BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ODISHA
ROURKELA

Curriculum and Syllabus

Of

B.Tech (*ECE/ETC*) from the Batch 2018-19

Semester (3rd)

Director, Curriculum Development
Biju Patnaik University of Technology, Odisha
Rourkela

Third Semester							
Theory							
Sl No	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**	**University Marks**	**Internal Evaluation**
1	BS	RMA3A001	Mathematics - III	3-0-0	3	100	50
2	ES	ROP3B001	Object Oriented Programming Using JAVA	3-0-0	3	100	50
3	HS	REN3E001 / ROB3E002	Engineering Economics / Organisational Behaviour	3-0-0	3	100	50
4	PC	REC3C001	Analog Electronic Circuits	3-0-0	3	100	50
5	PC	REC3C002	Signals and Systems	3-0-0	3	100	50
6	MC*	RES3F001	Environment Science	3-0-0	0	—	100 (Pass mark is 37)
Total Credit (Theory)					15		
Total Marks						**500**	**250**
Practical							
1	PC	REC3C201	Analog Electronic Circuits Lab.	0-0-3	2		100
2	PC	REC3C202	Signals and Systems Lab using Software	0-0-3	2		100
3	ES	ROP3B201	OOP Using JAVA Lab.	0-0-3	2		100
4	PSI	RIP3H201	Evaluation of Internship - I	0-0-3	1		100
Total Credit (Practical)					7		
Total Semester Credit					**22**		
Total Marks							**400**

***Mandatory Non-Credit Courses (MC) result will be reflected with Pass (P) / Fail (F) grade. Thus the grade obtained will not be affecting the grade point average. However it shall appear on the grade sheet as per AICTE rule.**

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3rd Semester	RMA3A001	MATHEMATICS – III	L-T-P 3-0-0	3 CREDITS

Module-I (10 Hours)

Solution of Non-linear equation in one variable (Bisection, Secant, Newton Rapson Method, Fixed Point Iteration method). Numerical Solutions of system of Linear equations (Gauss-Seidel, Successive Over Relaxation, Doolittle method, Crouts method, Choleskys Method).
Interpolation: Newton's forward and backward interpolation, Newton divided difference interpolation, Lagrange Interpolation.

Module-II (8 Hours)

Numerical Differentiation, integration and Solution of Differential Equations: Numerical Differentiation, The trapezoidal rule, The Simpson's rule, Gauss Integration formulas. Solution of ordinary differential equation: Euler's method, Improvement of Euler's method, Runge-Kutta methods, multi step methods, Methods for system and higher order ordinary differential equations.

Module-III (8 Hours)

Sample Space, Probability, Conditional Probability, Independent Events, Bayes' Theorem, Random variables, Probability distributions, Expectations, Mean and variance, Moments.

Module-IV (9 Hours)

Bernoulli Trials, Binomial, Poisson, Hyper Geometirc Distribution, Uniform., Exponential and Normal distribution, Bivariate Distributions.

Module-V (10 Hours)

Correlation and Regression Analysis, Rank Correlation, Maximum Likely hood estimate, Method of Moments, Confidence intervals mean and variance of a Normal Distribution, p-value. Testing of hypothesis: test for goodness of fit, Test for single mean and variance of a Normal Distribution.

Books:

1. E. Kreyszig," Advanced Engineering Mathematics:,Tenth Edition, Wiley India
2. S.Pal and S.C. Bhunia, "Engineering Mathematics" Oxford University Press
3. Jay L. Devore, "Probability and Statistics for Engineering and Sciences", Seventh Edition, Thomson/CENGAGE Learning India Pvt. Ltd
4. R. E. Walpole, R. h. Myers, S. L. Myers, K. E. Ye; "Probability and Statistics, Pearson".
5. R. L. Burden, J. D. Faires, " Numerical Analysis, Cenage Learning India Pvt. Ltd"
6. B.V.RAMANA,"Higher Engineering Mathematics"Tata Magraw Hill

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3rd Semester	ROP3B001	OBJECT ORIENTED PROGRAMMING USING JAVA	L-T-P 3-0-0	3 CREDITS

Module-I (10 Hrs)

Chapter 1-: An introduction to programming.

Different types of programming languages, Description of Compiler and Interpreter, Advantage of Object Oriented Programming, Object Oriented Programming, Features of Object Oriented Programming.

Chapter 2-: Introduction to Java.

What is Java?, Why Java?, History behind Java, Different versions of Java, Difference between C/C++ and Java, Features of Java, First Java Program, Prerequisites Before start writing a java program, Writing the program, Compiling the program, How Java program compiles?, Executing the program, How Java program executes?, What is JVM and its significance in executing a program?, Architecture of JVM.

Chapter 3-: Understanding First Program and a step forward, Understanding every term of the program, Java Tokens, Datatypes, Operators, What are Operators?, Different types of Operators, Typecasting, Control Structures and Arrays, Different types of control structures, Conditional Statements, Loops/ Iterators, Jumping Statements, Java Arrays, Multidimensional Arrays, Taking Input from keyboard, Command Line Arguments, Using Scanner Class, Using Buffered Reader class.

Module-II: (08 Hrs.)

Chapter 1-: Introduction to Classes and Objects.

Classes, Methods, Objects, Description of data hiding and data encapsulation, Constructors, Use of static Keyword in Java, Use of this Keyword in Java, Array of Objects, Concept of Access Modifiers (Public, Private, Protected, Default).

Chapter 2-: Inheritance

Understanding Inheritance, Types of Inheritance and Java supported Inheritance, Significance of Inheritance, Constructor call in Inheritance, Use of super keyword in Java, Polymorphism, Understanding Polymorphism, Types of polymorphism, Significance of Polymorphism in Java, Method Overloading, Constructor Overloading, Method Overriding, Dynamic Method Dispatching.

Chapter 3-: String Manipulations.

Introduction to different classes, String class, String Buffer, String Builder, String Tokenizer, Concept of Wrapper Classes, Introduction to wrapper classes, Different predefined wrapper classes, Predefined Constructors for the wrapper classes. Conversion of types from one type (Object) to another type (Primitive) and Vice versa, Concept of Auto boxing and unboxing.

Module-III: (09 Hrs.)

Chapter 1:-Data Abstraction

Basics of Data Abstraction, Understanding Abstract classes, Understanding Interfaces, Multiple Inheritance Using Interfaces, Packages, Introduction to Packages, Java API Packages, User-Defined Packages, Accessing Packages, Error and Exception Handling, Introduction to error and exception, Types of exceptions and difference between the types, Runtime Stack Mechanism, Hierarchy of Exception classes, Default exception handling in Java, User defined/Customized

Exception Handling, Understanding different keywords (try, catch, finally, throw, throws), User defined exception classes, Commonly used Exceptions and their details.

Chapter 2:-Multithreading

Introduction of Multithreading/Multitasking, Ways to define a Thread in Java, Thread naming and Priorities, Thread execution prevention methods. (yield(), join(), sleep()), Concept of Synchronisation, Inter Thread Communication, Basics of Deadlock, Demon Thread, Improvement in Multithreading, Inner Classes, Introduction, Member inner class, Static inner class, Local inner class, Anonymous inner class.

Module-IV: (10 Hrs.)

Chapter 1:-IO Streams (java.io package)

Introduction, Byte Stream and Character Stream, Files and Random Access Files, Serialization, Collection Frame Work (java.util), Introduction, Util Package interfaces, List, Set, Map etc, List interfaces and its classes, Setter interfaces and its classes.

Chapter 2:-Applet

Introduction, Life Cycle of an Applet, GUI with an Applet, Abstract Window Toolkit (AWT), Introduction to GUI, Description of Components and Containers, Component/Container hierarchy, Understanding different Components/Container classes and their constructors, Event Handling, Different mechanisms of Event Handling, Listener Interfaces, Adapter classes.

Module-V: (08 Hrs.)

Chapter 1:-Swing (JFC)

Introduction Diff b/w awt and swing, Components Hierarchy, Panes, Individual Swings Components JLabel, JButton, JTextField, JTextArea.

Chapter 2:-JavaFX

Getting started with JavaFX, Graphics, User Interface Components, Effects, Animation, and Media, Application Logic, Interoperability, JavaFX Scene Builder 2, Getting Started with scene Builder.

Working with scene Builder.

Books :-

1. Programming in Java. Second Edition. OXFORD HIGHER EDUCATION. (SACHIN MALHOTRA/SAURAV CHOUDHARY)
2. CORE JAVA For Beginners. (Rashmi Kanta Das), Vikas Publication
3. JAVA Complete Reference (9th Edition) Herbalt Schelidt.

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3rd Semester	ROP3B201	OOP USING JAVA LAB.	L-T-P 0-0-3	2 CREDITS

JAVA programs on:

1. Introduction, Compiling & executing a java program.
2. Data types & variables, decision control structures: if, nested if etc.
3. Loop control structures: do, while, for etc.
4. Classes and objects.
5. Data abstraction & data hiding, inheritance, polymorphism.
6. Threads, exception handlings and applet programs
7. Interfaces and inner classes, wrapper classes, generics

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3rd Semester	REN3E001	ENGINEERING ECONOMICS	L-T-P 3-0-0	3 CREDITS

Module - I (08 hours)

Engineering Economics- Nature, Scope, Basic problems of an economy, Micro Economics and Macro Economics.
Demand - Meaning of demand, Demand function, Law of Demand and its exceptions, Determinants of demand, Elasticity of demand & its measurement (Simple numerical problems to be solved), Demand Forecasting – Meaning
Supply-Meaning of supply, Law of supply and its exception, Determinants of supply, Elasticity of supply, Determination of market equilibrium (Simple numerical problems to be solved).

Module - II (08 hours)

Production - Production function, Laws of returns: Law of variable proportion, Law of returns to scale
Cost and Revenue Concepts - Total Costs, Fixed cost, Variable cost, Total revenue, Average revenue and Marginal revenue, Cost-Output Relationships in the Short Run, and Cost-Output Relationships in the Long Run, Analysis of cost minimization.

Module III (08 hours)

Market - Basic understanding of different market structures, Determination of equilibrium price under perfect competition (Simple numerical problems to be solved), Break Even Analysis-linear approach (Simple numerical problems to be solved).

Module - IV (12 hours)

Time Value of Money- Interest - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence.
Evaluation of Engineering Projects-Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects.
Depreciation- Depreciation of capital assert, Causes of depreciation, Methods of calculating depreciation - Straight line method, Declining balance method, SOYD method, After tax comparison of project.

Module –V (06 Hours)

Inflation-Meaning of inflation, types, causes, measures to control inflation.
National Income-Definition, Concepts of national income, Method of measuring national income.
Banking -Commercial bank, Functions of commercial bank, Central bank, Functions of Central Bank.

Books:

1. Principles of Economics by Deviga Vengedasalam and Karaunagaran Madhavan, Oxford

2. Riggs, Bedworth and Randhwa, "Engineering Economics", McGraw Hill Education India
3. C. S. Park, Contemporary Engineering Economics, 6th Edition, Pearson Education, 2015.
4. Engineering Economy by William G.Sullivan, Elin M.Wicks, C. Patric Koelling, Pearson
5. R.Paneer Seelvan, " Engineering Economics", PHI
6. Ahuja,H.L., "Principles of Micro Economics" , S.Chand & Company Ltd
7. Jhingan,M.L., "Macro Economic Theory"
8. Macro Economics by S.P.Gupta, TMH

Course Outcomes of Engineering Economics

At the end of the course the engineering graduates will be able to

1. **Remembering** : Define the basic concept of micro and macro economics, engineering economics and their application in engineering economy.

2. **Understanding** : Evaluate numerically the effects of changes in demand and supply on price determination of products and services.

3. **Analyze :** the macroeconomic environment and financial systems of the country and its impact on business, society and enterprise.

4. **Develop :** the ability to account for time value of money using engineering economy factors and formulas.

5. **Apply:** knowledge of mathematics, economics and engineering principles to solve engineering problems and to analyze decision alternatives in engineering projects considering upon depreciation, taxes and inflation.

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3rd Semester	ROB3E002	ORGANISATIONAL BEHAVIOUR	L-T-P 3-0-0	3 CREDITS

Objectives:

1. To develop an understanding of the behavior of individuals and groups inside organizations
2. To enhance skills in understanding and appreciating individuals, interpersonal, and group process for increased effectiveness both within and outside of organizations.
3. To develop theoretical and practical insights and problem-solving capabilities for effectively managing the organizational processes.

Module-I: **(06 Hrs.)**

Fundamentals of OB: Definition, scope and importance of OB, Relationship between OB and the individual, Evolution of OB, Theoretical framework (cognitive), behavioristic and social cognitive), Limitations of OB.

Module-II: **(12 Hrs.)**

Attitude: Importance of attitude in an organization, Right Attitude, Components of attitude, Relationship between behavior and attitude, Developing Emotional intelligence at the workplace, Job attitude, Barriers to changing attitudes.
Personality and values: Definition and importance of Personality for performance, The Myers-Briggs Type Indicator and The Big Five personality model, Significant personality traits suitable to the workplace (personality and job – fit theory), Personality Tests and their practical applications.
Perception: Meaning and concept of perception, Factors influencing perception, Selective perception, Attribution theory, Perceptual process, Social perception (stereotyping and halo effect).
Motivation: Definition & Concept of Motive & Motivation, The Content Theories of Motivation (Maslow's Need Hierarchy & Herzberg's Two Factor model Theory), The Process Theories (Vroom's expectancy Theory & Porter Lawler model), Contemporary Theories – Equity Theory of Work Motivation.

Module-III: **(10 Hrs.)**

Foundations of Group Behavior: The Meaning of Group & Group behavior & Group Dynamics, Types of Groups, The Five – Stage Model of Group Development.
Managing Teams: Why Work Teams, Work Teams in Organization, Developing Work Teams, Team Effectiveness & Team Building.
Leadership: Concept of Leadership, Styles of Leadership, Trait Approach Contingency Leadership Approach, Contemporary leadership, Meaning and significance of contemporary leadership, Concept of transformations leadership, Contemporary theories of leadership, Success stories of today's Global and Indian leaders.

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Module-IV: **(08 Hrs.)**

Organizational Culture : Meaning & Definition of Organizational Culture, creating & Sustaining Organizational Culture, Types of Culture (Strong vs. Weak Culture, Soft Vs. Hard Culture & Formal vs. Informal Culture), Creating Positive Organizational Culture, Concept of Workplace Spirituality.

Module-V: **(09 Hrs.)**

Organizational Change: Meaning, Definition & Nature of Organizational Change, Types of Organizational Change, Forces that acts as stimulants to change.
Implementing Organizational Change : How to overcome the Resistance to Change, Approaches to managing Organizational Change, Kurt Lewin's-Three step model, Seven Stage model of Change & Kotter's Eight-Step plan for Implementing Change, Leading the Change Process, Facilitating Change, Dealing with Individual & Group Resistance, Intervention Strategies for Facilitating Organizational Change, Methods of Implementing Organizational Change, Developing a Learning Organization.

Books:

1. Understanding Organizational Behaviour, Parek, Oxford
2. Organizational Behaviour, Robbins, Judge, Sanghi, Pearson.
3. Organizational Behaviour, K. Awathappa,HPH.
4. Organizational Behaviour, VSP Rao, Excel
5. Introduction to Organizational Behaviour, Moorhead, Griffin, Cengage.
6. Organizational Behaviour, Hitt, Miller, Colella, Wiley

3rd Semester	REC3C001	Analog Electronic Circuits	L-T-P 3-0-0	3 CREDITS

MODULE – I **(12 Hours)**

MOS Field-Effect Transistor: Principle and Operation of FETs and MOSFETs; P-Channel and N-Channel MOSFET; Complimentary MOS; V-I Characteristics of E- MOSFET and D-MOSFET; MOSFET as an Amplifier and as a Switch.
Biasing of BJTs: Load lines (AC and DC); Operating Points; Fixed Bias and Self Bias, DC Bias with Voltage Feedback; Bias Stabilization; Examples.
Biasing of FETs and MOSFETs: Fixed Bias Configuration and Self Bias Configuration, Voltage Divider Bias and Design

MODULE – II **(12 Hours)**

Small Signal Analysis of BJTs: Small-Signal Equivalent-Circuit Models; Small Signal Analysis of CE, CC, CB amplifiers. Effects of R_S and R_L on CE amplifier operation, Emitter Follower; Cascade amplifier, Darlington Connection and Current Mirror Circuits.
Small Signal Analysis of FETs: Small-Signal Equivalent-Circuit Model, Small Signal Analysis of CS, CD, CG Amplifiers. Effects of R_{SIG} and R_L on CS Amplifier; Source Follower and Cascaded System.

MODULE – III **(8 hours)**

High Frequency Response of FETs and BJTs: High Frequency equivalent models and frequency Response of BJTs and FETs; Frequency Response of CS Amplifier, Frequency Response of CE Amplifier.

MODULE – IV **(6 hours)**

Feedback amplifier and Oscillators: Concepts of negative and positive feedback; Four Basic Feedback Topologies, Practical Feedback Circuits, Principle of Sinusoidal Oscillator, Wein-Bridge, Phase Shift and Crystal Oscillator Circuits, Power Amplifier (Class A, B, AB, C).

MODULE – V **(7 hours)**

Operational Amplifier: Ideal Op-Amp, Differential Amplifier, Op-Amp Parameters, Non-inverting Configurations, Open-loop and Closed-loop Gains, Differentiator and Integrator, Instrumentation amplifier.

Books:

- *Microelectronics Circuits, Adel Sedra and Kenneth C Smith, Oxford University Press, New Delhi, 5th Edition, International Student Edition,2009. (Selected portion of Chapter 2,4, 5, 6, 8, 13, and 14)*
- *Electronic Devices and Circuits theory, R.L. Boylestad and L. Nashelsky, Pearson Education, New Delhi , 9th/10th Edition,2013. (Selected portions of Chapter 4, 5, 6, 7, 8, 9,*

10, 11, 12, and 14)

- *Milliman's Electronics Devices and Circuits, J. Milliman, C. Halkias, S. Jit., Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2nd Edition,2008.*
- *Electronic Devices and Circuits, Jimmie J. Cathey adapted by Ajay Kumar Singh, Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition, (For Problem Solving)*
- *Electronics Circuits Analysis and Design, Donald A. Neamen, Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition,2002.*
- *Integrated Electronics: Analog and Digital Circuits and Systems, J. Milliman, C. Halkias, Tata McGraw Hill Publishing Company Ltd., New Delhi,2nd Edition.2004.*
- *Microelectronic Circuits: Analysis and Design, M.H. Rashid, PWS Publishing Company, a division of Thomson Learning Inc. India Edition.*
- *Electronic device and circuits, David A. Bell, Oxford University Press, 5th edition,2008.*
- *Electronics devices and circuits, Anil.K.Maini, Wiley India Pvt.Ltd,2009*

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3rd Semester	REC3C201	Analog Electronic Circuits Lab.	L-T-P 0-0-3	2 CREDITS

List of Experiments

(At least 10 out of 12 experiments should be done)

1. Design and simulate BJT bias circuit and compare the results.
2. *Design and simulate JEET/MOSFET bias circuit and compare the results.*
3. *Design and simulate BJT common-emitter circuit and compare D.C and A.C performance:*
4. *Design and simulate JFET/MOSFET common-emitter circuit and compare D.C and A.C performance:*
5. *Determining the frequency response of a common-emitter amplifier: low frequency, high frequency and mid frequency response and compare with simulated results.*
6. *Differential amplifiers circuits: D.C bias and A.C operation without and with current source.*
7. *Study of Darlington connection and current mirror circuits.*
8. *OP-Amp Frequency Response and Compensation.*
9. *Application of Op-Amp as differentiator, integrator, square wave generator.*
10. *Obtain the band width of FET/ BJT using Square wave testing of an amplifier.*
11. *R.C phase shift oscillator/Wien-Bridge Oscillator using OP-Amp/Crystal Oscillator.*
12. *Class A and Class B Power Amplifier.*

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3rd Semester	REC3C002	Signals and Systems	L-T-P 3-0-0	3 CREDITS

MODULE – I (7 Hours)

Discrete-Time Signals and Systems:

Discrete-Time Signals: Some Elementary Discrete-Time signals, Classification of Discrete-Time Signals, Simple Manipulation, Discrete-Time Systems : Input-Output Description, Block Diagram Representation, Classification, Interconnection.

