DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

RULES AND REGULATIONS

SCHEME OF INSTRUCTION AND SYLLABI

of

B.Tech. Programs

NATIONAL INSTITUTE OF TECHNOLOGY

WARANGAL 506 004

SCHEME OF INSTRUCTION AND EVALUATION

B. Tech. COMPUTER SCIENCE AND ENGINEERING

I - Year I - Semester

S. No.	Course No.	Course Title	L	T	P	Credits	Cat. Code
1.	MA101	Mathematics - I	4	0	0	4	BSC
2.	HS101	English for Communication (or)	3	0	2	4	HSC
	ME102	Engineering Graphics	2	0	3	4	OEC
3.	PH101	Physics (or)	4	0	0	4	BSC
	CY101	Chemistry	4	0	0	4	BSC
4.	EC101	Basic Electronics Engg. (or)	3	0	0	3	OEC
	EE101	Basic Electrical Engineering	3	0	0	3	OEC
5.	CE102	Environmental Studies (or)	3	0	0	3	MDC
	ME101	Basic Mechanical Engg.	3	0	0	3	OEC
6.	CS101	Problem Solving and Computer Programming (or)	4	0	0	4	OEC
	CE101	Engineering Mechanics	4	0	0	4	OEC
7.	PH102	Physics Laboratory (or)	0	0	3	2	BSC
	CY102	Chemistry Laboratory	0	0	3	2	BSC
8.	CS102	Problem Solving and Computer Programming Laboratory (or)	0	0	3	2	OEC
	ME103	Workshop Practice	0	0	3	2	OEC
9.	EA151	EAA: Games and Sports	0	0	3	0	MDC
		Total	**21**	**0**	**11**	**26**	
			20	**0**	**12**	**26**	

I - Year II - Semester

S. No.	Course No.	Course Title	L	T	P	Credits	Cat. Code
1.	MA151	Mathematics - II	4	0	0	4	BSC
2.	ME102	Engineering Graphics (or)	2	0	3	4	OEC
	HS101	English for Communication	3	0	2	4	HSC
3.	CY101	Chemistry (or)	4	0	0	4	BSC
	PH101	Physics	4	0	0	4	BSC
4.	EE101	Basic Electrical Engineering (or)	3	0	0	3	OEC
	EC101	Basic Electronics Engineering	3	0	0	3	OEC
5.	ME101	Basic Mechanical Engg. (or)	3	0	0	3	OEC
	CE102	Environmental Studies	3	0	0	3	MDC
6.	CE101	Engineering Mechanics (or)	4	0	0	4	OEC
	CS101	Problem Solving and Computer Programming	4	0	0	4	OEC
7.	CY102	Chemistry Laboratory (or)	0	0	3	2	BSC
	PH102	Physics Laboratory	0	0	3	2	BSC
8.	ME103	Workshop Practice (or)	0	0	3	2	OEC
	CS102	Problem Solving and Computer Programming Laboratory	0	0	3	2	OEC
9.	EA151	EAA: Games and Sports	0	0	3	0	MDC
		Total	**20**	**0**	**12**	**26**	
			21	**0**	**11**	**26**	

II - Year I - Semester

S. No.	Course No.	Course Title	L	T	P	Credits	Cat. Code
1.	MA238	Statistical and Numerical Methods for Engineers	4	0	0	4	BSC
2.	EE236	Network Analysis	3	0	0	3	PCC
3.	EC237	Digital Logic Design	3	0	0	3	PCC
4.	CS201	Discrete Mathematics	4	0	0	4	PCC
5.	CS202	Data Structures and Algorithms	4	0	0	4	PCC
6.	CS203	File Structures	2	0	3	4	PCC
7.	EC238	Basic Electronics Laboratory	0	0	3	2	PCC
8.	CS204	Data Structures Laboratory	0	0	3	2	PCC
		Total	**20**	**0**	**9**	**26**	

II - Year II - Semester

S. No.	Course No.	Course Title	L	T	P	Credits	Cat. Code
1.	EC287	IC Applications	3	0	0	3	OEC
2.	CS251	Object Oriented Programming	4	0	0	4	PCC
3.	CS252	Computer Architecture	4	0	0	4	PCC
4.	CS253	Database Management Systems	4	0	0	4	PCC
5.	CS254	Systems Programming	4	0	0	4	PCC
6.	EC288	IC Applications Laboratory	0	0	3	2	OEC
7.	CS255	Database Management Systems Laboratory	0	0	3	2	PCC
8.	CS256	Programming Laboratory	0	0	3	2	PCC
		Total	**19**	**0**	**9**	**25**	

III - Year I - Semester

S. No.	Course No.	Course Title	L	T	P	Credits	Cat. Code
1	SM335	Engineering Economics and Accountancy	3	0	0	3	HSS
2	CS301	Theory of Computation	4	0	0	4	PCC
3	CS302	Operating Systems	4	0	0	4	PCC
4	CS303	Data Warehousing and Data Mining	4	0	0	4	PCC
5	CS304	Software Engineering	4	0	0	4	PCC
6	CS305	Operating Systems Laboratory	0	0	3	2	PCC
7	CS306	Knowledge Engineering Laboratory	0	0	3	2	PCC
8	CS307	CASE Tools Laboratory	0	0	3	2	PCC
		Total	**19**	**0**	**9**	**25**	

III - Year II - Semester

S. No.	Course No.	Course Title	L	T	P	Credits	Cat. Code
1	CS351	Language Processors	4	0	0	4	PCC
2	CS352	Computer Networks	4	0	0	4	PCC
3	CS353	Language Processors Lab	0	0	3	2	PCC
4	CS354	Computer Networks Lab	0	0	3	2	PCC
5		Open Elective - 1	3	0	0	3	OPC
6		Department Elective -1	3	0	0	3	DEC
7		Department Elective - 2	3	0	0	3	DEC
8		Department Elective - 3	3	0	0	3	DEC
		Total	**20**	**0**	**6**	**24**	

IV - Year I - Semester

S. No.	Course No.	Course Title	L	T	P	Credits	Cat. Code
1.	CS401	Distributed Computing	4	0	0	4	PCC
2.	CS402	Cryptography and Network Security	4	0	0	4	PCC
3.	CS403	Security Laboratory	0	0	3	2	PCC
4.		Open Elective - II	3	0	0	3	OPC
5.		Department Elective - 4	3	0	0	3	DEC
6.		Department Elective - 5	3	0	0	3	DEC
7.	CS449	Project Work Part-A	0	0	4	2	PRC
		Total	**20**	**0**	**7**	**21**	

IV - Year II - Semester

S. No.	Course No.	Course Title	L	T	P	Credits	Cat. Code
1.	ME435	Industrial Management	3	0	0	3	OEC
2.	CS451	Wireless and Mobile Computing	3	0	0	3	PCC
3.	CS452	Machine Learning and Soft Computing	3	0	0	3	PCC
4.		Department Elective - 6	3	0	0	3	DEC
5.		Department Elective - 7	3	0	0	3	DEC
6.		Department Elective - 8	3	0	0	3	DEC
7.	CS491	Seminar	0	0	3	1	MDC
8.	CS499	Project Work Part-B	0	0	6	4	PRC
		Total	**18**	**0**	**9**	**23**	

