NATIONAL INSTITUTE OF TECHNOLOGY, GOA

Department of Computer Science & Engineering (CSE)
Bachelor of Technology in Computer Science & Engineering

Foundation Courses (Fndn)

MA100 Engineering Mathematics – I	(3-1-0) 4
MA101 Engineering Mathematics – II	(3-1-0) 4
PH100 Physics	(3-0-0) 3
PH101 Physics Lab	(0-0-3) 1
CY100 Chemistry	(3-0-0) 3
CY101 Chemistry Lab	(0-0-3) 1
CV100 Engineering Mechanics	(3-1-0) 4
EE100 Elements of Electrical Engg	(3-1-0) 4
EC100 Elements of Electronics and Communication Engg.	(3-1-0) 4
ME100 Elements of Mechanical Engg.	(3-0-0) 3
ME101 Engineering Graphics	(1-0-3) 2
ME102 Workshop	(0-0-3) 1
CS100 Computer Programming	(3-0-0) 3
CS101 Computer Programming Lab	(0-0-3) 1
HU100 Professional Communication	(3-1-0) 4
HU300 Engineering Economics	(3-1-0) 4
HU301 Management Theory & Practice	(3-1-0) 4

Programme Specific Core (PSC)

CS200 Design of Digital Systems	(3-1-0) 4
CS201 Data Structures and Algorithms	(3-1-0) 4
CS202 Computer Organization and Architecture	(3-1-0) 4
CS203 Principles of Data Communication	(3-1-0) 4
CS204 Discrete Mathematics	(3-1-0) 4
CS205 Digital Systems Lab	(0-0-3) 1
CS206 Data Structures Lab	(0-0-3) 1
CS207 Unix Programming Lab	(0-0-3) 1
CS250 Microprocessor and Interfacing	(3-1-0) 4
CS251 Computer Graphics	(3-1-0) 4
CS252 Theory of Computation	(3-1-0) 4
CS253 Systems Programming	(3-1-0) 4
CS254 Microprocessor Lab	(0-0-3) 1
CS255 Computer Graphics Lab	(0-0-3) 1
CS290 Seminar	(0-0-2) 1
CS300 Operating Systems	(3-1-0) 4
CS301 Database Systems	(3-1-0) 4
CS302 Software Engineering	(3-1-0) 4
CS303 Computer Networks	(3-1-0) 4
CS304 Operating Systems Lab	(0-0-3) 1
CS305 Database Systems Lab	(0-0-3) 1
CS306 Networks Lab	(0-0-3) 1
CS350 Design and Analysis of Algorithms	(3-1-0) 4
CS351 Compiler Design	(3-1-0) 4
CS352 Distributed Computing Systems	(3-1-0) 4
CS353 Internet Technologies & Applications	(3-1-0) 4
CS354 Compilers Lab	(0-0-3) 1
CS355 Web Technologies Lab	(0-0-3) 1
CS440 Practical Training	1

Programme Specific Electives (PSE)

CS400 Object Oriented Programming	(3-0-0) 3
CS401 Information Systems	(3-0-0) 3
CS402 Object Oriented Analysis & Design	(3-1-0) 4
CS403 Advanced Data Structures	(3-1-0) 4
CS404 Computer Vision	(3-0-0) 3
CS405 Advance Computer Architecture	(3-1-0) 4
CS406 Advanced Microprocessors	(3-0-0) 3
CS407 Optimization Techniques in Computing	(3-1-0) 4
CS408 Artificial Intelligence	(3-0-0) 3
CS409 Multimedia and Virtual Reality	(3-0-0) 3
CS410 Advanced Database Systems	(3-1-0) 4
CS411 Data Warehousing and Data Mining	(3-1-0) 4
CS412 Soft Computing	(3-0-0) 3
CS413 Number Theory and Cryptography	(3-1-0) 4
CS414 Applied Algorithms	(3-1-0) 4
CS415 Software Quality Assurance	(3-0-0) 3
CS416 Network Management	(3-0-0) 3
CS417 Protocol Engineering	(3-0-0) 3
CS418 Software Testing	(3-0-0) 3
CS419 Cyber laws & Security Standards	(3-0-0) 3
CS420 Mobile Communication	(3-0-0) 3
CS421 Software Architecture	(3-0-0) 3
CS422 Information Security	(3-1-0) 4
CS423 Network Security	(3-0-0) 3
CS 424Wireless Networks & Systems	(3-0-0) 3
CS425 Parallel Algorithms	(3-1-0) 4
CS426 Distributed Algorithms	(3-1-0) 4
CS427 Web Engineering	(3-0-0) 3
CS428 Software Project Management	(3-0-0) 3
CS429 Cloud Computing	(3-0-0) 3
CS430 E-Commerce	(3-0-0) 3
CS 431 Advanced Operating Systems	(3-1-0) 4
CS 432 Advanced Compilers	(3-1-0) 4
CS433 Web Services	(3-0-0) 3

Open Electives (OE)

CS400 Object Oriented Programming	(3-0-0) 3
CS401 Information Systems	(3-0-0) 3
CS408 Artificial Intelligence	(3-0-0) 3
CS412 Soft Computing	(3-0-0) 3

Programme Major Project (PMP)

CS449 Major Project – I	(0-0-6) 4
CS499 Major Project – II	(0-0-9) 6

Mandatory Learning Courses (MLC)

MLC1 Environmental Studies	(1-0-0) 1
MLC2 Professional Ethics and Human Values	(1-0-0) 1

NATIONAL INSTITUTE OF TECHNOLOGY, GOA

Suggested Plan of Study

Semester	III	IV	V	VI	VII	VIII
1	CS200	CS250	CS300	CS350	CS440	CS499
2	CS201	CS251	CS301	CS351	CS449	Elective
3	CS202	CS252	CS302	CS352	Elective	Elective
4	CS203	CS253	CS303	CS353	Elective	Elective
5	CS204	CS254	CS304	CS354	Elective	Elective
6	CS205	CS255	CS305	CS355	Elective	Elective
7	CS206	CS290	CS306	HU301	Elective	
8	CS207	Elective	HU300	Elective		
9			Elective			

Course Structure

<table>
<tr><th colspan="2">Category of Courses</th><th>Minimum Credits to be Earned</th></tr>
<tr><td colspan="2">Foundation Courses (Fndn)</td><td>50</td></tr>
<tr><td colspan="2">Programme Specific Core (PSC)</td><td>80</td></tr>
<tr><td colspan="2">Electives</td><td rowspan="3">38</td></tr>
<tr><td>Programme Specific Elective (PSE)</td><td>Open Elective (OE)</td></tr>
<tr><td>20 credits (minimum)</td><td>0 -18 credits</td></tr>
<tr><td colspan="2">Programme Major Project (PMP)</td><td>10</td></tr>
<tr><td colspan="2">Mandatory Learning Courses (MLC)</td><td>02</td></tr>
<tr><td colspan="2">Total</td><td>180</td></tr>
</table>

CS100 COMPUTER PROGRAMMING (3-0-0) 3

Concepts, definitions, taxonomy and history of Computer Programming, Operating systems and Program Execution basics. Problem solving and programming: strategies, programming paradigms, software development lifecycle. C programming language: C fundamentals, operators and expressions, Data input and output, Control statements, Functions, Arrays, Pointers, Dynamic memory allocations, Structure and unions, Files, Low- level Programming and Macros.

Joyce Farell, A guide to Programming Logic & Design, Course Technology, Thomson learning 2003
Brian W. Kernighan & Dennis M. Ritchie, The C Programming Language, Second edition, Printice Hall Inc.
Byron S. Gottfried, Program with C, second edition, Schaums Outline series.
Yashavanth Kanetkar, Let us C – BPB Publications. 2002
Balagurusamy, C Programming – TMH, 2002

CS101 COMPUTER PROGRAMMING LAB (0-0-3) 1

Introduction to fundamentals of DOS and Windows, C Programming exercise on simple statements, Control structures, Arrays, Matrices, Strings, Functions and Recursions, Structures and Unions, Bit Operations, Pointers, Dynamic Memory allocation, Files and Macros.

Brian W. Kernighan & Dennis M. Ritchie, The C Programming Language, Second edition, Printice Hall Inc.
Byron S. Gottfried, Program with C, second edition, Schaums Outline series.
Yashavant Kanetkar, Let us C BPB Publications.2002.
Balagurusamy, C Programming –TMH, 2002.

CS200 DESIGN OF DIGITAL SYSTEMS (3-1-0) 4 PREREQ: EC100

Switching algebra and logic circuits; combinational and sequential circuits and their algorithmic synthesis; Computer aided synthesis and optimization (introduction); Hardware modeling using VHDL; Logic optimization: two level, multi level, circuits; Introduction to VLSI design: MOS devices, system level design; Introduction to VLSI testing: fault models, testing combination and sequential circuits.

Alan B.Marcovitz, Intro. To Logic Design, TMH, 2002.
Giovanni De Micheli, Synthesis and Optimization of Digital circuits, 2000
Zvi Kolavi, Switching and finite automata theory, Tata McGraw Hil 2000
Pucknell & Shrayhian, Basic VLSI design systems and circuits, PH India 2000
ParagK.Lala, Fault tolerant & fault testable hardware design, B.S pub, 2003.

CS201 DATA STRUCTURES AND ALGORITHMS (3-1-0) 4 PREREQ: CS100

Algorithm analysis and design techniques. Basic data structures – Stack, Queue and List –their sequential and linked representations, variations, operations with algorithms on these; Trees and graphs and sets - variations, operations and representation methods. Algorithms for Searching & Sorting. Data structures and algorithms for external storage.

Data structures & Algorithms- Alfred V Aho, John E Hoperoft, Jeffrey D. Ullman- Addison Wesley. 2003
Data Structures and Algorithms using C/C++, Horowitz and Sahni, 2003

CS202 COMPUTER ORGANISATION AND ARCHITECTURE (3-1-0) 4 PREREQ: CS100

Logical organization of computers; Processor basics, CPU organization, Data Representation, Instruction Sets, Data path design, Fixed Point arithmetic, ALU design, Control design: Basic concepts, Micro programmed Control & hardwired; Introduction to parallel processing: Principles of pipeline and vector processing. Multiprocessor architectures and programming.

J.P.Hayes Computer Architecture and organization III Edition, McGraw Hill, 1998.
Patterson and Henessy, Computer Architecture A quantitative approach, Morgan Kanfmann – 2000
Hwang and Briggs, Computer Architecture and parallel processing, McGraw Hill, 1985.
David A. Patterson & John L. Hennessy, Computer Organization and design, Morgan Kaufmann Publ.,3rd edition.

CS203 PRINCIPLES OF DATA COMMUNICATION (3-1-0) 4

Evolution of Data Communication and Networks; Transmission fundamentals: Signals, media, encoding and modulation, multiplexing, devices, error detection and correction, Data link control and protocols, data transmission over networks - switching techniques and LAN.

William Stallings, Data and Computer Communications and Networking, 2nd Edition, TMH, 2002.
Behrouz A Forouzan, Data Communications and Networking, 2nd edition, TMH, 2002
Leon, Garcia and Widjaja - Communication Networks, TMH 2002.

CS204 DISCRETE MATHEMATICS (3-1-0) 4

Proportional and Predicate Calculus, Normal forms, Applications to Artificial Intelligence, Lattice Theory and Boolean Algebra, Introduction to Graph Theory – Trees, Planarity, Connectivity, Traversability, Shortest Path and Spanning Tree Algorithms. Groups: Cosets, Normal Subgroups, Permutation groups, Burnside's Theorem and simple applications.

J.P. Tremblay & R. Manohar, Discrete Math Structures with app. To Comp. Sc. McGraw Hill
C.L.Liu, Elements of Discrete Mathematics, McGraw Hill
Kenneth Rosen, Discrete Mathematics and its applications, TMH

CS205 DIGITAL SYSTEMS LAB (0-0-3) 1

Design of basic gates, adders, subtractors, encoders, decoders, shifters: up, down, up-down, counters, flipflops, code conversion, multiplexers(All using behavioral modeling). Introduction to structural modeling: Adders, subtractors, multiplexors, counters, multiplier(array multiplier), Design of FSM: Moore machine, Melay machine.

J. Bhasker, VHDL primer, 3rd edition, Addison Wesley Longmen Singapore Pvt. Ltd.
Douglas Perry, VHDL by McGraw Hill International, 1998.
Peter Ashenden, The Designer Guide to VHDL by 1998

CS206 DATA STRUCTURES LAB (0-0-3) 1 PREREQ: CS101

Implementation of array operations: Stacks, Queues, Circular Queues, Multiple stacks and queues. Implementation of linked lists: stacks, queues, polynomial operations. Doubly linked lists. Tree traversal:

AVL tree implementation, application of trees. Hash Table. Searching and sorting.

Mark Allen Weiss, Algorithms Data structures and problem solving with C++, Addison Wesley

CS207 UNIX PROGRAMMING LAB (0-0-3) 1 PREREQ : CS100

Introduction to Unix / Linux Operating System;. Basic commands- such as cp, mv, mkdir, rm, ls, ln, grep, wc, find, sed, awk. Usage of gcc and gdb. Basic system administration skills. Usage of the vi editor. Shell programming. Installation of the Linux Operating System and precautions to be taken. Basics of Kernal modules. Introduction to Linux device drivers. MAKE Files.

Brian W.Kernighan, The Unix Programming Environment, Pearson Education 2003
Jeff Horwitz,Unix System Management-Primer Plus, Sams / Pearson Education, 2003
Mark G.Sobell, A Practical Guide to Red Hat Linux 8 Pearson Education, 2003.
www.tldp.org (The Linux Documentation Project)

CS250 MICROPROCESSOR AND INTERFACING (3-1-0) 4 PREREQ: CS202

Microprocessor Architecture, 8086, Instruction set, Subroutines, Programming examples, Software development with Interrupts; Intel 80286, 80386; Programmable peripheral devices, 8255, 8253, 8259,8257, Motorola 68000 Processors, 68020, 68030; Mother boards, I/o bus, I/o channel, BIOS, DOS,PC bus, Multibus I & II, VME, CRT Controller, Floppy disc Controller, Hard disc Controller, CD ROM Drive, Serial Communication Controller, Pen drive, Mouse drive.

Doughlas V. Hall, Microprocessors & Interfacing, TMH, 2000
Govindarajlu, IBM PC & Clones, 2003.

CS251 COMPUTER GRAPHICS (3-1-0) 4 PREREQ: CS201

GRAPHICS hardware. Scan conversion: lines, circles, ellipses. Filling algorithms. Clipping algorithms. 2D Graphics & Transformations; Viewing in 3D, 3D projections & transformations. Curves and surfaces, Visible surface determination. Illumination and shading. Animation.

Hearn & Baker, Computer Graphics Principles and Practice- C version, 2003
Van Dam, foley, Feimer, Hugher, Computer Graphics Principles and Practice in C, Addison Wesley

CS252 THEORY OF COMPUTATION (3-1-0) 4

Formal Languages and Automata Theory: Generative grammar, Chomsky hierarchy, Finite state Automata: Definition, Concept of Non-determinism, Equivalence of deterministic and Non-deterministic Automata; Relation between CFL and Type3 grammars; Pumping Lemma for CFL; Closure properties. Push down Automata: Definition, Equivalence between NPDA and context free grammars, Pumping Lemma for C.F.L's,Decision problems, Closure properties. Turing machines:Definition, extension to turing machines: Multi-track, Multi-tape, and Non determinism. TM as an acceptor, TM as a computing device; Relation between TM and type-0-grammars. Universal Turing Machine, Concept of computability, Undecidable problems. Recursive function theory: Primitive recursive functions, general recursive function, relation between general recursive functions and Turing machines, Church's thesis, P, NP, NP- Hard & NP- Complete problems.

J.E.Hopcroft and J.D.Ullman, Introduction to automata, Languages and computation, Narossa/Addison Wesley.
H.E.Lewis and C.H. Papadimitiou,Elements of the Theory of Computation,Prentice-Hall of India, 1981.
Derickwood, Theory of Computation, John Wiley & Sons.

CS253 SYSTEMS PROGRAMMING (3-1-0) 4 PREREQ: CS202

Introduction to system software, Desirable characteristics of systems programs, Introduction to Assemblers, loaders and text editor, Study of detailed machine language structure and PDP-11 Input/Output operations in PDP-11; subroutines and coroutines; concurrent I/O; supervisor mode. Macro facilities in PDP-11, Macro facilities in PDP-11, Design of an assembler, Linkers and loaders, Design of a simple text editor.

Schneider, Principles of Computer Organization, Wiley International Edition
Mac Ewan, Introduction to Computer Systems through PDP-11 & Pascal, McGraw Hill
D.M. Dhamdhere, Introduction to system software, Tata McGraw Hill, New Delhi, 2002.

CS254 MICROPROCESSOR LAB (0-0-3) 1 PREREQ: CS205

Experiments based on 8086 microprocessor, Programming 8086, Using various interrupts, BIOS, DOS, Assembly level Programming, Display Controller, Keyboard & Mouse Controller, FDC and CDC; interfacing with ADC, DAC, PLC etc.

ROM-BIOS service summary- Programmer's Guide to the IBM PC.

CS255 COMPUTER GRAPHICS LAB (0-0-3) 1 PREREQ: CS206

Scan conversions: lines, circles, ellipses. Filling algorithms, clipping algorithms. 2D and 3D transformation. Curves. Visible surface determination. Simple animations Application of these through exercises in C/C++/ Open GL

Van Dam, foley, Feimer, Hugher, Computer Graphics Principles and Practice in C- - Addison Wesley

CS290 SEMINAR (0-0-2) 1

This course is a 1 credit course. Students will have to choose a topic in CSE's current trends or industry practices, prepare a write up, present it along with a suitable demonstration. Evaluation will be based on the relevance of topic, communication skills, and the reporting / documenting procedure.

CS300 OPERATING SYSTEMS (3-1-0) 4 PREREQ: CS254

Introduction to O.S, File Systems, CPU scheduling, Memory management, Disk Scheduling algorithms, virtual memory concept, Deadlocks, Concurrent processes, Performance Evaluation, Operating system Security, Case Studies - The UNIX operating system

Silberschartz & Galvin, Operating System Concepts, Addison Wesley, Fifth Edition, 1997.
Melin Milenkovic, Operating Systems: Concepts and Design, McGraw Hill, New York, 2000.

CS301 DATABASE SYSTEMS (3-1-0) 4 PREREQ: CS202

Introduction & need for database systems, database Vs file systems, Relational Data model and languages, Example Database system, Database design, Normalization, Transaction Processing concepts, Database security

Elmasri, Rames, Shamkant B Navathe, Fundamentals of database systems, 2003
J D Ullman, Principles of database systems, 2001

CS302 SOFTWARE ENGINEERING (3-1-0) 4

Introduction to software engineering, Software development life cycle & various models, requirements engineering, software specification, software metrics, software design, modular structure, Object Oriented software engineering, Software testing & various testing mechanisms, Software verification and validation, Verifying performances, Verifying reliability, Software cost estimation models, Software development tools including CASE Tools, Software Project management.

R.S. Pressman, Software Engineering, McGrawHill, 2002
Pankaj Jalote, An Integrated Approach to software Engineering, Narosa Pub., 2002
Ian Sommerville, Software Engineering, 5th Edition. Addison-Wesley Publication House, 1997
Bell Morry, and Pugh. Software Engineering Approach. Prentice Hall. 2001
K. C. Shet., Software Engineering & Quality Assurance, BPB Publications, New Delhi.
Waman S. Jawadekar, Software Engineering, Principles and Practice, Tata McGraw Hill.

CS303 COMPUTER NETWORKS (3-1-0) 4 PREREQ: CS203

Introduction, Layered Architecture of Computer Networks, OSI and TCP/IP architectures & layers with protocols, Internetworking & routing, Network security, Mobile networks and current trends

Andrew. S. Tannenbaum, Computer Networks, Prentice Hall of India, 2nd Edn, 2002.
Fred Halsall, Data Communications, Computer networking on OSI, Addison Wesley Publishing Co., 2nd Edition, 2002.
William Stallings,Data & Computer Communications, 2nd Edition, Maxwell, MacMillan International Edn., 2003.
Behrouz A. Forouzan, Data Communications & Networks, third edition, Tata McGraw Hill.