MODULE – II (8 Hours)

Analysis of Discrete-Time LTI Systems: Techniques, Response of LTI Systems, Properties of Convolution, Causal LTI Systems, Stability of LTI Systems; Discrete-Time Systems Described by Difference Equations; Implementation of Discrete-Time Systems. Correlation of Discrete-Time Signals: Cross correlation and Autocorrelation Sequences, Properties.

MODULE – III (10 Hours)

The Continuous-Time Fourier Series:

Basic Concepts and Development of the Fourier series; Calculation of the Fourier Series, Properties of the Fourier Series.

The Continuous-Time Fourier Transform:

Basic Concepts and Development of the Fourier Transform; Properties of the Continuous-Time Fourier Transform.

MODULE- IV (10 Hours)

The Z-Transform and Its Application to the Analysis of LTI Systems:

The Z-Transform: The Direct Z-Transform, The Inverse Z-Transform; Properties of the Z-Transform; Rational Z-Transforms: Poles and Zeros, Pole Location and Time-Domain Behavior for Causal Signals, The System Function of a Linear Time-Invariant System; Inversion of the Z-Transforms: The Inversion of the Z-Transform by Power Series Expansion, The Inversion of the Z-Transform by Partial-Fraction Expansion; The One-sided Z-Transform: Definition and Properties, Solution of Difference Equations.

MODULE- V (10 Hours)

The Discrete Fourier Transform: Its Properties and Applications:

Frequency Domain Sampling: The Discrete Fourier Transform; Properties of the DFT: Periodicity, Linearity, and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution, Additional DFT Properties.

Books:

1. *Digital Signal Processing – Principles, Algorithms and Applications, John. G. Proakis and Dimitris. G. Manolakis, 4th Edition, Pearson.*
2. *Fundamentals of Signals and Systems - M. J. Roberts, TMH*
3. *Signal & Systems by Tarun Kumar Rawat, Oxford University Press.*
4. *Signals and Systems – A NagoorKani, TMH*
5. *Signals and Systems, Chi-Tsong Chen, Oxford*
6. *Principles of Signal Processing and Linear Systems, B.P. Lathi, Oxford.*
7. *Principles of Linear Systems and Signals, B.P Lathi, Oxford*

3rd Semester	REC3C202	Signals and Systems Lab using Software	L-T-P 0-0-3	2 CREDITS

List of Experiments:
(At least 10 out of 15 experiments should be done)

1. *Write a program to generate the discrete sequences (i) unit step (ii) unit impulse (iii) ramp (iv) periodic sinusoidal sequences. Plot all the sequences.*
2. *Find the Fourier transform of a square pulse .Plot its amplitude and phase spectrum.*
3. *Write a program to convolve two discrete time sequences. Plot all the sequences. Verify the result by analytical calculation.*
4. *Write a program to find the trigonometric Fourier series coefficients of a rectangular periodic signal. Reconstruct the signal by combining the Fourier series coefficients with appropriate weightings.*
5. *Write a program to find the trigonometric and exponential Fourier series coefficients of a periodic rectangular signal. Plot the discrete spectrum of the signal.*
6. *Generate a discrete time sequence by sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs while reconstructing the signal.*
7. *The signal x (t) is defined as below. The signal is sampled at a sampling rate of 1000 samples per second. Find the power content and power spectral density for this signal.*

$$x(t) = \begin{cases} \cos(2\pi \times 47t) + \cos(2\pi \times 219t), & 0 \le t \le 10 \\ 0 & otherwise \end{cases}$$

8. *Write a program to find the magnitude and phase response of first order low pass and high pass filter. Plot the responses in logarithmic scale.*
9. *Write a program to find the response of a low pass filter and high pass filter, when a speech signal is passed through these filters.*
10. *Write a program to find the autocorrelation and cross correlation of sequences.*
11. *Generate a uniformly distributed length 1000 random sequence in the range (0,1). Plot the histogram and the probability function for the sequence. Compute the mean and variance of the random signal.*
12. *Generate a Gaussian distributed length 1000 random sequence. Compute the mean and variance of the random signal by a suitable method.*
13. *Write a program to generate a random sinusoidal signal and plot four possible realizations of the random signal.*
14. *Generate a discrete time sequence of N=1000 i.i.d uniformly distributed random numbers in the interval (-0.5,-0.5) and compute the autocorrelation of the sequence.*
15. *Obtain and plot the power spectrum of the output process when a white random process is passed through a filter with specific impulse response*

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3rd Semester	RES3F001	ENVIORMENT SCIENCE	L-T-P 3-0-0	0 CREDIT

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students on the above issues through following two type of activities.

(a) Awareness Activities:

i) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
ii) Slogan making event
iii) Poster making event
iv) Cycle rally
v) Lectures from experts

(b) Actual Activities:

i) Plantation
ii) Gifting a tree to see its full growth
iii) Cleanliness drive
iv) Drive for segregation of waste
v) To live some big environmentalist for a week or so to understand his work
vi) To work in kitchen garden for mess
vii) To know about the different varieties of plants
viii) Shutting down the fans and ACs of the campus for an hour or so

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Tentative Curriculum and Syllabus

of

B.Tech (*ECE / ETC)* from the Batch 2018-19

Semester (4th)

Fourth Semester							
Theory							
Sl No	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**	**University Marks**	**Internal Evaluation**
1	PC	REC4C001	Electromagnetic Theory	3-0-0	3	100	50
2	PC	REC4C002	Digital Systems Design	3-0-0	3	100	50
3	HS	REN4E001 / ROB4E002	Engineering Economics / Organisational Behaviour	3-0-0	3	100	50
4	PC	REC4C003	Network Theory	3-0-0	3	100	50
5	PE	REC4D001	Semiconductor Devices	3-0-0	3	100	50
		REC4D002	Power Electronics				
		REC4D003	Sensors and Transducers				
6	OE	REC4G001	Probability Theory And Stochastic Process	3-0-0	3	100	50
		REC4G002	Data Structure				
		REC4G003	Brain Control Interface				
6	MC*	RCN4F001	Constitution of India	3-0-0	0	__	100 (Pass mark is 37)
Total Credit (Theory)					**18**		
Total Marks						**600**	**300**
Practical							
1	PC	REC4C201	Electronic Device Laboratory	0-0-3	2		100
2	PC	REC4C202	Digital System Design Laboratory	0-0-3	2		100
3	PC	REC4C203	Network Theory Laboratory	0-0-3	2		100
Total Credit (Practical)					**6**		
Total Semester Credit					**24**		
Total Marks							**300**

***Mandatory Non-Credit Courses (MC) result will be reflected with Pass (P) / Fail (F) grade. Thus the grade obtained will not be affecting the grade point average. However it shall appear on the grade sheet as per AICTE rule.**

4th Semester	**REC4C001**	**Electromagnetic Theory**	**L-T-P 3-0-0**	**3 CREDITS**

Module-I (10 Hours)

1. Cartesian, Cylindrical and Spherical Coordinate Systems; Scalar and Vector Fields; Line, Surface and Volume Integrals.
2. Coulomb's Law; The Electric Field Intensity; Electric Flux Density and Electric Flux; Gauss's Law; Divergence of Electric Flux Density: Point Form of Gauss's Law; The Divergence Theorem; The Potential Gradient; Energy Density; Poisson's and Laplace's Equations.
3. Ampere's Magnetic Circuital Law and its Applications; Curl of H; Stokes' Theorem; Divergence of B; Energy Stored in the Magnetic Field.

Module-II (9 Hours)

1. The Continuity Equation; Faraday's Law of Electromagnetic Induction; Conduction Current: Point Form of Ohm's Law, Convection Current; The Displacement Current;
2. Maxwell's Equations in Differential Form; Maxwell's Equations in Integral Form; Maxwell's Equations for Sinusoidal Variation of Fields with Time; Boundary Conditions; The Retarded Potential; The Poynting Vector; Poynting Vector for Fields Varying Sinusoid ally with Time.

Module-III (10 Hours)

1. Solution of the One-Dimensional Wave Equation; Solution of Wave Equation for Sinusoid ally Time-Varying Fields; Polarization of Uniform Plane Waves; Fields on the Surface of a Perfect Conductor; Reflection of a Uniform Plane Wave Incident Normally on a Perfect Conductor and at the Interface of Two Dielectric Regions; The Standing Wave Ratio; Oblique Incidence of a Plane Wave at the Boundary between Two Regions; Oblique Incidence of a Plane Wave on a Flat Perfect Conductor and at the Boundary between Two Perfect Dielectric Regions.

Module-IV (8 Hours)

1. Types of Two-Conductor Transmission Lines; Circuit Model of a Uniform Two-Conductor Transmission Line; The Uniform Ideal Transmission Line; Wave Reflection at a Discontinuity in an Ideal Transmission Line; Matching of Transmission Lines with Load.

Module-V (8 Hours)

1. Formulation of Field Equations; Wave Types; the Parallel-Plate Waveguide; the Rectangular Waveguide. TE and TM modes of propagation in a Rectangular waveguide
2. Radiation Properties of a Current Element; Radiation Properties of a Half-Wave Dipole; Yagi–Uda Antenna; the Parabolic Reflector Antenna.

Books:

- Principles of Electromagnetic, S.C. Mahapatra, S. Mahapatra, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2nd Edition, 2015.
- Principles of Electromagnetics**,**Mathew N.O. Sadiku & S.V. Kulkarni., Oxford University Press, 6th edition,2009.
- Electromagnetic Waves and Radiating Systems, E.C. Jordan and K.G. Balmain, Pearson Education, New Delhi, 2nd Edition,2009.
- Engineering Electromagnetic Essentials, B. N. Basu, University Press.
- Engineering Electromagnetic Essentials, Nathan Ida, Springer
- Engineering Electromagnetic, William H. Hayt & J. Buck, Tata McGraw Hill Publishing
- Company Ltd., New Delhi, 7th Edition,2006
- Electromagnetic, Joseph A. Edminister, adapted by Vishnu Priye, Tata McGraw Hill
- Publishing Company Ltd., New Delhi, 2nd Edition.
- Fundamentals of Electromagnetic for Engineering, First Impression, N. N. Rao, Pearson Education, New Delhi, 2009.
- Fields and Waves in Communication Electronics, Simon Ramo, Wiley Publication, 3ed, 2007.
- Electromagnetic Field Theory, Bhag Singh Guru, Cambridge Publication,3rd Edition, 2011.

4th Semester	**REC4C201**	**Electronic Device Laboratory**	**L-T-P 0-0-3**	**2 CREDITS**

Laboratory Experiments: (Minimum 8 experiments)

1. *Wave-propagation in conductors and dielectrics using HFSS/CST/MATLAB.*
2. *Current and charge flow of electromagnetic wave in a rectangular waveguide using HFSS/CST/MATLAB.*
3. *Uniform Plane Wave Propagation in an Arbitrary Direction*
4. *Transverse Electric Waves in a Parallel-Plate Waveguide*
5. *To calculate Dispersion and Group Velocity*
6. *To design Rectangular Waveguide*
7. *To design cavity Resonator*
8. *To show the modes of a rectangular waveguide using HFSS.*
9. *To show azimuth and elevation patterns*
10. *To show the input and output impedence*
11. *SWR measurements of rectangular waveguide*
12. *Reflection of plane waves*

*HFSS – High Frequency Structure Simulator
*CST- Computer Simulation Tool

4th Semester	**REC4C002**	**Digital Systems Design**	**L-T-P 3-0-0**	**3 CREDITS**

MODULE – I (10 Hours)

Revision of Number System: Introduction to various number systems and their Conversion. Arithmetic Operation using 1's and 2`s Compliments, Signed Binary and Floating Point Number Representation Introduction to Binary codes and their applications.

Revision Boolean Algebra and Logic Gates: Boolean algebra and identities, Complete Logic set, logic gates and truth tables. Universal logic gates, Algebraic Reductionand realization using logic gates

MODULE – II (11 Hours)

Combinational Logic Design: Specifying the Problem, Canonical Logic Forms, Extracting Canonical Forms, EX-OR Equivalence Operations, Logic Array, K-Maps: Two, Three and Four variable K-maps, NAND and NOR Logic Implementations.

Logic Components: Concept of Digital Components, Binary Adders, Subtraction and Multiplication, An Equality Detector and comparator, Line Decoder, encoders, Multiplexers and De-multiplexers.

MODULE – III (8 Hours)

Synchronous Sequential logic Design: sequential circuits, storage elements: Latches (SR, D), Storage elements: Flip-Flops inclusion of Master-Slave, characteristics equation and state diagram of each FFs and Conversion of Flip-Flops. Analysis of Clocked Sequential circuits and Mealy and Moore Models of Finite State Machines**.**

MODULE – IV (9 Hours)

Binary Counters : Introduction, Principle and design of synchronous and asynchronous counters, Design of MOD-N counters, Ring counters. Decade counters, State Diagram of binary counters.
Shift resistors: Principle of 4-bit shift resistors. Shifting principle, Timing Diagram, SISO, SIPO, PISO and PIPO resistors.

Memory and Programmable Logic: Types of Memories, Memory Decoding, error detection and correction), RAM and ROMs. Programmable Logic Array, Programmable Array Logic, Sequential Programmable Devices.

MODULE – V (7 Hours)

IC Logic Families: Properties DTL, RTL, TTL, I^2L and CMOS and its gate level implementation. A/D converters and D/A converters**.**

College Level (20%)
Basic hardware description language: Introduction to Verilog/VHDL programming language, Verilog/VHDL program of logic gates, adders, Substractors, Multiplexers, Comparators, Decoders flip-flops, counters, Shift resistors.

Books:

- Digital Design, 3rd Edition, Moris M. Mano, Pearson Education.
- Fundamentals of digital circuits, 8th edition, A. Anand Kumar, PHI
- Digital Fundamentals, 5th Edition, T.L. Floyd and R.P. Jain, Pearson Education, New Delhi.
- Digital Electronics, G. K. Kharate, Oxford University Press.
- Digital Systems – Principles and Applications, 10th Edition, Ronald J. Tocci, Neal S. Widemer and Gregory L. Moss, Pearson Education.
- A First Course in Digital System Design: An Integrated Approach, India Edition, John P. Uyemura, PWS Publishing Company, a division of Thomson Learning Inc.
- Digital Systems – Principles and Applications, 10th Edition, Ronald J. Tocci, Neal S. Widemer and Gregory L. Moss, Pearson Education.

4th Semester	**REC4C202**	**Digital System Design Laboratory**	**L-T-P 0-0-3**	**2 CREDITS**

List of Experiments

(At least 10 experiments should be done, Experiment No. 1 and 2 are compulsory and out of the balance 8 experiments at least 3 experiments has to be implemented through both Verilog /VHDL and hardware implementation as per choice of the student totaling to 6 and the rest 2 can be either through Verilog /VHDL or hardware implementation.)

1. Digital Logic Gates: Investigate logic behavior of AND, OR, NAND, NOR, EX-OR, EX-NOR, Invert and Buffer gates, use of Universal NANDGate.
2. Gate-level minimization: Two level and multi level implementation of Booleanfunctions.
3. Combinational Circuits: design, assemble and test: adders and subtractors, code converters, gray code to binary and 7 segmentdisplay.
4. Design, implement and test a given design example with (i) NAND Gates only (ii) NOR Gates only and (iii) using minimum number ofGates.
5. Design with multiplexers andde-multiplexers.
6. Flip-Flop: assemble, test and investigate operation of SR, D & J-Kflip-flops.
7. Shift Registers: Design and investigate the operation of all types of shift registers with parallelload.
8. Counters: Design, assemble and test various ripple and synchronous counters - decimal counter, Binary counter with parallelload.
9. Memory Unit: Investigate the behaviour of RAM unit and its storage capacity – 16 X 4 RAM: testing, simulating and memoryexpansion.
10. Clock-pulse generator: design, implement andtest.
11. Parallel adder and accumulator: design, implement andtest.
12. Binary Multiplier: design and implement a circuit that multiplies 4-bit unsigned numbers to produce a 8-bitproduct.
13. Verilog/VHDL simulation and implementation of Experiments listed at Sl. No. 3 to 12

4th Semester	REN4E001	ENGINEERING ECONOMICS	L-T-P 3-0-0	3 CREDITS

Module - I (08 hours)

Engineering Economics- Nature, Scope, Basic problems of an economy, Micro Economics and Macro Economics.
Demand - Meaning of demand, Demand function, Law of Demand and its exceptions, Determinants of demand, Elasticity of demand & its measurement (Simple numerical problems to be solved), Demand Forecasting – Meaning
Supply-Meaning of supply, Law of supply and its exception, Determinants of supply, Elasticity of supply, Determination of market equilibrium (Simple numerical problems to be solved).

Module - II (08 hours)

Production - Production function, Laws of returns: Law of variable proportion, Law of returns to scale
Cost and Revenue Concepts - Total Costs, Fixed cost, Variable cost, Total revenue, Average revenue and Marginal revenue, Cost-Output Relationships in the Short Run, and Cost-Output Relationships in the Long Run, Analysis of cost minimization.

Module III (08 hours)

Market - Basic understanding of different market structures, Determination of equilibrium price under perfect competition (Simple numerical problems to be solved), Break Even Analysis-linear approach (Simple numerical problems to be solved).

Module - IV (12 hours)

Time Value of Money- Interest - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence.
Evaluation of Engineering Projects-Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects.
Depreciation- Depreciation of capital assert, Causes of depreciation, Methods of calculating depreciation - Straight line method, Declining balance method, SOYD method, After tax comparison of project.

Module –V (06 Hours)

Inflation-Meaning of inflation, types, causes, measures to control inflation.
National Income-Definition, Concepts of national income, Method of measuring national income.
Banking -Commercial bank, Functions of commercial bank, Central bank, Functions of Central Bank.

Books:

1. Principles of Economics by Deviga Vengedasalam and Karaunagaran Madhavan, Oxford
2. Riggs, Bedworth and Randhwa, “Engineering Economics”, McGraw Hill Education India
3. C. S. Park, Contemporary Engineering Economics, 6th Edition, Pearson Education, 2015.
4. Engineering Economy by William G.Sullivan, Elin M.Wicks, C. Patric Koelling, Pearson
5. R.Paneer Seelvan, “ Engineering Economics”, PHI
6. Ahuja,H.L., “Principles of Micro Economics” , S.Chand & Company Ltd
7. Jhingan,M.L., “Macro Economic Theory”

8. Macro Economics by S.P.Gupta, TMH

Course Outcomes of Engineering Economics

At the end of the course the engineering graduates will be able to

1. **Remembering** : Define the basic concept of micro and macro economics, engineering economics and their application in engineering economy.
2. **Understanding** : Evaluate numerically the effects of changes in demand and supply on price determination of products and services.
3. **Analyze :** the macroeconomic environment and financial systems of the country and its impact on business, society and enterprise.
4. **Develop :** the ability to account for time value of money using engineering economy factors and formulas.
5. **Apply:** knowledge of mathematics, economics and engineering principles to solve engineering problems and to analyze decision alternatives in engineering projects considering upon depreciation, taxes and inflation.

4th Semester	ROB4E002	ORGANISATIONAL BEHAVIOUR	L-T-P 3-0-0	3 CREDITS

Objectives:

1. To develop an understanding of the behavior of individuals and groups inside organizations
2. To enhance skills in understanding and appreciating individuals, interpersonal, and group process for increased effectiveness both within and outside of organizations.
3. To develop theoretical and practical insights and problem-solving capabilities for effectively managing the organizational processes.

Module-I: **(06 Hrs.)**

Fundamentals of OB: Definition, scope and importance of OB, Relationship between OB and the individual, Evolution of OB, Theoretical framework (cognitive), behavioristic and social cognitive), Limitations of OB.

