DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY UTTAR PRADESH, LUCKNOW

EVALUATION SCHEME & SYLLABUS

FOR

B. TECH. THIRD YEAR

ELECTRONICS AND COMPUTER ENGINEERING

Based On

NEP2020

(Effective from the Session: 2024-25)

B.Tech. V Semester
Electronics and Computer Engineering

SEMESTER- V												
S. No.	**Course Code**	**Course Title**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credits**
			L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1	BCS501	Database Management System	3	1	0	20	10	30		70		100	4
2	BECZ501	Control System	3	1	0	20	10	30		70		100	4
3	BCS503	Design and Analysis of Algorithm	3	1	0	20	10	30		70		100	4
4	BECZ051/ BCS052/ BCS053/ BECZ052	Department Elective-I	3	0	0	20	10	30		70		100	3
5	BECZ053/ BCIT054/ BCS057/ BECZ054	Department Elective-II	3	0	0	20	10	30		70		100	3
6	BCS551	Database Management System Lab	0	0	2				50		50	100	1
7	BECZ551	Control System Lab	0	0	2				50		50	100	1
8	BCS553	Design and Analysis of Algorithm Lab	0	0	2				50		50	100	1
9	BCS554	Mini Project/Internship **	0	0	2				100			100	2
10	BNC501/ BNC502	Constitution of India/ Essence of Indian Traditional Knowledge	2	0	0	20	10	30		70			
		Total	**17**	**3**	**8**							**900**	**23**

**The Mini Project or Internship (4 weeks) conducted during summer break after IV Semester and will be assessed during Vth Semester.

**It is desirable that the students should do their Summer Internship and Minor Project in their Specialization area in line with the B.Tech program.

Minor Degree/Honors Degree MT-1/HT-1

B.Tech. VI Semester
ELECTRONICS AND COMPUTER ENGINEERING

SEMESTER- VI													
S. No.	**Course Code**	**Course Title**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credits**
			L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1	BCS601	Software Engineering	3	1	0	20	10	30		70		100	4
2	BECZ601	Digital Signal Processing	3	1	0	20	10	30		70		100	4
3	BCS603	Computer Networks	3	1	0	20	10	30		70		100	4
4	BECZ061/ BCDS062/ BCS063 / BECZ062	Department Elective–III	3	0	0	20	10	30		70		100	3
5		Open Elective-I	3	0	0	20	10	30		70		100	3
6	BCS651	Software Engineering Lab	0	0	2				50		50	100	1
7	BECZ651	Digital Signal Processing Lab	0	0	2				50		50	100	1
8	BCS653	Computer Networks lab	0	0	2				50		50	100	1
9	BNC601/ BNC602	Constitution of India/ Essence of Indian Traditional Knowledge	2	0	0	20	10	30		70			
		Total	**17**	**3**	**6**							**800**	**21**
Minor Degree/Honors Degree MT-1/HT-1													
***The Mini Project or internship (4 weeks) will be done during summer break after 6th Semester and will be assessed during 7th semester.** ***It is desirable that the students should do their Summer Internship and Minor Project in their specialization area in line with the B.Tech. program.**													

Departmental Elective-I

1. BECZ051 Optical Communication System
2. BCS052 Data Analytics
3. BCS053 Computer Graphics
4. BECZ052 Advance Digital Design using Verilog

Departmental Elective-II

1. BECZ053 VLSI Technology
2. BCIT054 Artificial Intelligence
3. BCS057 Image Processing
4. BECZ054 Integrated Circuit Design

Department Elective-III

1. BECZ061 Microcontroller for Embedded System Design
2. BCDS062 Machine Learning Techniques
3. BCS063 Blockchain Architecture & Design
4. BECZ062 Industrial Electronics

Database Management System (BCS501)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to:		
CO 1	Apply knowledge of database for real life applications.	K_3
CO 2	Apply query processing techniques to automate the real time problems of databases.	K_3, K_4
CO 3	Identify and solve the redundancy problem in database tables using normalization.	K_2, K_3
CO 4	Understand the concepts of transactions, their processing so they will familiar with broad range of database management issues including data integrity, security and recovery.	K_2, K_4
CO 5	Design, develop and implement a small database project using database tools.	K_3, K_6
DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** Overview, Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence and Database Language and Interfaces, Data Definitions Language, DML, Overall Database Structure. Data Modeling Using the Entity Relationship Model: ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Concepts of Super Key, Candidate Key, Primary Key, Generalization, Aggregation, Reduction of an ER Diagrams to Tables, Extended ER Model, Relationship of Higher Degree.	**08**
II	**Relational data Model and Language:** Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra, Relational Calculus, Tuple and Domain Calculus. Introduction on SQL: Characteristics of SQL, Advantage of SQL. SQl Data Type and Literals. Types of SQL Commands. SQL Operators and Their Procedure. Tables, Views and Indexes. Queries and Sub Queries. Aggregate Functions. Insert, Update and Delete Operations, Joins, Unions, Intersection, Minus, Cursors, Triggers, Procedures in SQL/PL SQL	**08**
III	**Data Base Design & Normalization:** Functional dependencies, normal forms, first, second, 8 third normal forms, BCNF, inclusion dependence, loss less join decompositions, normalization using FD, MVD, and JDs, alternative approaches to database design	**08**
IV	**Transaction Processing Concept:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Checkpoints, Deadlock Handling. Distributed Database: Distributed Data Storage, Concurrency Control, Directory System.	**08**
V	**Concurrency Control Techniques:** Concurrency Control, Locking Techniques for Concurrency Control, Time Stamping Protocols for Concurrency Control, Validation Based Protocol, Multiple Granularity, Multi Version Schemes, Recovery with Concurrent Transaction, Case Study of Oracle.	**08**

Text books:

1. Korth, Silbertz, Sudarshan," Database Concepts", McGraw Hill
2. Date C J, "An Introduction to Database Systems", Addision Wesley
3. Elmasri, Navathe, "Fundamentals of Database Systems", Addision Wesley
4. O'Neil, Databases, Elsevier Pub.
5. RAMAKRISHNAN "Database Management Systems", McGraw Hill
6. Leon & Leon," Database Management Systems", Vikas Publishing House
7. Bipin C. Desai, " An Introduction to Database Systems", Gagotia Publications
8. Majumdar & Bhattacharya, "Database Management System", TMH

CONTROL SYSTEM (BECZ501)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to		
CO 1	Describe the basics of control systems along with different types of feedback and its effect. Additionally they will also be able to explain the techniques such as block diagrams reduction, signal flow graph and modelling of various physical systems along with modelling of DC servomotor.	K_2, K_3
CO 2	Explain the concept of state variables for the representation of LTI system.	K_2, K_3
CO 3	Interpret the time domain response analysis for various types of inputs along with the time domain specifications.	K_3, K_4
CO 4	Distinguish the concepts of absolute and relative stability for continuous data systems along with different methods.	K_3, K_4
CO 5	Interpret the concept of frequency domain response analysis and their specifications.	K_3, K_5

DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Control Systems:** Basic Components of a control system, Feedback and its effect, types of feedback control systems. Block diagrams Reduction and signal flow graphs, Modeling of Physical systems: electrical networks, mechanical systems elements, free body diagram, analogous Systems, sensors and encoders in control systems, modeling of armature controlled and field-controlled DC servomotor.	**08**
II	**State-Variable Analysis:** Introduction, vector matrix representation of state equation, state transition matrix, state-transition equation, relationship between state equations and high- order differential equations, relationship between state equations and transfer functions, Decomposition of transfer functions, Controllability and observability, Eigen Value and Eigen Vector, Diagonalization.	**08**
III	**Time domain Analysis of Control Systems:** Time response of continuous data systems, typical test signals for the time response of control systems, unit step response and time- domain specifications, time response of a first order system, transient response of a prototype second order system, Steady-State error, Static and dynamic error coefficients, error analysis for different types of systems.	**08**
IV	**Stability of Linear Control Systems:** Bounded-input bounded-output stability continuous data systems, zero-input and asymptotic stability of continuous data systems, Routh Hurwitz criterion, Root-Locus Technique: Introduction, Properties of the Root Loci, Design aspects of the Root Loci.	**08**
V	**Frequency Domain Analysis:** Resonant peak and Resonant frequency, Bandwidth of the prototype Second order system, effects of adding a zero to the forward path, effects of adding a pole to the forward path, polar plot, Nyquist stability criterion, stability analysis with the Bode plot, relative stability: gain margin and phase margin.	**08**

Text books:

Text Book:

1. I. J. Nagrath & M. Gopal, "Control System Engineering", 6th Ed. New Age International Publishers, 2018
2. B.C. Kuo & Farid Golnaraghi, "Automatic Control Systems", 9th Edition, John Wiley India, 2008

Reference Books:

1. (Schaums Outlines Series) Joseph J. Distefano III, Allen R. Stubberud, Ivan J. Williams, "Control Systems", 3rd Edition, TMH, Special Indian Edition, 2010.
2. A. Anand Kumar, "Control Systems", Second Edition, PHI Learning private limited, 2014.
3. William A. Wolovich, "Automatic Control Systems", Oxford University Press, 2011.