CS304 OPERATING SYSTEMS LAB (0-0-3) 1 PREREQ: CS207

Linux and/or other OS based exercises to practice/simulate: scheduling, memory management algorithms; Concurrent programming; use of threads and processes; kernel reconfiguration, device drivers and systems administration of different operating systems, Writing utilities and OS performance tuning

CS305 DATABASE SYSTEMS LAB (0-0-3)1 PREREQ: CS206

Assignment in Design and Implementation of Database systems or packages for applications such as office automation, hotel management, hospital management; deployment of Forms, Reports Normalization, Query Processing Algorithms in the above application project; Distributed data base Management & other related exercises.

CS306 NETWORKS LAB (0-0-3) 1 PREREQ: CS203

Exercises comprising simulation of various protocols and performance study; TCP/IP Level Programming, Routing Algorithms and internetworking.

Kris Jamsa, Ken Cope, Internet Programming, Galgotia.

CS350 DESIGN AND ANALYSIS OF ALGORITHMS (3-1-0) 4 PREREQ: CS201

Models of computation, various performance measures, General techniques of algorithm design, Analysis of different algorithms for sorting and selection, Data structures for efficient manipulation of sets and partition, Efficient Graph algorithms based on Depth first search, Strassen's matrix multiplication algorithm, Efficient algorithms for matrix inversion and LUP decomposition, Modular arithmetic, NP complete problems and approximation algorithms.

Aho, Hopcroft and Ullman the design and analysis of Computer Algorithms, Addison Weseley.
Horowitz and Sahni, Fundamentals of Computer Algorithms, Galgotia Publications, 2000.
Baase S.,Computer Algorithm Introduction to Design and Analysis, Addison Wesley. 2000
Knuth D.E., The Art of Computer Programming, Vol. I: Fundamental Algorithms, Addison Wesley.2000

CS351 COMPILER DESIGN (3-1-0)4 PREREQ: CS252

Introduction to compiler design, Lexical analyzer, Regular expressions and finite automata, Introduction to context free grammars, BNF notation, Parsing Techniques: Top-down parsing and Bottom-up parsing, Error recover strategies for different parsing techniques, Intermediate code generation, symbol table, Runtime storage allocation, Code Optimization, Code generation.

Alfred V. AHO, Ravi Sethi & Jeffrey D. Ullman, Compilers; Principles, Techniques & Tools, Addison- Wesley Publication, 2001.
William A. Barrett et.al, compiler Construction, Theory and Practice, Galgotia 2000
Holub A.I., Compiler Design in C, Prentice Hall India.2000

CS352 DISTRIBUTED COMPUTING SYSTEMS (3-1-0) 4 PREREQ: CS251

Introduction Distributed Systems and applications, Message Passing mechanisms IPC and RPC, Distributed Operating Systems – resources/process/thread management, Distributed File Systems and Services, Shared data, Synchronization Transaction and Concurrency Control, Distributed databases, Name service, Timing & Coordination, Replication, Security and Fault Tolerance.

Pradeep Sinha, Distributed Operating Systems- Concepts and Design, PHI,2000
George Couloris, Jean Dollimore & Time Kindberg,Distributed Systems:Concepts & design, 2nd ed, Addision Wesley 2003.
A.S. Tanenbaum and M.V. Steen, Distributed Systems – Principles and Paradigms, PHI.2003
V. Rajaraman, C. Siva Ram Murthy, Parallel, Computers Architecutre & Programming, PHI.

CS353 INTERNET TECHNOLOGIES AND APPLICATIONS (3-1-0) 4

Internet & Web Technology, Infrastructure and tools for Internet Commerce /E-Commerce Current Trends in E-Commerce applications development, Enterprise level E-Commerce: SCM, CRM, EDI, B2Bi, ERP.

Henury Chan et al. E-commerce-Fundamental and applications, John Wiley & Sons, 2002
G. Winfield Treese and Lawrence C.S. Designing Systems for Internet Commerce, Pearson Edison, LPE, 2002.

CS354 COMPILERS LAB (0-0-3) 1 PREREQ: CS206

The laboratory course would consist of building a minicompiler (possibly subsets of Standard Compilers like PASCAL or other languages) and executing Simple problems to demonstrate the Compiler capabilities. LEX & YACC of Unix to be used.

CS355 WEB TECHNOLOGIES LAB (0-0-3) 1

Development of Web-based applications (server-side and client-side programming), Web services, Web site creation, maintenance and management with web technologies like HTML, XML , ASP, JSP , Java servlets, Ajax, PHP, Perl etc.

Larry Randles Lagerstrom, Programming the Web Using XHTML and JavaScript, McGraw-Hill, 2003,

Robert W. Sebesta, Programming the World Wide Web, 2/e, Addison-Wesley

Darrel Ince, Developing Distributed and E-commerce Applications, 2nd Ed., Addison-Wesley, 2004,

Kurata Deborah, Doing Web Development: Client-Side Techniques, Apress, 2002

Nick Todd, Mark Szolkowski, JavaServer Pages: Developer's Handbook, or otherwise called, JavaServer Pages 2.0 Unleashed, Sams, 2003

CS400 OBJECT ORIENTED PROGRAMMING (3-0-0) 3 PREREQ: CS100

Object-oriented paradigm, elements of object oriented programming – Merits and demerits of OO methodology.C++ fundamentals – data types, operators and expressions, control flow, arrays, strings, pointers and functions, Classes and objects – constructors and destructors, operator overloading – inheritance, virtual functions and polymorphism , C++ streams – console streams – console stream classes-formatted and unformatted console I/O operations, manipulators - File streams - classes file modes file pointers and manipulations file I/O – Exception handling .

An overview of Java, data types, variables and arrays, operators, control statements, classes, objects, methods – Inheritance. Packages and Interfaces, Exception handling, Multithreaded programming, Strings, Input /Output.

K.R.Venugopal, Rajkumar Buyya, T.Ravishankar, "Mastering C++", TMH, 2003
Herbert Schildt, "the Java 2 : Complete Reference", Fourth edition, TMH, 2002
Ira Pohl, "Object oriented programming using C++", Pearson Education Asia, 2003
Bjarne Stroustrup, "The C++ programming language", Addison Wesley, 2000
John R.Hubbard, "Programming with C++", Schaums outline series, TMH, 2003
H.M.Deitel, P.J.Deitel, "Java: how to program", Fifth edition, Prentice Hall of India private ltd.
E.Balagurusamy "Object Oriented Programming with C++", TMH 2/e

CS401 INFORMATION SYSTEMS (3-0-0) 3 PREREQ: CS100

Information System Design and Development - phases; System analysis methods - Data, Process, Network and Object modeling; System design approaches / methods - architectures and processes, input and output, prototyping; system implementation, safety & security, maintenance.

Jeffrey.L.Whitten, Lonnie.D.Bentley, System analysis and design methods 4th edition, TMH, 2002
James.A.Senn, Analysis and Design of Information System, 2nd edition, McGraw Hill, 2002

CS402 OBJECT ORIENTED ANALYSIS AND DESIGN (3-1-0) 4 PREREQ: CS100

An Overview of Object Oriented Systems Development - Object Basics – Object Oriented Systems Development Life Cycle. Rumbaugh Methodology - Booch Methodology - Jacobson Methodology - Patterns – Frameworks – Unified Approach – Unified Modeling Language – Use case - class diagram - Interactive Diagram - Package Diagram - Collaboration Diagram - State Diagram - Activity Diagram. Identifying use cases - Object Analysis - Classification – Identifying Object relationships - Attributes and Methods. Design axioms - Designing Classes – Access Layer - Object Storage - Object Interoperability. Designing Interface Objects – Software Quality Assurance – System Usability - Measuring User Satisfaction

Ali Bahrami, "Object Oriented Systems Development", Tata McGraw-Hill, 1999
Martin Fowler, "UML Distilled", Second Edition, PHI/Pearson Education, 2002.
Stephen R. Schach, "Introduction to Object Oriented Analysis and Design", Tata McGraw-Hill, 2003.
James Rumbaugh, Ivar Jacobson, Grady Booch "The Unified Modeling Language Reference Manual", Addison Wesley, 1999.
Hans-Erik Eriksson, Magnus Penker, Brain Lyons, David Fado, "UML Toolkit", OMG Press Wiley Publishing Inc., 2004

CS403 ADVANCED DATA STRUCTURES (3-1-0) 4 PREREQ: CS201

Data structures and its operations, trees, Heaps, Advanced Graph Algorithms and application, Internet Algorithms, Compression algorithms, search engine algorithms, spiders and crawlers, Integer and polynomial Arithmetic, modular Arithmetic, NP-Completeness and approximation algorithms.

Thomas Cormen, Charles E Leiserson and Ronald D River, Introduction to Algorithms, PHI, 2001.
Mark Allen Weiss, Algorithms, Data Structures and Problem Solving with C++, Addison Wesley, 2002.

CS404 COMPUTER VISION (3-0-0) 3 PREREQ: CO251

Concept of application of computer vision, functional architecture of a vision system visual sensory model and camera calibration, processing tools, 3D vision, 3D representative schemes, High level vision and navigation.

Sonka M., Hlavac V., Boyle R., Image Processing Analysis and Machine Design. PWS Publishers
Ballard D., Brown C., Computer Vision, Prentice Hall
Bratt W., Digital Image Processing, John Wiley & sons

CS405 ADVANCED COMPUTER ARCHITECTURE (3-1-0) 4 PREREQ: CS202

Flynn's Classification, RISC Vs CISC, Data flow and control flow, Pipelining: Linear and non linear pipelines, pipeline hazards, instruction scheduling, Branch handling techniques, Arithmetic pipeline. VLIW architecture, Superscalar processors. Instruction level Data-Parallel architectures: Introduction to data-parallel architecture, SIMD architectures, Systolic architecture, Vector architecture. Introduction to MIMD architectures. Systems interconnect architecture: Network properties and routing, Static and dynamic interconnection networks. Multiprocessor architecture: symmetric shared memory architectures, Distributed shared memory architectures, models of memory consistency, cache coherence protocols, cache based directory protocols.

Dezso Sima, Peter Karsuk, Peter Kacsuk, Advanced Computer Architectures:A design space approach, Addison Wesley.
K.Hwang and F.A. Briggs, Computer architecture and parallel processing, McGraw Hill Publications
K. Hwang, Advanced computer architecture-parallelism, scalability, programmability, McGraw Hill.
J. Hennesy and D. Patterson, Computer Architecture –A quantitative approach, Morgan Kaufmann, 2003

CS406 ADVANCED MICROPROCESSORS (3-0-0) 3 PREREQ: CS250

General Features of 32 bit and 64 bit microprocessors, Advanced Intel processors – Architecture and programming including xeon and others, dual processors, DSP processors, Various peripherals and interfacing including memory and I/O

Babby B.Brey, The Intel Microprocessors – Architecture, Programming & Interfacing, Pearson Education, 2003

Babby B.Brey, The Intel Microprocessors 8086/8088, 80186, 80286, 80386 & 80486, Architecture Programming & Interfacing, PHI.

CS407 OPTIMIZATION TECHNIQUES IN COMPUTING (3-1-0) 4

Basic OR techniques, requirements, networks, design, role and methods, databases, compilers, optimization and performance in web computing, internet application, performance measurement tools, case studies

K Kanth, Introduction to computer system performance evaluation, McGraw Hill, 1992

David K Smith, Network Optimization in Practice, ellise, Horrwood publications, 1982

CS408 ARTIFICIAL INTELLIGENCE (3-0-0) 3 PREREQ: CS201

Architecture of AI & KBCS Systems, Design Issues and AI techniques, Introduction & Design of Expert Systems various applications, Introduction to fuzzy logic systems, Natural Language processing, Heuristic Search techniques, knowledge based systems.

Nilson, Artificial Intelligence : A new synthesis, 2001.

Edwin wise, Hands on AI with Java, McGraw Hill, 2004.

CS409 MULTIMEDIA AND VIRTUAL REALITY (3-0-0) 3 PREREQ: CS251

Introduction to Multimedia Technology and its applications; concepts of Virtual Reality and its effectiveness in Real Time Applications, Introduction to Scientific Visualization and Virtual Reality, Hardware requirements, Sound, Animation techniques, Compression and decompression techniques, CASE study of multimedia workstations.

The Winn L. Rosch Multimedia Bibble, Winn L. Rosch, SAMS Publishing

Hypermedia: From Multimedia to V. R., D. P. Kothari & Anshu, PHI, 2004.

CS410 ADVANCED DATABASE SYSTEMS (3-1-0) 4 PREREQ: CS301

Distributed Databases: principles, Architecture, Design, Query, Optimization, Transaction, Concurrency, Client/server, Parallel, and Object Oriented Databases: XML and Internet DB.

Raghu Ramakrishnan, Database Management Systems, McGraw-Hill, 2000

Ceri S and Pelagatti G, Distributed Databases Principles and Systems, 2nd Edition, Mc-Graw Hill, 1999.

CS411 DATA WAREHOUSING AND DATA MINING (3-1-0) 4 PREREQ: CS301

Data Warehousing: Data Warehousing components and building data warehouse. Data Mining – Objectives, examples, data mining process, Data mining techniques, Generalization, Data mining knowledge representation.

Raph Kimball, Data Warehouse Toolkit, John Wiley & Sons Publications

Michael. J. Berry, Gordon Linoff, :Data Mining Techniques: Marketing, Sales, Customer support. John Wiley & Sons.

CS412 SOFT COMPUTING (3-0-0) 3

Optimization and some Traditional Methods and Issues, Introduction to Genetic Algorithms, Some Specialized Genetic Algorithms, Introduction to Fuzzy sets, Fuzzy Reasoning and Clustering, Fundamentals of Neural Networks, Fundamentals biologically inspired computing, Applilcations and Recent Research Trends.

A Ghosh, S. Dehuri and S. Ghosh(eds), Multi-Objective Evolutionary Algorithms for Knowledge Discovery from Databases, ISBN 978-3-540-77466-2, Springer 2008

S. Bandyopadhyay and S.K. Pal, Classification and Learning using Genetic Algorithms: Applications in Bioinformatics and Web Intelligence, ISBN978-3-540-49606-9, Springer-Verlag, Hiedelberg, German, 2007

A Ghosh, R.K.De and S.K. Pal(eds), Pattern Recognition and Machine Intelligence, Springer2007

D.K. Pratihar, Soft Computing, Narosa, 2007.

CS413 NUMBER THEORY & CRYPTOGRAPHY (3-1-0) 4

Elementary number theory, Finite fields, Arithmetic and algebraic algorithms, Secret key and public key cryptography, Pseudo random bit generators, Block and stream ciphers, Hash functions and message digests, Public key encryption, Probabilistic encryption, Authentication, Digital signatures, Zero knowledge interactive protocols, Elliptic curve cryptosystems, Formal verification, Hard problems, Randomness and Pseudo randomness and Testing.

Koblitz, N. Course on Number Theory and Cryptography, Springer Verlag, 1986

Menezes, A, et.al. Handbook of Applied Cryptography, CRC Press, 1996

Ivan Niven, Herbert S. Zukerman, Hugh L.Montgomery, An Introduction to the Theory of Numbers.

Thomas Koshy, Elementary Number Theory with applications, Elsevier India, 2005

CS414 APPLIED ALGORITHMS (3-1-0) 4 PREREQ: CS350

Sequential Algorithms: Algorithm Design Techniques; Parallel Algorithms: Designing parallel algorithms; Distributed Algorithms; External Memory Algorithms, Online Algorithms, Internet Algorithms and Security- Cryptography Algorithms.

Alfred V Aho, John E Hopcroft, Jeffery D Ullman- Data Structure and Algorithms, Addison Wesley Publi., 1993

Michael Jay Quinn- Designing Efficient Algorithms for Parallel Computers, McGraw Hill 1997.

CS415 SOFTWARE QUALITY ASSURANCE (3-0-0) 3 PREREQ: CS302

Evaluation, Role, maturity in development, life cycle, models, maintenance issues, specification, object oriented design, management, testing, mechanisms, verification and validation, cost estimation, tools, debugging, simulators, ISO 9000 standards, Quality Assurance.

Pankaj Jalote, An Integrated Approach to Software Engineering, Narosh Publication, 1995.

John J Marciniack, Editor in chief Encyclopedia of Software Engineering, John Wiley and sons, 1994.

Isabel Evans, Achieving Software Quality through Team Work, Allied Publishers, 2004.

Mordechai Ben, Menachem, Garry S. Marliss, Software Quality Producing Practical, Consistent Software, Thomson Learning.

James F. Peters, Witold Pedrycz, Software Engineering, An Engineering Approach WSE, Wiley

CS416 NETWORK MANAGEMENT (3-0-0) 3 PREREQ: CS303

Network management Overview, Network Management, SNMP and Network Management, TMN, Network Management Applications, Management of Heterogeneous Network with Intelligent Agents, Network Security Management, Internet Management (IEEE Communication May, Oct. 03), QoS in IP Network, Basic Methods & theory for Survivable Network Design & Operation, Network Planning, Network Management Standards.

M. Subramanian, Network Management: Principles and Practice, Addson- Wesley, 2000

James F. Kurose and Keith W. Rose, Computer Networking, Pearson Education, LPE, 2003

J. Burke, Network Management Concepts and Practice, A Hands-On Approach, Pearson Education, 2000.

Larry L. Peterson and Bruce S. Davie, Computer Networks, A System Approach, Elsevier, 3rd edition.

CS417 PROTOCOL ENGINEERING (3-0-0) 3 PREREQ: CS350

Communication protocols, Protocol Design and Implementation, Protocol Verification and Validation, Protocol Testing, Formal Methods (FDTs).

Web sites, IEEE, ISO and ITU-T sites

P. Venkatram & S. S. Manavi, Protocol Engineering, PHI, 2004.

CS418 SOFTWARE TESTING (3-0-0) 3 PREREQ: CS302

Software testing concepts & principles, Testing Strategies, Testability and Related Issues, Methods for developing the strategy, Life Cycle Testing, Installation Phase Testing and Various Phases of Testing; Tools and Techniques for Software Testing, Testing Object Oriented Software

Glenford J. Myers, The Art of Software Testing, John Wiley & Sons, 1979.

Boris Beizer, Black Testing: Techniques for Functional Testing of Software and Systems, John Wiley & Sons, 1995

William Perry, Software Testing : Effective Methods for Software Testing, John Wiley, 1995

Cem Kaner, Jack Falk, Hung Quoc Nguyen, Testing Computer Software, 2nd Ed, Intl. Thomson Computer Press.

CS419 CYBER LAWS & SECURITY STANDARDS (3-0-0) 3

Perimeter barrier Standards, cyber laws, cyber Security issues, FGIB Cyber Security Proposals, NRIC Cyber Security recovery best Practices, Creation of new practices, NRIC Physical Security Practices.

www. Bell-labs.com/user/krauscher/nric/#intraduction%20TO%20NRIC

CS420 MOBILE COMMUNICATIONS (3-0-0) 3 PREREQ: CS303

History and Evolution of mobile radio communication, Radio paging, Cellular radio systems, Cordless telecommunication systems, Mobile communications by satellite service systems in operation, INMARSAT, MSAT, LEO mobile satellite services

Lee W.C.Y., "Mobile Cellular Telecommunications", McGraw Hill, 1995.

Mazda F., "Telecommunications Engineering" Reference book, Butterworth, 1993.

Gibson J.D., "Mobile Communication Hand Book", CRC press, U.S.A., 1996

Macario R.C.V., "Cellular Radio", Macmillan, 1993.

Bud Bates, "Wireless networked Communication", McGraw Hill, 1991.

CS421 SOFTWARE ARCHITECTURE (3-0-0) 3 PREREQ: CS302

Introduction to Software Architecture; Software Architectures in Different Application; shared Information Systems, Architectural Design, User interface Architecture, Tools

Mary Shaw David Garlan, Software Architecture Perspective on an emerging discipline, PHI 1996
Wolfgang pree, Design patterns for object oriented software development, Addison Wesley, 1995.
Len Bass, Paul Clements and Rick Kazman- Software Architecture in Practice, Addison Wesley, 1998.
Steve McConnell, Rapid Development, Microsoft Press, WP Publishers & Distributors (P) Ltd.

CS422 INFORMATION SECURITY (3-1-0) 4

Basic concepts, access control, Protection, Secure coding, Cryptography, Network security, Firewalls, Confining untrusted code, Security on the Internet and the World Wide Web, Attack Techniques, Casestudies, extra topics

Matt Bishop, Computer Security, Arts & Science, Pearson Education, 2003.
Pceprzyk et.al., Fundamentals of Computer Security, Allied Publishers, 2004.
Derek Atkins and 9 others, Internet Security, Techmedia 2nd edition, 1997.
Michael Howard and David LeBlane, Writing Secure Code, Microsoft, WP Publishers.