Module-II: **(12 Hrs.)**

Attitude: Importance of attitude in an organization, Right Attitude, Components of attitude, Relationship between behavior and attitude, Developing Emotional intelligence at the workplace, Job attitude, Barriers to changing attitudes.
Personality and values: Definition and importance of Personality for performance, The Myers-Briggs Type Indicator and The Big Five personality model, Significant personality traits suitable to the workplace (personality and job – fit theory), Personality Tests and their practical applications.
Perception: Meaning and concept of perception, Factors influencing perception, Selective perception, Attribution theory, Perceptual process, Social perception (stereotyping and halo effect).
Motivation: Definition & Concept of Motive & Motivation, The Content Theories of Motivation (Maslow's Need Hierarchy & Herzberg's Two Factor model Theory), The Process Theories (Vroom's expectancy Theory & Porter Lawler model), Contemporary Theories – Equity Theory of Work Motivation.

Module-III: **(10 Hrs.)**

Foundations of Group Behavior: The Meaning of Group & Group behavior & Group Dynamics, Types of Groups, The Five – Stage Model of Group Development.
Managing Teams: Why Work Teams, Work Teams in Organization, Developing Work Teams, Team Effectiveness & Team Building.
Leadership: Concept of Leadership, Styles of Leadership, Trait Approach Contingency Leadership Approach, Contemporary leadership, Meaning and significance of contemporary leadership, Concept of transformations leadership, Contemporary theories of leadership, Success stories of today's Global and Indian leaders.

Module-IV: **(08 Hrs.)**

Organizational Culture : Meaning & Definition of Organizational Culture, creating & Sustaining Organizational Culture, Types of Culture (Strong vs. Weak Culture, Soft Vs. Hard Culture & Formal vs. Informal Culture), Creating Positive Organizational Culture, Concept of Workplace Spirituality.

Module-V: **(09 Hrs.)**

Organizational Change: Meaning, Definition & Nature of Organizational Change, Types of Organizational Change, Forces that acts as stimulants to change.
Implementing Organizational Change : How to overcome the Resistance to Change, Approaches to managing Organizational Change, Kurt Lewin's-Three step model, Seven Stage model of Change & Kotter's Eight-Step plan for Implementing Change, Leading the Change Process, Facilitating Change, Dealing with Individual & Group Resistance, Intervention Strategies for Facilitating Organizational Change, Methods of Implementing Organizational Change, Developing a Learning Organization.

Books:

1. Understanding Organizational Behaviour, Parek, Oxford
2. Organizational Behaviour, Robbins, Judge, Sanghi, Pearson.
3. Organizational Behaviour, K. Awathappa,HPH.
4. Organizational Behaviour, VSP Rao, Excel
5. Introduction to Organizational Behaviour, Moorhead, Griffin, Cengage.
6. Organizational Behaviour, Hitt, Miller, Colella, Wiley

4th Semester	REC4C003	Network Theory	L-T-P 3-0-0	3 CREDITS

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Apply network theorems for the analysis of electrical circuits.
- Obtain the transient and steady-state response of electrical circuits.
- Analyse circuits in the sinusoidal steady-state (single-phase and three-phase).
- Analyse two port circuit behavior.

Module-I: **(10 Hrs.)**

Network Theorems:Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

MODULE – II (09 Hrs.)

Solution of First and Second order networks: Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

MODULE – III (09 Hrs.)

Sinusoidal steady state analysis: Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

MODULE – IV (08 Hrs.)

Electrical Circuit Analysis Using Laplace Transforms: Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances

MODULE – V (09 Hrs.)

Two Port Network and Network Functions: Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

Books:

- M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
- D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
- W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
- C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
- K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.

- Network Synthesis – M E Van Valkenburg – Pearson Education.

- Network Analysis and Synthesis – Franklin F. Kuo – Wiley Student Edition.
- Linear Circuits Analysis and Synthesis – A Ramakalyan – Oxford University Press.
- Problems & Solutions in Electric Circuit Analysis – Sivananda & Deepa – Jaico Book.
- Theory and problem of electrical circuits, Schaum's Outline Series, TMH – Joseph A. Edminister, MahmoodMaqvi.
- Electric Circuits – David A.Bell – Oxford, 7th Edition, 2015.

4th Semester	**REC4C203**	**Network Theory Laboratory**	**L-T-P 0-0-3**	**2 CREDITS**

List of Experiments:
(At least 08 out of 10 experiments should be done)

1. Verification of Network Theorems using AC circuits. (Superposition, Thevenin, Norton, Maximum Power Transfer).
2. Study of DC and AC Transients for R-L, R-C & R-L-C circuits using storage oscilloscope.
3. Determination of circuit parameters: Open Circuit and Short Circuit parameters.
4. Determination of circuit parameters: Hybrid and Transmission parameters.
5. Frequency response of Low pass and High Pass Filters.
6. Frequency response of Band pass and Band Elimination Filters.
7. Determination of self inductance, mutual inductance and coupling coefficient of a single phase two winding transformer representing a coupled circuit.
8. Study of resonance in R-L-C series circuit using oscilloscope.
9. Study of resonance in R-L-C parallel circuit using oscilloscope.
10. Spectral analysis of a non-sinusoidal waveform.

4th Semester	REC4D001	Semiconductor Devices	L-T-P 3-0-0	3 CREDITS

MODULE-I (08 Hours)

Introduction to the quantum theory of solids: Formation of energy bands; the k-space diagram (two and three dimensional representation), conductors, semiconductors and insulators.

Electrons and Holes in semiconductors: Silicon crystal structure; Donors and acceptors in the band model; electron effective mass; Density of states; Thermal equilibrium; and Fermi-Dirac distribution function for electrons and holes; Fermi energy. Equilibrium distribution of electrons & holes: derivation of *n* and *p* from D(E) and f(E), Fermi level and carrier concentrations.

MODULE-I (09 Hours)

The *np* product and the intrinsic carrier concentration. General theory of *n* and *p;* Carrier concentrations at extremely high and low temperatures: complete ionization, partial ionization and freeze-out; Energy-band diagram and Fermi-level, Variation of E_F with doping concentration and temperature.

Motion and Recombination of Electrons and Holes: Carrier drift: Electron and hole mobilities; Mechanism of carrier scattering; Drift current and conductivity.

MODULE-III (10 Hours)

Motion and Recombination of Electrons and Holes (continued): Carrier diffusion: diffusion current, Total current density; relation between the energy diagram and potential, electric field; Einstein relationship between diffusion coefficient and mobility; Electron-hole recombination; Thermal generation.

PN Junction: Building blocks of the pn junction theory: Energy band diagram and depletion layer of a pn junction, Built-in potential; Depletion layer model: Field and potential in the depletion layer, depletion-layer width; Reverse-biased PN junction; Capacitance-voltage characteristics; Junction breakdown: peak electric field. Tunneling breakdown and avalanche breakdown; Carrier injection under forward bias-Quasi-equilibrium boundary condition; current continuity equation; Excess carriers in forward-biased pn junction; PN diode I-V characteristic, Charge storage.

MODULE-IV (08 Hours)

The Bipolar Transistor: Introduction, Modes of operation; Minority Carrier distribution, Collector current, Base current, current gain, Base width Modulation by collector current, Breakdown mechanism, Equivalent Circuit Models – Ebers -Moll Model.

MODULE-V (10 Hours)

Metal-Semiconductor Junction: Schottky Diodes: Built-in potential, Energy-band diagram, I-V characteristics, Comparison of the Schottky barrier diode and the pn-junction diode; Ohmic contacts: tunneling barrier, specific contact resistance**.**

MOS Capacitor: The MOS structure, Energy band diagrams, Flat-band condition and flat-band voltage, Surface accumulation, surface depletion, Threshold condition and threshold voltage, MOS C-V characteristics, Q_{inv} in MOSFET.

Books:

- Semiconductor Physics and Devices-Donald A. Neamen, Tata McGraw Hill Publishing Company Limited, New Delhi, 3rd Edition.
- Solid State Electronics Devices-Ben. G. Streetman and Sanjay Banarjee, Pearson Education, New Delhi, 6th Edition.
- Modern Semiconductor Devices for Integrated Circuits-Chenming Calvin Hu, Pearson Education/Prentice Hall, 2009.
- Physics of Semiconductor Devices-S.M. Sze and Kwok K. Ng, Wiley India Pvt. Limited, New Delhi, 3rd Edition.
- Physics of Semiconductor Devices-Dillip K. Roy, University Press (India) Pvt. Ltd., Hyderabad, 2nd Edition
- Semiconductor Physics and Devices- Fowler, Oxford University Press.
- Solid State Electronics Devices-D.K. Bhattacharya and Rajnish Sharma, Oxford University Press, New Delhi, 2nd Edition
- Fundamentals of Semiconductor Devices-M.K. Achuthan and K.N. Bhatt, Tata McGraw Hill Publishing Company Limited, New Delhi.

4th Semester	**REC4D002**	**Power Electronics**	**L-T-P 3-0-0**	**3 CREDITS**

Course Outcomes:

At the end of this course students will demonstrate the ability to

- Understand the differences between signal level and power level devices.
- Ability to analyze various single phase and three phase power converter circuits and understand their applications.
- Ability to analyze the operation of DC-DC choppers and their applications.
- Ability to analyze the operation of voltage source inverters and their applications.

Module-I: Power switching devices (8 Hours)

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Module-II: Thyristor rectifiers (9 Hours)

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R- load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

Module-III: DC-DC buck converter (8 Hours)

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage.

Module-IV: DC-DC boost converter (8 Hours)

Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Module-V: Single-phase voltage source inverter (12 Hours)

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage

Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation

Books:

- M. H. Rashid, "*Power electronics: circuits, devices, and applications*", Pearson Education India, 2009.
- N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
- R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
- L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

4th Semester	REC4D003	Sensors and Transducers	L-T-P 3-0-0	3 CREDITS

MODULE–I (12 Hours)

Elements of a general measurement system; Static Characteristics: systematic characteristics, statistical characteristics, calibration; Dynamic characteristics of measurement systems: transfer functions of typical sensing elements, step and frequency response of first and second order elements, and dynamic error in measurement systems.

MODULE–II (10 Hours)

Sensing elements: Resistive sensing elements: potentiometers, Resistance Temperature Detector (RTD), thermistors, strain gages. Capacitive sensing elements: variable separation, area and dielectric; Inductive sensing elements: variable reluctance and LVDT displacement sensors.

MODULE–III (10 Hours)

Signal Conditioning Elements: Deflection bridges: design of resistive and reactivebridges, push-pull configuration for improvement of linearity and sensitivity Amplifiers: Operational amplifiers-ideal and non-ideal performances, inverting, non-inverting and differential amplifiers, instrumentation amplifier, filters. A.C. carrier systems, phase sensitive demodulators and its applications in instrumentation.

MODULE–IV (8 Hours)

Thermoelectric sensing elements: laws, thermocouple characteristics, installation problems, cold junction compensation. IC temperature sensor Elastic sensing elements: Bourdon tube, bellows, and diaphragms for pressure sensing, force and torque measurement.

MODULE–V (5 Hours)

Electromagnetic sensing elements: velocity sensors

Books:

- Principles of Measurement Systems, J.P. Bentley, Pearson Education, New Delhi, 3rd Edition 2007.
- Introduction to Measurement and Instrumentation, A.K. Ghosh , PHI Learning, 3rd Edition,2009.
- Transducers and Instrumentation, D.V.S. Murthy, PHI Learning, New Delhi, 2009.
- Measurement Systems Application and Design, E.O. Doeblin, McGraw-Hill, 4th Edition.
- Instrumentation for Engineering Measurements, J.W. Dally, W.F. Riley and K.G. McConnel , John Wiley, NY,2nd edition 2003.
- Industrial Instrumentation, T.R. Padmanabhan, Springer, London, 2000.

4th Semester	REC4G001	Probability Theory And Stochastic Process	L-T-P 3-0-0	3 CREDITS

MODULE – I (12 Hours)

Sets and set operations; Probability space; Conditional probability and Bayes theorem;Combinatorial probability and sampling models.

MODULE – II (12 Hours)

Discrete random variables, probability mass function, probability distribution function,example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions;

MODULE – III (8 hours)

Joint distributions, functions of one and two random variables, moments of randomvariables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds.

MODULE – IV (7 hours)

Random sequences and modes of convergence (everywhere, almost everywhere,probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem.

MODULE – V (6 hours)

Random process. Stationary processes. Mean and covariance functions. Ergodicity.Transmission of random process through LTI. Power spectral density.

Books:

- H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education
- A.Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill.
- K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International
- P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers,
- P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers
- S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand representation of random signals
2. Investigate characteristics of random processes
3. Make use of theorems related to random signals
4. To understand propagation of random signals in LTI systems.

4th Semester	REC4G002	Data Structure	L-T-P 3-0-0	3 CREDITS

Module - I (12 Hrs.)

Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off.
Searching: Linear Search and Binary Search Techniques and their complexity analysis.

Module – II (08 Hrs.)

Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

Module - III (08 Hrs.)

Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

Module - IV (10 Hrs.)

Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.

Module - V (07 Hrs.)

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Books:

- "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.
- Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
- "How to Solve it by Computer", 2nd Impression by R.G. Dromey, Pearson Education.

4th Semester	REC4G003	Brain Control Interface	L-T-P 3-0-0	3 CREDITS

Module - I (10 Hrs.)

Introduction to Brain Control Interface
Fundamentals of BCI – Structure of BCI system – Classification of BCI: Invasive, Non-invasive and Partially invasive BCI-Brain signal acquisition, Signal Preprocessing, Artifacts removal.

Module – II (10 Hrs.)

Electrophysiological Sources
Sensorimotor activity –Neuronal activity in motor cortex and related areas- Electric and magnetic fields produced by the brain- signals reflecting brain metabolic activity- Mu rhythm, Movement Related Potentials – Slow Cortical Potentials - P300 Event related potential - Visual Evoked Potential - Activity of
Neural Cells - Multiple Neuromechanisms

Module - III (10 Hrs.)

Feature Extraction Methods
Time/Space Methods – Fourier Transform, Wavelets, AR, MA, ARMA models, Bandpass filtering, Template matching, Kalman filter, PCA, Laplacian filter – Linear and Non-Linear Features.

Module - IV (07 Hrs.)

Feature Translation Methods
Linear Discriminant Analysis –Nearest neighbours, Support Vector Machines - Regression – Learning Vector Quantization – Gaussian Mixture Modeling – Hidden Markov Modeling –
Neural Networks.

Module - V (08 Hrs.)

Applications of BCI
Study of BCI Competition III – Dataset I, II, III, IV and V, Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External
device controllers, Case study: Brain actuated control of mobile Robot. Ethical issues in BCI research

Books:

- Jonathan Wolpaw,Elizabeth Winter Wolpaw,'Brain Computer Interfaces: Principles and practice", Edition 1, Oxford University Press, USA, January 2012
- Special Issue on Brain Control Interfaces, IEEE Transactions on Neural Systems and Rehabilitation Engineering, Vol 14, June 2006.
- R. Spehlmann, "EEG Primer", Elsevier Biomedical Press, 1981.
- Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010
- Ali Bashashati, Mehrdad Fatourechi, Rabab K Ward, Gary E Birch," A survey of signal Processing algorithms in brain–computer interfaces based on electrical

brain signals" JOURNAL OF NEURAL ENGINEERING, VOL.4, 2007, PP.32-57

- Arnon Kohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, Boca Rato, Florida.
- Bishop C.M., "Neural networks for Pattern Recognition", Oxford, Clarendon Press, 1995.
- Andrew Webb, "Statistical Pattern Recognition", Wiley International, Second Edition, 2002.
- Torsten Felzer, "On the possibility of Developing a Brain Computer Interface", Technical Report, Technical University of Darmstadt, Germany,2001.
- Wolpaw J.R, N.Birbaumer et al, "Brain control interface for Communication and control", Clinical Neurophysiology, 113, 2002.
- Jose del R.Millan et al, "Non-invasive brain actuated control of a mobile robot by human
- EEG", IEEE Transactions on biomedical Engineering, Vol 51, No.6, 2004 June.
- S.Coyle, T.Ward et al, "On the suitability of near infra red systems for next generation Brain Computer interfaces", Physiological Measurement, 25, 2004.
- Carlo Tomasi, "Estimating Gaussian Mixture Densities with EM – A Tutorial", Duke University, 2000.
- R.Dugad, U.B Desai, "A Tutorial on Hidden Markov Modeling", Signal Processing and Artificial Neural Networks Laboratory, IIT Bombay, 1996.
- http:://ida.first.fhg.de/projects/bci/competition_iii

Course Outcomes:

Capable of acquiring the brain signal in the format required for the specific application

1. Well prepared for preprocessing the signal for signal enhancement
2. Ability to extract the dominant and required features and classify the signal for applications

4th Semester	RCN4F001	Constitution of India	L-T-P 3-0-0	0 CREDIT

Basic features and fundamental principles

The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India

11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21.

BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ODISHA

ROURKELA

Curriculum and Syllabus

B. Tech (*Electronics and Communication / Electronics and Telecommunication Engineering)* for the Batch

2018-19

Semester (5^{th})

B. Tech in Electronics and Communication / Electronics and Telecommunication Engineering (Admission Batch: 2018-2019)

5th Semester

Theory					
Sl. No.	Category	Course Code	Course Title	L-T-P	Credit
1	PC 11		Analog and Digital Communication	3-0-0	3
2	PC 12		Digital Signal Processing	3-0-0	3
3	PC 13		Microprocessors & Microcontrollers	3-0-0	3
4	PE 2		Fiber Optics & Opto Electronics Devices	3-0-0	3
			Computer Architecture and Organisation	3-0-0	
			Control System	3-0-0	
5	PE 3		Advance Electronic Circuits	3-0-0	3
			Electronics Instrumentation and Measurement	3-0-0	
			Digital VLSI Design	3-0-0	
6	MC 5		Universal Human Values		0
Total Credit (Theory)					**15**
Practical					
1	PC 14		Analog and Digital Communication Lab	0-0-3	2
2	PC 15		Digital Signal Processing Lab	0-0-3	2
3	PC 16		Microprocessors & Microcontrollers Lab	0-0-3	2
4	PSI 2		Evaluation of Summer Internship	0-0-3	1
Total Credit (Practical)					**7**
Total Semester Credit					**22**

5Th Semester

Analog and Digital Communication

Module I: **(4 hours)**

Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.

Module II: **(10 hours)**

Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and Deemphasis, Threshold effect in angle modulation.

Module III: **(12 hours)**

Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.

Module IV: **(6 hours)**

Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Base band Pulse Transmission- Inter symbol Interference and Nyquist criterion. Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Module V: **(10 hours)**

Digital Modulation trade-offs. Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation.

Books:

[1] Haykin S., "Communications Systems", John Wiley and Sons, 2001.

[2] Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.

[3] Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill,2001.

[4] Wozencraft J. M. and Jacobs I. M., "Principles of Communication Engineering", John Wiley, 1965.

[5] Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.

[6] Proakis J.G., " Digital Communications", 4th Edition, McGraw Hill, 2000.

Digital Learning Resources:

Course Name:	Analog communication
Course Link:	https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ee46
Course Instructor:	Prof. Goutam Das, IIT Kharagpur

Course Name:	Modern Digital Communication Techniques
Course Link:	https://nptel.ac.in/courses/117/105/117105144/
Course Instructor:	Prof. S.S. Das, IIT Kharagpur

Course Name:	Communication Engineering
Course Link:	https://nptel.ac.in/courses/117/102/117102059/
Course Instructor:	Prof. Surendra Prasad, IIT Delhi

5Th Semester

Digital Signal Processing

Module-I: **(08 hours)**

Discrete Time System: Basic Discrete Time Signals and their classifications, Discrete times systems and their classifications, Stability of discrete time system, Analysis and response (convolution sum) of discrete - time linear LTI system, Recursive and Non-recursive discrete time system, impulse response of LTI system, Correlation of discrete time Signal.

Module-II: **(08 hours)**

Z-Transform and Its Application to the Analysis of LTI Systems: Z-Transform, Direct Z-Transform, Properties of the Z- Transform, Inverse Z-Transform, Inversion Z-Transform by Power Series Expansion, Inversion of the Z-Transform by Partial-Fraction Expansion, Analysis of Linear Time Invariant Systems in the z-Domain.