LIST OF ELECTIVES

III Year II Semester

CS361	Design and Analysis of Algorithms	(3 - 0 - 0)	3
CS362	Computational Neuroscience	(3 - 0 - 0)	3
CS363	Web Technologies	(3 - 0 - 0)	3
CS371	Software Metrics and Software Project Management	(3 - 0 - 0)	3
CS372	Programming Language Concepts	(3 - 0 - 0)	3
CS373	Unix Tools and Programming	(3 - 0 - 0)	3
CS381	Advanced Data Structures	(3 - 0 - 0)	3
CS382	Advanced Databases	(3 - 0 - 0)	3
CS383	Advanced Data Mining	(3 - 0 - 0)	3

IV Year I Semester

CS411	Business Intelligence	(3 - 0 - 0)	3
CS412	Game Theory	(3 - 0 - 0)	3
CS413	Pattern Recognition	(3 - 0 - 0)	3
CS414	Semantic Web	(3 - 0 - 0)	3
CS421	Secure Software Engineering	(3 - 0 - 0)	3
CS422	Distributed Object Technologies	(3 - 0 - 0)	3
CS423	Design Patterns	(3 - 0 - 0)	3
CS424	Advanced Compiler Design	(3 - 0 - 0)	3

IV Year II Semester

CS461	Model-driven Frameworks	(3 - 0 - 0)	3
CS462	Service Oriented Architecture	(3 - 0 - 0)	3
CS463	Heterogeneous Computing	(3 - 0 - 0)	3
CS464	Bio-Informatics	(3 - 0 - 0)	3
CS465	DNA Computing	(3 - 0 - 0)	3
CS471	Advanced Computer Networks	(3 - 0 - 0)	3
CS472	Computer Vision	(3 - 0 - 0)	3
CS473	Security and Privacy	(3 - 0 - 0)	3
CS474	Information Security and Auditing	(3 - 0 - 0)	3
CS475	Real Time Systems	(3 - 0 - 0)	3
CS481	Cloud Computing	(3 - 0 - 0)	3
CS482	Social Network Analysis	(3 - 0 - 0)	3
CS483	Intelligent Agents	(3 - 0 - 0)	3
CS484	Big Data Analytics	(3 - 0 - 0)	3

B. Tech. COMPUTER SCIENCE AND ENGINEERING

SYLLABUS

MA101 **MATHEMATICS - I** (4-0-0)4

Rank, Normal form, Inverse of a matrix - solutions of systems of linear equations - Characteristic roots and vectors - Rolle's and Mean value theorems - Expansions - Indeterminate forms- Curve tracing - Partial Differentiation - maxima and minima of functions - solution of first order first degree differential equations - Homogeneous and non-homogeneous linear equations of arbitrary order.

Reading:

1. R.K.Jain and S.R.K.Iyengar, *Advanced Engineering Mathematics,* Narosa Pub. House, 2008.
2. Erwyn Kreyszig, *Advanced Engineering Mathematics,* 8th Edition, John Wiley and Sons, 2008.
3. B.S.Grewal, *Higher Engineering Mathematics,* Khanna Publications, 2009.

HS101 **ENGLISH FOR COMMUNICATION** (3-0-2) 4

Vocabulary Building - Effective Sentence Construction; Paragraphs- Note-making - Letter-writing - Reading Techniques - Technical Report writing - Book Review; English Sound System - Stress, Rhythm and Intonation - Group Discussions- Listening Comprehension.

Reading:

1. Dept. of Humanities and Social Sciences, Anna University, *English for Engineers and Technologists,* Combined Edition, Vol. 1 and 2, Orient Blackswan, 2008.
2. Ashraf, M Rizvi. *Effective Technical Communication.* Tata McGraw-Hill, 2006.
3. Meenakshi Raman and Sangeetha Sharma. *Technical Communication: Principles and Practice 2nd Edition,* Oxford University Press, 2011.

ME102 **ENGINEERING GRAPHICS** (2-0-3)4

Principles of orthographic projections, projections of points, lines, planes and solids, Section of solids, Isometric views, Auto-CAD.

Reading:

1. Bhatt, N.D., *Elements of Engineering Drawing,* Charotar Publishers, 2005.
2. Sham Tikoo., *Understanding AutoCAD 2002,* Tata McGraw Hill Book Company, New Delhi, 2001.
3. Lakshminarayanan, V. and Vaishwanar, R.S., *Engineering Graphics including AutoCAD 2002,* Jain Brothers, New Delhi, 2005.
4. Siddique, A.N., *Engineering Drawing with a Primer on Auto CAD,* Prentice Hall of India, New Delhi, 2004.

CY101 **CHEMISTRY** (4-0-0)4

Electrochemistry: Reference electrodes - Ion selective electrodes-Chemically modified electrodes as sensors - Electrochemical energy systems-lithium batteries - Fuel cells Corrosion and its prevention: Molecular Interactions-Molecular orbital theory-self-assembly involving different types of interactions - Chemistry of Nano-materials-Synthesis and applications-Basic Principles of Organic Chemistry-Polymer Chemistry - Thermoplastic and Thermosetting resins - Conducting polymers-Chemical Spectroscopy- Photochemistry.

Reading:

1. P. W. Atkins and Julio de Paula, *Atkins Physical Chemistry I Chemistry,* 7th Edition, Oxford University Press, New York, 2002.
2. Shashi Chawla, *A Reading of Engineering Chemistry,* 3rd Edition, Dhanpat Rai and Co., New Delhi, 2007.
3. S. Vairam, P. Kalyani and Suba Ramesh, *Engineering Chemistry,* 1st Edn, John Wiley & Sons, India, 2011.

PH101 **PHYSICS** (4-0-0)4

Interference - Interferometers- Applications; Diffraction- Multiple slits- resolving power- Applications; Polarization - Optical activity- photoelasticity; Lasers - Holography - Applications; Optical Fibers - Sensing; Functional materials - Nano materials; Matter waves, Schrodinger wave equation, Tunneling, particle accelerators; Acoustics - Ultrasonics - Applications.

Reading:

1. Halliday, Resnic and Walker, *Fundamentals of Physics,* 9th Edition, John Wiley, 2011.
2. Beiser.A, Shobhit Mahajan, *Concepts of Modern Physics,* 6th Edition, McGraw Hill, 2009.
3. Ajoy Ghatak, *Optics,* 5th Edition, TMH, 2012.

EE101 **BASIC ELECTRICAL ENGINEERING** (3-0-0)3

DC Circuits - AC Circuits - Magnetic Circuits - Single Phase Transformers - DC Machines - Three Phase Induction Motor - Measuring Instruments.

Reading:

1. Edward Hughes, *Electrical Technology,* 6th Edition, ELBS, 2001.
2. Vincent Del Toro, *Electrical Engineering Fundamentals,* 2nd Edition, PHI, 2003.
3. V N Mittle, *Basic Electrical Engineering,* TMH Edition, 2000.