DESIGN AND ANALYSIS OF ALGORITHM (BCS503)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to:		
CO 1	Design new algorithms, prove them correct, and analyze their asymptotic and absolute runtime and memory demands.	K4, K6
CO 2	Find an algorithm to solve the problem (create) and prove that the algorithm solves the problem correctly (validate).	K5, K6
CO 3	Understand the mathematical criterion for deciding whether an algorithm is efficient, and know many practically important problems that do not admit any efficient algorithms.	K2, K5
CO 4	Apply classical sorting, searching, optimization and graph algorithms.	K2, K4
CO 5	Understand basic techniques for designing algorithms, including the techniques of recursion, divide-and-conquer, and greedy.	K2, K3
DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** Algorithms, Analyzing Algorithms, Complexity of Algorithms, Growth of Functions, Performance Measurements, Sorting and Order Statistics - Shell Sort, Quick Sort, Merge Sort, Heap Sort, Comparison of Sorting Algorithms, Sorting in Linear Time.	**08**
II	**Advanced Data Structures:** Red-Black Trees, B – Trees, Binomial Heaps, Fibonacci Heaps, Tries, Skip List	**08**
III	**Divide and Conquer** with Examples Such as Sorting, Matrix Multiplication, Convex Hull and Searching. **Greedy Methods** with Examples Such as Optimal Reliability Allocation, Knapsack, Minimum Spanning Trees – Prim's and Kruskal's Algorithms, Single Source Shortest Paths - Dijkstra's and Bellman Ford Algorithms.	**08**
IV	**Dynamic Programming** with Examples Such as Knapsack. All Pair Shortest Paths – Warshal's and Floyd's Algorithms, Resource Allocation Problem. Backtracking, Branch and Bound with Examples Such as Travelling Salesman Problem, Graph Coloring, n-Queen Problem, Hamiltonian Cycles and Sum of Subsets.	**08**
V	**Selected Topics:** Algebraic Computation, Fast Fourier Transform, String Matching, Theory of NP- Completeness, Approximation Algorithms and Randomized Algorithms.	**08**

Text Books:

1. Thomas H. Coreman, Charles E. Leiserson and Ronald L. Rivest, "Introduction to Algorithms", Printice Hall of India.
2. E. Horowitz & S Sahni, "Fundamentals of Computer Algorithms",
3. Aho, Hopcraft, Ullman, "The Design and Analysis of Computer Algorithms" Pearson Education, 2008.
4. LEE "Design & Analysis of Algorithms (POD)",McGraw Hill
5. Richard E.Neapolitan "Foundations of Algorithms" Jones & Bartlett Learning
6. Jon Kleinberg and Éva Tardos, Algorithm Design, Pearson, 2005.

OPTICAL COMMUNICATION SYSTEM (BECZ051)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to:		
CO 1	Define and explain the basic concepts and theory of optical communication.	$K_{1,}K_2$
CO 2	Describe the signal losses with their computation and dispersion mechanism occurring inside the optical fiber cable.	K_2, K_3
CO 3	Differentiate the optical sources used in optical communication with their comparative study.	K_2, K_4
CO 4	Identify different optical components on receiver side; assemble them to solve real world problems related to optical communication systems.	K_2, K_3
CO 5	Evaluate the performance of an optical receiver to get idea about power budget and ultimately be an engineer with adequate knowledge in optical domain.	K_5
DETAILED SYLLABUS		**3L:0T:0P**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Optical Communication:** Optical Spectral Band with Operating Windows, General Communication System, Optical Communication System with its advantages. **Optical Fiber Waveguides:** Ray Theory of Transmission with TIR, Acceptance Angle, Numerical Aperture and Skew Rays, Electromagnetic Mode Theory for Optical Propagation, Modes in a Planar Guide, Phase and Group Velocity, Phase Shift with Total Internal Reflection, Evanescent Field, Goos-Haenchen Shift, Cylindrical Fiber Modes, Mode Coupling, Step Index fibers Vs Graded Index fibers, Single Mode Fibers- Cut off wavelength, MFD & Spot Size.	**08**
II	**Signal Loss in Optical Fibers:** Attenuation, Material Absorption Losses (Intrinsic and Extrinsic absorption), types of Linear and Non-Linear Scattering Losses, Fiber Bending Losses, Kerr Effect. **Dispersion:** Introduction with its types: Chromatic / Intramodal Dispersion (Material and Waveguide Dispersion), Intermodal dispersion (for MSI and MGI fibers), Overall (Total) Fiber Dispersion in Multimode and Singe Mode Fiber, Dispersion Modified Single Mode Fibers, Polarization & Fiber Birefringence.	**08**
III	**Optical Sources: LEDs-**Introduction to LEDs & Materials used for fabrication, LED Power and Efficiency, LED Structures, LED Characteristics, Modulation Bandwidth. **Laser Diodes-**Introduction, Optical Feedback & Laser Oscillations, Resonant Frequencies, Laser Modes, and Threshold Condition for Laser Oscillation, Laser Diode Rate Equations, Semiconductor injection Laser- Efficiency, Laser Single Mode operation, Reliability of LED & ILD.	**08**
IV	**Power Launching in Fiber:** Source to Fiber Power Launching and Coupling Techniques, Power Launching Vs Wavelength, Equilibrium Numerical Aperture. **Photo Detectors:** Introduction, Physical Principles of Photodiodes: The PIN Photo Detector, Avalanche Photodiodes, Temperature Effect on Avalanche Gain, Detector Response Time, Photo Detector Noise: Noise Sources, Signal to Noise Ratio, Comparison of Photo Detectors, Fundamental Receiver Operation with Digital Signal Transmission.	**08**
V	**Digital Receiver Performance:** Probability of Error / BER, Receiver Sensitivity & The Quantum Limit, Error Control Techniques, Eye Diagram Pattern Features, Coherent Detection: Homodyne Detection and Heterodyne Detection, Digital links: Point to Point Links, Power Penalties, Multichannel & Multiplexing Transmission Techniques, basic concept of Free Space Optics (FSO) based Communication System.	**08**

Text Book:

1. John M. Senior, "Optical Fiber Communications", Pearson, 3rd Edition, 2010.
2. Gerd Keiser, "Optical Fiber Communications", McGraw Hill, 5th Edition, 2013.
3. Govind P. Agrawal, "Fiber Optic Communication Systems", John Wiley, 3rd Edition, 2004.