Module-III: **(12 hours)**

Discrete Fourier Transform: Frequency-Domain Sampling and Reconstruction of Discrete-Time Signals, Discrete Fourier Transform, DFT as a Linear Transformation, Relationship of DFT to other Transforms, Properties of DFT: Periodicity, Linearity, and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution, Use of DFT in Linear Filtering, Filtering of Long Data Sequences.
Efficient Computation of DFT: FFT Algorithms, Direct Computation of the DFT, Radix-2 FFT Algorithms, Decimation-In-Time (DIT), Decimation-In-Time (DIF).

Module-IV: **(10 hours)**

Structure and Implementation of FIR and IIR Filter: Structure for the Realization of Discrete-Time Systems, Structure of FIR Systems: Direct- Form Structure, Cascade-Form Structure, Frequency Sampling Structure, Design of FIR Filters: Symmetric and Antisymmetric FIR Filters, Design of Linear-Phase FIR Filters by using Windows, Design of Linear-Phase FIR Filters by Frequency Sampling Method. Structure for IIR Systems: Direct-Form Structure, Signal Flow Graphs and Transposed Structure, Cascade-Form Structure, Parallel-Form Structure. Design of IIR Filters.

Module-V: **(07 hours)**

Analog Filters: IIR Filter Design by Impulse Invariance, IIR Filter Design by the Bilinear Transformation. Basic adaptive filter: Structure of Adaptive FIR filter, System Modelling and Inverse Modeling, Matlab realization of DFT, FFT, Z-transform, IIR, FIR and adaptive filter.

Books:

[1] Digital Signal Processing – Principles, Algorithms and Applications by J. G. Proakis and D Manolakis, Pearson.
[2] Digital Signal Processing: Tarun Kumar Rawat, Oxford University Press.
[3] Digital Signal Processing – S. Salivahan, A. Vallavraj and C. Gnanapriya, Tata McGrawHill.
[4] Digital Signal Processing – Manson H. Hayes (Schaum's Outlines) Adapted by Subrata Bhatt Tata McGraw Hill.
[5] Digital Signal Processing - Dr. Shalia D. Apte, Willey Publication

Digital Learning Resources:

Course Name: Digital Signal Processing
Course Link: https://nptel.ac.in/courses/117/105/117105144/

Course Instructor: Prof. Govind Sharma, IIT Kanpur

Course Name: Digital Signal Processing
Course Link: https://nptel.ac.in/courses/117/105/117105144/
Course Instructor: Prof. S.C. Dutta Roy, IIT Delhi

5Th Semester

Microprocessors and Microcontrollers

Module I:

Introduction to 8 bit and 16 bit Microprocessors-H/W architecture: (10 Hours)

Introduction to microprocessor, computer and its organization, Programming system; Address bus, data bus and control bus, Tristate bus; clock generation; Connecting Microprocessor to I/O devices; Data transfer schemes; Architectural advancements of microprocessors. Introductory System design using microprocessors; 8086 – Hardware Architecture; External memory addressing; Bus cycles; some important Companion Chips; Maximum mode bus cycle; 8086 system configuration; Memory Interfacing; Minimum mode system configuration, Interrupt processing.

Module II:

16-bit microprocessor instruction set and assembly language programming: (08 Hours)

Programmer's model of 8086; operand types, operand addressing; assembler directives, instruction Set-Data transfer group, Arithmetic group, Logical group.

Module III:

Microprocessor peripheral interfacing: (08 Hours)

Introduction; Generation of I/O ports; Programmable Peripheral Interface (PPI) - Intel 8255; Sample-and-Hold Circuit and Multiplexer; Keyboard and Display Interface; Keyboard and Display Controller (8279).

Module IV:

8-bit microcontroller- H/W architecture instruction set and programming: (12 Hours)

Introduction to 8051 Micro-Controllers, Architecture; Memory Organization; Special Function register; Port Operation; Memory Interfacing, I/O Interfacing; Programming 8051 resources, interrupts; Programmer's model of 8051; Operand types, Operand addressing; Data transfer instructions, Arithmetic instructions, Logic instructions, Control transfer instructions; Programming.

Module V: **(10 Hours)**

Maximum mode system configuration, Direct memory access, Interfacing of D- to-A converter, A-to-D converter, CRT Terminal Interface, Printer Interface, Programming of 8051 timers, 8051 serial interface. Introduction to 80386 and 80486 Microprocessor family.

Books:

[1] Microprocessor Architecture, Programming and application with 8085, R.S. Gaonkar, PRI Penram International publishing PVT. Ltd., 5th Edition

[2] Microprocessors and Interfacing, Programming and Hardware, Douglas V Hall, TMH Publication, 2006.

[3] Microprocessors and Interfacing, N. Senthil Kumar, M. Saravanan, S. Jeevananthan

and S.K. Shah, Oxford University Press.
[4] The 8051 Microcontroller and Embedded Systems, Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D.M C Kinlay, Pearson Education, Second Edition, 2008.
[5] Microcontrollers: Principles and Application, Ajit Pal, PHI Publication
[6] Microprocessors and Microcontrollers Architecture, programming and system design using 8085, 8086, 8051 and 8096, Krishna Kant, PHI Publication, 2007.
[7] Advanced Microprocessors and Peripherals, A.K. Ray, K M Bhurchandi, TMH Publication, 2007.
[8] Textbook of Microprocessor and Microcontroller, Thyagarajan, Scitech Publication.

Digital Learning Resources:

Course Name:	Microcontrollers and Applications
Course Link:	https://nptel.ac.in/courses/117/104/117104072/
Course Instructor:	Prof. S. P Das, IIT Kanpur

5Th Semester

Fiber Optics & Opto Electronics Devices

Module I: **(12 Hours)**

Fundamental of fiber optics, Different generations of optical fiber communication systems. Optical fiber structure, Fiber types, step index fiber and graded index fiber, ray propagation, total internal reflection, Numerical Aperture, acceptance angle. Wave propagation in a cylindrical wave guides, modal concept, V-number, power flow in step index fiber and graded index fiber, attenuation (absorption, scattering and bending) and dispersion (inter and intramodal, chromatic, wave guide and polarization) in fiber, dispersion shifted and dispersion flattened fiber.

Module II: **(12 Hours)**

Fiber fabrication, Double crucible method, Fiber optic cables, Connector and splice. Losses during coupling between source to fiber, fiber to fiber. Schemes for coupling improvement. Optoelectronic Sources, LED, ILD, light source materials, Radiation Pattern modulation capability.

Module III: **(06 Hours)**

Optoelectronic Detector, PIN AND APD, Responsivity, Band width, Detector noise equivalent circuit and SNR calculation.

Optoelectronic Modulators, Basic principle, Electro optic and Acoustoptic modulators.

Module IV:

Optical Amplifier, Semiconductor optical Amplifier and Erbium Doped Fiber Amplifier.

Module V:

WDM components-couplers, isolators, circulators, filters. Optical switching- self electro optic effect Device, switching speed and energy

Books:

[1] Optical Fiber Communications, Keiser G, Tata McGraw Hill Education Private Limited, 4th Edition.

[2] Optical Fiber Communication Principles and practice, Senior J, Prentice Hall of India.

[3] Fiber-Optic Communication Systems, G P Agarwal,4th edition, John wiley & sons publication,2011.

[4] Fiber optic communications, Joseph C Palais, fourth edition, Pearson Education.

[5] Semiconductor Optoelectronic Devices, Pallab Bhatttacharya, second edition, Pearson Education.

[6] Fiber optics and Optoelectronics, R.P. Khare, Oxford University Press.

Digital Learning Resources:

Course Name:	Fibre Optics
Course Link:	https://nptel.ac.in/courses/115/107/115107095/
Course Instructor:	Prof. V. Rastogi, IIT Roorkee

Course Name:	Fibre Optics
Course Link:	https://nptel.ac.in/courses/115/107/115107095/
Course Instructor:	Prof. V. Rastogi, IIT Roorkee

5Th Semester

Computer Organisation and Architecture

MODULE-I **(08 Hours)**

Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU–registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common CPUs.

MODULE-II **(08 Hours)**

Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift and add, Booth multiplier, carry save multiplier, etc. Division restoring and non restoring techniques, floating point arithmetic.

MODULE–III **(08 Hours)**

Introduction to x86 architecture. CPU control unit design: hardwired and micro-programmed design approaches, Case study – design of a simple hypothetical CPU. Memory system design: semiconductor memory technologies, memory organization. Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers–program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes–role of interrupts in process state transitions, I/O device interfaces – SCII, USB

MODULE –IV **(08 Hours)**

Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

Books:

[1] "Computer Organization and Design: The Hardware/Software Interface", 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.

[2] "Computer Organization and Embedded Systems", 6th Edition by CarlHamacher, McGraw Hill Higher Education

[3] "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill

[4] "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.

[5] "Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education.

Digital Learning Resources:

Course Name:	Computer Architecture and Organisation
Course Link:	https://nptel.ac.in/courses/106/105/106105163/
Course Instructor:	Prof. Indranil Sengupta and Prof. Kamalika Datta, IIT Kharagpur

Course Name:	Computer Organisation and Architecture
Course Link:	https://nptel.ac.in/courses/106/106/106106166
Course Instructor:	Prof. V. Kamakoti, IIT Madras

Course Name:	Computer Organisation
Course Link:	https://nptel.ac.in/courses/106/106/106106092
Course Instructor:	Prof. S. Raman, IIT Madras

Course Name:	Computer Organisation and Architecture
Course Link:	https://nptel.ac.in/courses/106/104/106104073
Course Instructor:	Prof. B. Raman, IIT Kanpur

Course Name:	Computer Organisation and Architecture
Course Link:	https://nptel.ac.in/courses/106/103/106103068
Course Instructor:	Prof. J.K Deka, IIT Guwahati

Course Name:	Computer Organisation and Architecture- A Pedagogical Aspect
Course Link:	https://nptel.ac.in/courses/106/103/106103180
Course Instructor:	Prof. J.K Deka, Dr. S. Biswas and Prof. A. Sarkar, IIT Guwahati

5Th Semester

Control System

Module I: **(5 hours)**

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Negative Feedback. Block diagram algebra. Signal Flow Graph and Mason's Gain formula.

Module II: **(10 hours)**

Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Module III: **(7 hours)**

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist stability criterion – gain and phase margins. Closed-loop frequency response: Constant M Circle, Constant N Circle, Nichols Chart.

Module IV: **(10 hours)**

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Tuning of PID controllers, Lead and Lag and Lag-Lead compensator design.

Module V: **(10 hours)**

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

Books:

[1] I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009.

[2] K. Ogata, "Modern Control Engineering", Prentice Hall, 1991

[3] M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.

[4] B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.

Digital Learning Resources:

Course Name:	Control System Engineering
Course Link:	https://nptel.ac.in/courses/108/102/108102043/
Course Instructor:	Prof. M Gopal, IIT Delhi

Course Name:	Control Systems
Course Link:	https://nptel.ac.in/courses/107/106/107106081/
Course Instructor:	Prof. C.S.Shankar Ram, IIT Madras

5Th Semester

Advance Electronics Circuits

Module-I: **(10 Hours)**

Active Filters :Active Filters, Frequency response of Major Active filters, First order low-pass Butterworth filter: Filter Design, Frequency Scaling, Second-order low- pass Butterworth filter: First-order high-pass Butterworth filter, Second-order high- pass Butterworth filter, Band-pass filters: Wide band-pass Filter, Narrow Band-Pass Filter, Band-reject filters: Wide Band-Reject Filter, Narrow Band-Reject Filter, All- Pass filter.

Oscillators: Oscillators: Oscillator Principles, Oscillator Types, Quadrature Oscillator, Saw tooth wave generator, Voltage-controlled oscillator.

Comparators: Comparators: basic comparator, zero-crossing detector, Schmitt trigger, comparator characteristics, limitations of Op-Amp as comparators, voltage limiters.

Module-II: **(10 Hours)**

Bistable Multivibrator: Bistable Multivibrator, fixed-bias bistable multi vibrator, Loading, self-biased transistor binary, commutating capacitors, Triggering the binary, Unsymmetrical Triggering of the bistable multivibrator, Triggering Un symmetrically through a Unilateral Device, Triggering, Triggering of a Bistable Multi Symmetrically without the Use of Auxiliary Symmetrical Diodes, Schmitt Trigger Circuit (Emitter-coupled Bistable Multivibrator

Monostable and Astable Multivibrator: Monostable Multivibrator, Gate width of a Collector-Coupled Monostable Multivibrator, wave form of the Collector-Coupled Monostable Multivibrator, Emitter -Coupled Monostable Multivibrator, triggering of the Monostable Multivibrator, Astable Collector-Coupled Multivibrator, Emitter -Coupled Astable Multivibrator

Wideband amplifiers: Wideband amplifiers: The Hybrid-π, High-frequency, Small- signal, Common-emitter Model, RC-Coupled Amplifier, Frequency Response of a Transistor Stage-The Short-Circuit Current Gain, Current Gain with Resistive Load, Transistor Amplifier Response taking Source Impedance into Account, Transient Response of a Transistor Stage.

Module-III: **(10 Hours)**

Negative Resistance Switching Devices: Voltage Controllable Negative resistance devices, Tunnel Diode operation and characteristics, Monostable Astable, Bistable circuits using tunnel diode, Voltage controlled Negative Resistance Switching Circuits.

Voltage and Current Time Base Generators: Time-Base Generators, General features of a Time-base signal, Methods of generating a voltage time-base waveform, Exponential sweep circuit, Miller and bootstrap time base generators-Basic principles, Transistor miller time base generator, Transistor bootstrap time base generator, Current Time-Base Generators, A Simple Current sweep, Linearity Correction through adjustment of driving waveform, Transistor current time base generator.

Module IV **(10 Hours)**

Specialized IC Applications: IC 555 Timer: IC 555 Timer as a Monostable Multivibrator and its applications, IC 555 Timer as Astable Multivibrator and its applications. Phase Locked Loop: Operating principle of PLL, Phase detectors, Exclusive-OR phase detector, Monolithic phase detector, Instrumentation Amplifier and its applications.

Module V

Cascaded CE Transistor Stages, Rise-time Response of Cascaded Stages, Shunt Compensation of a Transistor Stage in a Cascade, Rise Time of Cascaded Compensated Stages, Low frequency Compensation.

Books:

[1] Pulse, Digital and switching Waveforms, Jacob Millman, Herbert Taub and MS Prakash Rao, TMH Publication, Second Edition.

[2] Pulse, Switching and Digital Circuits,David A. Bell, Oxford University Press, Fifth Edition.

[3] OP-Amps and Linear Integrated Circuits, Ramakant A. Gayakwad, PHI Publication.

[4] Pulse & Digital Circuits, K.Venkata Rao, K Rama Sudha& G Manmadha Rao, Pearson Education, 2010.

[5] OP-Amps and Linear Integrated Circuits, Robert F. Coughlin, Frederick F. Driscoll, Pearson Education Publication.

[6] Pulse and Digital Circuits**,** A. Anand Kumar, PHI.

Digital Learning Resources:

5Th Semester

Electronics Instrumentation & Measurements

Module-I (12 Hours)

Basics of Measurements: Accuracy, Precision, resolution, reliability, repeatability, validity, Errors and their analysis, Standards of measurement. Bridge Measurement: DC bridges- wheat stone bridge, AC bridges – Kelvin, Hay, Maxwell, Schering and Wien bridges, Wagner ground Connection. Electronic Instruments for Measuring Basic Parameters: Amplified DC meter, AC Voltmeter, True- RMS responding Voltmeter, Electronic multi-meter, Digital voltmeter, Vector Voltmeter.

Module-II (12 Hours)

Oscilloscopes: Cathode Ray Tube, Vertical and Horizontal Deflection Systems, Delay lines, Probes and Transducers, Specification of an Oscilloscope. Oscilloscope measurement Techniques, Special Oscilloscopes – Storage Oscilloscope, Sampling Oscilloscope, Signal Generators: Sine wave generator, Frequency – Synthesized Signal Generator, Sweep frequency Generator. Pulse and square wave generators. Function Generators.

Module-III (10 Hours)

Signal Analysis: Wave Analyzer, Spectrum Analyzer. Frequency Counters: Simple Frequency Counter; Measurement errors; extending frequency range of counters Transducers: Types, Strain Gages, Displacement Transducers.

Module-IV (6 Hours)

Digital Data Acquisition System: Interfacing transducers to Electronics Control and Measuring System. Instrumentation Amplifier, Isolation Amplifier. An Introduction to Computer-Controlled Test Systems.IEEE-488 GPIB Bus

Books:

[1]. Modern Electronics Instrumentation & Measurement Techniques, by Albert D.Helstrick and William D.Cooper, Pearson Education.

[2]. Elements of Electronics Instrumentation and Measurement-3rd Edition by Joshph J. Carr. Pearson Education.

[3]. Electronics Instruments and Instrumentation Technology – Anand, PHI

[4] Doebelin, E.O., Measurement systems, McGraw Hill, Fourth edition, Singapore, 1990.

[5] A Course in Electrical and Electronic Measurements and Instrumentation, A K Sawhney, Puneet Swhney, Dhanpat Rai & Co

Digital Learning Resources:

Course Name:	Electrical Measurement and Electronics Instrument
Course Link:	https://nptel.ac.in/courses/108/105/108105153
Course Instructor:	Prof. Avisek Chatterjee, IIT, Kharagpur

5Th Semester

Digital VLSI Design

MODULE-I

Introduction: Historical Perspective, VLSI Design Methodologies, VLSI Design Flow, Design Hierarchy, Concept of Regularity, Modularity and Locality, VLSI Design Styles, Computer-Aided Design Technology.

Fabrication of MOSFETs: Introduction, Fabrication Processes Flow – Basic Concepts, The CMOS n-Well Process, Layout Design Rules, Stick Diagrams, Full Customs Mask Layout Design.

MOS Transistor: The Metal Oxide Semiconductor (MOS) Structure, The MOS System under External Bias, Structure and Operation of MOS Transistor (MOSFET), MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitance.

MODULE-II

MOS Inverters – Static Characteristics: Introduction, Resistive-Load Inverters, Inverters with n-Type MOSFET Load, CMOS Inverter.

MOS Inverters – Switching Characteristics and Interconnect Effects: Introduction, Delay-Time Definitions, Calculation of Delay-Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters.

Combinational MOS Logic Circuits: Introduction, MOS Logic Circuits with Depletion NMOS Loads, CMOS Logic Circuits, Complex Logic Circuits, CMOS Transmission Gates (Pass Gates).

MODULE-III

Sequential MOS Logic Circuits: Introduction, Behaviour of Bistable Elements, SR Latch Circuits, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge Triggered Flip Flop.

Dynamic Logic Circuits: Introduction, Basic Principles of Pass Transistor Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques, High Performance Dynamic CMOS Circuits.

MODULE-IV

Design for Testability: Introduction, Fault Types and Models, Ad Hoc Testable Design Techniques, Scan-Based Techniques, Built-In Self-Test (BIST) Techniques, Current Monitoring IDDQ Test.

MODULE-V

Semiconductor Memories: Introduction, Dynamic Random Access Memory (DRAM), Static Random Access Memory (SRAM), Non-volatile Memory, Flash Memory.

Books:

[1] *CMOS Digital Integrated Circuits: Analysis and Design*, Sung-Mo Kang and Yusuf Leblebici, Tata McGraw-Hill Publishing Company Limited, 3rdEdn, 2003.

[2] Principles of CMOS VLSI Design – a Systems Perspective, K. Eshraghian and N.H.E. Weste, Addison Wesley,2nd Edition, 1993.

[3] Digital Integrated Circuits– *A Design Perspective***,** Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, PHI, 2nd Edn.

[4] Modern VLSI Design System – *on – Chip Design*, Wayne Wolf, PHI, 3rd Edn.
[5] VLSI Design, Debaprasad Das, Oxford University Press, New Delhi, 2010.
[6] CMOS Logic Circuit Design, John P. Uyemura, Springer, 2001.
[7] Digital Integrated Circuit Design, Ken Martin, Oxford University Press, 2000.
[8] VLSI Design Technique forAnalog and Digital Circuits, R L Geiger, TMH.