EC101 **BASIC ELECTRONICS ENGINEERING** (3-0-0)3

Electronic Systems- Transistor and applications- Feedback in Electronic Systems- Integrated Circuits-.Digital Circuits- Electronic Instrumentation Principles of Communication.

Reading:

1. Salivahanan, *Electronic Devices and Circuits,* 2nd Edition, Tata McGraw Hill, 2011.
2. Neil Storey, *Electronics: A Systems Approach,* 4th Edition, Pearson Education, 2009.
3. William David Cooper, *Electronic Instrumentation and Measurement Techniques*, 2nd Edition, PHI, 1999.

CE102 **ENVIRONMENTAL STUDIES** (3-0-0) 3

Environmental studies and its importance, Environment and Society, Sustainable development, Global Concerns, Resources, Ecosystems, Ecological pyramids, Biodiversity, Environmental Pollution, Nuclear radiation hazards, Solid waste management, Disaster Management, Rain water harvesting, Environmental Acts and Legislation, Environment and human health

Reading:

1. Garg, S.K and Garg, R., *Ecological and Environmental Studies,* Khanna Publishers, Delhi, 2006.
2. Henry J.G. and Heinke G.W., *Environmental Science and Engineering,* 2nd Edition, Prentice Hall of India, New Delhi, 2004.
3. Masters G.M., *Introduction to Environmental Engineering and Science,* 2nd Edition, Prentice Hall of India, New Delhi, 2004.

ME101 **BASIC MECHANICAL ENGINEERING** (3-0-0)3

Basic principles of thermodynamics, thermal power plant layout and different components, vapour compression refrigeration, fundamentals of heat transfer, I.C. engines and gas turbines, salient features of an automobile, transmission of power: belt and gear drives, manufacturing processes: casting, welding, Forming and machining.

Reading:

1. Mathur, M.L., Mehta, F.S., and Tiwari, R.P., *Elements of Mechanical Engineering*, Jain Brothers, New Delhi, 2011.
2. Roy, K.P., and Hazra Chowdary, S.K., *Elements of Mechanical Engineering,* Media Promoters and Publishers Pvt. Ltd., 2002.
3. Rudramoorthy, R., *Thermal Engineering,* Tata McGraw Hill Book Company, New Delhi, 2003.
4. Hazra Chowdary, S.K. and Bose, *Workshop Technology*, Vol. I and II, Media Promoters and Publishers Pvt. Ltd., 2002.

CS101 **PROBLEM SOLVING AND COMPUTER PROGRAMMING** (4-0-0)4

Introduction to computers - Basics of C++ - Flow of Control - Conditional statements - Loops - Functions - parameter passing-Recursion - types of Variables - Single, Multi-Dimensional Arrays-Pointers and Dynamic Arrays - Multidimensional Dynamic Arrays - C Strings, Standard String Class - I/O Streams, Character I/O - File I/O - Structures and Classes.

Reading:

1. Walter Savitch, *Problem Solving with C++*, 6th Edition, Pearson, 2007
2. Cay Horstmann, Timothy Budd, *Big C++*, Wiley, Indian Edition, 2006

CE101 **ENGINEERING MECHANICS** (4-0-0)4

Force and Moment vectors - Degree of freedom - Equilibrium equations- D'Alembert's principle - Dynamic equilibrium of a body- force systems in space - Friction - Analysis of pin jointed plane frames- Centroid and Moment of Inertia- Kinematics and Kinetics of particles - Rectilinear and curvilinear motion- Principle of work and energy - Impulse and momentum- Simple stress strain- Hooke's law- Poisson's ratio - Analysis of axially loaded members.

Reading:

1. J.L. Meriam and L.G. Kraige, *Engineering Mechanics,* 7th Edition, John Wiley & Sons, 2012.
2. Timoshenko and Young, *Engineering Mechanics,* 3rd Edition, McGraw Hill Publishers, 2006.
3. Gere and Timoshenko, *Mechanics of Materials*, 2nd Edition, CBS Publishers, 2011.

PH102 **PHYSICS LABORATORY** (0-0-3)2

Newton's rings; λ of He-Ne laser; Width of single slit; specific rotation of sugar solution; RC circuit; LCR resonance circuit; Half Life of a Radioactive substance; Diffraction grating; Numerical aperture and bending losses; Planck's constant; Ultrasonic diffraction.

CY102 **CHEMISTRY LABORATORY** (0-0-3)2

Volumetric Analysis: Redox titrations - Complxometric titrations-Instrumental methods of analysis: pH-metry - Potentiometry-Conductometry- Colorimetry - Ion-exchange - Adsorption- Photochemical reduction-Study of rate of corrosion.

Reading:

1. A.I. Vogel, *Quantitative Inorganic Analysis,* 6th Edition, 2007.

CS102 **PSCP LABORATORY** (0-0-3)2

Familiarization - Editing - Conditional expressions - Series evaluation - Functions - Recursion - Arrays - Pointers - C-strings - Strings - File I/O - Formatted Output - Structures, Classes.

ME103 **WORKSHOP PRACTICE** (0-0-3)2

Exposure is given to the student in the following Trades: Fitting, Welding, Carpentry, Foundry, Power Tools, House Wiring and Machine Shop.

Reading:

1. Rajendra Singh, *Introduction to Basic Manufacturing Process and Workshop Technology,* New Age International (P) Ltd. Publishers, 2006.
2. Raghuwanshi, B.S.: *Workshop Technology, Vol.I and II,* Dhanpat Rai & Co. (P) Ltd., 2008.
3. P. Kannaiah and K.L. Narayana, *Engineering Practices Laboratory,* SciTech. Publications, Chennai, 2006.

MA151 **MATHEMATICS - II** (4-0-0)4

Laplace transform - Inverse Laplace transform - Solution of ODE - Evaluation of plane areas, volume and surface area of a solid of revolution and lengths - Convergence of Improper integrals - Double and triple integrals - Vector Differentiation - Gradient - Divergence and Curl - Line and surface integrals - Green's theorem, Gauss Divergence theorem, Stokes' theorem.

Reading:

1. R.K.Jain and S.R.K.Iyengar, *Advanced Engineering Mathematics,* Narosa Pub. House, 2008.
2. Erwyn Kreyszig, *Advanced Engineering Mathematics,* 8th Edition, John Wiley and Sons, 2008.
3. B.S.Grewal, *Higher Engineering Mathematics,* Khanna Publications, 2009.

MA238 **STATISTICAL AND NUMERICAL METHODS FOR ENGINEERS** (4-0-0)4

Random variables and their distributions - joint probability mass function - Testing of Hypothesis for large and small samples - Chi-square test for goodness of fit - regression, correlation - single and multiple server queuing models - Curve fitting- Gauss Seidal iteration method - Regula-Falsi and Newton-Raphson's methods - interpolation - Numerical differentiation and integration - numerical solution of first order ordinary differential equations.