Data Analytics (BCS052)

Course Outcome (CO)		Bloom's Knowledge Level (KL)
At the end of course , the student will be able to :		
CO 1	Describe the life cycle phases of Data Analytics through discovery, planning and building.	K1, K2
CO 2	Understand and apply Data Analysis Techniques.	K2, K3
CO 3	Implement various Data streams.	K3
CO 4	Understand item sets, Clustering, frame works & Visualizations.	K2
CO 5	Apply R tool for developing and evaluating real time applications.	K3, K5, K6

DETAILED SYLLABUS		3-0-0
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Data Analytics:** Sources and nature of data, classification of data (structured, semi-structured, unstructured), characteristics of data, introduction to Big Data platform, need of data analytics, evolution of analytic scalability, analytic process and tools, analysis vs reporting, modern data analytic tools, applications of data analytics. **Data Analytics Lifecycle:** Need, key roles for successful analytic projects, various phases of data analytics lifecycle – discovery, data preparation, model planning, model building, communicating results, operationalization.	**08**
II	**Data Analysis:** Regression modeling, multivariate analysis, Bayesian modeling, inference and Bayesian networks, support vector and kernel methods, analysis of time series: linear systems analysis & nonlinear dynamics, rule induction, neural networks: learning and generalisation, competitive learning, principal component analysis and neural networks, fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, stochastic search methods.	**08**
III	**Mining Data Streams:** Introduction to streams concepts, stream data model and architecture, stream computing, sampling data in a stream, filtering streams, counting distinct elements in a stream, estimating moments, counting oneness in a window, decaying window, Real-time Analytics Platform (RTAP) applications, Case studies – real time sentiment analysis, stock market predictions.	**08**
IV	**Frequent Itemsets and Clustering:** Mining frequent itemsets, market based modelling, Apriori algorithm, handling large data sets in main memory, limited pass algorithm, counting frequent itemsets in a stream, clustering techniques: hierarchical, K-means, clustering high dimensional data, CLIQUE and ProCLUS, frequent pattern based clustering methods, clustering in non-euclidean space, clustering for streams and parallelism.	**08**
V	**Frame Works and Visualization:** MapReduce, Hadoop, Pig, Hive, HBase, MapR, Sharding, NoSQL Databases, S3, Hadoop Distributed File Systems, Visualization: visual data analysis techniques, interaction techniques, systems and applications. **Introduction to R** - R graphical user interfaces, data import and export, attribute and data types, descriptive statistics, exploratory data analysis, visualization before analysis, analytics for unstructured data.	**08**

Text books and References:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer
2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press.
3. Bill Franks, Taming the Big Data Tidal wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & Sons.
4. John Garrett, Data Analytics for IT Networks : Developing Innovative Use Cases, Pearson Education

Computer Graphics (BCS053)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to:		
CO 1	Understand the graphics hardware used in field of computer graphics.	K_2
CO 2	Understand the concept of graphics primitives such as lines and circle based on different algorithms.	K_2, K_4
CO 3	Apply the 2D graphics transformations, composite transformation and Clipping concepts.	K_4
CO 4	Apply the concepts of and techniques used in 3D computer graphics, including viewing transformations.	K_2, K_3
CO 5	Perform the concept of projections, curve and hidden surfaces in real life.	K_2, K_3

DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction and Line Generation:** Types of computer graphics, Graphic Displays- Random scan displays, Raster scan displays, Frame buffer and video controller, Points and lines, Line drawing algorithms, Circle generating algorithms, Mid-point circle generating algorithm, and parallel version of these algorithms.	**08**
II	**Transformations:** Basic transformation, Matrix representations and homogenous coordinates, Composite transformations, Reflections and shearing. **Windowing and Clipping:** Viewing pipeline, Viewing transformations, 2-D Clipping algorithms- Line clipping algorithms such as Cohen Sutherland line clipping algorithm, Liang Barsky algorithm, Line clipping against non rectangular clip windows; Polygon clipping – Sutherland Hodgeman polygon clipping, Weiler and Atherton polygon clipping, Curve clipping, Text clipping	**08**
III	**Three Dimensional:** 3-D Geometric Primitives, 3-D Object representation, 3-D Transformation, 3-D viewing, projections, 3-D Clipping.	**08**
IV	**Curves and Surfaces:** Quadric surfaces, Spheres, Ellipsoid, Blobby objects, Introductory concepts of Spline, Bspline and Bezier curves and surfaces.	**08**
V	**Hidden Lines and Surfaces:** Back Face Detection algorithm, Depth buffer method, A- buffer method, Scan line method, basic illumination models– Ambient light, Diffuse reflection, Specular reflection and Phong model, Combined approach, Warn model, Intensity Attenuation, Color consideration, Transparency and Shadows.	**08**

Text books:

1. Donald Hearn and M Pauline Baker, "Computer Graphics C Version", Pearson Education
2. Foley, Vandam, Feiner, Hughes – "Computer Graphics principle", Pearson Education.
3. Rogers, " Procedural Elements of Computer Graphics", McGraw Hill
4. W. M. Newman, R. F. Sproull – "Principles of Interactive computer Graphics" – McGraw Hill.
5. Amrendra N Sinha and Arun D Udai," Computer Graphics", McGraw Hill.
6. R.K. Maurya, "Computer Graphics " Wiley Dreamtech Publication.
7. Mukherjee, Fundamentals of Computer graphics & Multimedia, PHI Learning Private Limited.
8. Donald Hearn and M Pauline Baker, "Computer Graphics with Open GL", Pearson education

ADVANCED DIGITAL DESIGN USING VERILOG (BECZ052)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to:		
CO 1	Describe mixed logic circuits and their implementation.	K_1, K_2
CO 2	Implement combinational circuits using mixed logic and Verilog.	K_4, K_5
CO 3	Design sequential circuits using mixed logic and Verilog with mapping of Algorithm.	K_2, K_3
CO 4	Understand faults and its elimination in sequential and combinational circuits.	K_1, K_2
CO 5	Understand the working of programmable logic families.	K_1, K_2
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	Introduction to Mixed Logic, Logic Representation and Minimization with cost, Multiple output minimization, Entered Variable K- Map including don't care handling, XOR Pattern Handling.	**08**
II	Combinational Circuit Design, Multiplexers, Decoders, Encoders, Code Comparators, Adders, Subtractors, Multipliers, Introduction to Verilog, Behavioral and Structural specification of logic circuits, Boolean function implementation using Verilog, Timing Analysis, Hazard Detection and Elimination	**08**
III	Synchronous Sequential Circuits Design, Mapping Algorithm, Synchronous State Machines, ASM Charts, Asynchronous Sequential Circuit Design, Races, Multi-level minimization and optimization.	**08**
IV	Factoring, Decomposition, BDD, Ordered BDD, LPDD, Fault Detection and Analysis in combinational and sequential systems, Path Sensitization method, Boolean Difference Method, Initial State Method.	**08**
V	Study of programmable logic families, PLD, CPLD, FPGA, ASIC, PLA, Architectures, Design of Combinational and sequential circuits using CPLD and FPGA, Design Examples.	**08**

Text Books:

1. Richard F. Tinder, "Engineering Digital Design", Academic Press.
2. Parag K. Lala, "Digital system Design Using PLDs", PHI India Ltd.
3. Stephen Brown and ZvonkoVranesiv, "Fundamental of Digital Logic with Verilog Design", McGraw Hill.

Reference Books:

1. John Williams, "Digital VLSI Design with Verilog", Springer Publication..
2. Samuel C. Lee, "Digital Circuit and Logic Design", PHI India Ltd.
3. Alexander Miczo, "Digital Logic Testing and Simulation",Wiley Interscience.

VLSI TECHNOLOGY (BECZ053)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to:		
CO 1	Interpret the basics of crystal growth, wafer preparation and wafer cleaning.	K_3, K_5
CO 2	Evaluate the process of Epitaxy and oxidation.	K_2, K_3
CO 3	Differentiate the lithography, etching and deposition process.	K_3, K_4
CO 4	Analyze the process of diffusion and ion implantation.	K_4, K_5
CO 5	Express the basic process involved in metallization and packaging.	K_2, K_3

DETAILED SYLLABUS		3-0-0
Unit	**Topic**	**Proposed Lecture**
I	**Introduction To IC Technology:** SSI, MSI, LSI, VLSI Integrated Circuits.Crystal Growth and Wafer Preparation: Electronic Grade Silicon, Czochralski Crystal Growth, Silicon Shaping, Processing Considerations. Wafer Cleaning Technology - Basic Concepts, Wet cleaning, Dry cleaning	**08**
II	**Epitaxy:** Vapor-Phase Epitaxy, Molecular Beam Epitaxy, Silicon onInsulators, Epitaxial Evaluation. **Oxidation:** Growth Kinetics, Thin Oxides, Oxidation Techniques and Systems, Oxides Properties.	**08**
III	**Lithography:** Optical Lithography, Electron beam lithography, Photomasks, Wet Chemical Etching. **Dielectric and Polysilicon Film Deposition:** Deposition Processes of Polysilicon, Silicon Dioxide, Silicon Nitride.	**08**
IV	**Diffusion:** Models of diffusion in solids, Fick's 1-Dimensional diffusion equation, Diffusion of Impurities in Silicon and Silicon Dioxide, Diffusion Equations, Diffusion Profiles, Diffusion Furnace, Solid, Liquid and Gaseous Sources, **Ion-Implantation:** Ion-Implantation Technique, Range Theory, Implantation Equipment.	**08**
V	**Metallization:** Metallization Application, Metallization Choices, Physical Vapor Deposition, Vacuum Deposition, Sputtering Apparatus. **Packaging of VLSI devices**: Package Types, Packaging Design Consideration, VLSI Assembly Technologies, Package Fabrication Technologies, CMOS fabrication steps.	**08**