Digital Learning Resources:

Course Name:	VLSI Design
Course Link:	https://nptel.ac.in/courses/117/101/117101058/
Course Instructor:	Prof. A.N. Chandorkar, IIT Bombay

Course Name:	Digital VLSI Testing
Course Link:	https://nptel.ac.in/courses/117/105/117105137/
Course Instructor:	Prof. S, Chattopadhyay, IIT Kharagpur

Course Name:	VLSI Technology
Course Link:	https://nptel.ac.in/courses/117/106/117106093/
Course Instructor:	Dr. Nandita Dasgupta, IIT Madras

5Th Semester

Universal Human Values

(Self, Society and Nature)

Pre-requisites: Universal Human Values: Self & Family (desirable); 4-day Harmony-2 Workshop (co-requisite). Please refer to AICTE Model Curriculum-Vol-II.

1. Objective:

The objective of the course is four-fold:

A. Sensitization of student towards issues in society and nature.
B. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.
C. Strengthening of self reflection.
D. Development of commitment and courage to act.

(For elaboration on some of the above, consult course description for Universal Human Values 1: Self and Family, AICTE Model Curriculum-VOL-II).

2. Course Topics :

In this Universal Human Values course, the focus is more on understanding society and nature on the basis of self and human relationships.

i) Purpose and motivation for the course.
ii) Recapitulation (from the previous course) on ideas of self, pre-conditioning, and natural acceptance.
iii) Harmony in the self. Understanding human being as co-existence of self and body. Identifying needs and satisfying needs of self and body. Self-observations. Handling peer pressure.
iv) Recapitulation on relationships. Nine universal values in relationships. Reflecting on relationships in family. Hostel and institute as extended family. Real life examples.
v) Teacher-student relationship. Shraddha. Guidance. Goal of education.
vi) Harmony in nature. Four orders of nature – material order, plant order, animal order and human order. Salient features of each. Human being as cause of imbalance in nature. (Film **"Home"** can be used.)
vii) Human being as cause of imbalance in nature. Depletion of resources – water, food, mineral resources. Pollution. Role of technology. Mutual enrichment not just recycling.
viii) Prosperity arising out of material goods and understanding of self. Separation of needs of the self and needs of the body. Right utilization of resources. lkekU; vkdka{kk ,oa egRokdka{kk, Understanding the purpose they try to fulfil.

ix) Recapitulation on society. Five major dimensions of human society. Fulfilment of the individual as major goal. Justice in society. Equality in human relationships as naturally acceptable. Establishment of society with abhaya (absence of fear).

x) Ethical human conduct. Values, character and netikataa.

xi) Professional ethics. Conduct as an engineer or scientist.

Analog and Digital Communication Laboratory

List of Experiments

Analog Communication: (Any five)

1. Analyze and plot the spectrum of following signals with aid of spectrum analyzer: Sine wave, square wave, triangle wave, saw-tooth wave of frequencies 1 KHz, 10 KHz, 50 KHz, 100KKz and 1 MHz.
2. Analyze the process of frequency division multiplexing and frequency division demultiplexing.
3. Study and design of AM modulator and demodulator. (Full AM, SSB, DSBSC, SSBSC)
4. Study of FM modulation and Demodulation Techniques.
4. Observer the process of PAM, quantization and determination of quantization noise.
5. Multiplex 2-4 PAM/ PPM and PWM signals.
6. Using MATLAB/ LABVIEW generate a carrier and a modulating signal. Modulate the carrier using AM. Show the waveform in time domain and analyze its frequency spectrum. Repeat the simulation for modulating signal being square, triangular and other forms waveform.
7. Using MATLAB/ LABVIEW generate a carrier and a modulating signal. Modulate the carrier using FM. Show the waveform in time domain and analyze its frequency spectrum. Repeat the simulation for modulating signal being square, triangular and other forms waveform.
8. Using Lab-View software simulates AM/FM modulation and demodulation system.

Digital Communication: (Any five)

1. Study the functioning of PCM and Delta modulator; Demonstrate the process of PCM modulation and Delta modulation.
2. Modulation generation and detection Signal generator CRO
3. To study Time division multiplexing.
4. To study the different channel coding and decoding technique.
5. Generation and reception of different types of signals like ASK, PSK, FSK.
6. To transmit and receive three separate signal audio, video, tone simultaneously through satellite link.
7. To transmit PC data through satellite link using a satellite communication demonstration unit.
8. Experimentally compare different forms of BPSK, QPSK, and OQPSK and analyze their Spectrum with spectrum analyzer.

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Digital Signal Processing Laboratory

List of Experiments

1. Familiarization with the architecture of a standard DSP kit (Preferably TMS 320C6XXX DSP kit of Texas Instruments)
2. Generation of various types of waveforms (sine, cosine, square, triangular etc.) using MATLAB and DSP kit.
3. Linear convolution of sequences (without using the inbuilt conv. function in MATLAB) and verification of linear convolution using DSP kit.
4. Circular convolution of two sequences and comparison of the result with the result obtained from linear convolution using MATLAB and DSP kit.
5. (i) Computation of autocorrelation of a sequence, cross correlation of two sequences using MATLAB.
   (ii) Computation of the power spectral density of a sequence using MATLAB also implementing the same in a DSP kit.
6. Finding the convolution of a periodic sequence using DFT and IDFT in MATLAB.
7. (i) Implementation of FFT algorithm by decimation in time and decimation in frequency using MATLAB.
   (ii) Finding the FFT of a given 1-D signal using DSP kit and plotting the same.
8. Design and implementation of FIR (lowpass and highpass) Filters using windowing techniques (rectangular window, triangular window and Kaiser window) in MATLAB and DSP kit.
9. Design and implementation of IIR (lowpass and highpass) Filters (Butterworth and Chebyshev) in MATLAB and DSP kit.
10. (i) Convolution of long duration sequences using overlap add, overlap save using MATLAB.
    (ii) Implementation of noise cancellation using adaptive filters on a DSP kit.

Digital Learning Resources:

Virtual Lab Link: http://vp-dei.vlabs.ac.in/Dreamweaver/list.html

Microprocessors and Microcontrollers Laboratory

List of Experiments

(Perform any 10 Experiments)

1. Programs for 16-bit arithmetic operations using 8086.
2. Programs for Sorting and Searching (Using 8086).
3. Programs for String manipulation operations (Using 8086).
4. Programs for Digital clock and Stop watch (Using 8086).
5. Interfacing ADC and DAC.
6. Parallel Communication between two MP Kits using Mode 1 and Mode 2 of 8255.
7. Interfacing and Programming 8279, 8259, and 8253.
8. Serial Communication between two MP Kits using 8251.
9. Interfacing and Programming of Stepper Motor and DC Motor Speed control.
10. Programming using Arithmetic, Logical and Bit Manipulation instructions of 8051microcontroller.
11. Programming and verifying Timer, Interrupts and UART operations in 8051
12. Communication between 8051 Microcontroller kit and PC.
13. A design problem using 8051 (A problem like multi-parameter data acquisition system, voltmeter, power meter, frequency counter, traffic simulation, digital clock, etc)

Digital Learning Resources:

Virtual Lab Link: http://202.3.77.143/virtuallab/login.php

BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ODISHA

ROURKELA

Curriculum and Syllabus

B. Tech (Electronics and Communication Engineering/ Electronics and Tele Communication Engineering) from the Admission Batch

2018-19

Semester (6th)

Sixth Semester							
Theory							
Sl. No.	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**	**University Marks**	**Internal Evaluation**
1	PC	RCS6C001	Microwave Engineering	3-0-0	3	100	50
2	PC	RCS6C002	Wireless Communication	3-0-0	3	100	50
3	BS		Optimization in Engineering	3-0-0	3	100	50
4	PE		Antenna Engineering	3-0-0	3	100	50
			Micro Electronic Mechanical Systems	3-0-0			
			Biomedical Instrumentation	3-0-0			
5	OE		Artificial Intelligence and Machine Learning	3-0-0	3	100	50
			Renewable Power Generation Systems	3-0-0			
			Data Communication and Computer Networks	3-0-0			
6	MC*	RIK6F001	Essence of Indian Knowledge Tradition - I	3-0-0	0	-	100 (Pass mark is 37)
Total Credit (Theory)					**15**		
Total Marks						**500**	**250**
Practical							
1	PC	RCS6C201	Microwave Engineering Lab	0-0-3	2		100
2	PC	RCS6C202	Wireless Communication Lab	0-0-3	2		100
3	PSI		Future-ready Contributor Program	0-0-3	2		100
4	PSI		Seminar - I	0-0-3	1		100
Total Credit (Practical)					**7**		
Total Semester Credit					**22**		
Total Marks							**400**
SUMMER ENTERNSHIP TRAINING FOR 45 DAYS							

***Mandatory Non-Credit Courses (MC) result will be reflected with Pass (P) / Fail (F) grade. Thus the grade obtained will not be affecting the grade point average. However it shall appear on the grade sheet as per AICTE rule.**

6th Semester	RCS6C001	Microwave Engineering	L-T-P 3-0-0	3 Credits

Module I: **(10 hours)**

High Frequency Transmission lines and Wave guides : The Lumped –Element Circuit model for a Transmission line. Wave propagation. The lossless line. Field Analysis of Co-ax Transmission Lines. R, L. C. G parameters of Co-ax& Two wire Transmission Lines. Terminated lossless transmission line. Transmission line as circuit element. The Smith Chart. Solution of Transmission line problems using Smith Chart. Single Stub and Double Stub matching. Lowloss line.

Wave guides : Rectangular waveguide, Field solution for TE and TM modes, Field patterns power flow through waveguide. Attenuation due to conductor and dielectric losses. Design of Rectangular waveguide to support Dominant TE10 only.

Module II: **(10 hours)**

TEM mode in Co-ax line. Cylindrical waveguide - Dominant Mode. Design of Cylindrical Waveguide to support Dominant TE11 mode. Microwave Resonator : Rectangular Waveguide Cavities. Resonant frequencies and of Cavity Supporting. Dominant mode only. Excitation of waveguide and Resonators (in princle only) Waveguide Components: Power Dividers and Directional Couplers : Basic Properties. The T-Junction Power Divider. Waveguide Directional Couplers. Fixed and Precision Variable Attenuator. Ferrite, Fermle Isolator . Principle of Operationing.

Module III: **(8 hours)**

Principle of Operation as an amplifier at high frequency, HEMT Amplifier, Concept of Doherty Amplifier and its use at high frequency, Gunn Oscillator Principle and performance Simple Analysis Electron – field interaction, Mixer: Linear Mixer Operation, active devices to use as mixer

Module IV: **(6 hours)**

Microwave Antennas: Horn Antennas : E-And H- Plane Horns. Radiation Patterns. Pyramidal Horn. Gain of Horn Antenna. Paraboloid Reflector Antenna – Simple Analysis , Radiation Pattern in principal Planes. Gain and Bandwidth of Reflector Antenna. Microwave Propagation : Line of sight propagation. Attenuation of Microwaves by Atmospheric gases, Water Vapour & Precipitates. Microwave Measurement : Measurement of Admittance . Measurement of Gain of a Horn Antenna.

Books:

[1] Microwave Engineering by D. M. Pozor , 2nd Edition. John Willy & Sons. Selected portions from Chapter 2, 3, 4, 6, 7 & 9.
[2] Principles of Microwave Engineering By Reich, Oudong and Others.
[3] Microwave Device and Circuit, 3rd Edition, Sammuel Y., Liao, Perason
[4] Microwave Devices and Circuits, G S N Raju

Digital Learning Resources:

Course Name:	Microwave Engineering
Course Link:	https://nptel.ac.in/courses/108/103/108103141/
Course Instructor:	Dr. Ratnajit Bhattacharjee, IIT, Guwahati

Course Name:	Microwave Theory and Techniques
Course Link:	https://nptel.ac.in/courses/108/101/108101112/
Course Instructor:	Prof. Girish Kumar, IIT, Bombay

6th Semester		Wireless Communication	L-T-P 3-0-0	3 Credits

Module I: **(5 hours)**

History of wireless communication: Concept of mobile and personal communication, wireless cellular platform, the design fundamentals of cellular networks, frequency reuse, spectrum capacity enhancement techniques, co-channel and adjacent channel interference, location management, handoff management; Concept of mobile IP for mobility management issues.

Module II: **(10 hours)**

Propagation Models for Wireless Networks: Two-ray ground reflection model, a micro-cell propagation model, a macro-cell propagation model, shadowing model, large scale path loss and shadowing, multi path effects in mobile communication, linear time variant channel model; Concept of coherent bandwidth, Coherent time, Doppler Shift - Effect of velocity of the mobile, models for multi path reception, mobile communication antennas.

Module III: **(7 hours)**

Multiple access techniques in wireless communications: frequency division multiple access technology (FDMA), time division multiple access (TDMA), space division multiple access (SDMA), code division multiple access (CDMA); spectral efficiency of different wireless access technologies, spectral efficiency in FDMA system, spectral efficiency in TDMA system, spectral efficiency for DS-CDMA system.

Module IV: **(10 hours)**

Second Generation Mobile Networks-GSM: Architecture and protocols, access technology, call set up procedure, 2.5 G networks; evolution to GPRS, concept of data communication on GPRS, session management and PDP Context, data transfer through GPRS network and routing, concept of LTE, WiMax, 4G and 5G

Module V: **(8 hours)**

Applications of different RF bands: ranges • Brief about various applications of RF technology like WiFi, Bluetooth, Air traffic control, GPS navigation system, satellite systems, mobile networks, radio astronomy and remote sensing, 5G technology. • LTE-WiFi Radio Level Aggregation (LWA).

Books:

[1] Wireless Communications- Principles and Practice, T S Rappaport, Pearson Education India, Second Edition.
[2] Wireless Communication and Networks, Upen Dalal, Oxford university Press, First Edition, 2015.
[3] Wireless Communication and Networks 3G and Beyond, Iti Saha Misra, Tata McGraw Hill Education Pvt. Ltd, Second Edition, 2009.
[4] Mobile Communication Engineering – Theory and Applications W C Y Lee, TMH Publication, Second Edition, 2008.
[5] Wireless Communication, Andrea Goldsmith, Cambridge University Press, 2005
[6] Fundamentals of Wireless Communication, David Tse and Pramod Viswanath, Cambridge University Press, 2005

Digital Learning Resources:

Course Name:	Wireless Communication
Course Link:	https://nptel.ac.in/courses/117/102/117102062/
Course Instructor:	Prof. Ranjan Bose, IIT, Delhi

Course Name:	Introduction to Wireless and Cellular Communication
Course Link:	https://nptel.ac.in/courses/108/106/106106167/
Course Instructor:	Prof. David KoilPillai, IIT, Madras

6th Semester		Optimization in Engineering	L-T-P 3-0-0	3 Credits

Module I: **(10 Hours)**

Idea of Engineering optimization problems, Classification of optimization algorithms, modeling of problems and principle of modeling. Linear Programming: Formulation of LPP, Graphical solution, Simplex method, Big-M method, Revised simplex method, Duality theory and its application, Dual simplex method, Sensitivity analysis in linear programming.

Module II: **(10 Hours)**

Transportation problems: Finding an initial basic feasible solution by Northwest Corner rule, Least Cost rule, Vogel's approximation method, Degeneracy, Optimality test, MODI method, Stepping stone method. **Assignment problems:** Hungarian method for solution of Assignment problems. Integer Programming: Branch and Bound algorithm for solution of integer programming problems.

Module III: **(12 Hours)**

Non-linear programming: Introduction to non-linear programming. Unconstraint optimization: Fibonacci and Golden Section Search method. Constrained optimization with equality constraint: Lagrange multiplier, Projected gradient method. Constrained optimization with inequality constraint: Kuhn-Tucker condition, Quadratic programming.

Module IV: **(6 Hours)**

Queuing models: General characteristics, Markovian queuing model, M/M/1 model, Limited queue capacity, multiple server, Finite sources, Queue discipline.

Books:

[1] Operations Research- Principle and Practice, A. Ravindran, D. T. Philips, J. Solberg, Second edition, Wiley India Pvt Ltd.
[2] Operation Research, Prabhakar Pai ,Oxford University Press
[3] Optimization for Engineering Design, Kalyanmoy Deb, PHI Learning Pvt Ltd.
[4] Operations Research, H.A.Taha, A.M.Natarajan, P.Balasubramanie, A.Tamilarasi, Pearson Education, Eighth Edition.
[5] Engineering Optimization, S S Rao, New Age International Pvt Ltd, 2003.
[6] Linear and Non-linear Optimization, **S**tephen G. Nash, A. Sofer, McGraw Hill, 2nd Edition.
[7] Engineering Optimization, A.Ravindran, K.M.Ragsdell, G.V.Reklaitis, Wiley India Pvt. Ltd, Second edition.
[8] Operations Research, F.S.Hiller, G.J.Lieberman, Tata McGraw Hill, Eighth Edition, 2005.
[9] Operations Research, P.K.Gupta, D.S.Hira, S.Chand and Company Ltd, 2014.

Digital Learning Resources:

Course Name	Constrained and Unconstrained Optimization
Course Link	https://nptel.ac.in/courses/111/105/111105100/
Course Instructor	Prof. A. Goswami and Prof. D. Chakraborty, IIT Kharagpur

6th Semester		Antenna Engineering	L-T-P 3-0-0	3 Credits

Module-I: **(10 Hours)**

Principles of Radiation, Retarded Vector Magnetic Potential. Radiation field from Current element. Radiation Resistance, Current Distribution, on a thin Wire. Half wave dipole and Quarter wave monopole. Two-element array. Principle of Pattern Multiplication. Linear Array. Broadside and end fire patterns. Antenna Gain, effective length of an antenna. Input Impedance. Balun.

Module-II: **(10 Hours)**

Folded Dipole, Yagi Antenna. Frequency Independent Antenna. Log Periodic Dipole array. Secondary Sources and Aperture Antennas . Magnetic Current. Principles of Images. The Equivalence Theorem. Radiation form Huygen's Sources. Radiation from open end of a Co-axial line. Aperture in an absorbing screen. Radiation through an aperture in a perfectly conducting screen. Babinet's Principle– Complementary Screen. A thin slot in an infinite Screen. Slot antenna on a rectangular wave guide wall.

Module-III: **(8 Hours)**

Horn Antennas – Pyramidal &Sectoral Horn. Radiation Pattern and Gain of horn antenna. Parabolic Reflector Antenna Principle, analysis, Radiation Pattern and Gain. Principles of Casse grain Antenna. Inducted EMF method of Calculating Input Impedance of wire antenna. Mutual Impedance between two dipoles.

Module IV **(8 Hours)**

Microstrip Antenna – Basic Characteristics, Rectangular Patch, Circular Patch, Microship Array Antenna. Electronic Scanning Antenna- Phase Scanning, Frequency Scanning and Beam switching Antenna Measurements – Radiation Pattern, Gain and Input Impedance. 5G Antenna

Books:

[1] Electromagnetic Wave and Radiating Systems by E. C Jordan and K. G. Balmain, 2nd Edition , PHI. Ch. 10,11,12,13,14 and 15.
[2] Antennas Theory - Analysis and Design By C Balamis, 2nd Edition, John Willey & Sons. Selected portion Ch. 11,12,13, 15 and 16.
[3] Antenna Engineering by J. D. Krauss.
[4] Antenna Engineering by W. L. Weeks
[5] Antennas and Wave Propagation by G. S. N. Raju, Pearson Education.
[6] Antenna & Wave Propagation by R.E. Collins.