Reading:

1. Miller and Freund, *Probability and Statistics for Engineers,* Pearson, 2005.
2. Jain, Iyengar and Jain, *Numerical Methods for Scientific and Engineering Computation,* New Age International Publications, 2008.
3. Kantiswarup, Manmohan and P.K. Gupta, *Operations Research,* S. Chand & Co., 2006.

EE236 **NETWORK ANALYSIS** (3-0-0)3

Circuit elements and relations, network graphs and analysis, Time domain analysis, Applications of Laplace transformations in circuit theory, Steady state analysis of circuits for sinusoidal excitations, Resonance, Network theorems and applications.

Reading:

1. M.E. Van Valkenberg, *Network Analysis,* 3rd Edition, PHI, 2002.
2. Charles A Desoer and Ernest S Kuh, *Basic Circuit Theory,* MGH, 1969.
3. M.L. Soni and J.C. Gupta, *A Course in Electrical Circuits Analysis,* Dhanpat Rai & Co. (P), 2001.
4. G.K. Mithal and Ravi Mittal, *Network Analysis,* Khanna Pub., 1998.

EC237 **DIGITAL LOGIC DESIGN** (3-0-0)3

Digital Hardware, Design Process, Logic Circuits: Boolean algebra, Logic Gates. Implementation Technologies, Standard chips, programmable logic devices. Custom chips, Standard cells and Gate Arrays. Implementation of Logic functions: Minimization, Number representations and Arithmetic circuits: Additions, Fast Adders, Design of Arithmetic Circuits, Multiplication, Combinational Circuit Building blocks: Flip-Flops, Registers and Counters, Synchronous and Asynchronous Counters. Synchronous Sequential circuits: State diagram, Assignment problem. Moore and Mealy State models, Design of Finite State Machines.

Reading:

1. Stephen Brown, Zvonko Vranesic, *Fundamentals of Digital Logic with VHDL Design,* MGH, 2000.
2. William I Fletcher, *An Engineering Approach to Digital Design,* Eastern Economy Edition, PHI, 2000.

CS201 **DISCRETE MATHEMATICS** (4-0-0)4

Sets, Relations, Functions - Fundamentals of Logic - Quantified propositions - mathematical Induction - Combinations and Permutations - Enumerations - Recurrence Relations - Generating Functions - Binary Relations - Lattices - Directed Graphs - Graphs - Spanning Trees - Planar Graphs - Euler Circuits - Hamiltonian Graphs

Reading:

1. Mott, Kandel, Baker, *Discrete Mathematics for Computer Scientists and Mathematicians,* 2nd Edition, PHI, 2001.
2. Tremblay J.P. and Manohar R., *Discrete Mathematical Structures,* MGH, 1987.

CS202 **DATA STRUCTURES AND ALGORITHMS** (4-0-0)4

Algorithm Analysis - Ordered Lists - Stacks, Queues - Trees - Search Trees - BST, AVL - Hashing - Hash Tables - Priority Queues - Sorting - Internal - Disjoint Sets - Graph Algorithms - Shortest Paths - Spanning Trees.

Reading:

1. Mark Allen Weiss, *Data Structures and Algorithm Analysis in C++,* 2nd Edition, Pearson, 2004.
2. Alfred V Aho, John E Hopcroft, Jeffrey D Ullman, *Data Structures and Algorithms,* Addison Wesley, 1983.

CS203 **FILE STRUCTURES** (2-0-3)4

Fundamental File Processing Operations - Fundamental File Structure Concepts - Managing Files and Records - Indexing - Consequential Processing and the Sorting of Large Files - Multilevel Indexing and B-Trees - Indexed Sequential File Access and B+ Trees - Hashing - Extendible Hashing - External sorting - Secondary storage algorithms.

Reading:

1. Folk, Zoellick, Riccardi; *File Structures: An Object Oriented Approach with C++,* 2nd Edition, Pearson Publishers, 1997.
2. Gio Wiederhold, *Database Design,* 2nd Edition, MGH, 2001.

CS204 **DATA STRUCTURES LABORATORY** (0-0-3)2

Implementation of ordered lists -Stacks - Queues- Applications of Stacks and Queues -- Generic ADTs - Trees - General tree - Binary tree -- Search Trees - BST - AVL Trees - Splaying - B-Trees - B(+)-Trees - Trie - C-trie -- Sorting algorithms - Graph traversals - Shortest paths - Spanning Trees - DFT Applications of graphs - Fundamental File Processing Operations - Object Oriented Support for Indexed, Entry-Sequenced Files of Data Objects - Hashed Files - Merging - Sort-Merging packages - Paged Binary Trees - Multi list and Inverted Files - Indexed Sequential File Access - Hashing and Extendible Hashing - External Sorting.

EC238 **BASIC ELECTRONICS LABORATORY** (0-0-3)2

Characteristics of semiconductor devices Diode, BJT, FET., Transistor biasing., Zener diode application as a regulator, Frequency Response of single stage CE Amplifier., R.C. Phase shift oscillator., Integrator and Differentiators, Clippers and Clampers., Rectifiers and Filters., Op-amp Inverting and non inverting amplifier., Op-amp Integrator and Differentiator Circuits.

CS251 **OBJECT ORIENTED PROGRAMMING** (3-0-0)3

Object Oriented Thinking - Messages and Methods - OO Design - Software Components - Design Paradigms - Inheritance - Mechanisms for software reuse - Polymorphism - AWT Class - Input output Streams.

Reading:

1. Timothy Budd, *Understanding Object Oriented Programming with Java,* AW, 1999.
2. Herbert Schildt, *Java 2 Complete Reference,* 5rh Edition, TMH, 2010.

CS252 **COMPUTER ARCHITECTURE** (4-0-0)4

Basic Structure - Functional units - Bus structure - Addressing Methods - Instructions - Instruction Sequencing - Assembly language program - Flow Control - Power PC example - Processing Unit - Hardwired control - Micro programmed Control - Memory - Performance Considerations - Arithmetic and Branching Conditions - Computer Peripherals - I/O - Interrupts - DMA - Synchronous and asynchronous busses - Standard I/O Interfaces.

Reading:

1. Hamacher, Vranesic, Zaky, *Computer Organization,* 5th Edition, MGH, 2002.
2. Wiiliam Stallings, *Computer Organization and Architecture Designing for Performance,* 8th Edition, Pearson Education, 2010.

CS253 **DATABASE MANAGEMENT SYSTEMS** (4-0-0)4

Entity Relationship model, Relational model - structure and operations, query languages - Relational Algebra - Relational Calculus - Mapping ER model to relation form. Features of SQL. Functional Dependencies - normalization process. Multi valued dependencies. Query optimization Transaction processing concepts. Concurrency Control and recovery. Security and Authorization.

Reading:

1. Elamsri, Navathe, Somayajulu and Gupta, *Database Concepts,* Pearson Edu, 2006.
2. Raghu Ramakrishnan, Johannes Gehrke, *Database Management Systems,* MGH 2003.

CS254 **SYSTEMS PROGRAMMING** (3-0-0)3

PC Hardware - Assembly Language Basics - Program Logic and Control - Keyboard and Screen Processing - Macro definitions and Linking - Advanced Screen and Keyboard Processing - Disk Processing - DOS Memory Management - Assemblers - Macro processors - Linkers - Loaders.