CS423 NETWORK SECURITY (3-0-0) 3 PREREQ: CS303

Discussion of known types of attacks on computer and networks, and techniques used by attackers today. Firewall: Packet Filtering, Circuit-Level Gateways; Application-Level Gateways, Firewall Configurations, Intrusion Control:- Detection; Anomaly-Based IDS Intrusion Recovery; Vulnerability Scanners; Login, Audit, and Sniffers, Communication Security Network Access Layer; - Internet Layer - Transport Layer; Application Layer - Message Security Risk Analysis, Policies, Procedures and Enforcement. Special Topics : DOS Mitigation ,VPNs Special Topics: Viruses, SPAM

C. Kaufman, R. Perlman, M. Speciner, Network Security: Private Communication in a Public World – Prentice Hall, 2002.
William Stallings, Network Security Essentials, 2/e, Pearson Education, 2003
Atul Kahate, Cryptography & Network Security, McGraw Hill, 2003.

CS424 WIRELESS NETWORKS & SYSTEMS (3-0-0) 3 PREREQ: CS303

Introduction to network resilience problems and solutions, Wireless beyond 3G, Performance modeling of (Wireless) networks and Formal methods, Network Design Algorithms & Network design using Network Processors, Wireless Ad-hoc Networks, Security Issues in Control, Management, Routing and other areas of networks, Distributed control in (Wireless) network and Middleware, Distributed Mobile Computing, Embedded Systems in Mobile/Wireless/Network Systems – Hardware & Software Design/Development issues, Standardization in Wireless/Mobile Network Systems.

Theodore S. Rappaport, Wireless Communications – Principles & Practices, Pearson Education, 2nd Edition 2002
Boucher N. Cellular Radio Handbook, Quantum Publishing, 1991
Feng & Leonidas, Wireless Sensor Networks, Elsevier India, 2005

CS425 PARALLEL ALGORITHMS (3-1-0) 4 PREREQ: CS350

Parallel processing, Parallel models, Performance of parallel algorithms, Techniques for designing parallel algorithms, Pointer jumping technique, Divide and conquer, partitioning strategy, Pipe lining, Accelerated cascading, Symmetry breaking, Lists and trees, List ranking, Euler-tour technique, Tree contraction, Computation of tree functions, Searching, Merging, Sorting, Parallel graph algorithms, Ear decomposition, Polynomial and matrix computations, General dense matrices.

Jaja,J.An Introduction to Parallel Algorithms, Addison- Wesley, Reading, MA, 1992.

Gibbons A. and W.Rytter, Efficient Parallel algorithms, Cambridge university Press; Cambridge, 1988.

CS426 DISTRIBUTED ALGORITHMS (3-1-0) 4 PREREQ: CS352

Role of Distributed Algorithms in designing applications, Synchronous algorithms, asynchronous network algorithms, distributed algorithms for memory management and web computing

Nancy & Lynch, Distributed Algorithms, Harcour Asia, 2001.

CS427 WEB ENGINEERING (3-0-0) 3 PREREQ: CS353

Requirements specification and analysis, Web-based systems development methodologies and techniques, Migration of legacy systems to Web environments, Web-based real-time applications development, Testing, verification and validation, Quality assessment, control and assurance, Configuration and project management, "Web metrics"- generating metrics for estimation of development efforts, Performance specification and evaluation, Update and maintenance, Development models, teams, staffing, Integration with legacy systems, Human and cultural aspects, User-centric development, user modeling and user involvement and feedback, End-user application development.

Journal of Web Engineering, Rinton Press, IEEE & ACM Publications.

Cato & John, User Centered web design, Pearson Education, 2001.

CS428 SOFTWARE PROJECT MANAGEMENT (3-0-0) 3 PREREQ: CS302

Data Collection and Analysis in software engineering, Product Metrics, Quality Metrics, Management Metrics, Conventional Software Management, Life cycle Phases, Iterative process planning,, Modern Project Profiles, Next generation cost models.

K. Conway, Software Project Management: From Concept to Development, IDG Books, 2001

I. Jacobson.G.Booch & J.Rumbaugh, The Unified Software Development Process, Addison Wesley, 1999.

Norman E- Fentar and Share Lawrence Pflieger, Software Metrics, International Thomson Computer Press 1997.

Stephan H.Kin, Metric and Models in Software Quality Engineering, Addison Wesley 1995.

Jim McCarthy, Dynamics of Software Development, Microsfot Press, WP Publ. & Distributors (P) Ltd.

CS429 CLOUD COMPUTING (3-0-0) 3 PREREQ: CS303

Introduction to Cloud Computing, Cloud Computing Delivery Models, Open Source and Industry case Studies of cloud (Apache VCL, Amazon, IBM and Eucalyptus) Introduction to Map/Reduce and Apache Hadoop Programming Models for Cloud Computing and examples/applications, Virtualizations as an enabler for Cloud Computing infrastructure,

"Cloud Application Architectures" by George Reese, O'Reillly Publications, 2009
"Cloud Security and Privacy", Tim Mather, Subra Kumaraswamy, O'Reilly, 2009
The Hadoop – Definitive Guide, Tom White, O'Reilly, 2009

CS430 E-COMMERCE (3-0-0) 3 PREREQ: CS353

Infrastructure and Tools for E-Commerce, Current Trends in E-Commerce applications development, the Business of Internet Commerce, Enterprise level E-Commerce, Security and encryption, Electronic payment systems, Search engines, Intelligent agents in E-Commerce, On-line auctions, Data Mining for E-Commerce, Web metrics, Recommended systems, Knowledge Management, Mobile E-Commerce, Legal, ethical and social issues.

Henry Chan et al., E-Commerce-Fundamental and applications, John Wiley & Sons 2002
G. Winfield Treese and Lawrence C.S., Designing Systems for Internet Commerce, Pearson Education, LPE, 2002
Fensel, Dieter, Brodie M.L., "Ontologies: A Silver Bullet for Knowledge Management and E-Commerce", Allied Publishers, 2004
Zimmermann, Olaf: Tomlinson, Mark R.: Peuser, Stefan, Perspectives on Web Services, Allied Publilshers, 2004

CS431 ADVANCED OPERATING SYSTEMS (3-1-0) 4 PREREQ: CS300

An overview if operating system functions, Distributed operating systems, Protection and security, Multiprocessor operating systems, Database operating systems, Concurrency control, Object Oriented operating systems and its characteristics, Case Studies of OS such as UNIX OS, Netware OS, Windows etc.

Mukesh Singhal Niranjan, Shivorothri G.: Advanced Concepts in Operating systems
Andrew S. Tenanbaum: Distributed Operating systems
Doreen L. Galli, Distributed Operating systems- Concepts and Practive, Prentice-Hall 2000
A Silberschatz, Applied Operating systems Concepts, Wiley 2000
Lubemir F. Bic & Alan C. Shaw, Operating systems Principles, Pearson Education, 2003

CS432 ADVANCED COMPILERS (3-1-0)4 PREREQ: CS351

Topics include control-flow and data-flow analysis, classical optimization, instruction scheduling, and register allocation. Advanced topics include memory hierarchy management, optimization for instruction-level parallelism, modulo scheduling, predicated and speculative execution.

Steven S. Muchnick, Advanced Compiler Design & Implementation, Morgan Kaufmann, 2004.
Robert Morgan, Building an Optimizing Compiler, Butterworth-Heinemann, 1998.
Andrew W. Appel, Modern Compiler Impementation in Java, Cambridge, 2005.
Randy Allen Rice, Optimising Compilers for Modern Architectures, Elsevier India, 2004

CS433 WEB SERVICES (3-0-0) 3 PREREQ: CS353

Basic Concepts, Enabling Infrastructure, Core functionality and standards, Service semantics, Web service composition, Service development and recent research trends.

AlonsoG., Casati F., Kuno H., Machiraju V., Web Services – Concepts, Architectures and Applications Series: Data- Centric Systems and Applications 2004

Sanjiva Weerawarana, Francisco Curbera, Frank Leymann et al, Web Services Platform Architecture: SOAP, WSDL, WS-Policy, WS-Addressing, WS-BPEL, WS-Reliable Messaging and more, Prentice Hall Publication, 2005.

Thomas Erl, Service oriented Architecture: Concepts, Technology and Design, Prentice Hall Publication, 2005

R. Allen Wyke et-al, XML Programming, WR Publishers, ISBN: 81-7853-064-3

J2EE Web Services, Richard Monson-Haefel, Pearson (LPE), 2005

CS440 PRACTICAL TRAINING 1

The Student has to under go a training programme or any equivalent programme fixed by the institution /department. This will be done during the third or fourth year. A report will be submitted by the student. Evaluation is based on the seminar and report.

CS449 MAJOR PROJECT- I (0-0-6) 4

The Student has to select a project work based on a topic of interest. Periodically the implementation will be evaluated by the guide. This work, started in VII semester continues through eighth semester, at the end of which, the student will be evaluated internally and externally.

CS499 MAJOR PROJECT - II (0-0-9) 6

The Student has to select a project work based on a topic of interest. Periodically the implementation will be evaluated by the project guide. This work, started in VII semester continues through eighth semester at the end of which, the student will be evaluated internally and externally.

Pankaj Jalote, Software Project Management in Practice, Pearson Education.

Department of Electrical and Electronics Engineering (EEE)
Bachelor of Technology in Electrical and Electronics Engineering

Foundation Courses (Fndn)

MA100	Engineering Mathematics – I	(3-1-0) 4
MA101	Engineering Mathematics - II	(3-1-0) 4
PH100	Physics	(3-0-0) 3
PH101	Physics Lab	(0-0-3) 1
CY100	Chemistry	(3-0-0) 3
CY101	Chemistry Lab	(0-0-3) 1
CV100	Engineering Mechanics	(3-1-0) 4
EE100	Elements of Electrical Engineering	(3-1-0) 4
EC101	Elements of of Electronics & Communication Engineering.	(3-1-0) 4
ME100	Elements of Mechanical Engineering	(3-0-0) 3
ME101	Engineering Graphics	(1-0-3) 2
ME102	Workshop	(0-0-3) 1
CO100	Computer Programming	(3-0-0) 3
CO101	Computer Programming Lab	(0-0-3) 1
HU100	Professional Communication	(3-1-0) 4
HU300	Engineering Economics	(3-1-0) 4
HU301	Management Theory and Practice	(3-1-0) 4

Programme Specific Core (PSC)

EE200	Circuit Theory	(3-1-0) 4
EE201	Mathematics for E&E Engg.	(3-1-0) 4
EE202	Electromagnetic Theory	(3-1-0) 4
EE203	Transformers and Induction Machines	(3-1-0) 4
EE204	Signals and Systems	(3-1-0) 4
EE205	Linear Integrated Circuits	(3-1-0) 4
EE206	Transformers and Induction Machines Lab	(0-0-3) 1
EE207	Signals and Systems Lab	(0-0-3) 1
EE250	Electrical Measurements & Measuring Instruments	(3-1-0) 4
EE251	Synchronous Machines	(3-1-0) 4
EE252	Power Electronics	(3-1-0) 4
EE253	Digital Electronic Circuits	(3-1-0) 4
EE254	Electrical Measurements Lab	(0-0-3) 1
EE255	Analog and Digital Electronics Lab	(0-0-3) 1
EE300	Elements of Power System Engineering	(3-1-0) 4
EE301	Digital Signal Processing	(3-1-0) 4
EE302	Electronic Measurements & Instrumentation	(3-1-0) 4
EE303	Linear and Digital Control Theory	(3-1-0) 4
EE304	Microprocessors	(3-1-0) 4
EE305	Power Electronics Lab	(0-0-3) 1
EE350	Power System Analysis	(3-1-0) 4
EE351	Switchgear and Protection	(3-1-0) 4
EE352	Microprocessors Lab	(0-0-3) 1
EE353	Power System Simulation Lab	(0-0-3) 1
EE400	Energy Auditing	(3-1-0) 4
EE440	Practical Training/Educational Tour	1

Programme Specific Electives (PSE)

EE230	Polyphase Systems & Component Transformations	(3-1-0) 4
EE231	Commutator Machines	(3-1-0) 4
EE232	Introduction to Algorithms & Data Structures	(3-0-0) 3
EE270	Digital Computer Organization & Architecture	(3-0-0) 3
EE271	Commutator Machines Lab	(0-0-3) 1
EE272	Synchronous Machines Lab	(0-0-3) 1
EE273	Elements of Analog and Digital Communication	(3-0-0) 3
EE330	Distribution Systems Planning & Control	(3-1-0) 4
EE331	Network Synthesis	(3-1-0) 4
EE332	Digital System Design	(3-1-0) 4
EE333	Power System Harmonics	(3-1-0) 4
EE334	Neural Networks and Applications	(3-0-0) 3
EE335	Linear and Nonlinear Systems	(3-1-0) 4
EE336	Traveling Waves on Transmission Systems	(3-0-0) 3
EE337	Distribution Systems Lab	(0-0-3) 1
EE338	Digital System Design Lab	(0-0-3) 1
EE339	Power System Harmonics Lab	(0-0-3) 1
EE371	Power System Communications	(3-0-0) 3
EE372	Optimal Operation of Power Systems	(3-1-0) 4
EE373	Advanced Digital Signal Processing	(3-0-0) 3
EE374	Special Machines and Drives	(3-1-0) 4
EE375	Embedded System Design	(3-0-0) 3
EE376	Power Electronic Applications to Power Systems	(3-0-0) 3
EE377	Solid-State Drives	(3-1-0) 4
EE386	Digital Signal Processing Lab	(0-0-3) 1
EE430	Electric Power Stations	(3-0-0) 3
EE431	Electric Energy Systems	(3-0-0) 3
EE432	Advanced Control Systems	(3-0-0) 3
EE433	Modeling and Simulation Techniques for Dynamic Systems	(3-0-0) 3
EE434	Incremental Motion Control	(3-0-0) 3
EE435	Energy Auditing Lab	(0-0-3) 1
EE470	HVDC Transmission	(3-1-0) 4
EE471	Soft Computing	(3-0-0) 3
EE472	Electromagnetic Compatibility	(3-0-0) 3
EE473	Power System Protection	(3-0-0) 3
EE474	Operation of Restructured Power Systems under Deregulation	(3-0-0) 3
EE475	Random Signal Processing	(3-0-0) 3
EE476	Non-Conventional Energy Systems	(3-0-0) 3
EE477	Advanced Power Electronics	(3-1-0) 4
EE478	Power System Dynamics	(3-1-0) 4
EE479	Computer Networks	(3-0-0) 3
EE480	The ARM Core: Architecture & Programming	(3-0-0) 3
EE481	Advanced Power Electronics Lab	(0-0-3) 1
EE482	Flexible AC Transmission Systems	(3-1-0) 4
EE483	High-Voltage Engineering	(3-1-0) 4
EE484	Photovoltaics and Applications	(3-0-0) 3
EE485	Power Generation and Economics	(3-1-0) 4

Open Electives (OE)

EE334	Neural Networks and Applications	(3-0-0) 3
EE373	Advanced Digital Signal Processing	(3-0-0) 3
EE431	Electric Energy Systems	(3-0-0) 3
EE432	Advanced Control Systems	(3-0-0) 3
EE471	Soft Computing	(3-0-0) 3
EE476	Non-Conventional Energy Systems	(3-0-0) 3
EE479	Computer Networks	(3-0-0) 3
EE382	Utilization of Electrical Energy	(3-0-0) 3
EE383	Computational Technique for large system analysis	(3-0-0) 3

Department of Electrical and Electronics Engineering (EEE)
Bachelor of Technology in Electrical and Electronics Engineering

EE486	Optimisation Techniques	(3-0-0) 3

Programme Major Project (PMP)

EE449	Major Project – I	(0-0-6) 4
EE499	Major Project - II	(0-0-9) 6

Mandatory Learning Courses (MLC)

MLC1	Environmental Studies	(1-0-0) 1
MLC2	Professional Ethics and Human Values	(1-0-0) 1

Department of Electrical and Electronics Engineering (EEE)
Bachelor of Technology in Electrical and Electronics Engineering

Suggested Plan of Study:

Semester	III	IV	V	VI	VII	VIII
1	EE200	EE250	EE300	EE350	EE400	EE499
2	EE201	EE251	EE301	EE351	EE440	Elective
3	EE202	EE252	EE302	EE353	EE449	Elective
4	EE203	EE253	EE303	HU301	Elective	Elective
5	EE204	EE254	EE304	Elective	Elective	Elective
6	EE205	EE255	HU300	Elective (4 cr)	Elective	Elective
7	EE206	Elective	EE305		Elective (4 cr)	
8	EE207		EE352			

Note: Elective with 3 credits and 4 credits (Electrical Engineering main streams) are offered based on nature of the course under PSE. Department shall ensure offering minimum of two 4 credit PSE from the list to enable earning 38 credits.

Degree Requirements :

Category of Courses	Minimum Credits to be Earned
Foundation courses (Fndn)	50
Programme Specific Core (PSC)	80
Programme Specific Elective (PSE) / Open Elective (OE)	38
Programme Major Project (PMP)	10
Mandatory Learning Courses (MLC)	2
Total	**180**

Department of Electrical and Electronics Engineering (EEE)
Bachelor of Technology in Electrical and Electronics Engineering

EE200 CIRCUIT THEORY (3-1-0) 4

Review of Kirchhoff's laws and circuit elements, Graphs, Loop and nodal method of analysis using differential equations, Wye-delta transformation, Coupled circuits, DC and AC Transient analysis of RL, RC and RLC circuits. Sinusoidal steady state analysis, Phasors, Power in AC circuits, Network Theorems applied to DC and AC circuits, Resonance, Impedance and admittance loci of RL, RC circuits. Polyphase circuits, Balanced and unbalanced systems, Symmetrical components, Measurement of power. Simulation examples using SPICE.

References:

Ernst A. Guillemin, Introductory Circuit Theory, John Wiley and Sons, 1953.
William H. Hayt Jr., Jack E. Kemmerly, Steven M. Durbin, Engineering Circuit Analysis, 6th Edition, TMH, 2002.
Charles A. Desoer, Ernest S. Kuh, Basic Circuit Theory, McGraw-Hill, 1969.
Russell M. Kerchner, George F. Corcoran, Alternating Current Circuits, 4th Edition, Wiley Eastern, 1960.
K.Y. Tang, Alternating Current Circuits.

EE201 Mathematics for E&E Engg. (3-1-0) 4

Laplace Transforms: Definition, Existence conditions, Laplace Transforms of 1, k, eat, cos(at), sin(at), cosh(at), sinh(at), Df(t), integral of f(t) between limits 0 to t .First and second shifting theorem, Laplace transform of periodic functions, Laplace transform of Dirac- Delta function, Laplace transform of Unit step function.

Inverse Laplace transforms, Convolution theorem, Applications of Laplace transforms in solving linear differential equations with initial conditions and system of linear simultaneous differential equations.

Fourier series: Periodic functions, Trigonometric series, Euler's formulae, Dirichlet's condition, Even and odd functions, Half Range Series, Parseval's identity. Fourier Transforms: Fourier transform, inverse Fourier transforms, applications, convolution theorem.

Partial Differential Equations: Equations governing transverse vibrations of elastic string (one dimensional wave equation), solution using Fourier series. Variable heat flow in one dimension, derivation and solution using variable separable method.

Introduction to Z transforms: Basic Z transforms, properties, inverse Z transforms, convolution theorem, applications to difference equations.

Complex Variables: Integration of complex functions, Cauchy's integral theorem for simply connected regions, Cauchy's integral formula, extension to multiply connected regions, Maximum modulus theorem. Taylor's and Lorentz's expansion, singularities-Zeros and poles, Residue theorem, Liouville's theorem, Contour integration.

Text Books:

1. Applied Mathematics-P.N. Wartikar and J.N. Wartikar; Pune Vidhyarhi Griha Prakashan
2. Higher Engineering Mathematics-B.S. Grewal; Khanna Publishers

Reference Books:

1. Engineering Mathematics-III- Veerarajan, Tata McGraw Hill
2. Engineering Mathematics Vol-III, P. Kandasamy, S. Chand Publication
3. Applied Mathematics- III, R.M.Baphana , Technova Publications

Department of Electrical and Electronics Engineering (EEE)
Bachelor of Technology in Electrical and Electronics Engineering

EE202 ELECTROMAGNETIC THEORY (3-1-0) 4
Static electric and magnetic fields. Time varying fields. Maxwell's equations. Boundary value problems. Propagation of plane waves in dielectric and conducting media. Introduction to computational methods in electromagnetics.

