	**Mode of Evaluation**	Test / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **PEC 559** Course Title: **Sensors Interfacing Lab**
2. Contact Hours: **L:** 1 **T:** 0 **P:** 2
3. Examination Duration (Hrs): **Theory** 0 **Practical** 3
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 2
6. Semester: **Autumn**
7. Subject Area: **Core Course**
8. Pre-requisite: **Microprocessor**

9. **Course Outcomes:**	• Understanding of different launch pads. • Analysis of sensors interfacing with launch pads. • Analysis of data storage of sensors on cloud using these lunch pads. • Understanding and analysis of Arduino.

10. **Details of the Course:**

Sl. No.	Contents
1.	Familiarization of TIVA C-series12 launch pad (TM4C123GXL)
2.	Interfacing of sensors with TIVA C-series12 launch pad (TM4C123GXL)
3.	Interfacing of sensors with cloud using TIVA C-series12 launch pad (TM4C123GXL)
4.	Interfacing of keypad with TIVA C-series12 launch pad (TM4C123GXL)
5.	Familiarization of MSP430G2 launch pad.
6.	Interfacing of sensors with MSP430G2 launch pad.
7.	Interfacing of sensors with cloud using MSP430G2 launch pad.
8.	Interfacing of keypad with MSP430G2 launch pad.
9.	Familiarization of Arduino Microcontroller.
10.	Interfacing of sensors with Arduino Microcontroller.
11.	Interfacing of keypad with Arduino Microcontroller.
Innovative	
1.	Interfacing of servo motor with TIVA C-series12 launch pad (TM4C123GXL)
2.	Interfacing of servo motor with MSP430G2

11.	**Mode of Evaluation**	Viva / Mid Term Lab Exam / End Term Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 659** Course Title: **Advanced Embedded System**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs.): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **ESE** **25** **RE** **50** **0**
5. Credits: **3**
6. Semester: **Spring**
7. Subject Area: **Core Course**
8. Pre-requisite: **Microprocessor, Microcontrollers**

9**. Course Outcomes:**	• Understand the differences between the general computing system, embedded system and the classification of embedded systems. • Analysis and understand the architecture of Intel 8051/8031 series and PIC microcontrollers. • Learning the programming framework and software development process for embedded systems and be able to write small programs. • Understand the structure and role of RTOS and related development tools in the development of real time applications using embedded systems. • Learning different types of embedded system architectures in the market. • Successful completion of embedded system course, student will develop small projects or participate in projects related to embedded applications.

10. Details of the Course: -

Sl. No.	Contents	Contact Hours
1	**Introduction to Embedded system:** Embedded System vs. General Computing Systems, History of embedded system, classification, Application Area. Typical Embedded System, Characteristics and Quality Attributes of Embedded System.	8

2	**Intel family of microcontrollers 8051 /8031 architectures:** Instruction set, addressing modes, interrupts and timer, PIC series of microcontrollers.	8
3	**System design, Peripheral Interfacing:** Digital and analog interfacing, Programming framework, Software development.	8
4	**Real time operating systems(RTOS):** Embedded System design, Operating system basics, types of operating system tasks, process, threads, multiprocessing and multitasking, task scheduling.	8
5	**16- and 32-bit microcontrollers:** 8096/80196 family, Motorola family MC68HC11/12, ARM 32bit MCU, AVR family.	8
	Total	**40**

11. **Suggested Books:**

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Raj Kamal: Microcontrollers, Programming, Interfacing and System Design, 2nd Edition, Pearson.	2005
2.	J.Morton: The PIC Microcontroller, 3rd Edition, Elsevier	2005
	Reference Books	
1.	M. Mazidi: 8051 Microcontroller and Embedded System, 2nd Edition, Pearson	2006
2.	K. V. Shibhu: Introduction To Embedded Systems, 1st Edition, Tata McGraw Hill	2009
3.	Frank Vahid, Tony Givargis: Embedded System Design, A Unified Hardware, Software Approach, 3rd Edition, Wiley Publications.	1999