Digital Learning Resources:

Course Name: Antennas
Course Link: https://nptel.ac.in/courses/108/101/108101092/
Course Instructor: Prof. Girish Kumar, IIT, Bombay

Course Name: Analysis and Design Principles of Microwave Antennas
Course Link: https://nptel.ac.in/courses/108/105/108105114/
Course Instructor: Dr. Amitabha Bhattacharya, IIT Kharagpur

6th Semester		Micro Electronic Mechanical Systems	L-T-P 3-0-0	3 Credits

Module-I: **(12 hours)**

Introduction and Emergence of MEMS, Scaling issues, materials for MEMS, Thin film deposition, Photolithography, doping, wet and dry etching

Micromachining Techniques: Surface and Bulk micro machining, wafer bonding, surface micro machining and LIGA process, Silicon as material for micromachining, (Chapter 3 and Section 8.2 of Book 1, Chapter 2 of Book 2)

Module-II: **(12 hours)**

MEMS devices, Engineering Mechanics for Micro System Modeling and Design – static bending of thin plates, Mechanical vibrational analysis, Thermo mechanical analysis, fracture mechanics analysis, thin film mechanics, Mechanics of deformable bodies, Energy method, Estimation of stiffness and damping for different micro-structures, Modeling of electromechanical systems, Pull-in voltage, Theory and design: Micro Pressure Sensor, micro accelerometer – capacitive and piezoresistive, micro actuator.(Section 4.1 to 4.3 and 6.2.2 of Book 1, Section 3.4 of Book 2)

Module-III: **(12 hours)**

MEMS Applications: Mechanical sensors and actuators: Piezoresistive pressure sensors, MEMS capacitive accelerometer, Optical Gyroscopes: Micro-lens, Micro-mirror, Optical Switch Radiofrequency MEMS: Inductor, Varactor, Filter, Resonator.

Microfluidics: Capillary action, Micro pumping, Electro wetting, Lab-on-a-chip.

Electronic interfaces, design, simulation and layout of MEMS devices using CAD tools. (Section 10.1to 10.8 of Book 2)

Books:

[1] G.K. Ananthsuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat and V.K. Atre: Micro and Smart Systems, Wiley India, New Delhi, 2010.

[2] N.P. Mahalik: MEMS, Tata McGraw-Hill, New Delhi, 2007.

[3] T. Hsu: MEMS and Microsystems: Design and Manufacture, Tata McGraw-Hill, New Delhi, 2002.

[4] Gabriel M. Rebeiz: RF MEMS Theory, design &Technology, Wiley India Education,2010.

Digital Learning Resources:

Course Name: MEMS and Microsystems
Course Link: https://nptel.ac.in/courses/117/105/117105082/
Course Instructor: Prof. Santiram Kal, IIT Kharagpur

6th Semester		Biomedical Instrumentation	L-T-P 3-0-0	3 Credits

Module-I: **(13 Hours)**

Introduction to Bioengineering, Biochemical Engineering, Biomedical Engineering, Sources of Biomedical Signals, Basic medical Instrumentation systems and their need, use of microprocessors in medical instruments, PC based medical Instruments, general constraints in design of medical Instrumentation system & Regulation of Medical devices.

Bioelectrical Signals & Electrodes: Origin of Bioelectric Signals, Electrocardiogram, Electroencephalogram, Electromyogram, Electrode-Tissue Interface, Polarization, Skin Contact Impedance, Motion Artifacts.

Module-II: **(10 Hours)**

Electrodes for ECG: Limb Electrode, Floating Electrodes, Pre-gelled disposable Electrodes, Electrodes for EEG, Electrodes for EMG.

Physiological Transducers: Introduction to Transducers, Classification of Transducers, Performance characteristics of Transducers, Displacement, Position and flow and pressure Transducers.

Strain gauge pressure transducers, Thermocouples, Electrical Resistance Thermometer, The mister, Photovoltaic transducers, Photo emissive Cells & Biosensors (Biochemical sensors).

Module-III: **(10 Hours)**

Recording Systems: Basic Recording systems, General considerations for Signal conditioners, Preamplifiers, Differential Amplifier, Isolation Amplifier, Electrostatic and Electromagnetic Coupling to AC Signals, Proper Grounding (Common Impedance Coupling)

Books:

[1] Hand Book of Biomedical Instrumentation by R.S. Khandpur,-2nd Edition, Tata McGrawHill, 2003.
[2] Introduction to Biomedical Engineering by Michael M.Domach,Pearson Education Inc,-2004.
[3] Biomedical Instrumentation and Measurements- by Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, 2ndEdition, PHI learning Pvt. Ltd
[4] Introduction to Biomedical equipment technology,4e. By JOSEPH.J.CAAR &JOHN M.BROWN (Pearson education publication).
[5] Medical Instrumentation-application & design. 3e – By JOHN.G.WEBSTER John Wiley & Sons publications.

Digital Learning Resources:

Course Name: Biomedical Signal Processing
Course Link: https://nptel.ac.in/courses/108/105/108105101/
Course Instructor: Prof. Sudipta Mukhopadhyay , IIT Kharagpur

6th Semester		Artificial Intelligence and Machine Learning	L-T-P 3-0-0	3 Credits

Module-I: **(12 hours)**

INTRODUCTION –The Foundations of Artificial Intelligence; - INTELLIGENT AGENTS – Agents and Environments, Good Behaviour: The Concept of Rationality, the Nature of Environments, the Structure of Agents, SOLVING PROBLEMS BY SEARCH – Problem-Solving Agents, Formulating problems, Searching for Solutions, Uninformed Search Strategies, Breadth-first search, Depth-first search, Searching with Partial Information, Informed (Heuristic) Search Strategies, Greedy best-first search, A* Search, CSP, Means-End-Analysis.

Module-II: **(12 hours)**

ADVERSARIAL SEARCH – Games, The Mini-Max algorithm, optimal decisions in multiplayer games, Alpha-Beta Pruning, Evaluation functions, Cutting off search, LOGICAL AGENTS – Knowledge-Based agents, Logic, Propositional Logic, Reasoning Patterns in Propositional Logic, Resolution, Forward and Backward chaining - FIRST ORDER LOGIC – Syntax and Semantics of First-Order Logic, Using First-Order Logic , Knowledge Engineering in First-Order Logic - INFERENCE IN FIRST ORDER LOGIC – Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution

Module-III: **(6 hours)**

UNCERTAINTY – Acting under Uncertainty, Basic Probability Notation, The Axioms of Probability, Inference Using Full Joint Distributions, Independence, Bayes' Rule and its Use, PROBABILISTIC REASONING – Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distribution, Exact Inference in Bayesian Networks, Approximate Inference in Bayesian Networks

Module-IV: **(10 hours)**

LEARNING METHODS – Statistical Learning, Learning with Complete Data, Learning with Hidden Variables, Rote Learning, Learning by Taking Advice, Learning in Problem-solving, learning from Examples: Induction, Explanation-based Learning, Discovery, Analogy, Formal Learning Theory, Neural Net Learning and Genetic Learning. Expert Systems: Representing and Using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition.

Books:

[1] Elaine Rich, Kevin Knight, & Shivashankar B Nair, Artificial Intelligence, McGraw Hill,3rd ed.,2009

[2] Stuart Russell, Peter Norvig, *Artificial Intelligence -A Modern Approach*, 2/e, Pearson, 2003.

[3] Nils J Nilsson, *Artificial Intelligence: A New Synthesis*, Morgan Kaufmann Publications,2000

[4] Introduction to Artificial Intelligence & Expert Systems, Dan W Patterson, PHI.,2010

[5] S Kaushik, Artificial Intelligence, Cengage Learning, 1st ed.2011

Digital Learning Resources:

Course Name:	Artificial Intelligence Search Methods For Problem Solving
Course Link:	https://swayam.gov.in/nd1_noc20_cs81/preview
Course Instructor:	Prof. D. Khemani, IIT Madras

	Fundamentals of Artificial Intelligence
Course Name:	
Course Link:	https://swayam.gov.in/nd1_noc20_me88/preview
Course Instructor:	Prof. S. M. Hazarika, IIT Guwahati
Course Name:	Introduction to Machine Learning
Course Link:	https://nptel.ac.in/courses/106/105/106105152
Course Instructor:	Prof. S. Sarkar, IIT Kharagpur
Course Name:	Machine Learning
Course Link:	https://nptel.ac.in/courses/106/106/106106202
Course Instructor:	Prof. Carl Gustaf Jansson, IIT Madras

6th Semester		Renewable Power Generation Systems	L-T-P 3-0-0	3 Credits

Module I: **(15 Hours)**

Introduction: Conventional energy Sources and its Impacts, Non-conventional energy– seasonal variations and availability, Renewable energy – sources and features, Distributed energy systems and dispersed generation (DG). Solar Energy: Solar processes and spectral composition of solar radiation. Solar Thermal system-Solar collectors, Types and performance characteristics, Applications-Solar water heating systems (active & passive), Solar space heating & cooling systems, Solar desalination systems, Solar cooker. Solar photovoltaic system-Operating principle, Photovoltaic cell concepts, Cell, module, array, Losses in Solar Cell, Effects of Shadowing-Partial and Complete Shadowing, Series and parallel connections, Cell mismatching, Maximum power point tracking, Applications-Battery charging, Pumping, Lighting, Peltier cooling. Modelling of PV cell.

Module II: **(10 Hours)**

Wind Energy: Wind energy, Wind energy conversion; Wind power density, efficiency limit for wind energy conversion, types of converters, aerodynamics of wind rotors, power ~ speed and torque speed characteristics of wind turbines, wind turbine control systems; conversion to electrical power: induction and synchronous generators, grid connected and self excited induction generator operation, constant voltage and constant frequency generation with power electronic control single and double output systems, reactive power compensation, Characteristics of wind powerplant, Concept of DFIG.

Module III: **(9 Hours)**

Biomass Power: Principles of biomass conversion, Combustion and fermentation, Anaerobic digestion, Types of biogas digester, Wood gassifier, Pyrolysis, Applications. Bio gas, Wood stoves,Bio diesel, Combustion engine, Application.

Module IV: **(6 Hours)**

Hybrid Systems: Need for Hybrid Systems, Range and type of Hybrid systems, Case studies of Diesel-PV, Wind-PV, Microhydel-PV, Biomass-Diesel systems, electric and hybrid electric vehicles.

Books:

[1] Godfrey Boyle "Renewable Energy- Power for a Sustainable Future",Oxford University Press.
[2] B.H.Khan, "Non-Conventional Energy Resources", Tata McGraw Hill, 2009.
[3] S. N. Bhadra, D. Kastha, S. Banerjee, "Wind Electrical Systems", Oxford University Press, 2005.
[4] S. A. Abbasi, N. Abbasi, "Renewable Energy Sources and Their Environmental Impact", Prentice Hall of India, New Delhi, 2006.

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Digital Learning Resources:

Course Name: Energy Resources and Technology
Course Link: https://nptel.ac.in/courses/108/105/108105058/
Course Instructor: Prof. S Banerjee, IIT Kharagpur

6th Semester		Data Communication and Computer Networks	L-T-P 3-0-0	3 Credits

Module – I (10 Hrs)

Overview of Data Communication Networks, Protocols and standards, OSI Reference model, TCP/IP Protocol. Physical Layer: Analog Signals, Digital Signals, Data Rate Limits, Transmission Impairment, Data rate limit, Digital Transmission: Digital-to-Digital conversion, Analog-to-Digital conversion, Transmission modes, Analog Transmission: Digital-to-Analog conversion, Analog-to-Analog conversion, Multiplexing: Frequency Division Multiplexing (FDM), Wave Division Multiplexing (WDM), Time Division Multiplexing (TDM), Transmission Media: Guided Media (Twisted-Pair Cable, Coaxial Cable and Fiber-Optic Cable) and unguided media (wireless), Switching: Circuit Switched Network, Datagram Network, Virtual-Circuit Network , Telephone Network, Dial-up Modems and Digital Subscriber Lines.

Module – II (09 Hrs)

Error Detection and correction: Types of Errors, Error Detection mechanism (Linear codes, CRC, Checksum), Error Correction mechanism: Hamming Encoding. Data Link Control and Protocols: Flow and Error Control, Stop-and-Wait ARQ. Go-Back-N ARQ, Selective Repeat ARQ, HDLC and Point-to-Point Protocol Multiple Access: Random Access (ALOHA, CSMA, CSMA/CD, CSMA/CA), Controlled Access (Polling, Reservation, Token Passing), Channelization (FDMA, TDMA, CDMA). Wired LANs (Ethernet): Traditional Ethernet, Fast Ethernet, Gigabit Ethernet.

Module – III (09 Hrs)

Wireless LANs: IEEE 802.11 and Bluetooth. Connecting Devices: Passive Hub, Repeater, Active Hub, Bridge, Two layers Switch, Router, Three layers Switch, Gateway. Virtual Circuit Networks: Frame Relay, Architecture & layers, ATM: Design goals, Architecture & layers. Network Layer: IPV4 addresses, IPV6 addresses, Internet Protocol: Internetworking, IPV4 datagram, IPV6 packet format and advantages. Network Layer Protocols: ARP, RARP, IGMP and ICMP. Routing: Unicast Routing Protocols and Multicast Routing Protocols. Transport Layer: Process to Process Delivery, User Datagram Protocol (UDP) and Transmission Control Protocol (TCP).

Module – IV (08Hrs)

Domain Name System (DNS): Name Space, Domain Name Space, DNS in Internet, Resolution and Dynamic Domain Name System (DDNS), Remote logging, Electronic Mail (SMTP) and file transfer (FTP), WWW: Architecture & Web document, HTTP: Transaction & Persistent vs. Non-persistent connection. Introduction to Wi-Fi and Li-Fi Technology.

Books:

1. Data Communications and Networking, Behrouz A. Forouzan, Tata McGraw-Hill.

2. Computer Networks, A. S. Tannenbum, D. Wetherall, Prentice Hall, Imprint of Pearson.

3. Computer Networks A system Approach, Larry L, Peterson and Bruce S. Davie, Elsevier.

4. Computer Networks, Natalia Olifer, Victor Olifer, Willey India.

5. Data and Computer Communications, William Stallings, Prentice Hall, Imprint of Pearson.

Digital Learning Resources:

Course Name:	Data Communication
Course Link:	https://nptel.ac.in/courses/106/105/106105082/
Course Instructor:	Prof. A. Pal , IIT Kharagpur

Course Name:	Computer Networks
Course Link:	https://nptel.ac.in/courses/106/105/106105080/
Course Instructor:	Prof. A. Pal , IIT Kharagpur

6th Semester	RIK6F001	Essence of Indian Knowledge Tradition-1	L-T-P 3-0-0	0 Credits

Course Objective:

The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care system.

Course Outcomes:

- Ability to understand, connect up and explain basics of Indian Traditional knowledge modern scientific perspective.

Course Content:

- Basic Structure of Indian Knowledge System (i) वेद, (ii) उपवेद (आयुर्वेद, धनुर्वेद, गान्धर्वेद, स्थापत्य आदि) (iii) वेदांग (शिक्षा, कल्प, निरुत, व्याकरण, ज्योतिष छंद), (iv) उपाङ्ग (धर्म शास्त्र, मीमांसा, पुराण, तर्कशास्त्र)
- Modern Science and Indian Knowledge System
- Yoga and Holistic Health care
- Case Studies.

Books:

1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014

2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan

3. Fritzof Capra, Tao of Physics

4. Fritzof Capra, The wave of Life

5. V N Jha (Eng. Trans,), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation, Velliarnad, Amaku,am

6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta

7. GN Jha (Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakasham, Delhi, 2016

8. RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakasham, Delhi, 2016 9. P R Sharma (English translation), Shodashang Hridayam

6th Semester	RCS6C201	Microwave Engineering Lab	L-T-P 0-0-3	2 Credits

(Any Ten of the following experiments are to be performed with X-band/S-band/ Ku- band Microwave components.}

1. Reflex Klystron Characteristics
2. Gun Diode Characteristics
3. Directional Coupler Characteristics
4. Measurement of Voltage Standing Wave Ratio.
5. Radiation Pattern Measurement of a Horn Antenna
6. Impedance, Wavelength and Frequency Measurement.
7. Determination of Polarization of Horn antenna.
8. Measurement of Scattering Parameters.
9. Coupling Measurement of H-plane, E-Plane and Magic Tee junctions.
10. Measurement of Dielectric Constant.
11. Measurement of Phase shift.
12. Scattering parameters of Circulator /Isolators.

Digital Learning Resources:

Virtual Lab Link:

6th Semester	RCS6C202	Wireless Communication Lab	L-T-P 0-0-3	2 Credits

List of Experiments

1. Evaluate the impact of path loss and shadowing in estimation of received signal power in mobile cellular communication using fading channel mobile communication virtual lab.

2. Calculate the boundary coverage probability in a cellular system using fading channel mobile communication virtual lab.

3. Demonstrate the impact the received power levels for hand-off in case of mobile cellular communication using fading channel mobile communication virtual lab.

4. Estimate the impact of sectoring in increasing cellular system capacity using fading channel mobile communication virtual lab.

5. Examine the impact of co-channel interference on the value of SIR in mobile cellular communication using fading channel mobile communication virtual lab.

6. Setting up of LTE 2x2 MIMO system for establishing two way communication.

7.Study of pure ALOHA and slotted ALOHA protocols for WLAN System.

8. Configure ZigBee module as an end device and, set up a communication link with two ZigBee modules.

9. Study of RFID system and its applications.

10. Using IE3D, design a rectangular micro strip patch antenna for inset feed for operating frequency of 1.88 GHz, relative permittivity of 4.4 and length of 31 mils.

11. Using GPS system, study the graphical representation of geographical position using Survey plotting.

12. Study the PN sequence and examine Gold code with variable sequence length and analyze its correlation. Also set up voice communication using DSSS scheme using CDMA trainer kit (ST-2131-A).

Optional Experiments

1. Study the GPRS system and use it for sending an e-mail through WI-GPRS trainer.

2. Study the GSM modem and its different module for phone book, setting up a call, sending SMS and identifying call history using AT commands.

3. Interfacing of GSM modem with control unit.

4. Design a patch antenna using IE3D using different parameters.

Digital Learning Resources:

Virtual Lab Link: http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/index.php

6th Semester		**Future-ready Contributor Program**	**L-T-P 0-0-3**	**2 Credits**

Outcomes: The Future-ready Contributor Program aims to accomplish the following outcomes in the lives of students–

- Improve the employability of students by giving them the right work ethic and thinking that employers are looking for.
- Build their confidence with which they can go into any job and contribute meaningfully.
- Improve their ability to engage better in the workplace and to be able to handle the challenges that come up there.
- Build their career-worthiness and help them develop into future-ready contributors with ability to navigate a career in a volatile, changing world.
- Widen their choices of career and success, so that they are able to open up more opportunities for themselves and take up unconventional career pathways.
- Enable them recognize how they as technical professionals, can participate and make a positive contribution to their communities and to their state.

The Program content is also designed to expose students to real-world workplace scenarios and sensitize them to some of the challenges faced in society around them, especially in the local communities around them and in their own state of Odisha.

The Contributor Program syllabus has been evolved and fine-tuned over several years, to –

a) address the changing need and contemporary challenges being faced by industry and what employers of today are looking for in the people they hire;
b) working extensively with universities and students and an appreciation of their challenges and concerns;
c) guided by the higher ideas and principles of practical Vedanta in work.