References:
William H. Hayt Jr., Engineering Electromagnetics.
John D. Kraus, Electromagnetics.
Martin A. Plonus, Applied Electromagnetics.
E C. Jordan, K. G. Balmain, Electromagnetic Waves and Radiating Systems..
Simon Ramo, John R. Whinnery, T..Van Duzer , Fields and Waves in Communication Electronics.

EE203 TRANSFORMERS AND INDUCTION MACHINES (3-1-0) 4
Basics of Electromagnetics, Magnetic Circuits, Transformers, Construction, Equivalent Circuits, Phasor diagrams, efficiency, voltage regulation, inrush phenomena, harmonics, three phase transformers, Distribution transformers, tap-changers, testing, maintenance and fault diagnosis, parallel operation, principles of autotransformer, pulse transformer, Basic Concepts of Design.
Basics of electromechanical energy conversion principles, energy, co-energy, voltage generation, torque production, Induction motors, construction, principle of operation, characteristics, performance analysis, starting, speed control, harmonic torques, testing, maintenance and fault diagnosis, induction generator and operating characteristics, single phase induction motors, types, characteristics, applications, testing, maintenance and fault diagnosis, Basic concepts of design.

References:
Fitzgerald, Kingsley, Umans, Electric Machinery, 5th Edition, McGraw-Hill, 1992
M.G. Say, Performance and Design of A.C. Machines, CBS, 1983.
Puchstein, Lloyd, Conrad, Alternating Current Machines, Asia Publishing House.

EE204 SIGNALS AND SYSTEMS (3-1-0) 4
Signals and Systems – Classification, Time-Domain Analysis of Continuous-time and Discrete-time systems, Continuous-time system analysis using the Laplace Transform, Discrete-time system analysis using the z-transform. Fourier Series, Fourier Transform, Sampling, Applications.
References:
B.P. Lathi, Linear Systems and Signals, 2nd Edition, Oxford University Press, 2005.
Simon Haykin , Barry Van Veen, Signals and Systems, John Wiley Asia, 2003.
A.V. Oppenheim, A.S. Willsky , S. H. Nawab, Signals and Systems,2nd. Edition, Prentice-Hall Signal Processing Series, 1997.

EE205 LINEAR INTEGRATED CIRCUITS (3-1-0) 4
Operational amplifiers, characteristics, Performance of op-amps, Filters, Applications. Other IC Applications : 555 Timer, PLL, VCO, Voltage Regulators. A/D, D/A, S/H circuits and applications.

References:
A.S. Sedra , K.C. Smith, Microelectronic Circuits, 5th edition, Oxford University Press, 2003.
J. Millman, A. Grabel , Microelectronics, 2nd Edition, McGraw-Hill, 1987.
Ramakant Gayakwad, OPAMPS and Linear Integrated Circuits , 4th Edition, PHI, 1990.

Department of Electrical and Electronics Engineering (EEE)
Bachelor of Technology in Electrical and Electronics Engineering

EE206 TRANSFORMERS AND INDUCTION MACHINES LAB (0-0-3) 1
Laboratory exercises and assignments to supplement EE203.

EE207 SIGNALS AND SYSTEMS LAB (0-0-3) 1
Laboratory exercises and assignments to supplement EE204.

EE250 ELECTRICAL MEASUREMENTS AND MEASURING INSTRUMENTS (3-1-0) 4
SI Units, Dimensions. Errors. Electromechanical indicating instruments, Galvanometers, response. Permanent magnet moving coil instruments, Construction, Torque equation, range extension with multipliers, Sensitivity. Moving iron instruments torque equation, type multipliers. Electro-dynamometer ammeter,wattmeter. Electrostatic voltmeter, Multiplier, Megger™, Earth tester. Principles of rectifier type instruments, voltmeter and ammeter. Measurement of resistance: Classification of R, Kelvin double bridge, Measurement of medium R: VA method, Wheatstone bridge, errors, limitations and sensitivity. Measurement of high R: Loss of charge method, direct deflection method, Insulation resistance of cable. Measurement of earth resistance, factors affecting earth resistance. Cable fault location types of faults and methods. Insulation R with line on. Measurement of L, C and M using ac bridges. Shielding in bridges, Wagner earthing device. DC Potentiometer: Student type, Brooks deflection type, Applications. AC Potentiometers: Theory, application of coordinate and polar type potentiometer. Instrument transformers: CT's PT's construction, operation for metering and protections, applications. Testing: Silsbee's method, Comparative deflection method. Measurement of energy: Single-phase induction type energy meter. Construction, operation, errors. Compensation, Three-phase energy meter. Transducers: Strain gauges, LVDT, thermistors, capacitive transducers, piezoelectric transducers. Speed measurements: Tachometers and stroboscopic method. Torque measurement: Magnetostrictive and inductive torque transducers (qualitative analysis).

References:
E.W. Golding, F.C. Widdis, Electrical Measurements and Measuring Instruments, Wheeler, 1979.
A.K. Sawhney , A Course in Electrical and Electronic Measurements and Instrumentation.

EE251 SYNCHRONOUS MACHINES (3-1-0) 4
Principle of operation, phasor diagram. Power developed. V and inverted V curves. Parallel operation. Synchronous machine on infinite bus bars. General electric load diagrams. Theory of salient pole machine. Dynamics of synchronous machines.
References:
M.G. Say, Performance and Design of Alternating Current Machines, CBS, 1983.
I.J. Nagrath , D.P. Kothari , Electrical Machines, TMH.
Fitzgerald, Kingsley, Umans, Electric Machinery, 5th Edition, McGraw-Hill, 1992

EE252 POWER ELECTRONICS (3-1-0) 4
Power devices, simplified models, linear power supplies, ac-dc, dc-dc, dc-ac and ac-ac converter circuits: topologies and steady state operation. Detailed study of ac-dc (controlled and uncontrolled) converters. Switching circuits, gate drive circuits and requirements.
References:
Ned Mohan, Undeland, Robbins, Power Electronics, John Wiley, 3rd Edition.
M. H. Rashid, Power Elctronics, PHI /Pearson Education, 2nd/3rd Edition.

Department of Electrical and Electronics Engineering (EEE)
Bachelor of Technology in Electrical and Electronics Engineering

EE253 DIGITAL ELECTRONIC CIRCUITS (3-1-0) 4
Boolean algebra, Combinational and sequential logic circuits, Adders, Comparators, Finite state machines, Flip flops, Shift registers, Counters, Multiplexers.
References:
J.F. Wakerly, Digital Design Principles and Practices, PHI, 1999.
B. Fletcher, Engineering Approach to Digital Design, PHI, 1993.
D. Givone, Digital Principles and Design, TMH, 2002.

EE254 ELECTRICAL MEASUREMENTS LAB (0-0-3) 1
Laboratory exercises and assignments to supplement EE250.

EE255 ANALOG AND DIGITAL ELECTRONICS LAB (0-0-3) 1
Laboratory exercises and assignments to supplement EE205 and EE253.

EE300 ELEMENTS OF POWER SYSTEM ENGINEERING (3-1-0) 4
Per-unit representation. Inductance and Capacitance of transmission lines. Equivalent circuit of transmission lines. Receiving end power diagram. Mechanical design of transmission lines. Suspension insulators. Corona phenomena. Traveling waves in power systems. Underground cables.
References:
Olle I. Elgerd, Electric Energy Systems Theory – An Introduction, TMH, 1982.
W.D. Stevenson Jr., Elements of Power System Analysis, McGraw-Hill, 1968.
J. Nagrath , D.P. Kothari, Power System Engineering, TMH.
Wadhwa, Electrical Power Systems.

EE301 DIGITAL SIGNAL PROCESSING (3-1-0) 4
Review of FT, DTFT, DFT. Interpreting DFT values, Frequency resolution and DFT bins. Properties of DFT, Limitations of DFT. Circular Convolution, DFT computation methods: Radix FFTs: Decimation in time and Decimation in frequency FFT, DCT. IIR Filters: Analog filters: Properties and Design of Butterworth, Chebychev and Elliptical filters. Frequency transformation. Review of Z-transform and its properties: Structure of Digital Filters. Methods of Converting Analog Filters to Digital Filter (IIR): Approximating the Integration: bilinear transformation, pole-zero mapping, Impulse invariant transformation. FIR filters : Structure and properties of FIR filters. Methods of designing the FIR filters: Window-based methods, Frequency Sampling Method. Introduction to the programmed digital systems. General Architecture of Digital Signal Processors, Instruction set, Introduction to Programming digital systems. Example of the TMS320F243, Application of DFT for Linear filtering.
References:
John G. Proakis, D.G. Manolakis, Digital Signal Processing.
Ashok Ambardar, Analog and Digital Signal Processing.
L. R. Rabiner, B. Gold , Theory and Applications of Digital Signal Processing, PHI, 1975
Richard G. Lyons, Understanding Digital Signal Processing.
Roman Kuc , Introduction to Digital Signal Processing.
A. V. Oppenheim, R. W. Schafer, Discrete-Time Signal Processing.

Department of Electrical and Electronics Engineering (EEE)
Bachelor of Technology in Electrical and Electronics Engineering

EE302 ELECTRONIC MEASUREMENTS AND INSTRUMENTATION (3-1-0) 4
Measurement Systems, Electromechanical Instruments, Bridges, Electronic Instrumentation, Oscilloscopes, Signal Analysis, Frequency, Time interval measurements, Physical Parameter Measurements, Transducers, Data Acquisition Systems.
References:
B. H. Oliver, J. M. Cage, Electronic Measurements and Instrumentation, McGraw-Hill, 1975
Albert D. Helfrick, William D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, PHI.

EE303 LINEAR AND DIGITAL CONTROL THEORY (3-1-0) 4
Introduction, Classification, Mathematical modeling of physical systems, Introduction to discrete time control systems, z-plane analysis of discrete time control systems, Transient response analysis, Design specifications and performance indices, Concept of stability and algebraic criteria, Root locus analysis, frequency response analysis, Bode diagrams, polar plots, Nyquist plots, Stability in the frequency domain, Basic control actions and response of control systems. Introduction to control system design using the root locus and frequency-domain approach.
References:
I. J. Nagrath, M. Gopal, Control Systems Engineering, 4th Edition, New Age International.
K. Ogata, Modern Control Engineering, 3rd Edition, PHI.
K. Ogata, Discrete Time Control Systems, 2nd Edition, Pearson Education.

EE304 MICROPROCESSORS (3-1-0) 4
Basics of finite state machines, Von Neumann Architecture, Functional blocks of a microcomputer, Architecture of 8-bit/16-bit Microprocessors/Microcontrollers [viz. Intel 8051 family, MOTOROLA 68HXX, ARM Core etc.]. Programmers' model of any one microprocessor/microcontroller chosen for detailed study, Instruction set, Chip Configuration and programming, Use of development and debug tools, Interface applications. Laboratory exercises.
References:
Intel Corporation, 8-bit Microcontroller Handbook, Intel Corporation, 1990.
ARM® Core Processor Hand book.
John B. Peatman, Design with Microcontrollers, McGraw-Hill, 1995.
Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield, ARM System Developer's Guide, Designing and Optimizing System Software, Elsevier, 2004.

EE305 POWER ELECTRONICS LAB (0-0-3) 1
Laboratory exercises and assignments to provide additional support to EE252.

EE350 POWER SYSTEM ANALYSIS (3-1-0) 4
System Modeling, System Analysis, Load Flow Studies, Short Circuit Studies, Stability Analysis.
References:
W.D. Stevenson Jr., Elements of Power System Analysis, McGraw-Hill, 1968.
Olle I. Elgerd , Electric Energy Systems Theory: An Introduction, TMH, 1982.

EE351 SWITCHGEAR AND PROTECTION (3-1-0) 4
Fuses and switches, methods of earthing, Circuit Breakers: Arcs, Interruption, RRRV, Current chopping, Interruption of capacitive current, Resistance switching. Types of circuit breakers, Circuit breaker ratings, Auto reclosure. Protective relaying: Functions, Standard definitions and terminology,

Fundamental characteristics. Relay classifications, Electromechanical relays. Directional relay, Reverse power relay. Differential protection schemes for bus-bars, transformers and alternators. Frame leakage, bus-bar and transformer protection. Buchholtz relay, Backup protection. Alternator protection: Negative phase sequence relay, Loss of field protection. Line protection: Overcurrent relays and schemes, Distance relays and schemes, Effect of arc resistance, Translay relaying, Carrier current relaying. Induction motor protection: Abnormal operating conditions, Undervoltage, Phase and earth fault, Overload and unbalance voltage protection. Solid state relays: Comparators, Duality between phase and amplitude comparators. General equation of comparators, Realization of directional, Ohm, reactance, impedance and Mho characteristics using the general characteristic equation, Static distance relays. Computer aided relaying: Introduction to microcomputer based relays, General functional diagram of microcomputer-based relays.

References:

Ravindranath, Chander , Power System Protection and Switchgear, Wiley Eastern, 1994.
C. L. Wadhwa, Electrical Power Systems, 2nd Edition, PHI, 1993.
Arun G. Phadke, S H Horowitz, Power System Relaying, 2nd Edition, John Wiley, 1995.
Badriram, D. N. Vishwakarma, Power System Protection and Switchgear, TMH, 1995.

EE352 MICROPROCESSORS LAB (0-0-3) 1

Programming and Interfacing experiments on the target processor / microcontroller discussed in EE304.

EE353 POWER SYSTEM SIMULATION LAB (0-0-3) 1

Time–domain simulation of SMIB and Multi-machine power systems in MATLAB®/SIMULINK™ to provide additional support to EE350.

EE440 PRACTICAL TRAINING/EDUCATIONAL TOUR 1

This course is a 1 credit course. A student may complete the training or educational tour before the beginning of 7th semester (or as stipulated by DUGC) and register for it in 7th Semester. The duration and the details shall be decided by the faculty advisor, with approval from DUGC.

HU300 ENGINEERING ECONOMICS (3-1-0) 4

Basic economic concepts and problems -Theories of demand, supply and Market equilibrium. Elasticity, demand forecasting, cost terminology. Methods of economic analysis in Engineering- Bases for Comparison of alternatives. Selection among alternatives, replacement analysis - Evaluating public activities - depreciation accounting - Estimating economic elements.

Samuelson P.A. and Nordhans W.D., Economics, 15th ed., McGraw Hill, New York, 1995. Thuesen G.J. and Fabrycky W.J.Engineering Economy, 9th ed., Prentice Hall of India, New Delhi 2002. Sullivan W.G., Bontadelli J.A. and Wicks E.M., Engineering Economy, 11th ed., Pearson Education Asia, New Delhi 2001 Leland Blank P.E and Anthony Tarquin P.E.,Engineering Economy, 4th ed., McGraw Hill, Singapore, 1998.

HU301 MANAGEMENT THEORY AND PRACTICE (3-1-0) 4

Management Philosophy, Management and Society, Functions of Management, Goals of Managers and Organizations, Productivity, Efficiency, Effectiveness, Evolution of Management thoughts, Systems Theory, Theories of Taylor, Fayol, Gilberth, Mayo, Chester Bernard, Concept and Practice of Planning, MBO, Strategic Planning, SWOT Analysis, Decision Making, Global Planning -

Organizing, Organization levels, Structures, Authority, Power, Delegation, Conflict, Human Resource Management & Development, Selection of Employees, Training and Orientation, Performance Appraisal, Human factors in Managing, Motivation Theory, Need Theories, Leadership, Communication, Controlling Human factors, Types of Controls, Effective Controls.

Koontz, H. Management, McGraw Hill Publication, 1998 Philip Kotler, Marketing Management, Tata McGraw Hill Publicaiton, 1998

ELECTIVE COURSE CONTENT

EE230 POLYPHASE SYSTEMS AND COMPONENT-TRANSFORMATIONS (3-1-0) 4

Balanced Polyphase Circuits: Generation of polyphase voltages, Phase sequence, Three-phase 3-wire and 4-wire systems, wye and delta connections, The n-phase star and mesh, Power calculations in balanced systems, General n-wire balanced systems, Harmonics in Wye- and Delta-systems.

Unbalancd Polyphase Circuits: Unbalanced loads, The Wye-Wye system with and without neutral connections, Neutral shift, the Wye-delta system, Phase-sequence effects, Methods of checking voltage phase sequence, The three-wattmeter/Two-wattmeter methods of measuring three-phase power, the use of (n-1) wattmeters for measuring n-wire power, Power-factor in unbalanced three-phase systems, Extensions to non-sinusoidal behaviour.

Introduction to Symmetrical components: A brief historical review, Application of the method,

Fundamental principles, Symmetrical component systems, resolution of three vectors into symmetrical components, Independence of sequences in symmetrical systems, sequence impedances.

Calculation of Unbalanced faults: Sequence networks, Connection of networks to represent faults, Outline of short-circuit calculations, Treatment of transformer connections, Measurement of sequence voltages and currents. Measurement of sequence power quantities, Flow of power due to unbalance.

Multiphase systems: Resolution of multiphase systems into symmetrical components, 2-phase and 4-phase systems, Irregular systems, General treatment of polyphase circuits, Impedances of symmetrical polyphase systems, Harmonics.

References:

C.F. Wagner, R.D. Evans, Symmetrical Components, McGraw-Hill, 1933.

J.L. Blackburn , Symmetrical Components for Power System Engineering, Marcel-Dekker ,1993.

Edith Clarke, Circuit Analysis of AC Power Systems – Volumes I and II, John Wiley and Sons, 1950.

EE231 COMMUTATOR MACHINES (3-1-0) 4

Constructional Details, Commutator action analysis, A control possibility, Windings, mmf production, limitations, Special features, Fields of application, Limitations, Fault detection and general maintenance, Basic design features.

References:

E. Openshaw Taylor, The Performance and Design of AC Commutator Machines.

Fitzgerald, Kingsley, Kusko, Electromechanical Energy Conversion.

Atkinson, Generalized Machine Theory.

EE232 INTRODUCTION TO ALGORITHMS AND DATA STRUCTURES (3-0-0) 3

Mathematical basis and notions for algorithm analysis. Sorting, Divide and Conquer, Linear time sorting, Elementary Data Structures, Priority Queues, BST and RBT.

Design and Analysis Paradigms – Dynamic Programming, Greedy Algorithms, Graph Algorithms.

References:

T.H. Cormen, C.E. Leiserson, R.L. Rivest , C. Stein, Introduction to Algorithms, 2nd Edition, PHI, 2004.
D.E. Knuth, The Art of Computer Programming, Volumes I and III, Addison-Wesley, 1973.
Anany Levitin, Introduction to the Design and Analysis of Algorithms, Pearson Education, 2003.

EE270 DIGITAL COMPUTER ORGANIZATION AND ARCHITECTURE (3-0-0) 3

Evolution of computers, Instruction set design, Processor design: Functional unit design, Microprogrammed
and hardwired approaches, Different architectures, Control unit design, Memory
organization, Input-Output organization, Introduction to system software, Operating system basics.
References:
J.P. Hayes, Computer Architecture and Organisation, 2nd Edition, McGraw-Hill, 1988.
M. Rafiquzzaman , Rajan Chandra, Modern Computer Architecture, Galgotia, 1999.

EE271 COMMUTATOR MACHINES LAB (0-0-3) 1

Laboratory exercises and assignments to provide additional support to EE231.

EE272 SYNCHRONOUS MACHINES LAB (0-0-3) 1

Laboratory exercises and assignments to supplement EE251.

EE273 ELEMENTS OF ANALOG AND DIGITAL COMMUNICATION (3-0-0) 3

Introduction to analog and digital communication: Bandwidth and information capacity, transmission modes, Signal analysis, Noise considerations. Modulation and demodulation concepts (AM, FM, PM), TDM and FDM concepts.
Classification of amplifiers (Class A, B, and C), tuned amplifiers, Oscillators, Amplitude Modulation, Demodulation Circuits, Mixer, TRF, Superheterodyne and direct conversion receivers. Monochrome TV transmitter and receivers.
Digital and data communication: Sampling theorem, coding and decoding, Pulse modulation, FSK, PSK, Modem.
Serial and parallel interface; Computer network configurations and protocols, OSI reference model, Internet protocol, Packet switching.
Satellite communication, orbital patterns, geostationary satellites, frequency band allocation. Optical fibre communication: Mode of signal transmission, signal sources and detectors, attenuators and channel capacity. Digital Telephony, PSTN and Cellular telephony.
References:
Wayne Tomasi, Electronic Communication Systems, 4th Edition, Pearson Education, 2002.
Kennedy, Communication Systems, 4th edition.
Gary Miller, Modern Electronic Communication, 7th Edition.
Andrew S. TanenBaum, Computer Networks, 3rd Edition.
William C. Y. Lee, Mobile Cellular Telecommunication, 2nd Edition.