Reading:

1. Peter Abel, *IBM PC Assembly Language and Programming,* 5th Edition, Pearson Education, 2003.
2. Sivarama P. Dandamudi, *Introduction to Assembly Language Programming,* Springer 1st Edition, 2003.

EC287 **IC APPLICATIONS** (3-0-0)3

Operational Amplifiers: Monolithic operational amplifiers. Application of Linear ICs: Operational Amplifier Applications: Inverting and Non-inverting Amplifiers, Comparators, Sine wave oscillators, Astable and Monostable multivibrators, Logarithmic amplifier. Other ICs: 555 timer and its applications, uA 723 and its applications. Study of Logic Families, Combinational Logic: IC Versions of combinational logic circuits multiplexer, decoder, demultiplexer, tristate buffers, binary adders. Sequential Logic: Semiconductor memories, Data Conversion Circuits, specifications.

Reading:

1. J. Millman, *Microelectronics,* MGH, 1987.
2. Ramakant A. Gayakwad, *Operational Amplifiers and Linear IC Technology,* PHI, 1987.
3. Taub and Schilling, *Digital Electronics,* McGraw Hill, 1986.

EC288 **IC APPLICATIONS LABORATORY** (0-0-3)2

Study and Operation of IC testers, pulse generator and digital trainer. Measurement of Op.amp parameters, Op.amp monostable and astable multivibrators. 555 timer: Monostable and astable multivibrators, Characteristics of TTL NAND gate:, Study of flip-flops: RS, JK, T and D, Mod-N counter using 7490 and 74190, Mod-N counter using 7492 and 74192, MUX and decoder ICSs(IC 74153 and 74138), Shift register IC 7495.

CS 255 **DATABASE MANAGEMENT SYSTEMS LABORATORY** (0-0-3)2

Familiarization of Oracle RDBMS, SQL* Plus, Design and development of database using Oracle, implementation of application with GUI, Implementation of relational operators using C/C^{++}, DSL, Front end development, Case study/project.

CS256 **PROGRAMMING LABORATORY** (0-0-3)2

Fixed Point Arithmetic - Text Processing - Keyboard and screen processing - Macro writing - Disk Processing - Memory Resident Programs - DOS file Management - Copy Protection schemes - Implementation of a simple editor - Construction of Assemblers.

SM335 **ENGINEERING ECONOMICS AND ACCOUNTANCY** (3-0-0)3

Basic concepts of national income, inflation, economic policies, financial accounting, preparation of cost sheet, concepts of financial management and smart investment.

Reading:

1. Henry M.S., *Engineering Economics Principles,* MGH, 2011.
2, Jain and Narang, *Accounting,* Kalyani Publishers, 2011.

CS301 **THEORY OF COMPUTATION** (4-0-0)4

Finite Automata - Deterministic, non-deterministic - Regular expressions - equivalence - Properties - Pumping Lemma - Context Free Grammars - Push Down Automata - Context Free Languages - Properties - Turing Machines - Computable Functions - Undecidability.

Reading:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D Ullman, *Introduction to Automata Theory,* Languages and Computation, 2nd Edition, Pearson, 2001
2. Michael Sipser, *Introduction to Theory of Computation,* 3rd Edition, Course Technology, 2012.

CS302 **OPERATING SYSTEMS** (4-0-0)4

Batch, iterative, time sharing and real-time systems - operating system structure - concurrent processes - synchronization - CPU scheduling - Deadlocks - Memory management - Virtual memory - secondary storage management - file systems - I/O systems - Mass-storage structure - Protection - Security.

Reading:

1. A. Silberschatz, Galvin, Gagne, *Operating System Concepts,* 8th Edition, John Wiley & Sons, 2009.
2. Andrew S Tanenbaum, *Modern Operating Systems,* 3rd Edition, Pearson Education, 2007.

CS303 **DATA WAREHOUSING AND DATA MINING** (4-0-0)4

Data Warehouse vs Databases - KDD process - Data pre-processing - Data Warehousing and OLAP technologies - Data Cube Computation, Multi Dimensional modelling, data warehouse architecture, Data warehouse implementation - Data Mining techniques - Association rules, classification, clustering.

Reading:

1. Jiawei Han and Kamber, M, *Data Mining Concepts and Techniques,* 2nd Edition, Elsevier Publications, 2006.
2. Vipinkumar, Michael Steinbach, *Introduction to Data Mining,* 1st Edition, Addition-Wesley, 2006.

CS304 **SOFTWARE ENGINEERING** (4-0-0)4

Introduction to Software Engineering - A generic view of process - Process models - Software Engineering Practice - System Engineering - Requirements Engineering - Building the Analysis model - Design Engineering - Creating an Architectural Design - Modelling Component level design - Testing Strategies - Testing - Tactics - Product Metrics - Project Management Metrics for Process and projects - Estimation - Project Scheduling - Risk Management - Quality Management - Change Management.

Reading:

1. Roger S. Pressman, *Software Engineering - A Practitioner's Approach,* 6th Edition, MGH, 2005
2. Ian Sommerville, *Software Engineering,* 9th Edition, Pearson Publishers, 2010.

CS305 **OPERATING SYSTEMS LABORATORY** (0-0-3)2

Unix Commands Implementation (6-10),Signal handling, Matrix and Graph operations using pthreads, Classical synchronization problems using IPC and pthreads, Thread Library implementation, CPU scheduling algorithms as part of thread library and also using IPC, Deadlock handling algorithms, Page replacement algorithms using pthreads and IPC, Sample file system inside disk image file.

CS306 **KNOWLEDGE ENGINEERING LABORATORY** (0-0-3)2

This laboratory provides hands on exposure on building of warehouse, analyzing the data using OLAP tools, and implementation of mining techniques using mining tools like SPSS, Weka etc.

CS307 **CASE TOOLS LABORATORY** (0-0-3) 2

Problem Analysis and Project Planning - Software Requirement Analysis - Modelling - Software Developments and Debugging - Software Testing.

CS351 **LANGUAGE PROCESSORS** (4-0-0)3

Phases of Compilers - Compiler Construction Tools - Bootstrapping - lexical analyzer - Parsing - Top-down - Operator precedence - LR Parsing - Ambiguous Grammars - Storage Allocation - Symbol Table - Syntax Directed Translation - Intermediate Code - Code Generation - Simple Code Generator - DAG - Peephole Optimization.

Reading:

1. Aho, Ravi Sethi, Monica S Lam, Ullman, *Compilers - Principles, Techniques and Tools,* 2nd Edition, Pearson, 2002.
2. Randy Allen, Ken Kennedy, *Optimizing Compilers for Modern Architectures,* Morgan Kauffmann, 2001.

CS352 **COMPUTER NETWORKS** (4-0-0)4

Network structures - Network Architecture - OSI model - LAN protocols - IEEE standard 802 - Ethernet - Token Bus and Token Ring - Error Detection and Correction - Sliding Window protocols - Routing algorithms - Congestion control algorithms - Internetworking - Network Layer in Internet IP - Transport Layer in Internet - UDP, TCP - Remote Procedure Call - Implementation and semantics of RPC - E-mail Protocol and File Transfer Protocol.