Sr. No.		Content	Total Hrs
1	**Part 1 : Developing self-efficacy and basic inner strength**	**Who is a Future-ready Contributor?** *In this topic, students understand the new work environment, expectations from future workforce, and importance of being a future-ready contributor. This enables students to transform their expectation of themselves in work*	3 hrs lab sessions (discovery-based facilitator led)
2		**Self-esteem & Growth Identity** *In this topic, students learn how to develop a deeper and more resilient self esteem and how to adopt a growth identity/ mindset, that is more appropriate to the demands of the future workplace.*	Same as above
3		**Become a Creator of one's destiny** *In a "victim stance", we see the career environment as full of difficulties and hurdles. We feel powerless or blame our circumstances for not having many opportunities. This makes us fearful of uncertainty and makes us settle for jobs where we remain mediocre. In this topic, students discover the "creator of destiny stance" to challenges and situations. This stance helps them take ownership & responsibility to shape destiny, build a new future & find answers to challenges; and stop being complainers.*	Same as above
4	**Part 2 : Building ability to make more effective career choices**	**Achieving Sustainable Success** *In this topic, students discover how to achieve sustainable or lasting success, by making themselves success-worthy. Where their focus shifts to building one's "engine of success" rather than being on chasing the "fruits of success". This is important, because over a lifetime of work, all people go through ups and downs – where the fruits are not in their control. People who are focused on the fruits of success, fall prey to disappointment, loss in motivation, quitting too early, trying to find shortcuts – when fruits don't come. Whereas people focused on building their engine of success continue to contribute steadily, irrespective of whether fruits come or not. This helps them make better choices in life, that leads to steady success & long-term career fulfillment in an uncertain world.*	Same as above
5		**Career Development Pathways for a changing world**	Same as above

		In this topic, students explore a range of diverse "career development models" and the possibilities for contribution each opens up to them. This helps them open up hidden opportunities that such an environment offers. And free themselves from a herd mentality when making career choices.	
6		**Make an impact in every part of one's life** *In this topic, students learn how to expand the contribution possible in any role they have. This helps them take charge of own career growth & discover their power to contribute in any role or job.*	Same as above
7	**Part 3 : Building ability to become solution and value creating individuals in the world**	**Think Solutions** *The market environment in which organizations are operating, is becoming increasingly dynamic and uncertain. So, employers are increasingly seeking out people who can innovate and figure out solutions in the face of any challenge (unlike in the past when it was the people who were most efficient and productive, who were valued by organizations). At the heart of innovation lies this way of thinking of "finding solutions" rather than "seeing problems or roadblocks". Students learn how to build this way of thinking, in this topic.*	Same as above
8		**Value Thinking** *Companies are also looking for employees who do not just work hard, or work efficiently or productively - but those who will make a valuable difference to the fortunes of the company. This difference may come from innovation, but it may also come from focusing on the right things and identifying what really matters – both to the company and to the customers. In this topic, students learn how to build this capability.*	Same as above
9		**Engaging Deeply** *The environment we live in is becoming increasingly complex because more and more things are getting interconnected, new fields are emerging, technologies are rapidly changing, capabilities and knowledge one is trained in will become fast obsolete. In such a scenario, the student's ability to quickly understand and master what is going on, dive deep, get involved in any area, rapidly learn new capabilities that a job demands, is*	Same as above

		important. In this topic, students learn how to engage deeply. Learning how to dive deep, to quickly understand what is going on, get involved in any area, and rapidly learn.	
10	**Part 4 : Building ability to work collaboratively and as good citizens of organizations and the country**	**Enlightened self-interest & collaboration at work** *The changing nature of work in organizations and in the global environment, is increasingly demanding that people work more collaboratively towards shared goals and more sustainable goals. A key to working successfully when multiple stakeholders are involved, is "thinking in enlightened self-interest". In this topic, students learn how to widen their thinking from "narrow self-interest" to "enlightened self-interest" to work more effectively in teams & collaboratives.*	Same as above
11		**Human-centered thinking & Empathy** *In this topic, students learn to recognize & respond to human needs and challenges – the way of thinking at the heart of user-centric designs & customer-centricity.*	Same as above
12		**Trust Conduct** *The biggest currency in a sustainable career is "trust" i.e. being trusted by team members, bosses, customers. When we are trusted, people listen to us, they are willing to give us the chance to grow, give us the space to make mistakes, and work seamlessly with each other without always having to "prove ourselves". In this topic, students learn how to build trust with people they engage with.*	Same as above
Contribution Project Lab Sessions		*3 Contribution projects that help them apply contributor thinking. After students complete their project work (beyond the classroom), each project ends with this 3 hr lab session where they build their project output and present.*	9 hrs (3 hr lab sessions for each of 3 projects)
Project work		*The above Contribution Projects require research, and may need field work beyond the classroom that students are expected to do.*	Beyond classroom

Lab Sessions:

- Students will have to attend twelve discovery-based lab sessions to build new models of thinking & capacities (3 hrs per module)
- They will work closely with their peers to discuss and understand these new models of thinking.
- Their learning will be facilitated by trained college faculty.

Contribution Projects

- Three contribution projects that help them apply contributor thinking
- These will require research and also may need field work
- Each ends with a 3 hr lab session where they build their project output and present

BIJUPATNAIKUNIVERSITY OF TECHNOLOGY, ODISHA

ROURKELA

Curriculum and Syllabus

B. Tech (Electronics and Communication Engineering/ Electronics and Tele Communication Engineering) from the Admission Batch

2018-19

Semester (7^{th})

Seventh Semester							
Theory							
Sl No	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**	**University Marks**	**Internal Evaluation**
1	HS	RED7E001	Entrepreneurship Development	3-0-0	3	100	50
2	PE	REC7D001	Digital Image Processing	3-0-0	3	100	50
		REC7D002	Embedded Systems				
		REC7D003	Advanced Digital Signal Processing				
3	PE	REC7D004	Image and Video Processing	3-0-0	3	100	50
		REC7D005	Adaptive Digital Signal Processing				
		REC7D006	Radar and TV Engineering				
4	OE	RIT7D001	Internet of Things	3-0-0	3	100	50
		RCS7D006	Deep Learning				
		REI7D003	Mechatronics				
5	OE	REV5D004	Disaster Management	3-0-0	3	100	50
		RIP7E002	Intellectual Property Right				
		RGT6A003	Green Technology				
6	OE	RIT7D002	Bigdata Analytics	3-0-0	3	100	50
		RCS7D005	Computer Vision				
		RCS7D007	Soft Computing				
7	MC*	RIK7F001	Essence of Indian Knowledge Tradition - II	3-0-0	0		100 (Pass Mark is 37)
Total Credit (Theory)					**18**		
Total Marks						**600**	**300**
Practical							
1	PSI	RMP7H201	Minor Project	0-0-6	3		200
2	PSI	RSM7H202	Seminar - II	0-0-3	1		100
3	PSI	RCV7H203	Comprehensive Viva	0-0-3	1		100
Total Credit (Practical)					**5**		
Total Semester Credit					**23**		
Total Marks							**400**

***Mandatory Non-Credit Courses (MC) result will be reflected with Pass (P) / Fail (F) grade. Thus the grade obtained will not be affecting the grade point average. However it shall appear on the grade sheet as per AICTE rule.**

7th Semester	RED7E001	Entrepreneurship Development	L-T-P 3-0-0	3 Credits

Module I: **(10 hours)**

Entrepreneurship: Concept of entrepreneurship and intrapreneurship, Types of Entrepreneurs, Nature and Importance, Entrepreneurial Traits and Skills, Entrepreneurial Motivation and Achievement, Entrepreneurial Personality

Module II: **(8 hours)**

Entrepreneurial Environment, Identification of Opportunities, Converting Business Opportunities into reality. Start-ups and business incubation, Setting up a Small Enterprise. Issues relating to location, Environmental Problems and Environmental pollution Act, Industrial Policies and Regulations

Module III: **(10 hours)**

Need to know about Accounting, Working capital Management, Marketing Management, Human Resources Management, and Labour Laws. Organizational support services - Central and State Government, Incentives and Subsidies.

Module IV: **(12 hours)**

Sickness of Small-Scale Industries, Causes and symptoms of sickness, cures of sickness, Role of Banks and Governments in reviving industries.

Books:

[1] Entrepreneurship Development and Management, Vasant Desai, HPH
[2] Entrepreneurship Management, Bholanath Dutta, Excel Books
[3] Entrepreneurial Development, Sangeeta Sharma, PHI
[4] Entrepreneurship, Rajeev Roy, Oxford University Press

Digital Learning Resources:

Course Name: Entrepreneurship
Course Link: https://nptel.ac.in/courses/110/106/110106141/
Course Instructor: Prof. C Bhaktavatsala Rao, IIT Roorkee

Course Name: Entrepreneurship Essentials
Course Link: https://nptel.ac.in/courses/127/105/127105007/
Course Instructor: Prof. Manoj Kumar Mondal, IIT Kharagpur

7th Semester	**REC7D001**	**Digital Image Processing**	**L-T-P 3-0-0**	**3 Credits**

Module-I

Fundamentals – Steps in digital image processing, sampling and quantization, relationship between pixels, imaging geometry Image Transforms – Fourier Transform, Discrete Fourier Transform, Fast Fourier Transform, Discrete Cosine Transform, Walsh Transform, Hadamard Transform, Hotelling Transform.

Module-II

Image Enhancement – Point processing, spatial filtering (smoothing and sharpening filters), enhancement in frequency domain. Filtering in the Frequency Domain: preliminary concepts, 2D DFT and its properties,basic filtering in the frequency domain, image smoothing and sharpening.

Module-III

Image Restoration and Reconstruction: Image restoration/degradation model, noisemodels, restoration in the presence of noise only, estimating the degradation function. Color Image Processing: Color models, Color transformation.

Module-IV

Wavelets and Multi-resolution Processing: multiresolution expansions, wavelettransforms in one and two dimensions. Image Compression: Fundamentals, Some basic compression methods (Chapter 8 of Book 1)

Books

1. Digital Image Processing, R.C. Gonzalez, R.E. Woods, Pearson Education , 3rd Edition, 2007
2. Digital Image Processing, S. Sridhar, Oxford University Press,2011
3. Digital Image Processing And Analysis, B. Chanda, Dutta D. Majumder ,PHI
4. Digital Image Processing using MATLAB, Rafael C. Gonzalez, Richard E. Woods Pearson Education, Inc., Seventh Edition, 2004.
5. Digital Image Processing, S. Sridhar, Oxford University Press,2011 3. Digital Image Processing, William K. Pratt, John Wiley, New York, 2002

Digital Learning Resources:

Course Name:	Digital Image Processing
Course Link:	https://nptel.ac.in/courses/117/105/117105135/
Course Instructor:	Prof. P.K. Biswas, IIT Kharagpur

7^{th} Semester	REC7D002	Embedded Systems	L-T-P 3-0-0	3 Credits

Module-I **(12 hrs)**

Hardware Concepts Embedded System: Application and characteristics of embedded systems, Overview of Processors and hardware units in embedded system, embedded software in a system, Examples of Embedded system.

ARM:ARM pipeline, Instruction Set Architecture ISA: Registers, Data Processing Instructions, Data Transfer Instructions, Multiplication's instructions, Software interrupt, Conditional execution, branch instruction, Swap instruction, THUMB instructions.

Module-II **(8hrs)**

Devices and device drivers: I/O devices, Serial peripheral interfaces,IIC, RS232C, RS422, RS485, Universal serial bus, USB Interface, USB Connector IrDA, CAN, Bluetooth, ISA, PCI, PCI -X and advance busses, Device drivers.

Module –III **(9 hrs)**

Real Time Operating System (RTOS): Real-Time Task Scheduling: Some important concepts, Types of real-time tasks and their characteristics, Task scheduling, Clock-Driven scheduling, Hybrid schedulers, Event-Driven scheduling, Earliest Deadline First (EDF) scheduling, Rate monotonic algorithm (RMA)

Module –IV **(8 hrs)**

Modelling Techniques: Software and programming concept: Processor selection for an embedded system, State chart, SDL, Petri-Nets, Unified Modeling Language (UML). Hardware software codesign. Hardware and software partitioning: K-L partitioning, Partitioning using genetic algorithm,

Module –V **(8 hrs)**

Low power embedded system design: Dynamic power dissipation, Static power dissipation, Power reduction techniques, system level power management. Software design for low power devices.

Books:

[1] "Embedded system architecture, programming and design" By Raj Kamal, TMH.

[2] "Embedded System Design" by SantanuChattopadhay, PHI

[3] Frank Vahid and Tony Givargis, Embedded Systems Design – A unified Hardware /Software Introduction, John Wiley, 2002.

[4] "Hardware software co-design of Embedded systems" By Ralf Niemann, Kulwer Academic.

[5] "Embedded real time system programming" By Sriram V Iyer, Pankaj Gupta, TMH.

Digital Learning Resources:

Course Name: Embedded Systems
Course Link: https://nptel.ac.in/courses/108/102/108102045/
Course Instructor: Prof. Santanu Chaudhary, IIT Delhi

Course Name: Embedded Systems
Course Link: https://nptel.ac.in/courses/108/105/108105057/
Course Instructor: Prof. Amit Patra et al, IIT Kharagpur

Course Name: Embedded Systems Design
Course Link: https://nptel.ac.in/courses/106/105/106105159/
Course Instructor: Prof. Anupam Basu, IIT Kharagpur

7^{th} Semester	REC7D004	Image and Video Processing	L-T-P 3-0-0	3 Credits

Module –I

Fundamentals of Image processing and Image Transforms: Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms

Module –II

Image Processing Techniques: Image Enhancement: Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation

Module –III

Image Compression: Image compression fundamentals – coding Redundancy, spatial and temporal redundancy. Compression models : Lossy and Lossless, Huffmann coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding , wavelet coding, JPEG standards

Module –IV

Basic Steps of Video Processing: Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation , Photometric Image formation, sampling of video signals, filtering operations

Module –V

2-D Motion Estimation: Optical flow, general methodologies, pixel based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Waveform based coding, Block based transform coding, predictive coding, Application of motion estimation in video coding.

Books:

1. Gonzaleze and Woods , "Digital Image Processing", 3rd edition , Pearson
2. Yao wang, JoemOstarmann and Ya – quin Zhang, "Video processing and communication",1st edition , PHI
3. M. Tekalp , "Digital video Processing", Prentice Hall International

7^{th} Semester	REC7D005	Adaptive Digital Signal Processing	L-T-P 3-0-0	3 Credits

MODULE–I (8 Hours)

Introduction: Adaptive Systems – Definition and characteristics, General properties, Open andClosed Loop Adaptations, Applications.
The Adaptive Linear Combiner: Performance function, Gradient and Mean Square Error, Examples.

MODULE – II (10 Hours)

Theory of Adaptation with Stationary Signals: Properties of the Quadratic PerformanceSurface, Significance of eigen values, eigen vectors, correlation matrix.
Searching the Performance Surface: A simple gradient search algorithm, Stability and Rate ofconvergence, the learning curve.

MODULE-III (10 Hours)

Gradient Estimation and its effects on Adoption: The performance penalty, Variance of thegradient estimate, Misadjustment.Adaptive Algorithms and Structures: The LMS Algorithm, Convergence, learning Curve,Performance analysis, Filtered X LMS algorithm,

MODULE-IV

Applications: Adaptive Modelling and System Identification using adaptive filter, InverseAdaptive Modelling, Deconvolution, and equalization using adaptive filter.

Books
1. *Adaptive Signal Processing*, Bernard Widrow and Samuel D. Stearns, Pearson Education, 2nd impression, 2009.
2. *Adaptive Filter Theory*, Simon Haykin, Pearson Education, 4th Edn.

7^{th} Semester	REC7D006	Radar and TV Engineering	L-T-P 3-0-0	3 Credits

Module I

Radar : The Radar equation-Pulse Radar-CW Radar-CW Radar with non zero IF, equation for Doppler frequency- FM-CW Radar using sideband superhetrodyne receiver, MTI Radar-Delay line canceller, MTI Radar with power amplifier & power oscillator, Non coherent MTI Radar, Pulse Doppler Radar, Radar Transmitters. Radar Modulator-Block diagram. Radar receivers- noise figure, low noise front ends, Mixers – Different types of Displays – Duplexers- Branch type and balanced type. Navigation- Loop Antenna, Radio compass. Hyperbolic Systems of Navigation, LORAN – A. Distance Measuring Equipment . Instrument Landing System – Localizer, Glide Slope, Marker beacons.

Module II

Television: Scanning, Blanking and synchronisation, Picture signal - composite video signalVestigial sideband transmission-Principle of CCD Camera - Monochrome picture tube-Monochrome TV receivers- RF tuner ,VHF tuner- Video amplifier, IF section, Vestigial sideband correction- Video detectors, Sound signal separation, AGC, sync separation, horizontal and vertical deflection circuits, EHT generation. Colour TV system: Principle of colour signal transmission and reception, PAL, NTSC, SECAM (block schematic description), Picture tube – delta gun.

Module III

Digital TV: Digitized Video, Source coding of Digitized Video – Compression of Frames – DCT based – (JPED), Compression of Moving Pictures (MPEG). Basic blocks of MPEG2 and MPE4. Digital Video Broadcasting (DVB) – Modulation: QAM – (DVB-S, DVB-C), OFDM for Terrestrial Digital TV (DVB –T). Reception of Digital TV Signals (Cable, Satellite and terrestrial). Digital TV over IP, Digital terrestrial TV for mobile. Display Technologies – basic working of Plasma, LCD and LED Displays.

Books:

1. Merrill I. Skolnik: Introduction to Radar Systems,3/e, Tata McGraw Hill,
2. N.S.Nagaraja: Elements of Electronic Navigation, 2/e, Tata McGraw Hill
3. R.R. Gulati: Monochroeme and Colour Television. New Age international, 2008.
4. Herve Benoit, Digital Television Satellite, Cable, Terrestrial, IPTV, Mobile TV in the DVB Framework, 3/e, Focal Press, Elsevier, 2008
5. Shlomo Ovadia: Broadband Cable TV Access Networks, PH-PTR, 2001
6. Byron Edde: Radar Principles, Technology & Applications, Pearson Education.
7. Mark E Long: ―The Digital Satlitte TV Hand Book‖, Butterworth-Heinemann.
8. K.R.Rao, J.O.Hwang, Techniques and standards for Image,Video and Audio coding,Prentice Hall,1996
9. John Arnold, Michael Frater, Mark Pickering,Digital Television Technology and Standards, John Wiley & Sons, Inc, 2007
10. Robert L. Hartwig,Basic TV Technology: Digital and Analog, 4/e, Focal Press, Elsevier, 2005

6^{th} Semester	RIT7D001	Internet of Things	L-T-P 3-0-0	3 Credits

Module-1

Introduction-Definition & Characteristics of IoT, Physical Design of IoT- Things in IoT, IoT Protocols, Logical Design of IoT- IoT Functional Blocks, IoT Communication Models, IoT Communication APIs , IoT Enabling Technologies- Wireless Sensor Networks , Cloud Computing, Big Data Analytics , Communication Protocols , Embedded Systems, IoT Levels & Deployment Templates.

Module-2

Domain Specific IoTs

Home Automation: Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors, Cities-Smart Parking, Smart Lighting, Smart Roads, Structural Health Monitoring, Surveillance, Emergency Response,

Environment-Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection , River Floods Detection , **Energy-** Smart Grids , Renewable Energy Systems , Prognostics , Retail-Inventory Management , Smart Payments , Smart Vending Machines , **Logistics-**Route Generation & Scheduling , Fleet Tracking , Shipment Monitoring , Remote Vehicle Diagnostics, **Agriculture-**Smart Irrigation ,Green House Control ,**Industry** -Machine Diagnosis & Prognosis Indoor Air Quality Monitoring ,Health & Lifestyle -Health & Fitness Monitoring, Wearable Electronics

IoT and M2M Introduction, M2M-Difference between IoT and M2M, SDN and NFV for IoT-Software Defined Networking , Network Function Virtualization

Module-3

IoT Platforms Design Methodology

IoT Design Methodology-Purpose & Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification , Service Specifications , IoT Level Specification, Functional View Specification , Operational View Specification , Device & Component Integration , Application Development, Case Study on IoT System for Weather Monitoring, Motivation for Using Python

IoT Physical Devices & Endpoints

What is an IoT Device-Basic building blocks of an IoT Device, Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi , Raspberry Pi Interfaces – Serial, SPI , I2C , Programming Raspberry Pi with Python-Controlling LED with Raspberry Pi , Interfacing an LED and Switch with Raspberry Pi ,Interfacing a Light Sensor (LDR) with Raspberry Pi , Other IoT Devices- pcDuino, Beagle Bone Black , Cubieboard

Module-4

IoT &Beyond : Use of Big Data and Visualization in IoT, Industry 4.0 Concepts. Overview of RFID, Low-power design (Bluetooth Low Energy), range extension techniques (data mining and mesh networking), and dataintensive IoT for continuous recognition applications. Overview of Android / IOS App Development tools & Internet Of Everything

Books:

1. Internet of Things, A Hands on Approach, by ArshdeepBahga& Vijay audisetti, University Press.
2. The Internet of Things, by Michael Millen, Pearson

7th Semester	RCS7D006	Deep Learning	L-T-P 3-0-0	3 CREDITS

MODULE-I:

Introduction to TensorFlow : Computational Graph, Key highlights, Creating a Graph, Regression example, Gradient Descent, TensorBoard, Modularity, Sharing Variables,KerasPerceptrons: What is a Perceptron, XOR Gate

MODULE-III:

Activation Functions : Sigmoid,ReLU, Hyperbolic Fns,Softmax Artificial Neural Networks : Introduction, Perceptron Training Rule, Gradient Descent Rule

MODULE-II:

Gradient Descent and Backpropagation: Gradient Descent, Stochastic Gradient Descent, Backpropagation, Some problems in ANN Optimization and Regularization :Overfitting and Capacity, Cross Validation, Feature Selection, Regularization, Hyperparameters

MODULE-IV:

Introduction to Convolutional Neural Networks: Introduction to CNNs, Kernel filter, Principles behind CNNs, Multiple Filters, CNN applications Introduction to Recurrent Neural Networks: Introduction to RNNs, Unfolded RNNs, Seq2Seq RNNs, LSTM, RNN applications

MODULE-V:

Deep Learning applications: Image Processing, Natural Language Processing, Speech Recognition, Video Analytics

Book

1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.