EE330 DISTRIBUTION SYSTEMS PLANNING AND CONTROL (3-1-0) 4

Distribution systems, their Importance in energy transfer, Distribution loss minimization techniques, radial and ring system , voltage regulation, reconfiguration , capacitor placement , power flow analysis , sizing of conductors and transformers , fault analysis , data acquisition and control, remote reading of energy meter , role of computers in distribution system operation , state of the art.

T. M. Gonen , Electrical Energy Distribution. C. L. Wadhwa., Electrical Energy Distribution. Recent publication in reputed journals and conference proceedings of relevance.

EE331 NETWORK SYNTHESIS (3-1-0) 4
Review of mathematics for network synthesis - Partial - fraction expansion, Continued - fraction expansion, Bilinear transformation. The Positive Real Concept - Hurwitz Polynomials, Analytic tests for positive real functions, Positive - Definite and Positive - Semi -Definite Quadratic forms. Realizability Conditions for networks with and without transformers (magnetic coupling) Realization of Driving - Point Functions -Canonical forms - LC, RC and RL Driving - Point functions.

Louis Weinberg, Network Analysis and Synthesis, McGraw - Hill, New York, 1962 M. E. Van Valkenburg, Modern Network Synthesis, Prentice - Hall, New Jersey

EE332 DIGITAL SYSTEM DESIGN (3-1-0) 4
Review of combinational logic design using PLDs., Design of Synchronous Sequential logic systems, Introduction to VHDL, Design of system controllers, Design of systems using PLDs / FPGAs, Fundamentals of Data converters.

C. H. Roth, Digital System Design, PWS, 1998. J. F. Wakerly, Digital Design, PHI, 3rd Edition., 2001 W. Fletcher, An Engineering Approach to Digital Design, PHI. M. J. Sebastian Smith, Application Specific Integrated Circuits, Addison-Wesley, 1999.

EE333 POWER SYSTEM HARMONICS (3-1-0) 4
Harmonic Sources : Power Electronic Converters, Transformers, Rotating Machines, Arc Furnaces, Fluorescent lighting Harmonic Effects A: Within Power system : Resonances, Rotating machines: Harmonic Torques, Static Power plant, Control systems, Power system protection , Consumer equipment, Measurements, and on power factor. B: Communication interference: Telephone Circuit susceptiveness, Harmonic weights, I-T and kV-T products, Shielding. C: Biological Effects. Power Theory, Single and three phase, non-sinusoidal conditions, Fryez and Budeno's methods. Complete survey upto date. Power Quality Parameters : Definitions . Standards for Power Quality. Transducers and Data Transmission, Hall Effect Voltage and Current Sensors, Data Transmission medium and methods, Harmonic Mitigation Techniques, Passive Filters : Design of Passive filters, DC side filters and Active Filters : Principles of operation, Algorithms for Extraction of Harmonic current in the line.

J. Arrillaga, Power System Harmonics, IEE Press. G. T. Heydt , Power Quality, Stars in a Circle, 1991. M. G. Say , Alternating Current Machines, ELBS.

EE334 NEURAL NETWORKS AND APPLICATIONS (3-0-0) 3
Introduction: Structure of the human brain, Organization of the brain, Biological neuron, Mc-Culloch-Pitts neuron model. Various thresholding functions, Feature vectors and feature space. Classification techniques - nearest neighbour classification. Distance metrics, Linear classifiers, Decision regions. The single layer and multilayer perception, Multilayer perception algorithm, Solution of the XOR problem, Visualizing the network behaviour in terms of energy functions, Mexican Hat function. Learning in Neural networks, supervised and unsupervised learning, Feed-forward networks, Linearly non-separable pattern classification, Delta learning rule. Error back-propagation training algorithms,

Feedback networks - Hopfield network, The energy landscape, Storing patterns, Recall phase, The Boltzmann machine, The traveling salesman problem. Associative memories - basic concepts, Recurrent autoassociative memory, Retrieval and Storage algorithm, Stability considerations. Application of neural systems - Linear programming, Modeling networks, Character recognition, Control system applications, Robotic applications.

R. Beale, T. Jackson, Neural Computing: An Introduction , IOP Publishing Ltd., 1990. Jack H. Zaruda, Introduction to Artificial Neural Systems , Jaico Publications.

EE335 LINEAR AND NONLINEAR SYSTEMS (3-1-0) 4
Characteristics of linear systems, Modeling and analysis of linear time-invariant systems using state-space approach, Analysis of linear time-variant systems. Characteristics of nonlinear systems, Common types of nonlinearities, Phase-plane analysis, Describing function analysis.

Thomas Kailath, Linear Systems, Prentice-Hall, 1980. K.Ogata, State-Space Analysis of Control Systems, Prentice-Hall, 1967. John E. Gibson, Non linear Automatic Control, McGraw-Hill, 1963.

EE336 TRAVELING WAVES ON TRANSMISSION SYSTEMS (3-0-0) 3
The line equations: The ideal (no-loss) line, the distortionless line, Line with small losses, Exact solution of the infinite line, Line of finite length, Attenuation and distortion of traveling waves. Reflection of traveling waves: Behaviour of a wave at a transition point, Dissimilar voltage and current waves, Typical cases, current-limiting reactors. Successive reflections: The reflection lattice, Construction and use of the lattice-diagram, Charging of a line from various sources, Reflection between a capacitor and a resistor, Effect of short lengths of cable, Effect of insulator capacitance. Traveling waves on multiconductor systems: The general differential equations of traveling waves, Transition points on multiconductor circuits, multivelocity waves, Surge tests on transmission lines, Physical concept of multivelocity waves, Two-conductor system, Multiconductor system. Theory of ground-wires: Direct stroke to a tower, effect of reflections up and down the tower, Tower grounding. The counterpoise: Multivelocity waves on the counterpoise, Tests on the counterpoise, Successive reflections on the insulated counterpoise. Induced lightning surges: The field gradient, induced surges with ideal ground wires. Arcing grounds: Normal frequency arc extinction – single-phase and three-phase, Oscillatory-frequency arc extinction, High-frequency effects, Interruption of line-charging currents, Cancellation waves, Initiated waves, Steady-state waves, Recovery voltage, Restriking phenomena.

L. V. Bewley, Traveling Waves on Transmission Systems, John Wiley and Sons, 1951. H. H. Skilling, Electric Transmission Lines, McGraw-Hill, 1951. L. F. Woodruff, Principles of Electric Power Transmission, John Wiley and Sons, 1952 .

EE337 DISTRIBUTION SYSTEMS LAB (0-0-3) 1
Laboratory exercises and assignments to provide additional support to EE303.

EE338 DIGITAL SYSYTEM DESIGN LAB (0-0-3) 1
Laboratory exercises and assignments to provide additional support to EE332.

Department of Electrical and Electronics Engineering (EEE)
Bachelor of Technology in Electrical and Electronics Engineering

EE339 POWER SYSTEM HARMONICS LAB (0-0-3) 1
Laboratory Exercises and assignments to provide additional support to EE312. Experiments around MATLAB, PSCAD, OrCAD and laboratory measurement exercises.

EE371 POWER SYSTEM COMMUNICATIONS (3-0-0) 3

The Electric Power supply and its properties, Historic development of Data communication over power lines, The European CENELEC Standard EN50065, Channel Characteristics, Coupling and Measuring Techniques at High Frequencies for PLC, Estimating Power line channel capacity, EMC problems and solutions, Modulation schemes for PLC, Communication over the Electric Power distribution Grid.
Klaus Dostert, Franzis Verlag, Power Line Communications, PHI.

EE372 OPTIMAL OPERATION OF POWER SYSTEMS (3-1-0) 4
Economic operation of power systems: Economic load dispatch, Unit Commitment. Load frequency control : Modeling of components of generating systems , Concept of coherent units, Operation of single area. Introduction to Multi-area systems. Sources of Reactive power. Introduction to contingency analysis. State Estimation: Importance of State Estimation, DC State Estimation. Energy interchange evaluation.

O. I. Elgerd, Electric Energy Systems Theory: An Introduction, McGraw-Hill, 1971. I. J. Nagrath, D.P. Kothari, Modern Power System Analysis, TMH. S. S. Rao , Optimisation Theory and Applications. Allen J. Wood , Bruce F. Wollenberg , Power Generation Operation and Control, 2nd Edition, John Wiley and Sons,1996

EE373 ADVANCED DIGITAL SIGNAL PROCESSING (3-0-0) 3
Time frequency Analysis, Time frequency distribution, Short time Fourier Transform. Multirate Signal Processing: Decimation Interpolation, DFT filter banks, QMF filter banks. Multiresolution Signal Analysis. Wavelets theory of sub band decompositions, sub band coding and Wavelet transforms, Application of wavelet transforms. Homomorphic signal processing : Homomorphic system for convolution, Properties of complex spectrum, Applications of homomorphic deconvolution. Multi-dimensional signal processing : Review of convolution and correlation. 2-D signals. Linear estimation of signals and applications: Random signals, Linear prediction and applications (deconvolution, least square filters). Recursive estimation and Kalman filters. Adaptive signal processing: Adaptive filters and applications. applications.

P. P. Vaidyanathan, Multirate Systems and Filter Banks, PH, 1993. S. J. Orfanidis, Optimum Signal Processing, McGraw-Hill, 1989. John G. Proakis, D. P. Manolakis, Introduction to DSP, Pearson, 2002. E. C. Ifeachor, B. W. Jervis, Digital Signal Processing: A Practical Approach, Pearson Education. Barrus, Gopinath, Guo, Introduction to Wavelet Transforms - A Primer. A. K . Jain, Image Processing. A. V. Oppenheim, R.W. Schafer, Discrete Time Signal Processing, PHI, 1994.

EE374 SPECIAL MACHINES AND DRIVES (3-1-0) 4
Method of control and application of Brushless DC Motor, PMSM, Stepper Motor, AC Servomotor, Universal Motor. Electric Drive, Motor Rating, Heating effects, Electric braking, Modification of speed-torque characteristic of an induction motor by V/f control, starting and braking. Synchronous motor --Speed torque and torque angle characteristics by V/f control, Braking.

G.K. Dubey, Fundamentals of Electrical Drives, Narosa. A .E. Fitzerald, C. Kingsley, S.D Umans, Electric Machinery, McGraw-Hill. S. K. Pillai, A First Course on Electric Drives, Wiley Eastern, 1990.

EE375 EMBEDDED SYSTEM DESIGN (3-0-0) 3
Embedded controllers, basic requirements, design of embedded systems, system on chip concept. VLSI CAD application, Case study: DSP/microprocessor based or FPGA based system design.

Charles H. Roth, Digital System Design using VHDL, PWS , 1998. User manuals of Microprocessor /DSPs

EE376 POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS (3-0-0) 3
HVDC systems: classical HVDC systems, CCC systems, HVDC Light systems. Application of FACTS devices such as SVC, TCSC, SSS, UPFC to improve steady state and dynamic behaviour of power systems. Modeling of HVDC systems and FACTS devices to perform system studies.

N. G. Hingorani, L. Gyugi, Understanding FACTS, IEEE Press, 2001. P. Kundur, Power System Stability and Control, McGraw-Hill, 1994.

EE377 SOLID-STATE DRIVES (3-1-0) 4
Separately excited dc motor drive: Operation and performance, single-phase fully controlled converter, Operation on dual converter. Chopper drive: operation and performance calculation on class A, class C, and class E choppers. Induction motor drive: Stator voltage control with constant supply frequency, qualitative comparison of converter combinations, Slip energy recovery scheme, VSI fed induction motor, CSI fed induction motor, Synchronous motor drive, VSI drive, brushless excitation, true synchronous and self-controlled operation, Performance with PMSM and synchronous reluctance motor.

S. B. Dewan, G. R. Slemon, A. Straughen, Power Semiconductor Drives , John Wiley and Sons, 1984. W. Shepherd, L. N. Halley, D. T. W. Liang, Power Electronics and Motor Control, 2nd Edition, Cambridge University Press, 1998. Vedam Subrahmanyam, Electric Drives – Concepts and Applications , TMH, 1994. G. K. Dubey, Power Semiconductor Controlled Drives, Prentice Hall, 1989.

EE386 DIGITAL SIGNAL PROCESSING LAB (0-0-3) 1
Laboratory exercises and assignments to provide additional support to EE301. Exercises around MATLAB®, MATHEMATICA®, LabVIEW®, DSP Programming.

MathWorks Inc., MATLAB® Signal Processing Toolbox Users Guide, MathWorks Inc. C. S. Burrus et al, ComputerBased Exercises for Signal Processing, PH, 1994. S. K. Mitra, DSP: A Computer-Based Approach, TMH, 1998. TMS 320c54x Users Manual, Texas Instruments, 1997.

EE430 ELECTRIC POWER STATIONS (3-0-0) 3 Choice of site for power plants (hydro, thermal, nuclear power). Thermal power plant: general layout, Air and flue-gas circuit, Fuel and ash handling circuit, Cooling water circuit, Steam and feed water circuit. Essential components associated with this circuit. Nuclear power plant: General layout of nuclear reactor, materials their requirements of heat

exchange, moderators, coolants, control rods. Classification of reactors, Fuels, Radioactive waste handling system. Hydro power plant: Site selection for hydro power plants: reservoir capacity from mass curve and hydrographs. Power availability. General layout, Type of hydropower plants, Characteristics of turbines, Specific speed, Speed governors. Gas turbines; Unconventional power generation. Electrical equipment in generating stations: General layout, Excitation systems and voltage regulation. Substation layout, Components of substation. Bus-bar arrangements, Current-limiting reactors and their location. Reactance of current limiting reactors. Station activities of operators, Maintenance engineer, Safety and coordination. Load forecasting and sharing: Load curve and load duration curves, Load factor, Diversity factor, Plant factor and plant use factor, Demand factor, Selection of generating units. Load sharing between base and peak load stations. Operational schedule.

M. V. Deshpande, Electrical Power Stations. Tata Electric Co., Operator Training Manual. Other Handbooks and O&M Manuals of relevance

EE431 ELECTRIC ENERGY SYSTEMS (3-0-0) 3
Conventional and Non Conventional Energy Sources and Systems, Generation, Transmission and Distribution Schemes, Energy Conservation Systems, Energy Efficient Equipment and Controllers, Energy Audit.

Olle I. Elgerd , Electric Energy System Theory: An Introduction, TMH, 1982. I.J. Nagrath, D.P. Kothari, Power System Engineering, TMH.

EE432 ADVANCED CONTROL SYSTEMS (3-0-0) 3
Introduction, review of state space approach to modeling dynamic system Introduction to discrete time control system, Signal processing in digital control, models of digital control devices and systems, z-plane analysis of discrete time control system, Transient response analysis, design specifications and performance indices, design of digital control algorithms, state variable analysis of digital control systems, Pole placement design and state observers, Linear quadratic optimal control K. Ogata, Discrete Time Control Systems, 2nd Edition, Pearson Education.

M. Gopal, Digital Control and State Variable Methods, TMH.

EE433 MODELING AND SIMULATION TECHNIQUES FOR DYNAMIC SYSTEMS (3-0-0) 3
Introduction to system dynamics, Transfer function approach to modeling dynamic systems, Modeling of electrical and electromechanical systems, Mechanical systems, State-space approach to modeling dynamic systems, Bond graphs method, Transient analysis of dynamic systems, Frequency domain analysis of dynamic systems, Numerical techniques applied to dynamic systems.

MathWorks Inc., MATLAB�/ SIMULINK� Reference/User Manuals, MathWorks Inc. K. Ogata, System Dynamics, 4th Edition, Pearson Education. K. Ogata, Discrete Time Control Systems, 2nd Edition, Pearson Education.

EE434 INCREMENTAL MOTION CONTROL (3-0-0) 3
Introduction to incremental motion systems, Principles of operation of various types of stepper motors, Static and dynamic torque characteristics of stepper motors, Open loop and closed loop controls, Microprocessor based controllers for stepper motors. P.P. Acarnley, Stepping motors-A Guide

to Modern Theory and Practice, 3rd Edition, Peter Peregrinus, 1992.

Takashi Kenjo, Akira Sugawara, Stepping Motors and their Microprocessor controls, 3rd Edition, Oxford University Press, 2005.

EE435 ENERGY AUDITING LAB (0-0-3) 1
Laboratory exercises and assignments to provide additional support to EE400.

EE470 HVDC TRANSMISSION (3-1-0) 4
Need, Basic principle of conversion, Economics of different configurations, The Graetz bridge circuit, Analysis, overlap, Firing delay, Inversion, Converter control, Tap-changing control, Power reversal, Measuring devices, Filters, Circuit breaker, Lighting arrester, DCCT, MRT. MTDC Systems, Interaction between AC and DC Systems, Voltage stability, Power modulation, Digital Simulation, HVDC Simulator, Future of the HVDC transmission system , Research and development.

E. W. Kimbark, Direct Current Transmission. K. R. Padiyar, Power Transmission by Direct Current, Wiley Eastern, 1990. Recent Publications of relevance.

EE471 SOFT COMPUTING (3-0-0) 3
Fuzzy Sets, Operations, Relations, Fuzzy Logic, Fuzzy Control, Neural Networks – Single layer, Multilayer Networks, Learning, BP Algorithm, Simple Genetic Algorithm, Neuro-Fuzzy Systems, Soft Computing Applications.

J. S. R. Jang, C. T. Sun , E. Mizutani, Neuro-Fuzzy and Soft Computing – A Computational Approach to Learning and Machine Intelligence, PHI, 2002. Timothy J. Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1997. Simon Haykin, Neural Networks – A Comprehensive Foundation, Prentice Hall, 1999. David E. Goldberg , Genetic Algorithms in Search, Optimization and Machine Learning, Pearson Education, 2003. International Journals and Conference Proceedings of relevance.

EE472 ELECTROMAGNETIC COMPATIBILITY (3-0-0) 3
Review of EM theory. EMI from apparatus and circuits. EMI measurements. Shielding and grounding. EMI filters. Electrostatic discharge. EMC standards.

H. W. Ott, Noise Reduction Techniques in Electronic Systems. V. Prasad Kodali, Engineering Electromagnetic Compatibility, S. Chand & Co.

EE473 POWER SYSTEM PROTECTION (3-0-0) 3
Introduction to power system protection, Review of conventional power system protection schemes, Power Apparatus Protection: viz. Transformer, Motor, Generator, Bus bar, Transmission and Distribution line protection schemes, Introduction to Computer aided protection, Numeric Relay Hardware design, Digital protection algorithms, Recent trends in Power Apparatus Protection methodology, Concepts of adaptive relaying and application of soft computing methods in numeric relaying.

Warrington , Protective Relays - Their theory and practice, Volumes. I, II, and III , Chapman and Hall. Arun G. Phadke , J. S. Thorpe, Computer Relaying for Power Systems, Research Studies Press. Gerhard Ziegler, Numerical Distance Protection: Principles and Applications.

A. T. Johns, S. K.Salman, Digital Protection for Power Systems , IEE, 1995.
M. S. Sachdev (Coordinator), IEEE Tutorial Course on Advancement in Microprocessor-based Protection and Communication, IEEE, 1979.

EE474 OPERATION OF RESTRUCTURED POWER SYSTEMS UNDER DEREGULATION (3-0-0) 3

Fundamentals of Deregulation, Restructuring Models and Trading Arrangements, Different Models of Deregulation, Operation and control, wheeling charges and pricing, Role of FACTS Controllers and Distributed Generation in Restructured Environment, Developments in India, IT applications in restructured markets.

K. Bhattacharya, M.H J Bollen and J.E Daalder, "Operation of Restructured Power Systems", Kluwer Academic Publisher, USA, 2001. L. Philipson and H.L. Willis, "Understanding Electric Utilities and Deregulation", Marcel Dekkar Inc. 1999. M. Shahidehpour and M. Alomoush, "Restructured Electrical Power Systems, Operation, Trading and Volatility", Marcel Dekkar Inc. 2001. Steven Stoft, "Power System Economics: Designing Markets for Eligibility". John Wiley & Sons, 2002

EE475 RANDOM SIGNAL PROCESSING (3-0-0) 3
Random signal processing: Review of probability and random variables, Mathematical description of random signals, response of linear systems to random inputs, Wiener filtering,. Basic estimation theory, Discrete Kalman filter, State-space modeling and simulation, Nonlinear estimation.