Reading:

1. Larry L Peterson, Bruce S Davis, *Computer Networks,* 5th Edition, Elsevier, 2012.
2. Andrew S. Tanenbaum, David J Wetherall, *Computer Networks,* 5th Edition, Pearson Edu, 2010.

CS353 **LANGUAGE PROCESSORS LABORATORY** (0-0-3)2

Lex and Yacc - Generation of Intermediate Code for Expression Grammar - Construction of Predictive Parsing Table - LR Parsing Tables - Parsing Actions.

CS354 **COMPUTER NETWORKS LABORATORY** (0-0-3)2

Error Correction and Detection - IP address Conversion functions - Client Server example using Pipes, FIFOs, Message Queues, Shared Memory - Connection Oriented Client Server with TCP - Connectionless Client Server with UDP - Concurrent Server - Multi-protocol Server - Internet Super Server - Chat Server - Mail Server.

CS361 **DESIGN AND ANALYSIS OF ALGORITHMS** (3-0-0)3

Algorithm Analysis - Asymptotic notation - Amortization - Greedy method - Divide and conquer - Dynamic programming - example problems in each case of design methods - Max flow min cut Algorithms - Strings and Pattern matching Algorithms - Backtracking, and Branch and Bound methods - Network Algorithms - P, NP, NP-hard, NP-complete classes.

Reading:

1. M T Goodrich, Roberto Tamassia, *Algorithm Design*, John Wiley & Sons 2001.
2. Horowitz, Sartaj Sahni, S Rajasekaran, *Computer Algorithms,* 2nd Edition, Silicon Pr., 2007.

CS362 **COMPUTATIONAL NEUROSCIENCE** (3-0-0)3

Analyzing and modelling neural responses- neural encoding, firing rate and spike statistics, neural decoding. Information theory - Entropy and mutual information. Modelling neurons and networks - neuroelectronics, Hodgkin - Huxley model, integrate and fire neuronal models. Network models- Firing rate models- feed forward and recurrent networks, winner-takes all situation, associative memory. Excitatory and inhibitory networks. Plasticity and learning-Hebb's rule, Delta rule, unsupervised and supervised learning. Representational learning-density factor, principal component analysis, the Helmholtz machine.

Reading:

1. Peter Dayan and L F Abbott, *Theoretical Neuroscience,* MIT Press, 2001.
2. Christopher Koeli, *Electrophysics of Neuron,* 1st Edition, MIT Press, 2004.

CS363 **WEB TECHNOLOGIES** (3-0-0)3

Creating home pages, Dynamic HTML, JavaScript, CSS, Including Multimedia, Web Servers, PHP, String Processing and Regular Expressions, Form processing and Business logic, Dynamic content, Database connectivity, Applets and Servlets, JDBC connectivity, JSP and Web development Frameworks.

Reading:

1. Deitel, Deitel and Nieto, *Internet and Worldwide Web - How to Program,* 5th Edition, PHI, 2011.
2. Bai and Ekedhi, *The Web Warrior Guide to Web Programming,* 3rd Edition, Thomson, 2008.

CS371 **SOFTWARE METRICS AND SOFTWARE PROJECT MANAGEMENT** (3-0-0)3

The Basics of Measurement - A goal-based framework for software measurement -Empirical investigation - Measuring internal product attributes - measuring external product attributes - Making process predictions. Software Project Management - General Management - Introduction to Project Management - Project Planning and Evaluation - Project Monitoring and Control - Case Studies.

Reading:

1. Norman E. Fenton, Shari Lawrence Pfleeger, *Software Metrics - A Rigorous and Practical Approach,* 2nd Edition, PWS Pub, 1996.
2. Walker Royce, *Software Project Management,* Addison Wesley, 1998.
3. Pankaj Jalote, *Software Project Management in Practice,* Pearson Education Inc. Delhi, 2002.

CS372 **PROGRAMMING LANGUAGE CONCEPTS** (3-0-0)3

Abstraction - Computational paradigms - Imperative languages -Symbol table - Scope - Side effects, aliasing - Data Types - Type constructs - Parameter Passing Mechanisms - Procedure environments - Abstract Data Types - Object Oriented languages - Classes and Methods - Design issues - implementation - Functional Programming - Delayed Evaluation - Recursive functions - Lambda Calculus.

Reading:

1. Kenneth C. Louden, *Programming Language Principles and Practices,* 2nd Edition, Thomson 2003.
2. Carlo Ghezzi, Mehdi Jazayeri, *Programming Language Concepts,* 3rd Edition, John Wiley & Sons, 1997.

CS373 **UNIX TOOLS AND PROGRAMMING** (3-0-0)3

Shell programming - Unix commands - Text processing - sed and awk utilities - grep utility - Introduction to Lex, Yacc utilities - Introduction to Perl programming.

Reading:

1. Sumitabha Das, Unix Concepts and Applications, 4th Edition, TMH, 2006.
2. John R Levine, Tony Mason, Doug Brown, Lex and Yacc, 2nd Edition, 2009.

CS381 **ADVANCED DATA STRUCTURES** (3-0-0)3

Dictionaries - Review of Hashing - Closed Hashing, Analysis of Closed Hashing, Hash Table Restructuring - Skip Lists and Analysis - Height Balanced Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees - Augmenting Data Structures (Chap. 14, Book 2) - van Emde Boas Trees - Strings and Pattern Matching - Suffix Trees - Tries - Text Compression, Text Similarity Testing - Range Trees, Priority Search Trees, Quadtrees and k-D trees.

Reading:

1. Mark Allen Weiss, *Data Structures and Algorithm Analysis in C++,* 2nd Edition, Pearson, 2004.
2. M T Goodrich, *Roberto Tamassia, Algorithm Design,* John Wiley, 2002.

CS382 **ADVANCED DATABASES** (3-0-0)3

Distributed Databases: Query processing, semi-joins, query optimization, Concurrency control Heterogeneity issues. Advanced Transaction Models: Save-points, Sagas, Nested Transactions, Multi Level Transactions. Recovery: Multi-level recovery, Shared disk systems, Distributed systems 2PC, 3PC, replication and hot spares. Recursive query processing: Top-down and bottom-up evaluation, Magic optimization. Parallel Databases: Parallel Architectures, performance measures, shared nothing/shared disk/shared memory based architectures, Data partitioning, Intra-operator parallelism, Pipelining, Scheduling, Load balancing, query optimization.

Reading:

1. M. Stonebraker, *Readings in Database Systems,* 2nd Edition, Morgan Kauffman, 1993.
2. M T Ozsu, Patrick Valduriez, *Principles of Distributed Database Systems,* Prentice Hall, 1999
3. S. Ceri and G. Pelaggati, *Distributed Database System Principles and Systems,* MGH, 1985.