2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
3. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
4. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
5. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

7th Semester	**REI7D003**	**Mechatronics**	**L-T-P 3-0-0**	**3 CREDITS**

MODULE-I **(10Hours)**

Evolution of Mechatronics, components of mechatronic system, types of mechatronic products, Signal theory, signal analysis and processing, Laplace transformation, Z-transformation modulation and de-modulation. Electrical components and electronic device – Resister, inductor and capacitor, reactance and impedance. Basic electronics devices junction diodes, Bipolar transistors

MODULE-II (08Hours)

Basic Digital Technology: Digital number system, Binary number system, Hexadecimal number system, Binary addition, Boolean Algebra, Logic function, Universal GATES, FLIP-FLOP, Registers counters. System modelling: Frequency response, Mechanical system, electrical system, Thermal system, Fluid system

MODULE-III(10Hours)

Actuators- Electric motors; D.C. Motors, Stepper motor, Hydraulic actuators, Pneumatic actuators Transducer and Sensors: Principles, difference between transducer and sensors, transducer types – photo emissive, photo conductive, photovoltaic, thermistors, Thermocouple, Inductive, capacitive, Peizoelectric, Hall effect transducers, Ionization transducer, Encoders- Incremental encoder, Optical encoder, Bimetallic strip, Strain gauge, load cell. Programmable Logic controller: Basic Structure - Programming: Ladder diagram Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls, data handling, Analog input / output, PLC Selection &Application. Microprocessor ad Microcontroller: Microprocessor based Digital control, registers, Program counter, Intel - 8085 microprocessor

Books:

[1] A Text Books of Mechatronics, R.K.Rajput, S.Chand& company
[2] Mechatronics, N.G. P.C Mahalik, Tata McGraw Hill
[3] Mechatronics, D.G. Alciator, M.B. Histand, Tata McGraw Hill
[4] Mechatronics, A.Smaili& F Mrad, Oxford University Press
[5] Mechatronics, K.P.ramchandran, G,K Vijay Raghavan, M. S Balachandran
[6] Mechatronics An Intigrated approach, Clarence W de Sliva, CRC Press

Digital Learning Resources:

Course Name: Mechatronics
Course Link: https://nptel.ac.in/courses/112/107/112107298/
Course Instructor: Prof. Pushparaj Mani Pathak, IIT Roorkee

7^{th} Semester	REV5D004	Disaster Management	L-T-P 3-0-0	3 CREDITS

Module I **(12 Hours)**

Understanding Disaster: Concept of Disaster - Different approaches- Concept of Risk - Levels of Disasters - Disaster Phenomena and Events (Global, national and regional) Hazards and Vulnerabilities: Natural and man-made hazards; response time, frequency and forewarning levels of different hazards - Characteristics and damage potential or natural hazards; hazard assessment - Dimensions of vulnerability factors; vulnerability assessment - Vulnerability and disaster risk - Vulnerabilities to flood and earthquake hazards

Module II **(6 Hours)**

Disaster Management Mechanism: Concepts of risk management and crisis managements - Disaster Management Cycle - Response and Recovery - Development, Prevention, Mitigation and Preparedness - Planning for Relief

Module III **(6 Hours)**

Capacity Building: Capacity Building: Concept - Structural and Non-structural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk - Counter-Disaster Resources and their utility in Disaster Management - Legislative Support at the state and national levels

Module IV **(12 Hours)**

Coping with Disaster: Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - Industrial Safety Plan; Safety norms and survival kits - Mass media and disaster management

Planning for disaster management: Strategies for disaster management planning - Steps for formulating a disaster risk reduction plan - Disaster management Act and Policy in India - Organizational structure for disaster management in India - Preparation of state and district disaster management plans

Books:

[1] Manual on Disaster Management, National Disaster Management, Agency Govt of India.
[2] Disaster Management by Mrinalini Pandey Wiley 2014.
[3] Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015
[4] Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015
[5] Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS

Publications 2009.

[6] National Disaster Management Plan, Ministry of Home affairs, Government of India http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf

7th Semester	RIP7E002	Intellectual Property Right	L-T-P 3-0-0	3 CREDITS

MODULE-I **(12Hours)**

Introduction: Intellectual property: meaning, nature and significance, need for intellectual property Right (IPR), IPR in India – Genesis and development, IPR in abroad, Examples: - Biotechnology Research and Intellectual Property Rights Management. What is a patent, what can be protected by a patent, why should I apply for a patent? Patent Law, Patentability requirements, non-Patentable subject matters, Layout of the Patents. Procedure for domestic and international filing of applications, Restoration, Surrender and Revocations of Patents, Rights of Patentee and Working of Patent, Licensing and Enforcing Intellectual Property.

MODULE-II **(10Hours)**

Copyrights: Copyright: meaning, scope; What is covered by copyright? How long does copyright last? Why protects copyright? Related rights, Rights covered by copyright. Ownership: Duration, Division, Transfer and Termination of Transfers.

MODULE-III (10Hours)

Infringement and Remedies: Literal and non-literal infringement, Role of claims, Doctrines on infringement: Equivalent doctrine, Pith and Marrow doctrine, Comparative test. Defences: Gillette Defence, General grounds, Patents granted with conditions, Parallel import. Remedies: Civil, Administrative.

MODULE-IV (08Hours)

State Law: Trade Secret, Contract, Misappropriation, Right of Publicity Trademarks, Trade Secret - Overview, Requirements, Misappropriation of Trade Secret, Departing Employees, Remedies, Criminal Liability, Misappropriation, Clickwrap Agreements, Idea Submissions; Right of Publicity, Federal Pre-emption, Review.

Books:

[1] W. R. Cornish and D. Llewellyn, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Rights, Sweet & Maxwell.
[2] Lionel Bently and Brad Sherman, Intellectual Property Law, Oxford University Press.
[3] P. Narayanan, Intellectual Property Law, Eastern Law House
[4] B. L. Wadehra, Law Relating to Intellectual Property, Universal Law Publishing Co.
[5] V. K. Ahuja, Law Relating to Intellectual Property Rights, LexisNexis

[6] AjitParulekar and Sarita D'Souza, Indian Patents Law – Legal & Business Implications;Macmillan India ltd, 2006
[7] P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi, 2010.

Reference:

[1] The Copyright Act, 1957
[2] The Patent Act, 1970
[3] The Trade Marks Act, 1999
[4] The Designs Act, 2000
[5] The Geographical Indication of Goods Act, 1999
[6] The Protection of Plant Varieties and Farmers' Rights Act, 2001
[7] The Semiconductor Integrated Circuits Layout Design Act, 2000

Digital Learning Resources:

Course Name:	Intellectual Property
Course Link:	https://nptel.ac.in/courses/109/106/109106137/
Course Instructor:	Prof. Feroze Ali, IIT Madras

7th Semester	RGT6A003	Green Technology	L-T-P 3-0-0	3 CREDITS

Module I: (12 Hrs)

Global Warming and its effect:- Introduction and physical definition of global warming, the New Carbon Problem: Accumulation, Long Half-Life, Heating Potential, Carbon Emission Factors, Carbon Absorption in Nature, The Global Emission Situation and its effect in India, The Kyoto and Other Protocols and its view in India, Effect of climate change and its impact.
Planning for the Future to reduce global warming:- Steps taken to Control Carbon Emissions universally, Use of Promotional and Punitive Mechanisms for Reducing Carbon in Atmosphere, The General Approach in Planning for the Future, Developing Countrywide Adaptive Measures for Safety of Local People, Developing Mitigative Measures for Global Reduction of Carbon, India's National Action Plan on Climate Change (NAPCC) till date, National Mission for a Green India, The MRV Debate.

Module II: (8 Hrs)

Opportunities in Control of Carbon Emissions and Accumulation:- Essential Steps for Control of Carbon Emissions and Accumulation, Procedure to develop own Priorities and Business Opportunities in India for control of carbon emissions and accumulation, Needs a Mix of Green and Traditional Power Sources in India, A Logical Approach for Carbon Reduction, Need in India —More Forests, Less Deforestation and payment rates procedure for controlling carbon emissions and its Promotional Mechanisms at India. Green Technologies for Energy Production: - Various Technologies Available for Energy Production, Cost Comparison of a Few Typical Systems for Power Generation, Sources of Energy Production Already in Use, Alternative Methods Ready for Use, Green Technologies Needing some Prior R&D Work.

Module III: **(10 Hrs)**

Green Technologies for Personal and Citywide Application: - Measures to be taken for Green city, Carbon Emission Reduction at Personal Level, Carbon Emission Reduction at Local Authority and Citywide Level, Carbon Emissions from Imports. Green Technologies for Specific Applications:- Promotion of 'Green' Buildings, Guidelines, The Energy Conservation Building Code (ECBC), Green Hotels and Hospitals, Green Technologies for Transport, Green Roads, Ports and Harbours, Industries, Carbon, Carbon Emissions from a Few Selected Industries in India, The Changing Scenario in Cities, Need for Wider Application to Town Planning and Area Re-Development Projects, 'Green' Infrastructure for Municipal Services, Bringing up Indian Villages, Green Services for Crematoria, Spreading Message to all Stakeholders.

Module IV: **(10 Hrs)**

Some High-tech Measures for Reducing Carbon Emissions: - Use of Solar Power with Satellite-Based Systems, Use of Carbon Capture and Storage (Sequestration), Microorganisms, A Quick SWOT Analysis.Recommended Plan of Action: - India's National Action Plan Take Us to a Low-Carbon Path, The Missions Help Develop Awareness, few case studies on Projects undertakenby Various Countries, Adaptive Measures Essential for Indian People to Cope with Climate Change

Books

[1] Green Technologies, Soli J. Arceivala, McGraw Hill Education
[2] Green Technologies and Environmental Sustainability edited by Ritu Singh, Sanjeev Kumar

Digital Learning Resources:

Course Name: Sustainable Materials and Green Buildings
Course Link:https://nptel.ac.in/courses/105/102/105102195/
Course Instructor:Dr. B. Bhattacharjee, IIT Delhi

7th Semester	RIT7D002	Bigdata Analytics	L-T-P 3-0-0	3 CREDITS

Module-1

Introduction to Big Data: Types of Digital Data-Characteristics of Data – Evolution of Big Data - Definition of Big Data - Challenges with Big Data - 3Vs of Big Data - Non Definitional traits of Big Data - Business Intelligence vs. Big Data - Data warehouse and Hadoop environment - Coexistence. Big Data Analytics: Classification of analytics - Data Science - Terminologies in Big Data - CAP Theorem - BASE Concept. NoSQL: Types of Databases – Advantages – NewSQL - SQL vs. NOSQL vs NewSQL. Introduction to Hadoop: Features – Advantages – Versions - Overview of Hadoop Eco systems - Hadoop distributions - Hadoop vs. SQL – RDBMS vs. Hadoop - Hadoop Components – Architecture – HDFS - Map Reduce: Mapper – Reducer – Combiner – Partitioner – Searching – Sorting - Compression. Hadoop 2 (YARN): Architecture - Interacting with Hadoop Eco systems.

Module-2

No SQL databases: Mongo DB: Introduction – Features - Data types - Mongo DB Query language - CRUD operations – Arrays - Functions: Count – Sort – Limit – Skip – Aggregate - Map Reduce. Cursors – Indexes - Mongo Import – Mongo Export. Cassandra: Introduction – Features - Data types – CQLSH - Key spaces - CRUD operations – Collections – Counter – TTL - Alter commands - Import and Export - Querying System tables.

Module-3

Hadoop Eco systems: Hive – Architecture - data type - File format – HQL – SerDe - User defined functions - Pig: Features – Anatomy - Pig on Hadoop - Pig Philosophy - Pig Latin overview - Data types - Running pig - Execution modes of Pig - HDFS commands - Relational operators - Eval Functions - Complex data type - Piggy Bank - User defined Functions - Parameter substitution - Diagnostic operator. Jasper Report: Introduction - Connecting to Mongo DB - Connecting to Cassandra - Introduction to Machine learning: Linear Regression – Clustering - Collaborative filtering - Association rule mining - Decision tree.

Books:

1. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley Publication, 2015.
2. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, "Big Data for Dummies", John Wiley & Sons, Inc., 2013.
3. Tom White, "Hadoop: The Definitive Guide", O'Reilly Publications, 2011.
4. Kyle Banker, "Mongo DB in Action", Manning Publications Company, 2012.
5. Russell Bradberry, Eric Blow, "Practical Cassandra A developers Approach", Pearson Education, 2014.

7th Semester	RCS7D005	Computer Vision	L-T-P 3-0-0	3 CREDITS

Module I: (8 Hrs)

Image formation and camera calibration: Introduction to computer vision, geometric camera models, orthographic and perspective projections, weak perspective projection, intrinsic and extrinsic camera parameters, linear and nonlinear approaches of camera calibration.

Module II: (6 Hrs)

Feature detection and matching: Edge detection, interest points and corners, local image features, feature matching and Hough transform, model fitting and RANSAC, scale invariant feature matching.

Module III: (12 Hrs)

Stereo Vision: Stereo camera geometry and epipolar constraints, essential and fundamental matrix, image rectification, local methods for stereo matching: correlation and multi-scale approaches, global methods for stereo matching: order constraints and dynamic programming, smoothness and graph-based energy minimization, optical flow.

Module IV: (10 Hrs)

Shape from Shading: Modeling pixel brightness, reflection at surfaces, the Lambertian and specular model, area sources, photometric stereo: shape from multiple shaded images, modeling inter-reflection, shape from one shaded image.

Module V: (6 Hrs)

Structure from motion: Camera self-calibration, Euclidean structure and motion from two images, Euclidean structure and motion from multiple images, structure and motion from weak-perspective and multiple cameras.

Books:

1. Forsyth, D. A. and Ponce, J., "Computer Vision: A Modern Approach", Prentice Hall, 2nd Ed.
2. Szeliki, R., "Computer Vision: Algorithms and Applications", Springer.
3. Hartley, R. and Zisserman, A., "Multiple View Geometry in Computer Vision", Cambridge University Press.

7^{th} Semester	RCS7D007	Soft Computing	L-T-P 3-0-0	3 CREDITS

Module I: (14 Hrs)

Basic tools of soft Computing: Fuzzy logic, Neural Networks and Evolutionary Computing, Approximations of Multivariate functions, Non - linear Error surface and optimization

Fuzzy Logic Systems: Basics of fuzzy logic theory, Crisp and fuzzy sets; Basic set operations; Fuzzy relations, Composition of Fuzzy relations, Fuzzy inference, Zadeh's compositional rule of inference; Defuzzification; Fuzzy logic control; Mamdani and Takagi and Sugeno architectures. Applications to pattern recognition.

Module II: (14 Hrs)

Neural networks: Single layer networks, Perceptron; Activation functions; Adaline- its training and capabilities, weights learning, Multilayer perceptrons; error back propagation, generalized delta rule; Radial basis function networks and least square training algorithm,

Kohenen self - organizing map and learning vector quantization networks; Recurrent neural networks, Simulated annealing neural networks; Adaptive neuro-fuzzy information; systems (ANFIS).

Module III: (8 Hrs)

Evolutionary Computing: Genetic algorithms: Basic concepts, encoding, fitness function, reproduction. Differences of GA and traditional optimization methods. Basic genetic, basic evolutionary programming concepts Applications, hybrid evolutionary algorithms.

Books:

1. F. O. Karry and C. de Silva, "Soft Computing and Intelligent Systems Design - Theory, Tools and Applications". Pearson Education.(Printed in India).
2. J. S. R. Jang. C. T. Sun and E. Mizutani, "Neuro-fuzzy and soft-computing". PHI Pvt. Ltd., New Delhi.
3. Fredric M. Ham and Ivica Kostanic, "Principle of Neuro Computing for Science and Engineering", Tata McGraw Hill.
4. S. Haykins, "Neural networks: a comprehensive foundation". Pearson Education, India. 4) V. Keeman,"Learning and Soft computing", Pearson Education, India.
5. R. C. Eberhart and Y. Shi, "Computational Intelligence Concepts to Implementation". Morgan Kaufmann Publishers (Indian Reprint).

7^{th} Semester	REC7D003	Advanced Digital Signal Processing	L-T-P 3-0-0	3 CREDITS

Module-I: **(10 hours)**

Multirate Digital Signal Processing: Introduction, Decimation by a factor D, Interpolation bya factor I, Sampling rate Conversion by a rational factor I/D, Implementation of Samplingrate Conversion, Multistage implementation of Sampling rate Conversion, Sampling rateConversion of Band pass Signals, Sampling rate Conversion by an Arbitrary Factor, DigitalFilter Banks, Two-channel Quadrature Mirror Filter Bank.

Module-II: **(10 hours)**

Linear Prediction and Optimum Linear Filters: Random Signals, Correlation Functions, andPower Spectra, Innovation Representation of a Stationary Random Process, Forward andBackward Linear Prediction, Solution of the normal equations: The Levinson-DurbinAlgorithm. Properties of the Linear Prediction Error filters. Wiener filters for filtering andPrediction. Adaptive Filters: Applications of Adaptive filters, Adaptive Direct-Form FIR filters- The LMS Algorithm.

Module-III: **(10 hours)**

Power Spectrum Estimation: Estimation of Spectra from Finite Duration Observations ofSignals, Nonparametric Methods for Power Spectrum estimation, Relationship between theAutocorrelation and the model parameters. Bayes Theorem, Maximum Likelihooddetection.

Module-IV: **(10 hours)**

The Yule-Walker Method for the AR Model Parameters, The Burg Method for the AR modelParameters, Unconstrained Least-Squares Method for the AR model parameters, MA Modelfor Power Spectrum Estimation, ARMA model for Power Spectrum Estimation.

Books:

[1] Digital Signal Processing, John G.Proakis, Dimitris G. Manolakis, Pearson Education, New Delhi, 4th Edition, 2013.
[2] Adaptive Filter Theory, Simon Haykin, Pearson Education, 5th Edition 2017.
[3] Adaptive Signal Processing, Bernard Widrow, Samuel D Stearns, Pearson Education

Digital Learning Resources:

Course Name: Advance Digital Signal Processing
Course Link: https://nptel.ac.in/courses/117/101/117101001/
Course Instructor: Prof. V.M. Gadre, IIT Bombay

7th Semester	RIK7F001	Essence of Indian Knowledge Tradition - II	L-T-P 3-0-0	3 CREDITS

Course Objectives:

1. To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
2. To make the students understand the traditional knowledge and analyse it and apply it to their day to day life

Course Outcomes :

At the end of the Course, Student will be able to:

1. Identify the concept of Traditional knowledge and its importance.
2. Explain the need and importance of protecting traditional knowledge.
3. IIllustrate the various enactments related to the protection of traditional knowledge.
4. Interpret the concepts of Intellectual property to protect the traditional knowledge.
5. Explain the importance of Traditional knowledge in Agriculture and Medicine.

Module-1:

Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

Module-2:

Protection of traditional knowledge:The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

Module-3:

Legal framework and TK: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

Module-4:

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

Module-5:

Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK

Books:

1. Traditional Knowledge System in India, by Amit Jha, 2009.

2. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.

3. "Knowledge Traditions and Practices of India" Kapil Kapoor, Michel Danino.

Digital Learning Resources:

Course Name:	Ayurvedic Inheritance of India
Course Link:	https://nptel.ac.in/courses/121/106/121106003/
Course Instructor:	Dr M. S. Valiathan, IIT, Madras

https://www.youtube.com/watch?v=LZP1StpYEPM