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRAD

Name of Department: - **Electronics and Communication Engineering**

1. Subject Code: **TEC 759** Course Title: **Internet of Things and Its Applications**
2. Contact Hours: **L:** **3** **T**: **0** **P**: **0**
3. Examination Duration (Hrs): **Theory** **3** **Practical** **0**
4. Relative Weight: **CWA** **25** **PRS** **0** **MSE** **25** **ESE** **50** **PRE** **0**
5. Credits: **3**
6. Semester: **Autumn (Odd)**
7. Subject Area: **Core Course**
8. Pre-requisite: **Basic knowledge in computer networks, Knowledge of sensors.**

9. **Course Outcome:**	• Understanding of wireless sensor network and Internet of Things. • Analysis of IoT Market perspective. • Understanding the State of the Art – IoT Architecture. • Analyzing the Applications of IoT. • Designing IoT applications for privacy, security and governance. • Successful completion of this course will provide the foundation for the students to implement IOT based projects.

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Introduction to IoT;** Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Defining IoT, Characteristics of IoT, Physical design of IoT: Things in IoT, Physical design; Logical design of IoT, Functional blocks of IoT, IoT communication models, Applications of Sensor Networks in IoT.	8
2	**M2M to IoT – A Basic Perspective–** Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. **M2M to IoT-An Architectural Overview–** Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.	9
3	**IoT Architecture -State of the Art –**	9

	Introduction, State of the art, **Architecture Reference Model-** Introduction, Reference Model and architecture, IoT reference Model, **IoT Reference Architecture-** Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.	
4	**Domain specific IoT Applications** Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and life style.	8
5	**Internet of Things Privacy, Security and Governance** Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security	8
	Total	**42**

11**. Suggested Books:**

SL. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
	Text Books	
1.	Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT.	2014
2.	Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press.	2014.
3.	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications.	2013
	Reference Books:	
1	Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493-9357-1	2011

12.	**Mode of Evaluation**	Test / Quiz / Assignment / Mid Term Exam / End Term Exam / Lab Exam

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: **Electronics and Communication Engineering**

1. Subject Code: **PEC 759** Course Title: **Networking Lab**
2. Contact Hours: **L:** 1 **T:** 0 **P:** 2
3. Examination Duration (Hrs): **Theory** 0 **Practical** 3
4. Relative Weight: **CWA** 25 **PRS** 0 **MSE** 25 **ESE** 50 **PRE** 0
5. Credits: 2
6. Semester: **Autumn**
7. Subject Area: **Core Course**
8. Pre-requisite: **Wireless Sensor Networks**

9. **Course Outcomes:**	• Understanding the concepts of SENSENUTS and its interfacing with hardware. • Analysis of temperature and humidity using SENSNUTS. • Understanding the fundamentals of Arduino microcontroller. • Analysis of different sensor parameters using Arduino uno.

10. **Details of the Course:**

Sl. No.	Contents
1.	To study the working and flow of operation in SENSENUTS.
2.	To study SENSNUTS GUI and interfacing of SENSNUTS with hardware.
3.	To study and analyze SENSENUTS with LED.
4.	To create network setup and measure ambient TEMPERATURE using SENSENUTS.
5.	To create network setup and measure ambient HUMIDITY using SENSENUTS.
6.	To monitor and analyze water level using ultrasonic sensor and Arduino Uno.
7.	To measure and analyze soil humidity using moisture sensor and Arduino Uno.
8.	To monitor and analyze air pollution using sensor and Arduino Uno.
9.	To monitor light intensity using sensor and Arduino Uno.
10.	To monitor motion in a room using Passive infrared motion sensor and Arduino Uno.

11.	**Mode of Evaluation**	Viva / Mid Term Lab Exam / End Term Lab Exam