CS383 **ADVANCED DATA MINING TECHNIQUES** (3-0-0)3

Sequential Pattern Mining concepts, primitives - Scalable Methods in Sequential Pattern Mining - Mining Time Series Data - Periodicity Analysis for Time Related Sequence Data - Mining Data Streams - Class Imbalance Problem - Graph Mining - Web Mining - Privacy Preserving Data Mining - Social Networks;

Reading:

1. J Han and M Kamber, *Data Mining Concepts and Techniques,* 2nd Edition, Elsevier, 2011
2. Pang Ning Tan, M Steinbach, Vipin Kumar, *Introduction to Data Mining,* Addision Wesley, 2006;
3. G Dong and J Pei, S*equence Data Mining,* Springer, 2007.

CS401 **DISTRIBUTED COMPUTING** (4-0-0)4

A model of distributed computations, Logical and physical times and clock synchronization, Global state and snapshot recording algorithms, Message ordering and group communication, Termination detection algorithms, Distributed mutual exclusion algorithms, Deadlock detection in distributed systems, Distribued shared memory, Check pointing and rollback recovery, Consensus and agrrement algorithms, Failure detectors.

Reading:

1. Ajay D. Kshemakalyani, Mukesh Singhal, *Distributed Computing*, Cambridge University Press, 2008.
2. Andrew S. Tanenbaum, Maarten Van Steen, *Distributed Systems - Principles and Paradigms,* PHI, 2004.

CS402 **CRYPTOGRAPHY AND NETWORK SECURITY** (4-0-0)4

Public key Cryptographic Algorithms for larger key sizes, Public key Cryptographic Algorithms using GMP Library for larger key sizes. Network Layout Discovery, Node Discovery, tcpdump, nmap, traceroute. Packet Sniffing, Intrusion Detection System - Snort. Security Vulnerabilities in SSL/TLS - OpenSSL, stunnel, Omen, Demonstration of SSL attacks, SQL Injection Demonstration. Block Ciphers and Encryption of "large" files using different Modes of Operation. Usage of Steganographic Tools, Identifying the System vulnerabilities using Vulnerability Detection Tools and National Vulnerability Database.

Reading:

1. Eric Cole, Dr. Ronald Kurtz and James W. Conley, *Network Security Bible,* Wiley Publishers, 2009.
2. Jason Albanese and Wes Sonnenreich, *Network Security Illustrated,* MGH Publishers, 2003.
3. Eric Maiwald, *Network Security: A Beginner's Guide,* 3rd Edition, MGH/Osborne, 2012.

ME435 **INDUSTRIAL MANAGEMENT** (3-0-0)3

Management theory and practice: functions of management; Hawthorne Experiments, leadership styles and motivational theories. Marketing management: Marketing management process, product life cycle and marketing strategies. Operations management: Productivity and work study, operations strategy, statistical process control, Taguchi's parametric design, Quality function deployment, Introduction to TQM and ISO 9000. inventory costs, ABC classification, EOQ, P and Q inventory systems. Project management: project planning and feasibility analysis, project scheduling methods.

Reading:

1. Koontz., H. et al., *Essentials of Management,* 7th Edition, MGH, New York, 2007.
2. Philip Kotler., *Marketing Management,* 13th Edition, Prentice Hall of India/Pearson, New Delhi, 2009.
3. Chase, Shankar, Jacobs and Aquilano, *Operations and Supply Management,* 12th Edition, Tata McGraw Hill, New Delhi, 2010.

CS411 **BUSINESS INTELLIGENCE** (3-0-0)3

Overview of managerial, strategic and technical issues associated with Business Intelligence and Data Warehouse - design, implementation and utilization. Data warehouse architecture, OLAP, data cubes, Reporting tools, Balance Scorecard, dash board design, and implementation, case studies.

Reading:

1. Efraim Turban, Ramesh Sharda, Jay Aronson, David King, *Decision Support and Business Intelligence Systems,* 9th Edition, Pearson Education, 2009.
2. David Loshin, *Business Intelligence - The Savy Manager's Guide Getting Onboard with Emerging IT,* Morgan Kaufmann Publishers, 2009.

CS412 **GAME THEORY** (3-0-0) 3

Basic Solution concepts and Computational Issues - The complexity of Nash Equilibria - Equilibrium Computation for Two-Player Games in Strategic and Extensive Form - Learning, Regret Minimization, and Equilibria - Combinatorial Algorithms for Market Equilibria - Computation of Market Equilibria by Convex Programming - Graphical Games;

Reading:

1. Noam Nisan, Tim Roughgarden, Eva Tardos, Vijay V. Vazirani, *Algorithmic Game Theory,* Cambridge University Press, September 2007.
2. Ronald Cohn Jesse Russell, *Algorithmic Game Theory,* VSD Publishers, 2012.

CS413 **PATTERN RECOGNITION** (3-0-0)3

Classifiers Based on Bayes Decision Theory - Linear classifiers - Non linear classifiers - Feature Selection - Dimensionality Reduction and Feature Generation - Template Matching - Markov Chain and Hidden Markov Model - System Evaluation - Unsupervised Learning and Clustering;

Reading:

1. S.Theodoridis and K. Koutroumbas, P*attern Recognition*, 4th Edition, Academic Press, 2009.
2. C.Bishop, *Pattern Recognition and Machine Learning,* Springer, 2006.

CS414 **SEMANTIC WEB** (3-0-0)3

The Semantic Web Vision, overview of techniques and standards, Semantic Web Architecture, Ontology languages- XML, RDF (Resource Description Framework), RDFS (RDF Schema) and OWL (Web Ontology Language), Ontology Development using Protege editor, Ontology Querying, Ontology Reasoning and Description Logic (DL), Semantic Web Application Areas, Ontology programming with Jena API, Ontology Engineering.

Reading:

1. Grigoris Antoniou and Frank van Harmelen, *A Semantic Web Primer,* 1st Edition, MIT Press, 2004.
2. John Hebeler, Matthew Fisher, *Ryan Blace and Andrew Perez-Lopez, Semantic Web Programming,* 1st Edition, Wiley, 2009.

CS421 **SECURE SOFTWARE ENGINEERING** (3-0-0)3

Software security Definition, Threats and Vulnerabilities, Risk Management, Security Requirements, Secure Design Principles and Patterns, Secure Programming: Data validation, Secure Programming: Using Cryptography Securely, Code Reviews and Static Analysis, Security Testing, Creating a Software Security Programs.

Reading:

1. Julia H Allen, Sean J Barnum, Robert J Ellison, Gary McGraw, Nancy R Mead, *Software Security Engineering: A Guide for Project Managers,* Addison Wesley, 2008
2. Ross J Anderson, *Security Engineering: A Guide to Building Dependable Distributed Systems,* 2nd Edition, Wiley, 2008.
3. Howard, M. and LeBlanc, D., *Writing Secure Code,* 2nd Edition, Microsoft Press, 2003.

CS422 **DISTRIBUTED OBJECT TECHNOLOGIES** (3-0-0)3

Introduction to client/server computing, CORBA with Java, DCOM, Introduction to C# and .NET platform, Java Bean component model, EJB and CORBA.