Athanasios Papoulis, Probability, Random variables, and Stochastic Processes, McGraw-Hill, 1991. R. G. Brown, P. Y. C. Hwang, Introduction to Random Signals and Applied Kalman Filtering, John Wiley and Sons, 1997. A. P. Sage, James L. Melsa, Estimation Theory with Applications to Communications and Control, McGraw-Hill, 1971.

EE476 NON-CONVENTIONAL ENERGY SYSTEMS (3-0-0) 3
Solar energy, Wind energy, Chemical energy sources. Energy from the ocean and tides. MHD generation, Thermo electric power. Geothermal energy. Energy from Bio-mass.

G. D. Rai , Non-conventional Energy Sources. P. S. Sukhatme , Solar Energy.

EE477 ADVANCED POWER ELECTRONICS (3-1-0) 4
Power devices, design of inductors, transformers, selection of core, design of capacitors, selection of capacitors for different applications. AC to DC converters, Multilevel inverters, DC to DC converters, Hard switch converters, design and analysis, Isolated converters, resonant converters.

Ned Mohan, Undeland, Robbins , Power Electronics. M. H. Rashid, Power Electronic Circuits – Devices and Applications

EE478 POWER SYSTEM DYNAMICS (3-1-0) 4

Power system component modeling for dynamic studies: Synchronous generator modeling, Exciter and turbine modeling, Load modeling. System stability analysis: Angle stability (small signal and large signal), Voltage stability, Frequency stability.

K.R. Padiyar, Power System Stability and Control, Interline, 1996. Prabha Kundur, Power System Stability and Control, McGraw-Hill, 1994.

EE479 COMPUTER NETWORKS (3-0-0) 3
Introduction, Physical layer, Data link, Media Access, Network layer, Transport layer, ATM, Applications.

Andrew S. Tanenbaum, Computer Networks, Pearson Education.

EE480 THE ARM CORE: ARCHITECTURE AND PROGRAMMING (3-0-0) 3
The ARM design philosophy, ARM processor fundamentals - Registers, Current program status register, pipeline, exceptions, interrupts and the vector table, core extensions, architecture revisions, ARM processor families. The ARM instruction set: Data processing instructions, Branch instructions, Load-store instructions, Software interrupt instructions, Program status register instructions, Conditional execution. The THUMB instruction set, THUMB register usage, ARM-THUMB interworking. Writing assembly code, Profiling and cycle counting, Instruction Scheduling, Register allocation, Looping constructs, Bit manipulation, Efficient switches, Handling unaligned data. Using the GNU assembler. Optimized primitives, Exception and interrupt handling. Rudimentary aspects of embedded operating systems.

David Seal (Ed.), ARM Architecture Reference Manual, 2nd Edition, Addison-Wesley, 2001. Steve Furber, ARM Sytem-on-Chip Architecture, 2nd Edition, Addison-Wesley, 2000. Andrew N. Sloss, Dominic Symes, Chris Wright, ARM System Developer's Guide, Elsevier, 2004. ARM Limited, ARM v7-M Architecture Application Level Reference Manual, ARM Limited, 2006. http://www.arm.com/documentation/ http://www.armepos.com/ (requires registration).

EE481 ADVANCED POWER ELECTRONICS LAB (0-0-3) 1
Laboratory exercises and assignments to provide additional support to EE418.

EE482 FLEXIBLE AC TRANSMISSION SYSTEMS (3-1-0) 4
Transmission System Performance, Compensation Approaches, Static Var Systems, VSI Based FACTS Controllers - STATCOM, UPFC, TCSC, TCPAR, TCBR. Applications: Transient Stability Improvement. Introduction to Custom Power .

K. R. Padiyar, Power System Dynamics, Stability and Control, 2nd Edition, B.S. Publishers. Prabha Kundur , Power System Stability and Control, McGraw-Hill EPRI Power System Engineering Series, 1994. Narain G. Hingorani , Laszlo Gyugyi, Understanding FACTS - Concepts and Technology of Flexible AC Transmission Systems, IEEE Press, 2001. International Journals and Conference Proceedings of relevance.

EE483 HIGH-VOLTAGE ENGINEERING (3-1-0) 4

Electric breakdown in solid, liquid and gas dielectrics. Generation of high ac, dc and impulse voltages. Impulse current generators. Methods of measuring high ac, dc and impulse voltages and current. Partial discharge.

E. Kuffel, Zengal, High Voltage Engineering. D. Kind, An Introduction to High Voltage Experimental Techniques. Kamaraju, Naidu, High Voltage Engineering. C. L. Wadhwa, High Voltage Engineering.

EE484 PHOTOVOLTAICS AND APPLICATIONS (3-0-0) 3

Overview of PV systems, Relevance and adaptology, Economics and efficiency, Insolation and its measurement, Types of cells. Elements of solar cell operation, Light absorption and carrier generation in semiconductors, Conversion efficiency and factors affecting it, Processing techniques. Concentrators, Stand-alone inverters, Grid operation, Issue of energy storage, General applications, Large PV power systems, Rural power supply systems, Issues in developing countries, Unconventional cell systems.

Chenming Hu, R. M. White, Solar cells- From Basic to Advanced Systems, McGraw-Hill.

EE485 POWER GENERATION AND ECONOMICS (3-1-0) 4

Hydro, thermal and nuclear power plants. Electrical equipments in generating stations. Load forecasting and sharing. Economic operation of power systems. Economic choice of transformers and electric motors.

Nagpal, Power Plant Engineering. M. V. Deshpande, Elements of Power Station Design. G. P Chalotra, Electrical Engineering Economics. S. Domkundwar, S. C. Arora, A Course in Power Plant Engineering.

EE382 UTILIZATION OF ELECTRICAL ENERGY (3-0-0) 3

Electric Traction: Requirements of an ideal traction system, systems of traction, Requirements of ideal traction motors, Comparison and Control of traction motors, Mechanics of train movement, Tractive effort for acceleration ,train resistance, gradient, coefficient of adhesion, Speed time curves, Specific energy consumption. Electric Heating: Advantages, classification of heating equipments, methods of heat transfer, Resistance heating, Design of heating element , Induction heating, Eddy current heating, Dielectric heating. Electric Welding: Resistance welding, Arc welding. Electrolytic processes: Faraday's laws of electrolysis, Calculation of current required and related definitions, Factors governing the character of deposits, Preparation of work for electroplating, Electro-extraction and refining of copper and aluminium. llIumination : Laws of illumination, Lighting calculations, Polar curves, Rousseau's construction.

Partab , Art and Science of Utilization of Electrical Energy. E. O. Taylor, Utilization of Electric Energy. C. L Wadhwa , Generation ,Distribution and Utilization of Electrical Energy.

EE383 COMPUTATIONAL TECHNIQUES FOR LARGE SYSTEM ANALYSIS (3-0-0) 3

Solution of linear system of equations, Solution of nonlinear system of equations, Sparsity techniques, Numerical integration techniques: explicit methods, implicit methods, fixed step methods, variable step methods, Stability and accuracy-analysis of numerical methods, Numerical calculation of eigenvalues, EMTP simulation techniques.

Steven C. Chapra, R. P. Canale, Numerical Techniques for Engineers, TMH, 2000. Mariessa Crow, Computer Techniques for Large Electric Power Systems, CRC Press, 2003.

EE486 OPTIMIZATION TECHNIQUES (3-0-0) 3

Linear Programming: Simplex method and extensions. Network models: Shortest path, maximum flow and minimum cost problems. Dynamic programming: resource allocation, production scheduling and equipment replacement problem. Non-linear programming: selected unconstrained and constrained non-linear programming algorithms like quasi Newton, reduced gradient and gradient projection methods. Penalty function methods, Quadratic programming.

Lueneburger , Linear and Non linear Programming, McGraw-Hill. Fletcher, Optimization techniques, John Wiley and Sons.

----*----

Department of Electronics and Communication Engineering (ECE)

Bachelor of Technology in Electronics and Communication Engineering

Foundation Courses (Fndn)

MA100	Engineering Mathematics – I	(3-1-0) 4
MA101	Engineering Mathematics – II	(3-1-0) 4
PH100	Physics	(3-0-0) 3
PH101	Physics Laboratory	(0-0-3) 1
CY100	Chemistry	(3-0-0) 3
CY101	Chemistry Lab	(0-0-3) 1
CV100	Engineering Mechanics	(3-1-0) 4
EE100	Elements of Electrical Engg.	(3-1-0) 4
EC100	Elements of Electronics & Communication Engg.	(3-1-0) 4
ME100	Elements of Mechanical Engg.	(3-0-0) 3
ME101	Engineering Graphics	(1-0-3) 2
ME102	Workshop	(0-0-3) 1
CO100	Computer Programming	(3-0-0) 3
CO101	Computer Programming Lab	(0-0-3) 1
HU100	Professional Communication	(3-1-0) 4
HU300	Engineering Economics	(3-1-0) 4
HU301	Management Theory and Practice	(3-1-0) 4

Programme Specific Core (PSC)

EC200	Analog Electronics Circuits	(3-1-0) 4
EC201	Signals and Systems	(3-1-0) 4
EC202	Digital Electronics	(3-1-0) 4
EC203	Electromagnetic Waves	(3-1-0) 4
EC204	Mathematics for E&C Engg.	(3-1-0) 4
EC205	Analog Electronic Circuits Lab	(0-0-3) 1
EC206	Digital Electronic Circuits Lab	(0-0-3) 1
EC207	Signals and Systems Lab	(0-0-3) 1
EC250	Linear Integrated Circuits	(3-1-0) 4
EC251	Analog Communication	(3-1-0) 4
EC252	Microprocessors	(3-1-0) 4
EC253	Digital Computer Organisation & Architecture	(3-1-0) 4
EC254	Linear Integrated Circuits Lab	(0-0-3) 1
EC255	Microprocessor Lab	(0-0-3) 1
EC290	Seminar	(0-0-2) 1
EC300	Digital System Design	(3-1-0) 4
EC301	Antennas and Propagation	(3-1-0) 4
EC302	Digital Communications	(3-1-0) 4
EC303	Linear Control Systems	(3-1-0) 4
EC304	Digital System Design Lab	(0-0-3) 1
EC305	Basic Communications Lab	(0-0-3) 1
EC350	Digital Signal Processing	(3-1-0) 4
EC351	VLSI Design	(3-1-0) 4
EC352	Microwave Engg & Optical Communication	(3-1-0) 4
EC353	Communication Networks	(3-1-0) 4
EC354	Digital Signal Processing Lab	(0-0-3) 1
EC355	VLSI Design Lab	(0-0-3) 1
EC356	Advanced Communication Lab	(0-0-3) 1
EC440	Practical Training	1

Programme Specific Elective (PSE)

EC400	Data Structures & Algorithms	(3-1-0) 4
EC401	Power Electronics	(3-1-0) 4
EC402	Opto-Electronics	(3-0-0) 3
EC403	VLSI Testing & Testability	(3-0-0) 3
EC404	Active Filters and Data Converters	(3-1-0) 4
EC405	Advanced Computer Architecture	(3-1-0) 4
EC406	Logic Synthesis & Techniques	(3-0-0) 3
EC407	Electronic Instrumentation	(3-0-0) 3
EC408	Biomedical Instrumentation	(3-0-0) 3
EC409	DSP Systems and Architecture	(3-1-0) 4
EC410	Advanced Digital Signal Processing	(3-1-0) 4
EC411	Speech and Image Processing	(3-1-0) 4
EC412	Embedded Systems	(3-0-0) 3
EC413	Operating Systems	(3-1-0) 4
EC414	TV Engineering	(3-0-0) 3
EC415	Satellite Communication	(3-0-0) 3
EC416	Fiber Optic Technology & Applications	(3-0-0) 3
EC417	Radar & Electronic Navigation Systems	(3-0-0) 3
EC418	Wireless Mobile Communication	(3-0-0) 3
EC419	Spread Spectrum Communications	(3-0-0) 3
EC420	Information Theory and Coding	(3-1-0) 4
EC421	Error Control Coding	(3-1-0) 4
EC422	Electromagnetic Interference & Compatibility	(3-0-0) 3
EC423	Adhoc and Sensor Networks	(3-0-0) 3
EC424	Digital Signal Compression	(3-1-0) 4
EC425	Soft Computing	(3-0-0) 3

Open Electives (OE)

EC407	Electronic Instrumentation	(3-0-0) 3
EC408	Biomedical Instrumentation	(3-0-0) 3
EC412	Embedded Systems	(3-0-0) 3
EC425	Soft Computing	(3-0-0) 3

Programme Major Project (PMP)

EC449	Major Project - I	(0-0-6) 4
EC499	Major Project – II	(0-0-9) 6

Mandatory Learning Courses (MLC)

MLC1	Environmental Studies	(1-0-0) 1
MLC2	Professional Ethics and Human Values	(1-0-0) 1

Suggested Plan of Study:

Semester →	III	IV	V	VI	VII	VIII
1	EC200	EC250	EC300	EC350	EC440	EC499
2	EC201	EC251	EC301	EC351	EC449	*Elective*
3	EC202	EC252	EC302	EC352	*Elective*	*Elective*
4	EC203	EC253	EC303	EC353	*Elective*	*Elective*
5	EC204	EC254	EC304	EC354	*Elective*	*Elective*
6	EC205	EC255	EC305	EC355	*Elective*	*Elective*
7	EC206	EC290	HU300	EC356	*Elective*	
8	EC207	*Elective*	*Elective*	HU301		
9				*Elective*		

Degree requirements:

Category of Courses		Minimum Credits to be Earned
Foundation Courses (Fndn)		50
Programme Specific Core (PSC)		80
Electives		38
Programme Specific Elective (PSE)	Open Electives (OE)*	
20 credits (minimum)	0-18 credits	
Programme Major Project (PMP)		10
Mandatory Learning Courses (MLC)		2
Total		**180**

* Refer clause 3.2 of regulations for details

Department of Electronics and Communication Engineering

EC100 ELEMENTS OF ELECTRONICS & COMMUNICATION ENGINEERING (3-1-0)4

Device construction and characteristics – Diode, Transistor and MOSFET. Two port network – z, y, h and ABCD parameters. MOSFET amplifier – Basic amplifier configuration (CS, CG, CD), Transistor biasing, load-line analysis, small signal analysis. MOSFET as a Resistor, and Capacitor, MOSFET as active load, CMOS. Current Mirrors. BJT amplifier configuration, biasing and analysis. Frequency response characteristics, gain bandwidth product. Distortion in amplifiers, multistage amplifiers. Operational amplifiers, Ideal characteristics, Linear and nonlinear application (Inverting & Noninverting amplifier, Voltage Follower, Adder, Differential Amplifier, ZCD, square wave generator). DAC – Current steering, R-2R,. ADC-Flash, SAR. Half wave, Full wave rectifier, Unregulated power supply, Zener and linear regulator, principle if SMPS. Desirable: Exposure to VLSI fabrication process-through java applers/flash movies-Resources form Internet.

A.S. Sedra & K.C Smith, Microelectronic Circuits, Oxford Univ. Press 1999.
Thomas L Floyd, Electronic devices, Pearson Education, 2002.
P. Boylstead and L. Nashelsky, Electronic Devices and Circuit Theory, PHI, 1998.
R R Spencer & M S Ghousi, Introduction to Electronic Circuit Design, Pearson, 2003.
Ramakant A Gayakwad, OP-AMPS and Linear Integrated Circuits, Prentice Hall, 1999.
Coughlin, Driscoll, OP-AMPS and Linear Integrated Circuits, Prentice Hall, 2001.

EC200 ANALOG ELECTRONICS CIRCUITS (3-1-0) 4

Positive and negative Feedback, sensitivity factor. Meritsof Negative feedback. Instability in amplifiers, Barkhausen condition for Oscillation, Nyquist stability criterion. Two port network parameters, Feedback topology (Z,Y,H and G feedback), Loop Gain, Transmission Matrix. Simulation of inductance using R,C and Amplifier. Universal Active filter, Biquad configuration for LPF, HPF, BPF, BRF. Butterworth, Chebychev, Elliptic, Bessel filter approximations and filter realization. Voltage controlled filter, Self tuning filters, Switched capacitor filters. Digitally controlled calibration. Biquad Phase shift oscillator, Wein Bridge oscillator. Ring oscillator(CMOS). Classification of amplifiers (Class A,B, AB & C), transformer coupled amplifiers, push-pull arrangements, theoretical efficiency, distortion analysis. Problem of thermal runaway, Complementary & quasi-complementary push-pull amplifiers.

A.S. Sedra & K.C. Smith, Microelectronic Circuits, Oxford Univ. Press, 1999.
Thomas L. Floyd, Electronic devices, Pearson Education, 2002.
Richard C. Jaeger and Travis N Blalock, Microelectronic Circuit Design, Mc Graw Hill, 2007.
Donald A Neamen, Electronic Circuit Analysis and Design, Irwin Publications, 1996.
Richard R. Spencer & Mohammed S.Ghousi, Introduction to Electronic Circuit Design, Pearson Education, 2003
J.Millman & A.Grabel, Microelectronics, McGraw Hill, 1987.
Jack Smith, Modern Communication Circuits, McGraw Hill, 1986.

EC201 SIGNALS AND SYSTEMS (3-1-0) 4

Time domain analysis of continuous time and discrete-time signals and systems: LTI systems, impulse response, convolution, correlation, causality and stability, Frequency domain analysis: FS, FT, DFS, DTFT, properties and applications, modulation, sampling & reconstruction, aliasing, Sampling in frequency domain, DFT, Transform domain analysis of systems: application of Laplace transforms and Z transforms to analysis of systems, transfer function, poles and zeros, representation of systems – signal flow graph, state-variable representation.

Simon Haykin, Signals & Systems, John Wiley, 1998
Mc Chellan, R.W. Schafer & Yoder, Signal Processing First, Pearson 2003.
A. Ambardar, Analog and Digital Signal Processing, Brooks Cole, 1999.

---**EC202**

DIGITAL ELECTRONICS (3-1-0) 4

Number systems and codes, Combinational logic analysis and design: Switching algebra, minimisation methods- Combinational design using MSI, LSI and PLDs, Sequential logic design: latches and flipflops, Finite state machine design, ASM charts, state minimisation, state assignment, synthesis using D-FF and JK-FF, counters, shift registers, MSI devices as state machines, asynchronous finite state machines.

J.F.Wakerly, Digital Design Principles and Practices, PH, 1999.
W. I. Fletcher, An Engineering Approach to Digital Design, PHI, 1999.
D.D. Givone, Digital Principles and Design, TMH, 2002

EC203 ELECTROMAGNETIC WAVES (3-1-0) 4

Review of vector analysis and orthogonal coordinate systems. Line, surface ,and volume integrals. Curl, divergence and gradient of fields. Static electric fields, static magnetic fields; Maxwell's equations in different forms; Electromagnetic waves-uniform plane waves in free space and material media, polarization, Power flow and energy storage; Boundary conditions and boundary value problems. Reflection and refraction of EM waves. Transmission lines-Low frequency and RF lines, Smith chart, line analysis in time domain, line discontinuity, line impedance matching. Guided waves between parallel planes, rectangular and circular wave guides, dielectric wave guide.

W.H.Hayt Jr., Engineering Electromagnetics, Tata Mc-Graw-Hill, 2001.
EC Jordan, EM waves and radiating systems, PHI, 1995.
N. Narayana Rao, Elements of Engineering Electromagnetics, Pearson Education, 2006 J.D.Ryder, Networks lines and fields, PHI, 1990.

EC204 MATHEMATICS FOR ELECTRONICS & COMMUNICATION ENGG. (3-1-0) 4

Linear Algebra: Basis, Vector Spaces and Subspaces, Inverse by partitioning, Linear Transformations, Rank and Echelon matrices, Homogeneous linear equations, Basic Solutions, Similarity, Symmetric matrices, Diagonalization, Quadratic forms, Rotation of co-ordinates, Orthogonal Transformations. Probability Theory and Applications: Random Variables and Transformations, Bernoulli, Binomial, Poisson, Uniform, Gaussian, Raleigh, Ricean probability distributions, Expectations, Moments and generating functions, Inequalities, Limit Theorems, Random Processes, Markov and Poisson Random processes, Error function, Complementary Error function, Q function and their applications Theory of Complex variables: Functions of Complex variables, Cauchy-Riemann equations, Properties of analytic functions, Conformal mapping, Line Integrals in a complex plane. Cauchy's Theorems, Evaluation of standard real line integrals using contour integration. Numerical Methods: Introduction, Solution of equations by iteration, Interpolation, Numerical Integration and Differentiation, Solution of Linear equations and Differential equations.

E. Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 1993.
G. Strang, Linear Algebra and its applications, Cenage Learning, 2006
C.W. Therrien and M. Tummala, Probability for Electrical and Computer Engineers, CRC Press, 2005.
T.K Moon and W.C Stirling, Mathematical Methods and Algorithms for Signal Processing, Pearson Education, 2000.

EC205 ANALOG ELECTRONICS LAB (0-0-3) 1

Design with RC circuits – AC analysis – Frequency response of First order RC Low pass filter and First order RC High pass filter; Transient analysis – Pulse shaping using RC circuits Clipping circuits, Clamping circuits; Design of full wave rectifier; Biasing transistors - BJT MOSFET Current Mirror – Basic and Cascode; RC coupled amplifier- using BJT and MOSFET Class AB push-pull amplifier; Design Project

---

EC206 DIGITAL ELECTRONICS LAB (0-0-3) 1

Digital Circuit design using SSI/MSI : Combinational Circuit design using gates, MUX, decoders, arithmetic circuits, ALU Sequential Circuits design - counters, shift registers, sequence generators, signature detectors. Design Project.

EC207 SIGNALS & SYSTEMS LAB (0-0-3) 1

Simulation exercises on linear equation solvers: Steady state and transient analysis of electric circuits, time and frequency domain responses of LTI systems, transformations, signal synthesis, effect of sampling

Exercises on circuit simulators: Time and frequency domain responses of first and second order systems. Design Project

EC250 LINEAR INTEGRATED CIRCUITS (3-1-0) 4

Trans linear Networks, Gilbert's cell, Two quadrant & Four quadrant multipliers, squarer. Noise Types, sources, OPAMP architecture (MOS and Bipolar based), CMR, CMRR. Dominant pole compensation, pole-zero compensation. Differential amplifiers, Active load, Folded cascode connection. Comparator architecture(MOS and Bipolar based), input stage, output stage, Offset calibration. DAC, Cap array design. Sample & Hold circuits. Flash ADC, pipeline ADC, SAR ADC, Sigma-Delta ADC, VCO architecture, operation and control. Phase Locked Loop operation, Delay Locked Loop, Frequency locked loop (Analog & Digital) operation and Lock range, Capture range.

A. S. Sedra & K. C. Smith, Microelectronics Circuit, Oxford University Press, 2003
Richard C. Jaeger and Travis N Blalock, Microelectronic Circuit Design, Mc Graw Hill, 2007.
Donald A Neamen, Elecronic Circuit Analysis and Design, Irwin Publications, 1996
J. Millman & A. Grabel, Microelectronics, McGraw Hill, 1987
Ramakanth Gaykwad, OPAMPs and Linear Intergrated Circuits, Prentice Hall, 1990.
Coughlin, Driscoll, "OP-AMPS and Linear Integrated Circuits", Prentice Hall. 2001
Carson Chen, "Active Filter Design", Hayden Book Co, New Jersy, 1987.
Sergio Franco, "Designing with OPAMPS and Linear Integrated circuits', Tata MCGraw Hill, 2002.

EC251 ANALOG COMMUNICATION (3-1-0) 4

Introduction to Analog Communication, amplitude modulation, circuits for AM generation / detection, AM receiver systems and circuits, Angle modulation (FM/PM), Circuits for (FM/PM) generation and detection, commercial applications, frequency division multiplexing systems, noise performance of analog communication system (AM / FM / PM), Receivers for Cmmunication Systems, Pulse Modulation systems

S. Haykin, Communication systems, John Wiley, 2001.
W. Tomasi, Electronic Communication systems, Pearson-Education, 2003.

EC252 MICROPROCESSORS (3-1-0) 4

Introduction to CPU architecture – register organization, addressing modes and their features. Introduction Cycle, machine cycle, Timing diagram. Hardware Interfacing: Interfacing memory, IO & memory mapped IO. Interrupts and DMA. Programmable Peripherals chips: Interfacing of A/D and D/A converters. Memory Organization. Input-Output Organization. Advanced processors : specific features, protected mode operation.

Douglas V. Hall, Microprocessors & Interfacing, McGraw Hill, 1992.
Steve Furber, ARM System, On Chip Architecture, Addison Wesley, 2000.
William Hohl, ARM Assembly Language – Fundamentals and Techniques, CRC Press, 2009.
J.R. Gibson, ARM Assembly Language –An Introduction, Lulu.com, 2008

EC253 DIGITAL COMPUTER ORGANISATION AND ARCHITECTURE (3-1-0) 4

Evolution of computers. Instruction Set. Architecture, Processor Design: Data path, functional unit design, different architectures. Algorithms for implementing various functional units. System Software. Control Unit Design. Memory Organization. Input-Output Organization. Pipelining, Parallel Processing, Instruction level parallelism, Advanced processor architectures.

J. P. Hayes, Computer Architecture and Oragnisation, McGraw Hill, 1988.
M. Raffiquzzman & Rajan Chandra, Modern Computer Architecture, Galgotia Publications, 1990.
David Patterson and John Hennessy, Computer Organization and Design, Elsevier, 2007

EC254 LINEAR INTEGRATED CIRCUITS LAB (0-0-3)1

OPAMPS Linear application: inverting and non-inverting amplifiers, summing amplifiers, difference amplifiers, Instrumentation amplifier, Voltage to current converter, all pass filter, practical integrator. OPAMP non-linear applications: comparators, Schmitt trigger (inverting and non-inverting), astable (fixed frequency and duty ratio, fixed frequency variable duty ratio), monostable multivibrator, triangular wave generator. Active filters: Low pass and High pass Butterworth filter. 555 timer applications: Schmitt trigger, astable (fixed frequency and duty ratio, fixed frequency variable duty ratio), monostable multivibrator (+ve edge triggered and –ve edge triggered), Sawtooth wave generator. Phase locked loop: NE565 – finding parameters, application as frequency multiplier. IC voltage regulator: □A7805, □A7905, LM317. ADC-0808/9, DAC-0800.

EC255 MICROPROCESSOR LAB (0-0-3)1

Programming exercises, Study of interfacing / peripheral chip and related experiments, Study of BIOS/ DOS utilities; Design Project.

EC290 SEMINAR (0-0-2) 1

EC300 DIGITAL SYSTEM DESIGN (3-1-0) 4

Review of Combinational and Sequential logic design, digital system design and implementation options, ASICs, PLDs, FPGAs. Programmable ASICs. Digital system modeling, Hardware description based on Hardware Description Languages, VHDL/ Verilog, data path and control path synthesis, Design case studies, computer aided design tools, Design flow, commercial CAD packages, clocking techniques, Functional simulation, clocking techniques, timing analysis, testability and fault tolerance in design.

M. J. S. Smith – ASICs, Pearson Education, 1997
C.H. Roth, Digital system design using VHDL, PWS Publising, 1998
Peter Ashenden, The Designer's Guide to VHDL, Morgan Kaufman, 2002

EC301 ANTENNAS AND PROPAGATION (3-1-0) 4

Fundamentals of Antennas, Radiation Mechanism, Vector potential functions, Electric and magnetic fields for electric and magnetic current sources solution of vector potential wave equation. Duality, Reciprocity and reaction theorems, Linear Wire and loop antennas, Circular, square, Triangular, Rectangular, Rhombic and Ferrite loop antennas, Antenna Arrays, Travelling wave and broad band antennas, Aperture, Reflector and lens antennas, Babinets's principles, Sectoral pyramidal and conical horns, parabolic and cassegrain reflector antennas, lens antennas, Propagation of Electro-magnetic waves.

C.A Balanis, Antenna Theory, John Wiley, 1996.
J.D.Krauss, Antenna, McGraw Hill, 2001.
R.S.Elliot, Antenna Theory and Design, Prentice Hall International, 2006

EC302 DIGITAL COMMUNICATIONS (3-1-0) 4

Introduction to digital communication systems, Pulse modulation systems, Non-uniform quantization and companding, Waveform coding techniques; Line codes; Base band pulse transmission, Matched filter and Inter symbol interference; Pass Band digital transmission, Digital modulation schemes; Digital signaling over a channel with inter-symbol interference and additive Gaussian noise, Signal design for band limited channels. Optimum demodulator for inter-symbol interference and additive Gaussian noise, coded modulation for bandwidth constraint channels-PSK, QAM & Trellis coded modulation, Linear equalization, decision feedback equalization, adaptive equalization. Introduction to spread spectrum systems. Introduction to coding theory – Entropy, mutual information, Shannon encoding algorithm Shannon Hartley law, source and channel coding theorems, Huffman and Shannon Fano coding, Error control coding: Linear block codes - Hamming Codes, Cyclic codes and Convolutional codes.

S.Haykin, Communication systems, John Wiley 2001
B.Sklar, Digital Communications, Pearson Education, 2001
J.G.Proakis, Digital Communications, McGraw Hill, 2000.

EC303 LINEAR CONTROL SYSTEMS (3-1-0) 4

System Modeling: modeling of Electrical and Mechanical (translational and rotational) systems. signal flow graphs. Basic requirements of a control system. Routh-Hurwitz criterion for stability. Root locus technique. Transient response and steady state error. Nyquist plot and Bode plot. Gain and phase margins, Compensators and Controllers. Lead, lag and dominant-pole compensators. Proportional, PI and PID controllers, Digital control system. Effect of sampling on system stability, transient response and steady state error. State space representation and state space analysis

K.Ogata, Modern Control Engineering, Pearson Education, 2001
K.Ogata, Discrete -Time Control Systems, Pearson Education Asia, 1995
R.C.Dorf and R. H. Bishop, Modern Control Systems, Addison-Wesley, 1998.

EC304 DIGITAL SYSTEM DESIGN LAB (0-0-3) 1

Design digital systems using hardware description languages – VHDL/Verilog and Implement the design using FPGAs. Combinational circuit design: Design of decoders, priority encoders, multiplexers, multi-bit adders and comparators. Sequential circuit design: Design of simple sequential circuits like counters, shift registers, sequence detectors, implementation of state machines for simple applications. DSP Building blocks: Design of multipliers, adders, multiply-accumulate unit and barrel shifter. Design of memory units, ALU, UART and simple microprocessors, Design Project

EC305 BASIC COMMUNICATIONS LAB (0-0-3) 1

AM and FM modulation and demodulation, Active equalizers, Video IF, RF timer response, Radio receiver characteristics, Design of active filters, Pulse code modulation, PAM, PWM, PPM, DSB-SC, SSB modulation and demodulation, Carrier recovery, Frequency division multiplexing, Simulation exercises.

EC350 DIGITAL SIGNAL PROCESSING (3-1-0) 4

Review of time-domain and frequency domain properties of discrete-time signals and systems Discrete Fourier Transforms : properties of DFT, linear convolution using DFT, FFT algorithms. Digital Filter Design: Filter Structures, FIR filter design, IIR Filter Design, Finite word length effects. Non-parametric and Parametric methods for power spectrum estimation. Multirate Signal Processing: Decimation, Interpolation, Short time Fourier Transform, Multi resolution Signal analysis. Discrete Wavelet transform. Real-time implementation of DSP algorithms: Custom VLSI, DSP Processors and FPGA based implementation, Applications of DSP

J.G.Proakis and D.G.Manolakis, Introduction to Digital Signal Processing, Pearson, 2003.
A.V.Oppenheim and R.W.Schafer, Discrete- time signal processing, Pearson, 2002.
Sanjit K. Mitra, Digital Signal Processing : A computer based Approach, TMH, 2002.

EC351 VLSI DESIGN (3-1-0) 4

Introduction to MOSFETs, MOSFET Equivalent Circuits. MOSFET logic circuits: NMOS inverter, CMOS inverter, CMOS Processing Technology. Layout design rules. CAD tools for VLSI Design. MOSFET Logic gates. CMOS combinational, sequential logic circuits, Flip flop and latch timings, Clocking. Circuit characterization and performance estimation: Resistance, capacitance estimation, Switching characteristics, Delay models. Power dissipation, Packaging, Scaling of MOS transistor dimensions. CMOS testing: Fault models. CMOS subsystem design. Datapath operations: Addition, Multiplication, Counters, Shifters, Memory elements.

Jan M. Rabaey, A. Chandrakasan, and B. Nikolic, Digital Integrated Circuits: A design Perspective, Pearson Education, 2002

S.M.Kang & Y. Leblebici, CMOS Digital Integrated Circuits, McGraw Hill, 2002

Ken Martin, Digital Integrated Circuit Design, Oxford Press, 2000.

EC352 MICROWAVE ENGINEERING & OPTICAL COMMUNICATION (3-1-0) 4

Microwave Engineering: Basic microwave concepts. Microwave network theory - S matrix representation of a multiport network, S-parameter properties, Relationship between Z, Y, ABCD parameters and S- parameters. Microwave passive devices; Microwave vacuum tubes and solid state devices - two cavity Klystron amplifier, reflex Klystron oscillator, TWT amplifier, magnetron oscillator, microwave diodes – crystal diode, PIN diode, Gunn diode, IMPATT diodes, parametric amplifier, microwave transistors. Microwave measurements. Optical Communication: elements of optical fiber communication link, fundamentals of ray optics, optical fiber modes and configurations. Signal degradation in optical fibers - losses, dispersion and group delay, Pulse broadening in GI fibers, mode coupling. Sources-direct and indirect band gap materials, LED, LASER diodes, fiber amplifiers. Fiber optical receivers-PIN and APD diodes, photo detector noise, SNR, detector response time. Digital transmission system-point-to-point links, fiber splicing and connectors, link power budget, rise-time budget, noise effects on system performance, operational principals of WDM and SONET.

Collin. R.E, Foundation of Microwave Engineering, IEEE Press, 2004

Samuel.Y.Liao, Microwave devices and Circuits, PHI, 1996.

Gerd Keiser, Optical Fiber Communication, McGraw-Hill International, Singapore, 2000

A Selvarajan, S.Kar, Optical Communications, TMH, 2006

EC353 COMMUNICATION NETWORKS (3-1-0) 4

Switching techniques, Multiplexing and Multiple Access techniques, Packet Switched Networks.

OSI and TCP/IP Models, Internet protocols and addressing, networking devices, data links and transmission, LANs and Network of LANS, Wireless Networks and Mobile IP, Routing and internetworking, transport and end to end protocols, congestion control techniques, Application Layer and network management, Network Security. Packet Queues and delays, Little's theorem, Birth and death process, Queuing disciplines, M/M/1 Queues, Burkes and Jackson theorems. Traffic models, ISDN, ATM Networks, Quality of service and resource allocation, VPNs and MPLS, Cellular Telephone and Optical networks, VOIP and Multimedia networking. Mobile Adhoc Networks and Wireless Sensor Networks

Nader F. Mir, Computer and Communication Networks, Pearson Education, 2007

Garcia and Widjaja, Communication Networks, McGraw Hill, 2006

J.F. Hayes, Modelling and analysis of Computer Comm. Networks, Plenum, 1984.

Jean Walrand & Pravin Varaiya, High Performance Communication Networks , Morgan Kaufmann Publishers, 2002.

EC354 DIGITAL SIGNAL PROCESSING LAB (0-0-3) 1

Simulation exercises on linear equation solvers: Digital Filter Design, DFT and spectral analysis, identification of sinusoids in noise. Speech processing, Image processing, Real time experiments using fixed point DSP processor (Assembly language programming) AND FPGAs: Waveform generation, Data i/o – effect of sampling and quantization, Digital Filter Implementation – FIR and IIR filter, Implementation of FFT.

---EC355

VLSI DESIGN LAB (0-0-3) 1

Design, Simulation and layout of basic digital blocks
Tools to be used: TANNER, MAGMA, CADENCE, MAGIC, SPICE
Design Project

EC356 ADVANCED COMMUNICATION LAB (0-0-3) 1

Experiments with Klyston bench, Gunn source bench, Antenna characteristic – pattern gain measure, Optical fibres experiments, Simulation exercises

EC400 DATA STRUCTURES AND ALGORITHMS (3-1-0) 4

Review of program performance. Array based representation. Linked representation. Arrays and matrices. Stacks and queues, implementation and applications. Skip lists and hashing. Binary and other trees. Heap and heap sort. Binary search trees. Graphs, Greedy method, shortest path and spanning trees. Divide and conquer method., Analysis of Algorithms

Sartaj Sahni, Data Structures, Algorithms and Applications in C++, Universities Press, 2005
A.V. Aho, J.E. Hopcroft and J. D. Ullman, Data structures and Algorithms, Pearson, 2004.
T.H.Cormen, C.E. Leiserson, R.L. Rivest, C. Stein, Introduction to Algorithms, PHI, 2004
Mark Allen Weiss, Algorithms, Data structures and problem solving with C++, Pearson, 2002.

EC401 POWER ELECTRONICS (3-1-0) 4

Power Electronic Devices: Thyristor, BJT, MOSFET, IGBT, MCT - control and protection of devices, gate/base driver circuits. High frequency inductor and transformer design considerations. DC-DC switch mode converter topologies- buck, boost, buck-boost and Cuk converters. Full bridge DC-DC converter. DC-AC switch mode inverters, single phase inverter, SPWM inverter, three phase inverter. Resonant Converters. Switched mode power supplies. Power conditioners & Uninterruptible power supplies. Controlled rectifiers, dual converters and cycloconverters.

N.Mohan, T.M.Undeland & W.P.Robbins, Power Electronics Converters, Application & Design, John-Wiley, 2003.
M.H.Rashid, Power Electronics-Circuits, Devices and Applications, PHI, 2004

EC402 OPTO-ELECTRONICS (3-0-0) 3

Light Propagation in Material Media- Optical waveguides- Waveguide devices and fabrication-techniques. Optical sources & detectors -Opto-electronic devices-Principles of Acousto-optic effect. Basics of photonic switching: Priniples of optical bistablity; bistable optical switches; self-electro-optic-effect-devices (SEED); basics of optical interconnects.

B. E. A. Saleh, M. C. Teich, Fundamentals of photonics, Wiley Inter science, 1991.
J. Singh, Optoelectronics: An introduction to materials & devices, McGraw Hill, 2002.
J. Wilson & J. F. B. Hawkes, Optoelectronics : An introduction, PHI, 2002.

EC403 VLSI TESTING & TESTABILITY (3-0-0) 3

Defects and their modeling as faults at gate level and transistor level. Functional v/s structural approach to testing. Complexity of testing problem. Controllability and observability. Generating test for a single stuck-atfault in combinational logic. Algebraic algorithms. Test optimization and fault coverage. Logic Level Simulation - Delay Models, Event driven simulation, General fault simulation (serial, parallel, deductive and concurrent). The problem of testing of sequential circuits. observability through the addition of DFT hardware, Adhoc and structured approaches to DFT - various kinds of scan designs. Fault models for PLAs, bridging and delay faults and their tests. Memory testing, Testing with random patterns. The LFSRs and their use in random test generation and response compression (including MISRs), Built-in self test. Analog testing - DSP based analog test and model based analog test. Test process and ATE, Test economics

M. Abramovici, M. A. Breuer, & A.D. Friedman, Digital Systems Testing and Testable Design, Piscataway, 1994.
M. L. Bushnell and V. D. Agrawal, Essentials of testing for digital, memory and mixed-signal VLSI circuits, Boston: Kluwer Academic Publishers, 2000.