Text Books:

1. S. M. Sze, "VLSI Technology", McGraw Hill Publication, 2nd Edition 2017
2. S.K. Ghandhi, "VLSI Fabrication Principles", Willy-India Pvt. Ltd, 2008

Reference Books:

1. J. D. Plummer, M. D. Deal and Peter B. Griffin, "Silicon VLSI Technology:Fundamentals, Practice and Modeling", Pearson Education Publication, 2009
2. Stephen A. Campbell, "Fabrication Engineering at the Micro and Nano scale", OxfordUniversity Press, 2013

ARTIFICIAL INTELLIGENCE (BCIT054)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of the course, the student will be able to:		
CO 1	Understand the basics of the theory and practice of Artificial Intelligence as a discipline and about intelligent agents.	K_1, K_2
CO 2	Understand search techniques and gaming theory.	K_1, K_2
CO 3	The student will learn to apply knowledge representation techniques and problem-solving strategies to common AI applications.	K_3, K_4
CO 4	Students should be aware of techniques used for classification and clustering.	K_3, K_4
CO 5	Students should aware of basics of pattern recognition and steps required for it.	K_2, K_3
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**INTRODUCTION :** Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.	**08**
II	**PROBLEM SOLVING METHODS** Problem solving Methods – Search Strategies- Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems – Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal Decisions in Games – Alpha – Beta Pruning – Stochastic Games	**08**
III	**KNOWLEDGE REPRESENTATION** First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation – Ontological Engineering-Categories and Objects – Events – Mental Events and Mental Objects – Reasoning Systems for Categories – Reasoning with Default Information	**08**
IV	**SOFTWARE AGENTS** Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.	**08**
V	**APPLICATIONS** AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing – Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving	**08**

Text books:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009.
2. I. Bratko, ―Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational PublishersInc., 2011.
3. M. Tim Jones, ―Artificial Intelligence: A Systems Approach(Computer Science)‖, Jones and Bartlett Publishers, Inc.;First Edition, 2008
4. Nils J. Nilsson, ―The Quest for Artificial Intelligence‖, Cambridge University Press, 2009.
5. William F. Clocksin and Christopher S. Mellish,‖ Programming in Prolog: Using the ISO Standard‖, Fifth Edition,Springer, 2003.
6. Gerhard Weiss, ―Multi Agent Systems‖, Second Edition, MIT Press, 2013.
7. David L. Poole and Alan K. Mackworth, ―Artificial Intelligence: Foundations of Computational Agents‖, CambridgeUniversity Press, 2010.

Image Processing (BCS057)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able:		
CO 1	Explain the basic concepts of two-dimensional signal acquisition, sampling, quantization and color model.	K_1, K_2
CO 2	Apply image processing techniques for image enhancement in both the spatial and frequency domains.	K_2, K_3
CO 3	Apply and compare image restoration techniques in both spatial and frequency domain.	K_2, K_3
CO 4	Compare edge based and region-based segmentation algorithms for ROI extraction.	K_3, K_4
CO 5	Explain compression techniques and descriptors for image processing.	K_2, K_3
DETAILED SYLLABUS		**3-0-0**

Unit	Topic	Proposed Lecture
I	**DIGITAL IMAGE FUNDAMENTALS:** Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels – Color image fundamentals – RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms – DFT, DCT.	**08**
II	**IMAGE ENHANCEMENT:** Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.	**08**
III	**IMAGE RESTORATION:** Image Restoration – degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering	**08**
IV	**IMAGE SEGMENTATION:** Edge detection, Edge linking via Hough transform – Thresholding – Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.	**08**
V	**IMAGE COMPRESSION AND RECOGNITION:** Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture – Patterns and Pattern classes – Recognition based on matching.	**08**

Text books:

1. Rafael C. Gonzalez, Richard E. Woods,Digital Image Processing Pearson, Third Edition, 2010
2. Anil K. Jain,Fundamentals of Digital Image Processing Pearson, 2002.
3. Kenneth R. Castleman,Digital Image Processing Pearson, 2006.
4. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,Digital Image Processing using MATLAB Pearson Education, Inc., 2011.
5. D,E. Dudgeon and RM. Mersereau,Multidimensional Digital Signal Processing Prentice Hall Professional Technical Reference, 1990.
6. William K. Pratt,Digital Image Processing John Wiley, New York, 2002
7. Milan Sonka et al Image processing, analysis and machine vision Brookes/Cole, Vikas Publishing House, 2nd edition, 1999

INTEGRATED CIRCUITS DESIGN (BECZ054)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to:		
CO 1	Explain complete internal analysis of Op-Amp 741-IC.	K_1, K_2
CO 2	Examine and design Op-Amp based circuits and basic components of ICs such as various types of filters.	K_3, K_4
CO 3	Implement the concept of Op-Amp to design Op-Amp based non-linear applications and wave-shaping circuits.	K_2, K_4
CO 4	Analyze and design basic digital IC circuits using CMOS technology.	K_3, K_5
CO 5	Describe the functioning of application specific ICs such as 555 timer, VCO IC 566 and PLL.	K_3, K_5
DETAILED SYLLABUS		**3L:0T:0P**
Unit	**Topic**	**Proposed Lecture**
I	**The 741 IC Op-Amp**: General operational amplifier stages (bias circuit, the input stage, the second stage, the output stage, short circuit protection circuitry), device parameters, DC and AC analysis of input stage, second stage and output stage, gain, frequency response of 741, a simplified model, slew rate, relationship between ft and slew rate.	**08**
II	**Linear Applications of IC Op-Amps:** Op-Amp based V-I and I-V converters, instrumentation amplifier, generalized impedance converter, simulation of inductors. **Active Analog filters:** Sallen Key second order filter, Designing of second order low pass and high pass Butterworth filter, Introduction to band pass and band stop filter, all pass active filters, KHN Filters. Introduction to design of higher order filters.	**08**
III	**Frequency Compensation & Nonlinearity:** Frequency Compensation, Compensation of two stage Op-Amps, Slewing in two stage Op-Amp. Nonlinearity of Differential Circuits, Effect of Negative feedback on Nonlinearity. **Non-Linear Applications of IC Op-Amps:** Basic Log–Anti Log amplifiers using diode and BJT, temperature compensated Log-Anti Log amplifiers using diode, peak detectors, sample and hold circuits. Op-amp as a comparator and zero crossing detector, a stable multivibrator & monostable multivibrator. Generation of triangular waveforms, analog multipliers and their applications.	**08**
IV	**Digital Integrated Circuit Design:** An overview, CMOS logic gate circuit's basic structure, CMOS realization of inverters, AND, OR, NAND and NOR gates. **Latches and Flip flops**: the latch, CMOS implementation of SR flip-flops, a simpler CMOS implementation of the clocked SR flip-flop, CMOS implementation of J-K flip- flops, D flip- flop circuits.	**08**
V	**Integrated Circuit Timer:** Timer IC 555 pin and functional block diagram, Monostable and A stable multivibrator using the 555 IC. Voltage Controlled Oscillator: VCO IC 566 pin and functional block diagram and applications. **Phase Locked Loop (PLL)**: Basic principle of PLL, block diagram, working, Ex-OR gates and multipliers as phase detectors, applications of PLL.	**08**

. Text Book:

1. Microelectronic Circuits, Sedra and Smith, 7th Edition, Oxford, 2017.
2. Behzad Razavi: Design of Analog CMOS Integrated Circuits, TMH

Reference Books:

1. Gayakwad: Op-Amps and Linear Integrated Circuits, 4th Edition Prentice Hall of India, 2002.
2. Franco, Analog Circuit Design: Discrete & Integrated, TMH, 1st Edition.
3. Salivahnan, Electronics Devices and Circuits, TMH, 3rd Edition, 2015
4. Millman and Halkias: Integrated Electronics, TMH, 2nd Edition, 2010

Database Management Systems Lab (BCS551)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to:		
CO 1	Understand and apply oracle 11 g products for creating tables, views, indexes, sequences and other database objects.	K_2, K_4
CO 2	Design and implement a database schema for company data base, banking data base, library information system, payroll processing system, student information system.	K_3, K_5
CO 3	Write and execute simple and complex queries using DDL, DML, DCL and TCL.	K_4, K_5
CO 4	Write and execute PL/SQL blocks, procedure functions, packages and triggers, cursors.	K_4, K_5
CO 5	Enforce entity integrity, referential integrity, key constraints, and domain constraints on database.	K_3, K_4

DETAILED SYLLABUS

1. Installing oracle/ MYSQL
2. Creating Entity-Relationship Diagram using case tools.
3. Writing SQL statements Using ORACLE /MYSQL:
   a)Writing basic SQL SELECT statements.
   b) Restricting and sorting data.
   c)Displaying data from multiple tables.
   d)Aggregating data using group function.
   e)Manipulating data.
   e)Creating and managing tables.
4. Normalization
5. Creating cursor
6. Creating procedure and functions
7. Creating packages and triggers
8. Design and implementation of payroll processing system
9. Design and implementation of Library Information System
10. Design and implementation of Student Information System
11. Automatic Backup of Files and Recovery of Files
12. Mini project (Design & Development of Data and Application) for following :
    a) Inventory Control System.
    b) Material Requirement Processing.
    c) Hospital Management System.
    d) Railway Reservation System.
    e) Personal Information System.
    f) Web Based User Identification System.
    g) Timetable Management System.
    h) Hotel Management System

Note: The Instructor may add/delete/modify/tune experiments, wherever he/she feels in a justified manner
It is also suggested that open source tools should be preferred to conduct the lab (MySQL , SQL server , Oracle ,MongoDB ,Cubrid ,MariaDBetc)

Database Management Systems Lab (BCS-551): Mapping with Virtual Lab

Name of the Lab	Name of the Experiment
Database Management Lab(BCS-551)	Data Definition Language(DDL) Statements: (Create table, Alter table, Droptable)
	Data Manipulation Language(DML) Statements
	Data Query Language(DQL) Statements: (Select statement with operations like Where clause, Order by, Logical operators, Scalar functions and Aggregate functions)
	Transaction Control Language(TCL) statements: (Commit(make changespermanent), Rollback (undo)
	Describe statement: To view the structure of the table created

CONTROL SYSTEM LAB (BECZ551)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to:		
CO 1	Determine the characteristics of control system components like ac servo motor, synchro, potentiometer, servo voltage stabilizer and use them in error detector mode.	K4
CO 2	Compare the performance of control systems by applying different controllers / CO3 compensators.	K_5
CO 3	Analyze the behavior of dc motor in open loop and closed loop conditions at various loads & determine the response of 1st& 2nd order systems for various values of constant K.	K_5
CO 4	Apply different stability methods of time & frequency domain in control systems using software & examine their stability.	K_4
CO 5	Convert the transfer function into state space & vice versa & obtain the time domain response of a second order system for step input and their performance parameters using software.	K5

DETAILED SYLLABUS

Note: Minimum 10 experiments are to be performed from the following list:

1. To determine speed-torque characteristics of an AC servomotor.
2. To study i) ii) Synchro Transmitter characteristics. Obtain Synchro Transmitter – Receiver output vs input characteristics.
3. To determine response of first order and second order systems for step input for various values of constant 'K' using linear simulator unit and compare theoretical and practical results.
4. To study characteristics of positional error detector by angular displacement of two servo potentiometers.
5. To simulate and compare the response of 2nd order system with and without lead, lag, Lead- Lag compensator / simulate PID controller for transportation lag.
6. To study P, PI and PID temperature controller for an oven and compare their characteristics.
7. To study performance of servo voltage stabilizer at various loads using load bank.
8. To study behavior of separately excited dc motor in open loop and closed loop conditions at various loads.

Note: The Instructor may add/delete/modify/tune experiments, wherever he/she feels in a justified manner.

Design and Analysis of Algorithm Lab (BCS-553)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to:		
CO 1	Understand and implement algorithm to solve problems by iterative approach.	K_2, K_3
CO 2	Understand and implement algorithm to solve problems by divide and conquerapproach.	K_2, K_5
CO 3	Understand and implement algorithm to solve problems by Greedy algorithm approach.	K_2, K_5
CO 4	Understand and analyze algorithm to solve problems by Dynamic programming, backtracking.	K_2, K_4
CO 5	Understand and analyze the algorithm to solve problems by branch and bound approach.	K_3, K_4

DETAILED SYLLABUS

1. Program for Recursive Binary & Linear Search.
2. Program for Heap Sort.
3. Program for Merge Sort.
4. Program for Selection Sort.
5. Program for Insertion Sort.
6. Program for Quick Sort.
7. Knapsack Problem using Greedy Solution
8. Perform Travelling Salesman Problem
9. Find Minimum Spanning Tree using Kruskal's Algorithm
10. Implement N Queen Problem using Backtracking
11. Sort a given set of n integer elements using Quick Sort method and compute its time complexity. Run the program for varied values of n> 5000 and record the time taken to sort. Plot a graph of the time taken versus non graph sheet. The elements can be read from a file or can be generated using the random number generator. Demonstrate using Java how the divide and- conquer method works along with its time complexity analysis: worst case, average case and best case.
12. Sort a given set of n integer elements using Merge Sort method and compute its time complexity. Run the program for varied values of n> 5000, and record the time taken to sort. Plot a graph of the time taken versus non graph sheet. The elements can be read from a file or can be generated using the random number generator. Demonstrate how the divide and-conquer method works along with its time complexity analysis: worst case, average case and best case.
13.6. Implement , the 0/1 Knapsack problem using
   (a) Dynamic Programming method
   (b) Greedy method.
14. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.
15.Find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm. Use Union-Find algorithms in your program.
16. Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.
17. Write programs to (a) Implement All-Pairs Shortest Paths problem using Floyd's algorithm.
   (b) Implement Travelling Sales Person problem using Dynamic programming.
18. Design and implement to find a subset of a given set S = {Sl, S2, ...,Sn} of n positive integers whose SUM is equal to a given positive integer d. For example, if S ={1, 2, 5, 6, 8} and d= 9, there are two solutions {1,2,6}and {1,8}. Display a suitable message, if the given problem instance doesn't have a solution.
19. Design and implement to find all Hamiltonian Cycles in a connected undirected Graph G of n vertices using backtracking principle.

Note: The Instructor may add/delete/modify/tune experiments, wherever he/she feels in a justified manner
It is also suggested that open source tools should be preferred to conduct the lab (C, C++ etc)

B.Tech 3rd Year VI Semester Syllabus

SOFTWARE ENGINEERING (BCS601)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to		
CO 1	Explain various software characteristics and analyze different software Development Models.	K_1, K_2
CO 2	Demonstrate the contents of a SRS and apply basic software quality assurance practices to ensure that design, development meet or exceed applicable standards.	K_1, K_2
CO 3	Compare and contrast various methods for software design	K_2, K_3
CO 4	Formulate testing strategy for software systems, employ techniques such as unit testing, Test driven development and functional testing.	K_3
CO 5	Manage software development process independently as well as in teams and make use of Various software management tools for development, maintenance and analysis.	K_5
DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Software Quality Attributes. Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.	**08**
II	**Software Requirement Specifications (SRS):** Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modelling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS. Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model.	**08**
III	**Software Design:** Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures: Halestead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.	**08**
IV	**Software Testing:** Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, TopDown and Bottom-Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies: Formal Technical Reviews (Peer Reviews), Walk Through, Code Inspection, Compliance with Design and Coding Standards.	**08**

V	**Software Maintenance and Software Project Management:** Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re- Engineering, Reverse Engineering. Software Configuration Management Activities, Change Control Process, Software Version Control, An Overview of CASE Tools. Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO), Resource Allocation Models, Software Risk Analysis and Management.	**08**

Text books:

1.RS Pressman, Software Engineering: A Practitioners Approach, McGraw Hill.
2. Pankaj Jalote, Software Engineering, Wiley
3. Rajib Mall, Fundamentals of Software Engineering, PHI Publication.
4. KK Aggarwal and Yogesh Singh, Software Engineering, New Age International Publishers.
5. Ghezzi, M. Jarayeri, D. Manodrioli, Fundamentals of Software Engineering, PHI Publication.
6. Ian Sommerville, Software Engineering, Addison Wesley.
7. Kassem Saleh, "Software Engineering", Cengage Learning.
8. P fleeger, Software Engineering, Macmillan Publication

DIGITAL SIGNAL PROCESSING (BECZ601)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to:		
CO 1	Design and describe different types of realizations of digital systems (IIR and FIR) and their utilities.	K_3,K_4
CO 2	Select design parameters of analog IIR digital filters (Butterworth and Chebyshev filters) and implement various methods such as impulse invariant transformation and bilinear transformation of conversion of analog to digital filters.	K_3, K_4
CO 3	Design FIR filter using various types of window functions.	K_2, K_3
CO 4	Define the principle of discrete Fourier transform & its various properties and concept of circular and linear convolution. Also, students will be able to define and implement FFT i.e. a fast computation method of DFT.	K_2, K_4
CO 5	Define the concept of decimation and interpolation. Also, they will be able to implement it in various practical applications.	K_3, K_5
DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Digital Signal Processing**: Basic elements of digital signal processing, advantages and disadvantages of digital signal processing, Technology used for DSP. **Realization of Digital Systems**: Introduction- basic building blocks to represent a digital system, recursive and non-recursive systems, basic structures of a digital system: Canonic and Non-Canonic structures. **IIR Filter Realization**: Direct form, cascade realization, parallel form realization, Ladder structures- continued fraction expansion of H (z), example of continued fraction, realization of a ladder structure, design examples. **FIR Filter Realization**: Direct, Cascade, FIR Linear Phase Realization and design examples.	**08**
II	**Infinite Impulse Response Digital (IIR) Filter Design:** Introduction to Filters, Impulse Invariant Transformation, Bi-Linear Transformation, All- Pole Analog Filters: Butterworth and Chebyshev, Design of Digital Butterworth and Chebyshev Filters, Frequency Transformations.	**08**
III	**Finite Impulse Response Filter (FIR) Design**: Windowing and the Rectangular Window, Gibb's phenomenon, Other Commonly Used Windows (Hamming, Hanning, Bartlett, Blackmann, Kaiser), Examples of Filter Designs Using Windows. **Finite Word length effects in digital filters**: Coefficient quantization error, Quantization noise – truncation and rounding, Limit cycle oscillations-dead band effects.	**08**
IV	**DFT & FFT**: Definitions, Properties of the DFT, Circular Convolution, Linear Convolution using Circular Convolution, Decimation in Time (DIT) Algorithm, Decimation in Frequency (DIF) Algorithm.	**08**
V	**Multirate Digital Signal Processing (MDSP)**: Introduction, Decimation, Interpolation, Sampling rate conversion: Single and Multistage, applications of MDSP- Subband Coding of Speech signals, Quadrature mirror filters, Advantages of MDSP.	**08**

Text Books:

1. John G Prokias, Dimitris G Manolakis, Digital Signal Processing. Pearson, 4th Edition, 2007
2. Johnny R. Johnson, Digital Signal Processing, PHI Learning Pvt Ltd., 2009.
3. S. Salivahanan, A. Vallavaraj, Digital Signal Processing, TMH, 4th Edition 2017.
4. Oppenheim & Schafer, Digital Signal Processing. Pearson Education 2015
5. S.K. Mitra, 'Digital Signal Processing–A Computer Based Approach, TMH, 4th Edition.

Computer Networks (BCS603)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to understand		
CO 1	Explain basic concepts, OSI reference model, services and role of each layer of OSI model and TCP/IP, networks devices and transmission media, Analog and digital data transmission	K_1,K_2
CO 2	Apply channel allocation, framing, error and flow control techniques.	K_3
CO 3	Describe the functions of Network Layer i.e. Logical addressing, subnetting & Routing Mechanism.	K_2,K_3
CO 4	Explain the different Transport Layer function i.e. Port addressing, Connection Management, Error control and Flow control mechanism.	K_2,K_3
CO 5	Explain the functions offered by session and presentation layer and their Implementation.	K_2,K_3
CO 6	Explain the different protocols used at application layer i.e. HTTP, SNMP, SMTP, FTP, TELNET and VPN.	K_2
DETAILED SYLLABUS		**3-1-0**

Unit	Topic	Proposed Lecture
I	**Introductory Concepts**: Goals and applications of networks, Categories of networks, Organization of the Internet, ISP, Network structure and architecture (layering principles, services, protocols and standards), The OSI reference model, TCP/IP protocol suite, Network devices and components. **Physical Layer:** Network topology design, Types of connections, Transmission media, Signal transmission and encoding, Network performance and transmission impairments, Switching techniques and multiplexing.	**08**
II	**Link layer:** Framing, Error Detection and Correction, Flow control (Elementary Data Link Protocols, Sliding Window protocols). Medium Access Control and Local Area Networks: Channel allocation, Multiple access protocols, LAN standards, Link layer switches & bridges (learning bridge and spanning tree algorithms).	**08**
III	**Network Layer:** Point-to-point networks, Logical addressing, Basic internetworking (IP, CIDR, ARP, RARP, DHCP, ICMP), Routing, forwarding and delivery, Static and dynamic routing, Routing algorithms and protocols, Congestion control algorithms, IPv6.	**08**
IV	**Transport Layer:** Process-to-process delivery, Transport layer protocols (UDP and TCP), Multiplexing, Connection management, Flow control and retransmission, Window management, TCP Congestion control, Quality of service.	**08**
V	**Application Layer:** Domain Name System, World Wide Web and Hyper Text Transfer Protocol, Electronic mail, File Transfer Protocol, Remote login, Network management, Data compression, Cryptography – basic concepts.	**08**

Text books and References:

1. Behrouz Forouzan, "Data Communication and Networking", McGraw Hill
2. Andrew Tanenbaum "Computer Networks", Prentice Hall.
3. William Stallings, "Data and Computer Communication", Pearson.
4. Kurose and Ross, "Computer Networking- A Top-Down Approach", Pearson.
5. Peterson and Davie, "Computer Networks: A Systems Approach", Morgan Kaufmann
6. W. A. Shay, "Understanding Communications and Networks", Cengage Learning.
7. D. Comer, "Computer Networks and Internets", Pearson.
8. Behrouz Forouzan, "TCP/IP Protocol Suite", McGraw Hill.

MICROCONTROLLER FOR EMBEDDED SYSTEMS (BECZ061)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able:		
CO 1	Explain the advance concept of 8051 architectures and AVR family architecture and compare them for different applications.	K_1, K_2
CO 2	To demonstrate the basics of MSP430x5x Microcontroller	K_2, K_3
CO 3	To execute the I/O interfacing and peripheral devices associated with Microcontroller SoC (system on chip).	K_3, K_4
CO 4	Evaluate the data transfer information through serial & parallel ports and implement its interfacing with MSP430.	K_4, K_5
CO 5	Demonstrate the basics of IoT, WSN and its application sectors and design IoT based projects using MSP430 microcontroller.	K_4, K_5

DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Advanced concepts in 8051 architectures:** Review of 8051 architecture, concept of synchronous serial communication, SPI and I2C communication protocols, study of SPI port on 89LP 51RD2, study of SAR ADC/DAC MCP3304 / MCP 33, interfacing concepts for SPI based ADC/DAC, study of watchdog timer, study of PCA timer in different modes like capture mode, PWM generation mode, High speed output toggle mode Embedded 'C' programming for the above peripherals **Introduction, AVR Family architecture**, Register File, The ALU. Memory access and Instruction execution. I/O memory. EEPROM. I/O ports. Timers. Interrupt Structure	**08**
II	**MSP430x5x Microcontroller:** series block diagram, address space, on-chip peripherals (analog and digital), and Register sets. Instruction set, instruction formats, and various addressing modes of 16-bit microcontroller; Sample embedded system on MSP430 microcontroller. Memory Mapped Peripherals, programming System registers, I/O pin multiplexing, pull up/down registers, GPIO control. Interrupts and interrupt programming.	**08**
III	**Peripheral Devices:** Watch dog timer, system clocks, Timer & Real Time Clock (RTC), PWM control, timing generation and measurements. Analog interfacing and data acquisition ADC and Comparator in MSP430, data transfer using DMA.	**08**
IV	**Serial communication** basics, Synchronous/Asynchronous interfaces (like UART, USB, SPI, and I2C). UART protocol, I2C protocol, SPI protocol. Implementing and programming UART, I2C, SPI interface using MSP430, Interfacing external devices.	**08**
V	**Internet of Things (IoT)**: overview and architecture, Overview of wireless sensor networks and design examples. Various wireless connectivity: NFC, ZigBee, Bluetooth, Bluetooth Low Energy, Wi-Fi. Adding Wi-Fi capability to the Microcontroller, Embedded Wi-Fi, User APIs for Wireless and Networking applications, Building IoT applications using CC3100 user API for connecting sensors.	**08**

Text Books:

1. Mazidi Ali Muhammad, Mazidi Gillispie Janice, and Mc Kinlay Rolin D "The 8051 Microcontroller and Embedded Systems using Assembly and C", Pearson Publication,2006
2. John H Davies, "MSP430 Microcontroller Basics" Newnes Publication,2008

Reference Books:

1. TI MSP430x5xx and MSP430x6xx Family User's Guide , Revised 2018.

MACHINE LEARNING TECHNIQUES (BCDS062)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able:		
CO 1	To understand the need for machine learning for various problem solving.	K_1, K_2
CO 2	To understand a wide variety of learning algorithms and how to evaluate models generated from data.	K_2, K_3
CO 3	To understand the latest trends in machine learning.	K_2, K_3
CO 4	To design appropriate machine learning algorithms and apply the algorithms to a real- world problems.	K_3, K_4
CO 5	To optimize the models learned and report on the expected accuracy that can be achieved by applying the models.	K_2, K_3

DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**INTRODUCTION** – Learning, Types of Learning, Well defined learning problems, Designing a Learning System, History of ML, Introduction of Machine Learning Approaches – (Artificial Neural Network, Clustering, Reinforcement Learning, Decision Tree Learning, Bayesian networks, Support Vector Machine, Genetic Algorithm), Issues in Machine Learning and Data Science Vs Machine Learning;	**08**
II	**REGRESSION:** Linear Regression and Logistic Regression **BAYESIAN LEARNING -** Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm. **SUPPORT VECTOR MACHINE:** Introduction, Types of support vector kernel – (Linear kernel, polynomial kernel,and Gaussiankernel), Hyperplane – (Decision surface), Properties of SVM, and Issues in SVM.	**08**
III	**DECISION TREE LEARNING -** Decision tree learning algorithm, Inductive bias, Inductive inference with decision trees, Entropy and information theory, Information gain, ID-3 Algorithm, Issues in Decision tree learning. **INSTANCE-BASED LEARNING** – k-Nearest Neighbour Learning, Locally Weighted Regression, Radial basis function networks, Case-based learning.	**08**
IV	**ARTIFICIAL NEURAL NETWORKS** – Perceptron's, Multilayer perceptron, Gradient descent and the Delta rule, Multilayer networks, Derivation of Backpropagation Algorithm, Generalization, Unsupervised Learning – SOM Algorithm and its variant; **DEEP LEARNING -** Introduction,concept of convolutional neural network , Types of layers – (Convolutional Layers , Activation function , pooling , fully connected) , Concept of Convolution (1D and 2D) layers, Training of network, Case study of CNN for eg on Diabetic Retinopathy, Building a smart speaker, Self-deriving car etc.	**08**
V	**REINFORCEMENT LEARNING**–Introduction to Reinforcement Learning , Learning Task,Example of Reinforcement Learning in Practice, Learning Models for Reinforcement – (Markov Decision process , Q Learning - Q Learning function, Q Learning Algorithm), Application of Reinforcement Learning,Introduction to Deep Q Learning. **GENETIC ALGORITHMS:** Introduction, Components, GA cycle of reproduction, Crossover, Mutation, Genetic Programming, Models of Evolution and Learning, Applications.	**08**

Text Books:

1. Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Ethem Alpaydin, ―Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
3. Stephen Marsland, ―Machine Learning: An Algorithmic Perspective, CRC Press, 2009.
4. Bishop, C., Pattern Recognition and Machine Learning. Berlin: Springer-Verlag.

Blockchain Architecture Design (BCS063)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to		
CO 1	Describe the basic understanding of Blockchain architecture along with its primitive.	K_1, K_2
CO 2	Explain the requirements for basic protocol along with scalability aspects.	K_2, K_3
CO 3	Design and deploy the consensus process using frontend and backend.	K_3, K_4
CO 4	Apply Blockchain techniques for different use cases like Finance, Trade/Supply and Government activities.	K_4, K_5

DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Blockchain**: Digital Money to Distributed Ledgers, Design Primitives: Protocols, Security, Consensus, Permissions, Privacy. Blockchain Architecture and Design: Basic crypto primitives: Hash, Signature,) Hashchain to Blockchain, Basic consensus mechanisms	**08**
II	**Consensus:** Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols Permissioned Blockchains:Design goals, Consensus protocols for Permissioned Blockchains	**08**
III	**Hyperledger Fabric (A):** Decomposing the consensus process, Hyperledger fabric components, Chaincode Design and Implementation **Hyperledger Fabric (B):** Beyond Chaincode: fabric SDK and Front End (b) Hyperledger composer tool	**08**
IV	**Use case 1:** Blockchain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance **Use case 2:** Blockchain in trade/supply chain: (i) Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc	**08**
V	**Use case 3**: Blockchain for Government: (i) Digital identity, land records and other kinds of record keeping between government entities, (ii) public distribution system social welfare systems Blockchain Cryptography, Privacy and Security on Blockchain	**08**

Text books:

1. Mstering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa, O'Reilly
3. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric
4. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits - https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

INDUSTRIAL ELECTRONICS(BECZ062)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able:		
CO 1	Describe the characteristics, operation of power switching devices and identify their ratings and applications.	K_1, K_2
CO 2	Recognize the requirement of SCR Protection and describe the Functioning of SCR.	K_2, K_3
CO 3	Analyze and design Power Converter based on SCR for various Industrial Applications.	K_3, K_4
CO 4	Explain High Frequency Heating Systems, Timers, Relevant Sensors & Actuator and their application in industrial setting.	K_3, K_5
CO 5	Explain and apply Data Communication, Telemetry & SCADA System in industrial applications.	K_2, K_5
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Power Switching Devices:** Description of working & constructional features, Switching Characteristics, ratings and Applications of Power Transistor, Power MOSFET, SCR, DIAC, TRIAC, IGBT and MCT.	**08**
II	**SCR Performance and Applications:** Protection of SCR, SCR Triggering and Commutation Circuits/Methods, Series and Parallel operation of SCR, two transistor model of SCR, , Describe Construction & Working of Opto- Isolators, Opto-TRIAC, Opto-SCR.	**08**
III	**Power Converter Performance & Applications:** Introduction to Basic Power Converters Architecture - Single Phase, there performance under different types of Loads, Average/RMS output Voltage & Current, Freewheeling Diode, Feedback Diode, State Relay using Opto SCR, SMPS and UPS functioning through Block Diagrams.	**08**
IV	**Timers & Delay Elements, High Frequency Power Heating, Sensor and Actuators:** RC Base Constant Timers, Timer Circuits using SCR, IC-555, Programmable Timer and their Industrial Applications, Induction Heating and Dielectric Heating System and Their Applications, Sensors, Transducers, and Transmitters for Measurement, Control & Monitoring: Thermoresistive Transducer, Photoconductive Transducers, Pressure Transducers, Flow Transducers, Level Sensors, Speed Sensing, Vibration Transducers, Variable-Frequency Drives, Stepper Motors and Servomotor Drives.	**08**
V	**Automation and Control:** Data Communications for Industrial Electronics, Telemetry, SCADA & Automation, AC & DC Drives, Voltage & Power Factor Control through Solid State Devices, Soft Switching, Industrial Robots.	**08**

Text Books:

1. M.H. Rashid, "Power Electronics: Circuits, Devices & Applications", Pearson, 4rd Edition, 2013.
2. P.C.Sen, "Power Electronics", McGraw Hill Education (India) Pvt. Ltd 2nd Ed, 2017
3. V.R. Moorthy, "Power Electronics: Devices, Circuits and Industrial Applications" Oxford University Press, 2007.
4. B. Paul, Industrial Electronic and Control, Prentice Hall of India Private Limited (2004).
5. Ned Mohan, T.M. Undeland and W.P. Robbins, "Power Electronics: Converters, Applications and Design", Wiley India Ltd, 2008.
6. P.S. Bhimbra, "Power Electronics", Khanna Publishers.