EC404 ACTIVE FILTERS & DATA CONVERTERS (3-1-0) 4

Butterworth, Chebyshev & Inverse-Chebyshev filter response and pole locations; LC ladder filter – prototype & synthesis; Frequency transformation of lowpass filter. Impedance converters; Gm-C filters, Active-RC Filters Sample and Hold Circuits: Basic S/H circuit, bias dependency, bias independent S/H. D/A Converter – General considerations, Static non-idealities and Dynamic non-idealities; Current-steering DAC – Binary weighted DAC, Thermometer DAC, Design issues, Effect of Mismatches. A/D converter – General considerations, static and dynamic non-idealities. Flash ADC – Basic architecture, Design issues, Comparator and Latch, Effect of non-idealities, Interpolative and Folding architectures. Successive Approximation ADC; Pipeline ADC. Over sampling ADC – Noise shaping, Sigma-Delta modulator

M.E. Van Valkenburg, Analog Filter Design, Oxford University Press, 1995.
R. Schaumann and M.E. Van Valkenburg, Design of Analog Filters, Oxford University Press, 2003.
Behzad Razavi, Principles of Data Conversion System Design, Wiley-IEEE Press, 1995
Rudy J. van de Plassche, CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters, Springer, 2003

EC405 ADVANCED COMPUTER ARCHITECTURE (3-1-0) 4

Instruction set architectures of CISC, RISC and DSP Processors. CISC Instruction set implementation, Microprogramming approaches. Pipeline implementation of RISC instruction set. Implementation of DSP instruction set. Instruction level parallelism – Dynamic scheduling, Dynamic hardware prediction, hardware based speculation, ILP through software approaches – VLIW, IA64 architecture as a case study, Memory hierarchy design, Multiprocessors, thread level parallelism and multi-core architectures, I/O buses. Arithmetic: Fixed point, Floating point and residue arithmetic, Multiply and Divide Algorithms, Issues in arithmetic system design Issues in the applications (optimizing the hardware – software
interface), ASIP, reconfigurable computing, Future microprocessor architectures.

D. A. Patterson and J. Hennessy, Computer Architecture:A Quantitative Approach, Harcourt,2003
D. A. Patterson and J. Hennessy, Computer Organization and Design, Harcourt Asia, 1998.
Flynn and Oberman, Advanced Computer Arithmetic Design, Wiley 2001
Behrooz Parhami, Computer Arithmetic Algorithms and Hardware Design, Oxford, 2000.

EC406 LOGIC SYNTHESIS & TECHNIQUES (3-0-0) 3

Introduction to Computer aided synthesis and optimization. Hardware Modeling. Two level combinational logic optimization. Multiple level combinational optimization. Sequential logic optimization. Cell Library Binding. State of the art and future trends: System level synthesis and hardware software co-design.

Giovanni De Micheli, Synthesis and Optimization of Digital Circuits, McGraw Hill, 1994.
Srinivas Devadas, Abhijith Ghosh and Kurt Keutzer, Logic Synthesis, Kluwer Academic, 1998.
G. D. Hachtel and F. Somenzi, Logic Synthesis and Verification Algorithms, Kluwer 1996.
S. Hassoun and T. Sasao, (Editors), Logic Synthesis and Verification, Kluwer , 2002.

EC407 ELECTRONIC INSTRUMENTATION (3-0-0) 3

Transducers, Measurement of Physical Quantities: Measurement of Length, Thickness, Linear Displacement, Temperature, Force, Weight, Pressure, Flow, Humidity, Acidity, Density, Sound, level, Motion, Chemical Analysis, Instrumentation Systems, Principles of Telemetry, Process Monitoring and Control, Bio-medical Instrumentation: Bio-medical Electrical Quantities: Bio-potential, Electrodes, ECG, EEG and EMG measuring techniques. Biological Non-Electrical Parameters: Pressure, Blood flow, Pulse rate, Temperature, pH, CO_2, O_2- Measuring methods. Diagnostic Systems Electronic Instruments for affecting the human body: Diathermy, Pace makers, Defibrillators, Respirators, Blood pumps, Lasers.

P.H .Mansfield, Electrical transducers for Industrial Measurement, Butterworth, London, 1973.
George C. Barney, Intelligent Instrumentation, Prentice hall of India, New Delhi, 1988.
C.S.Rangan et. el., Instrumentation, Devices and Systems, Tata McGraw Hill, 1989.
H.K.P. Neubert, Instrument Transducers, Clarendon Press, Oxford, 1975.

EC408 BIOMEDICAL INSTRUMENTATION (3-0-0) 3

Action potential, ECG, EEG and EMG signals, their origin and applications in medical diagnosis. Electrodes for recording ECG, EEG and EMG signals, Instrumentation amplifiers, signal conditioners, A/D and D/A converter interfaces to the PC, Computerised automatic analysis. Biotelemetry. Transducers for physiological parameter reading, their characteristics. Diagnostic methods, ultrasound, CT and MRI. Lasers and applications of lasers in medical diagnostics and therapy. Prosthesis and prosthetic devices. Patient safety, electrical shock hazards incorporation of safety aspects in Biomedical instrumentation.

L. Cromwell, F. Weibell and E. A. Pfiffer, Biomedical Instruments and Measurements, PH, 1980.
R.S.Khandpur, Handbook of Biomedical Engineering, Tata McGraw Hill Publishing, 1992.

EC409 DSP SYSTEMS AND ARCHITECTURE (3-1-0) 4

VLSI Architectures for DSP algorithms – Data flow representations, pipelining and parallel processing, retiming, unfolding, register minimization techniques, systolic architectures, algorithms for fast implementation of convolution, FIR, IIR and adaptive filters, DCT, analysis of finite word length effects, Low power design strategies; Architecture, programming and applications of general purpose digital signal processors (Emphasis on TI & AD processors); Application case studies: Speech coding, image and video compression, Viterbi decoding, wireless communication.

K.K. Parhi, VLSI Digital signal processing systems: Design and implementation, John Wiley, 1999.
Lars Wanhammar, DSP Integrated Circuits, Academic Press, 1999
S.M. Kuo, B.H.Lee, Real-Time Digital Signal Processing: Implementations, Applications, and Experiments with the TMS320C55X, Wiley, 2006

EC410 ADVANCED DIGITAL SIGNAL PROCESSING (3-1-0) 4

2-D signals and systems, Analysis of 2D systems in spatial, frequency and transform domains; Short time Fourier Transform; Multirate Signal Processing: Decimation Interpolation, DFT filter banks, QMF filter banks, Multiresolution Signal analysis wavelets theory of sub band decompositions, Sub band coding and wavelet transforms, Application of wavelet transforms. Power spectral estimation; Higher order spectral estimation; Adaptive filters and applications. Recursive estimation and Kalman filters.

P.P. Vaidyanathan, Multirate systems and Filter banks, Prentice Hall, 1993.
S.J. Orfanidis, Optimum Signal Processing, McGraw Hill, 1989.
S. Haykin, Adaptive Filter Theory, Pearson, 2002.

EC411 SPEECH AND IMAGE PROCESSING (3-1-0) 4

Speech Production, Speech Perception: Human hearing, auditory psychophysics, just noticeable difference, pitch perception, masking, models of speech perception. Speech Analysis: Time domain and frequency domain analysis of speech, parameter estimation. Speech Compression: quality measures, waveform coding techniques, vector quantisation, linear predictive coding. standards for speech and audio compression. Speech Synthesis and Speech Recognition, Basic Image processing systems, Two-dimensional systems: Properties of two dimensional sequences and systems, Image quantisation, Image perception, quality measures. Image Transforms. Image Compression Algorithms. Motion estimation, interframe coding, standards for image and video compression Image Segmentation, Image Enhancement and Restoration, Applications

Douglas O'Shaughnessy, Speech Communication, Human and Machine, IEEE Press, 1999
L.R. Rabiner and R.W. Schafer, Digital Processing of speech signals, Prentice Hall, 1979.
Anil K .Jain, Fundamentals of Digital Image Processing, PHI, 1995.
R.C.Gonzalez and R.E.Woods, Digital Image Processing, Pearson, 2008

EC412 EMBEDDED SYSTEMS (3-0-0) 3

Introduction: Overview of embedded systems, embedded system design challenges, common design metrics and optimizing. Survey of different embedded system design technologies & trade-offs. Embedded microcontroller cores, embedded memories, Examples of embedded systems. Architecture for embedded system, High performance processors – strong ARM processors, programming, interrupt structure, I/O architecture, Technological aspects of embedded systems: interfacing between analog and digital blocks, signal conditioning, Digital signal processing, Sub-system interfacing, interfacing with external systems. Software aspects of embedded systems: real time programming languages and operating systems for embedded systems – RTOS requirements, kernel types, scheduling, context switching, latency, inter-task communication and synchronization, Case studies

Jack Ganssle, The Art of Designing Embedded Systems, Elsevier, 1999.
J.W. Valvano, Embedded Microcomputer System: Real Time Interfacing, Brooks/Cole, 2000.
David Simon, An Embedded Software Primer, Addison Wesley, 2000.
R. Gupta, Co-synthesis of Hardware and Software for Embedded Systems, Kluwer 1995.

EC413 OPERATING SYSTEMS (3-1-0) 4

Introduction to O.S., Operating system services, Resource management, , CPU scheduling, File systems, Memory management, Virtual memory concept, Device Management, Deadlocks, Concurrent processes, Concurrent Programming, Performance evaluation, Operating system security, Case studies.

Silberschartz & Galvin, Operating System Concepts, Addison Wesley, 1997.
Melin Milenkovic, Operatng systems: Concepts and Design, McGraw Hill, 2000

EC414 TV ENGINEERING (3-0-0) 3

TV systems, standards, signal generation. TV Transmitter, TV receiver; Antennas, Video detector, Video section, contrast control methods, video amplifier transistor circuits, keyed AGC, sync separation circuit, transistor VHF tuner, Video IF section, Remote Control circuits, digital TV, Camera systems and picture tubes. HDTV, IPTV, Video conferencing.

R.R. Gulati, Monochrome and color TV, South Asia Books, 1990.
A.M. Dhake, Television and Video Engineering, Tata McGraw Hill, 1996,
K. Blair Benson and Donald G. Fink, HDTV: Advanced Television for the 1990's, McGraw Hill., 1990.

EC415 SATELLITE COMMUNICATION (3-0-0) 3

Introduction to satellite Communications, Space craft, space craft sub systems, Altitude and orbit control systems, Telemetry, tracking and command, Power Systems, Communication sub systems, description of communication systems, transponders, Space craft antennas, Equipment reliability and space qualification, Multiple access systems, FDMA, FDM/FM/FDMA, TDMA, CDMA spread spectrum transmission and reception. Applicability of CDMA to commercial systems, demand access in the INTELSAT. TDMA system, SPADE, the INMARSAT system, Earth station, Satellite television networks .

T. Pratt, Satellite communications, John Wiley, 2002
T. T. Ha., Digital satellite communication, Collier Macmillan, 1986

EC416 FIBER OPTIC TECHNOLOGY & APPLICATIONS (3-0-0) 3

Over view of optical fiber communication, optical fiber types, Fiber fabrication techniques, Semiconductor LED's & ILD's, drive circuitry, modulation characteristics. Single frequency lasers, Semiconductor photodiodes, PIN diodes, APD's noise characteristics, receiver systems & their SNR analysis, Source to fiber optic coupling, lensing schemes, Fiber to fiber coupling & splicing techniques & fiber optic couplers, Fiber optic link design and analysis, Power budget & rise time budget analysis. Line coding formats. Fiber optic data buses & LAN's. Wave length division, multiplexing (WDM), System measurements: Fiber attenuation & dispersion, OTDR, LED & photodiode characteristics. Eye pattern technique.

J.M. Senior, Optical Fibre Communication, Pearson Education, 2009
G.Keiser, Optical fiber communication, McGraw Hill, 1999.
S.D Personik, Fiber optics : Technology & Applications, Khanna publishers , 1987

EC417 RADAR & ELECTRONIC NAVIGATION SYSTEMS (3-0-0) 3

Introduction to Radar, Basic concepts, Radar equation, Radar systems, elementary Radar signal processing, RADAR cross section, RADAR detection, range & Doppler measurements, tracking, Electronic counter measures, Hyperbola system of navigation, Instrument landing system, Microwave landing systems, Satellite navigation systems.

M.Skolnik, Introduction to Radar system, McGraw Hill 2002.
J.C Toomay, Principles of Radar, Sci-Tech, 2004
R.J Sullivan, Radar foundation for imaging & advanced concepts, PHI, 2004.

EC418 WIRELESS MOBILE COMMUNICATION (3-0-0) 3

Concepts of cellular communication, Geometry of hexagonal cells; Co-channel interference, cellular system design in worst case, co-channel interference with the use of directional antennas, Cell splitting, Frequency allocation in mobile, Power control, JDC, JDC frame structure, TDMA, TDMA frame, delayed in TDMA, advantages CDMA, Capacity Comparison of FDM /TDM systems and cellular CDMA. Standards for Wireless mobile communication, Micro cells, high way micro cells, spectral efficiency, traffic carried, Signaling and call control; Mobility management, Location tracking. Wireless data networking

G.L. Sterber, Principles of Mobile Communications, Kluwer Academic, 1996.
T.S .Rappaport, Wireless communications, Principles and Practice, , Pearson Edn, 2002.
William C.Y. Lee, Mobile cellular telecommunication systems: Analog & Digital Systems, McGraw Hill, 1995.

EC419 SPREAD SPECTRUM COMMUNICATIONS (3-0-0) 3

Spread spectrum overview, Spreading techniques, Pseudo noise sequences, Direct sequence spread spectrum system, Frequency hop spread spectrum system, Hybrid systems, Synchronization, Jamming considerations, Commercial applications, Cellular systems, Performance of spread spectrum systems.

R.L.Peterson, Introduction to spread spectrum communication, PH,1995.
B.Sklar, Digital Communications, Pearson Education, 2001.
M.K.Simon, Spread spectrum communications Handbook, McGraw-Hill, 2001.
J.S.Lee, CDMA Systems Engineering handbook, Artech House, 1998

EC420 INFORMATION THEORY AND CODING (3-1-0)4

Communication systems and Information Theory, Measures of Information, Coding for Discrete sources, Discrete memory-less channels and capacity, Noisy channel coding theorem, Techniques for coding and decoding, Waveform channels, Source coding with Fidelity criterion.

Thomas M Cover & Joy A Thomas, Elements of Information Theory, John Wiley,1991
R.G.Gallagher, Information Theory and Reliable Communication, Addison Wesley, 1987.
A.J.Viterbi & J.K. Omura, Principles of Digital Communications and Coding, McGraw Hill, 1979.

EC421 ERROR CONTROL CODING (3-1-0) 4

Coding for reliable digital transmission and storage. Groups, Rings, Vector Spaces, Galois Fields, Polynomial rings, Channel models, Linear Block codes, Cyclic codes, BCH codes, Reed Solomon Codes, Berlekamp-Massey and Euclid decoding algorithm, Decoding beyond the minimum distance parameter, Applications of Reed-Solomon codes, Convolutional codes, Decoding algorithms for Convolutional codes, Viterbi, Stack and Fano algorithms, Application of Convolutional codes. Codes based on the Fourier Transform, Algorithms based on the Fourier Transform, Trellis coded modulation, Combinatorial description of Block and Convolutional codes, Algorithms for the construction of minimal and tail biting trellises, Soft decision decoding algorithms, Iterative decoding algorithms, Turbo-decoding, Two-way algorithm, LDPC codes, belief propagation (BP) algorithms, Space-Time codes.

Shu Lin and Daniel J. Costello Jr., Error Control Coding: Fundamentals and Applications, Prentice Hall, 2003.
S. B Wicker, Error Control Systems for Digital Communication and Storage, Prentice Hall, 1995.
Blahut R. E, Theory and Practise of Error Control Codes, Addison Wesley, 1983.
Blahut R.E., Algebraic codes for Data transmission, Cambridge University Press, 2003.

EC422 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY (3-0-0) 3

EMC requirements for electronic systems, EMI/EMC definitions, emission and immunity concepts, interference mechanisms, parameters and measurement units, EMI in time domain and frequency domain. Sources of electromagnetic interference; EMI coupling methods; EMI/EMC standards and measurements, EMI test instruments and systems, EMI control techniques; PCB design for EMC, high speed digital interconnects and signal integrity issues, system configuration and design for EMC.

Henry W.Ott, Electromagnetic Compatibility Engineering, Wiley, 2009.
C.R.Paul, Introduction to Electromagnetic Compatibility, Wiley, 2006
Dipak L.Senguta, Valdis V.Liepa, Applied Electromagnetics and Electromagnetic Compatibility, Wiley, 2006.
V.P.Kodali, Engineering EMC Principles, Measurements and Technologies, IEEE Press, 2001.

EC423 ADHOC AND SENSOR NETWORKS (3-0-0)3

Mobile ad hoc networks and wireless sensor networks concepts and architectures. Routing: proactive routing, Broadcasting and multicasting, TCP over mobile ad hoc networks,Wireless LAN (WiFi) standards, Medium Access Control Protocol issues power control, spatial reusability, and QoS, Bluetooth, Wireless sensor networks architecture: hardware and software components of a sensor node, OS for WSN, WSN MAC layer strategies; naming and addressing; Clock Synchronization; Node Localization; WSN Routing

C Sivarama Murthy and B S Manoj, Ad-Hoc Wireless Networks, Architectures and Protocols, PH , 2004.
Labiod.H, Wireless Adhoc and sensor networks, Wiley, 2008.
Li,X , Wireless ad hoc and sensor networks: theory and applications, Cambridge University Press,2008

EC424 DIGITAL SIGNAL COMPRESSION (3-1-0) 4

Data Compression. Speech & image waveform characterization. Predictive coding. Transform coding. Subband coding, VQ based compression, Fractal coding of images. High quality video & audio compression for digital broadcasting. Standards for digital signal compression-data, speech, audio, image & video.

D. Salomon, Data Compression – the complete reference, Springer, 2000.
K. Sayood, Introduction to Data Compression, Pearson Education, 2000.
M.Nelson, The Data compression book, BPB Publications, 2002.
Jayant & Noll, Digital coding of waveforms-Principles and applications to speech & video, PH, 1984.
Zi Nian Li, Fundamentals of Multimedia, Pearson Education, 2003.

EC425 SOFT COMPUTING (3-0-0)3

Introduction to learning systems - Feed forward Neural Networks - Perception - Multilayer Perceptron propagation algorithm and its variants - Improving generalization by various methods.
Recurrent Neural Networks - Hopfield net - Boltzmann machine and Mean field learning - solving combinational optimization problems using recurrent Neural Networks. Unsupervised Neural Networks. Competitive learning - Self organizing maps - Growing cell structures
Principal component analysis. Basics of fuzzy sets. Genetic algorithms: Population based search techniques, evolutionary strategies, mathematical foundations of genetic algorithms, search operators, genetic algorithms in function and combinational optimization, hybrid algorithms, application to pattern recognition

S. Haykin, Neural Networks : A comprehensive foundation, Pearson, 1999
J. M. Zurada, Introduction to artificial neural networks, Jaico publishing, 1997.
B. Yegnanarayana, Artificial Neural Networks, PHI, 1991

HU300 ENGINEERING ECONOMICS (3-0-0) 3

Basic economic concepts and problems -Theories of demand, supply and Market equilibrium. Elasticity, demand forecasting, cost terminology. Methods of economic analysis in Engineering- Bases for Comparison of alternatives. Selection among alternatives, replacement analysis - Evaluating public activities - depreciation accounting - Estimating economic elements.

Samuelson P.A. and Nordhans W.D., Economics, 15th ed., McGraw Hill, New York, 1995. Thuesen G.J. and Fabrycky W.J.Engineering Economy, 9th ed., Prentice Hall of India, New Delhi 2002. Sullivan W.G., Bontadelli J.A. and Wicks E.M., Engineering Economy, 11th ed., Pearson Education Asia, New Delhi 2001 Leland Blank P.E and Anthony Tarquin P.E.,Engineering Economy, 4th ed., McGraw Hill, Singapore, 1998.

HU301 MANAGEMENT THEORY AND PRACTICE (3-0-0) 3

Management Philosophy, Management and Society, Functions of Management, Goals of Managers and Organizations, Productivity, Efficiency, Effectiveness, Evolution of Management thoughts, Systems Theory, Theories of Taylor, Fayol, Gilberth, Mayo, Chester Bernard, Concept and Practice of Planning, MBO, Strategic Planning, SWOT Analysis, Decision Making, Global Planning - Organizing, Organization levels, Structures, Authority, Power, Delegation, Conflict, Human Resource Management & Development, Selection of Employees, Training and Orientation, Performance Appraisal, Human factors in Managing, Motivation Theory, Need Theories, Leadership, Communication, Controlling Human factors, Types of Controls, Effective Controls.

Koontz, H. Management, McGraw Hill Publication, 1998 Philip Kotler, Marketing Management, Tata McGraw Hill Publicaiton, 1998

EC440 PRACTICAL TRAINING 1

EC449 MAJOR PROJECT – I (0-0-6) 4

EC499 MAJOR PROJECT – II (0-0-9) 6