Reference Books:

1. Thomas E. Kissell, Industrial Electronics: Applications for Programmable Controllers, Instrumentation and Process Control, and Electrical Machines and Motor Controls, 3rd edition, 2003, Prentice Hall.
2. Chakrabarti & Rai, "Fundamentals of Power Electronics & Drives" Dhanpat Rai & Sons.
3. S.N.Singh, "A Text Book of Power Electronics" Dhanpat Rai &Sons.
4. G.K. Dubey, Power Semiconductor Controlled Drives, Prentice Hall inc. (1989).

Software Engineering Lab (BCS651)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to		
CO 1	Identify ambiguities, inconsistencies and incompleteness from a requirements specification and state functional and non-functional requirement	K_2, K_4
CO 2	Identify different actors and use cases from a given problem statement and draw use case diagram to associate use cases with different types of relationship	K_3, K_5
CO 3	Draw a class diagram after identifying classes and association among them	K_4, K_5
CO 4	Graphically represent various UML diagrams, and associations among them and identify the logical sequence of activities undergoing in a system, and represent them pictorially	K_4, K_5
CO 5	Able to use modern engineering tools for specification, design, implementation and testing	K_3, K_4

DETAILED SYLLABUS

For any given case/ problem statement do the following;

1. Prepare a SRS document in line with the IEEE recommended standards.
2. Draw the use case diagram and specify the role of each of the actors. Also state the precondition, post condition and function of each use case.
3. Draw the activity diagram.
4. Identify the classes. Classify them as weak and strong classes and draw the class diagram.
5. Draw the sequence diagram for any two scenarios.
6. Draw the collaboration diagram.
7. Draw the state chart diagram.
8. Draw the component diagram.
9. Perform forward engineering in java. (Model to code conversion)
10. Perform reverse engineering in java. (Code to Model conversion) 11. Draw the deployment diagram.

Note: The Instructor may add/delete/modify/tune experiments, wherever he/she feels in a justified manner
It is also suggested that open source tools should be preferred to conduct the lab (Open Office , Libra , Junit, Open Project , GanttProject , dotProject, AgroUML, StarUML etc.)

Software Engineering Lab (BCS-651): Mapping with Virtual Lab

Name of the Lab	Name of the Experiment
Software Engineering Lab (BCS-651)	Identifying the Requirements from Problem Statements
	Estimation of Project Metrics
	Modeling UML Use Case Diagrams and Capturing Use Case Scenarios
	E-R Modeling from the Problem Statements
	Identifying Domain Classes from the Problem Statements
	Statechart and Activity Modeling
	Modeling UML Class Diagrams and Sequence diagrams
	Modeling Data Flow Diagrams
	Estimation of Test Coverage Metrics and Structural Complexity
	Designing Test Suites

DIGITAL SIGNAL PROCESSING LAB (BECZ651)

Course Outcome (CO)		Bloom's Knowledge Level (KL)
At the end of course , the student will be able to:		
CO 1	Create and visualize various discrete/digital signals using MATLAB/Scilab.	K_2, K_4
CO 2	Implement and test the basic operations of Signal processing	K_3, K_5
CO 3	Examine and analyse the spectral parameters of window functions.	K_4, K_5
CO 4	Design IIR and FIR filters for band pass, band stop, low pass and high pass filters.	K_4, K_5
CO 5	Design the signal processing algorithms using MATLAB/Scilab.	K_3, K_4

DETAILED SYLLABUS

1. Introduction to MATLAB and or Open Source Software, Scilab (Using Spoken Tutorial MOOCs).
2. Write a Program for the generation of basic signals such as unit impulse, unit step, ramp, exponential, sinusoidal and cosine.
3. Implement IIR Butterworth analog Low Pass for a 4 KHz cut off frequency.
4. Verify Blackman and Hamming windowing techniques.
5. Evaluate 4-point DFT of and IDFT of x(n) = 1, $0 \leq n \leq 3$; 0 elsewhere.
6. Verify Linear convolution of two sequences using FFT
7. Verify Circular Convolution of two sequences using FFT.
8. To verify FFT as sample interpolator.
9. To implement Tone Generation.
10. To implement floating point arithmetic.
11. To study about DSP Processors and architecture of TMS320C6713 DSP processor.
12. **VIRTUAL Lab by NME-ICT available at*: (Through Virtual Lab)***
    - 12.1 Study of Discrete Fourier Transform (DFT) and its inverse.
    - 12.2 Study of FIR filter design using window method: Lowpass and highpass filter.
    - 12.3 Study of FIR filter design using window method: Bandpass and Bandstop filter.
    - 12.4 Study of Infinite Impulse Response (IIR) filter.

Virtual Lab Link: http://vlabs.iitkgp.ernet.in/dsp/index.html#
http://vlabs.iitkgp.ernet.in/dsp/

Available on: http://www.vlab.co.in/broad-area-electronics-and-communications

Spoken Tutorial (MOOCs):
Spoken Tutorial MOOCs, ' Course on Scilab', IIT Bombay (http://spoken-tutorial.org/)

Note: The Instructor may add/delete/modify/tune experiments, wherever he/she feels in a justified manner.

COMPUTER NETWORKS LAB (BCS653)		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to		
CO 1	Simulate different network topologies.	K_3, K_4
CO 2	Implement various framing methods of Data Link Layer.	K_3, K_4
CO 3	Implement various Error and flow control techniques.	K_3, K_4
CO 4	Implement network routing and addressing techniques.	K_3, K_4
CO 5	Implement transport and security mechanisms	K_3, K_4

DETAILED SYLLABUS

1. Implementation of Stop and Wait Protocol and Sliding Window Protocol.
2. Study of Socket Programming and Client – Server model
3. Write a code simulating ARP /RARP protocols.
4. Write a code simulating PING and TRACEROUTE commands
5. Create a socket for HTTP for web page upload and download.
6. Write a program to implement RPC (Remote Procedure Call)
7. Implementation of Subnetting .
8. Applications using TCP Sockets like
   a. Echo client and echo server b. Chat c. File Transfer
9. Applications using TCP and UDP Sockets like d. DNS e. SNMP f. File Transfer
10. Study of Network simulator (NS).and Simulation of Congestion Control Algorithms using NS
11. Perform a case study about the different routing algorithms to select the network path with its optimum and economical during data transfer. i. Link State routing ii. Flooding iii. Distance vector
12. To learn handling and configuration of networking hardware like RJ-45 connector, CAT-6 cable, crimping tool, etc.
13. Configuration of router, hub, switch etc. (using real devices or simulators)
14. Running and using services/commands like ping, traceroute, nslookup, arp, telnet, ftp, etc.
15. Network packet analysis using tools like Wireshark, tcpdump, etc.
16. Network simulation using tools like Cisco Packet Tracer, NetSim, OMNeT++, NS2, NS3, etc.
17. Socket programming using UDP and TCP (e.g., simple DNS, data & time client/server, echo client/server, iterative & concurrent servers)

Note: The Instructor may add/delete/modify/tune experiments, wherever he/she feels in a justified manner
It is also suggested that open source tools should be preferred to conduct the lab (C , C++ , Java , NS3, Mininet, Opnet, TCP Dump, Wireshark etc.