Reading:

1. Robert Orfali and Dan Harkey, *Client/Server Programming with Java and CORBA,* 2nd Edition, John Wiley & Sons, 1998.
2. Robert J. Oberg, *Introduction to C# Using* .NET, Prentice Hall, 2002
3. G. Brose, A Vogel, K Duddy, *Java Programming with CORBA,* 3rd Edition, Wiley, 1998.

CS423 **DESIGN PATTERNS** (3-0-0) 3

Introduction. - A Case Study: Designing a Document Editor - Design Pattern Catalog - Creational Patterns - Structural Pattern - Behavioral Patterns. What to Expect from Design Patterns, a Brief History, and the Pattern Community.

Reading:

1. Erich Gamma, *Design Patterns,* Addison-Wesley, 1994.
2. Frank Buschmann, RegineMeunier, Hans Rohnert, Peter Sommerlad, Michael Stal, *Pattern-Oriented Software Architecture: A System of Pattern,* John Wiley & Sons; 1996.

CS424 **ADVANCED COMPILER DESIGN** (3-0-0) 3

Loop optimizations - Register allocation - Local methods, Graph colouring, Code scheduling Software pipelining, Inter procedural dataflow analysis, Optimizing for memory Hierarchies.

High performance systems - Scalar, vector, multiprocessor, SIMD, Message Passing Architectures. Sequential and parallel loops. Data dependence Use-Def chains. Dependence system, GCD test, Banerjee's Inequality, Exact algorithm, Exact algorithm, Vectorization, Concurren-tization, Array region analysis, Loop restructuring transformations.

Reading:

1. Steven S. Muchnick, *Advanced Compiler Design and Implementation,* Morgan Kaufmann, Elsevier Science, 2003.
2. Michael Wolfe, *High Performance Compilers for Parallel Computing,* Addison Wesley, 1995.

CS451 **WIRELESS AND MOBILE COMPUTING** (3-0-0)3

Application Design Elements - Development Environments - Introduction to Objective-C - The MVC Model - The Delegate Pattern - The HTML5, iPhone, Android, and Blackberry SDKs- iOS - Windows Mobile - Wireless Communication Technologies -Cellular networks - Wireless (802.11) - TCP/IP in the mobile setting- The Unified Look and Feel Paradigm - The iPhone and Blackberry Human Interface Guidelines - Common User Interface Guidelines - Distributed Computing - Consistency and Reliability - Security Issues - Adhoc Networks - Sensor Networks - The Future of Mobile Computing - Upcoming Technologies - Convergence of Media and Communication Devices - Overview of Mobile Technologies - Anatomy of a Mobile Device.

Reading:

1. T. Mikkonen, *Programming Mobile Devices: An Introduction for Practitioners,* Wiley, 2007.
2. S. Hashimi, S. Komatineni, D. MacLean, *Pro Android 2*, Apress 2010.
3. D. Mark and J. LaMarche, *Beginning iPhone 3 Development: Exploring the iPhone SDK,* Apress, 2009.
4. Rizk, *Beginning BlackBerry Development,* Apress, 2009.

CS452 **MACHINE LEARNING AND SOFT COMPUTING** (3-0-0)3

The concept learning task. General-to-specific ordering of hypotheses. Version spaces. Inductive bias - Decision Tree Learning - Artificial Neural Networks- Perceptrons, Multilayer networks and backpropagation - Evaluating Hypotheses - Bayesian Learning - Computational Learning Theory - Instance-Based Learning - Radial basis function networks - Case-based learning - Genetic Algorithms - Reinforcement Learning.

Reading:

1. Tom Mitchell, *Machine Learning,* MGH International, 1997.
2. Ethem Alpaydin, *Introduction to Machine Learning,* Eastern Economy Edition, Prentice Hall of India, 2005.

CS461 **MODEL-DRIVEN FRAMEWORKS** (3-0-0)3

Traditional software engineering approach - drawbacks - Software processes - modular-based software design - Model-driven Architecture (MDA) - system modeling- MOF's metamodelling 4-layer hierarchy - domain specific modeling languages, UML profiles platforms - transformation - automated GUI generation - software

artifacts using UML standard modelling language - MDA Practice - Usage of QVT, Kermeta, etc. - MDA Transformation Languages - model editors- model validators - model metrics - modeling framework - middleware to support transformations - MDA applications.

Reading:

1. Thomas Stahl, Markus Voelter, *Model-Driven Software Development: Technology, Engineering, Management,* Wiley, 2006.
2. Anne Kleppe, Jos Warmer, and Wim Bast, *MDA Explained - The Model Driven Architecture: Practice and Promise,* Pearson Education, Boston, USA, 2003.

CS462 **SERVICE ORIENTED ARCHITECTURE** (3-0-0)3

SOA Fundamentals - SOA Planning and Analysis - SOA Design and implementation - Managing SOA Environment - SOA Security.

Reading:

1. Thomas Erl, *Service-Oriented Architecture: Concepts, Technology and Design,* Prentice Hall Publication, 2005.
2. Michael Rosen, Boris Lublinsky, *Applied SOA Service Oriented Architecture and Design Strategies,* Wiely India Edition, 2008.

CS463 **HETEROGENEOUS COMPUTING** (3-0-0) 3

Brief History of GPUs; An Overview of GPU, Programming; An Overview of GPU Memory Hierarchy Features;Introduction to Heterogeneous Computing - OpenCL; The OpenCL Kernel, The OpenCL Memory Model, The OpenCL Execution Model; OpenCL Platform and Devices; OpenCL Execution Environment, An Overview of OpenCL API; Heterogeneous Programming in OpenCL, An Overview of CUDA enabled NVIDIA GPUs, Introduction to CUDA C, Parallel Programming in CUDA C;

Reading:

1. Benedict R Gaster, Lee Howes, David R Kaeli Perhaad Mistry Dana Schaa, *Heterogeneous Computing with OpenCL,* MGH, 2011.
2. Jason Sanders, Edward Kandrot, *CUDA By Example - An Introduction to General-Purpose GPU Programming,* Addison Wesley, 2011.

CS464 **BIO-INFORMATICS** (3-0-0)3

Introduction and Biological databases - Introduction, Introduction to Biological databases, Sequence Alignment Database similarity searching, Multiple sequence alignment, Profiles and hidden Markov models, Molecular Phylogenetics, Genomics and Proteomics - Genome mapping, assembly and comparison, Functional genomics, Proteomics, Structural Bioinformatics.

Reading:

1. Jin Xiong, *Essential Bioinformatics,* Cambridge University Press 2011.
2. Arthur M.Lesk, *Introduction to Bioinformatics,* 2nd Edition, Oxford University Press, 2007.

CS465 **DNA COMPUTING** (3-0-0) 3

Introduction to DNA computing , Encoding information in DNA, Bio-operations, DNA models of computation, DNA algorithms, Error rates in DNA computing.

Reading:

1. Gheorghe Paun, Grzegorz Rozenberg, Artoo Salomaa, *DNA Computing Models,* Springer 2006.
2. Zoya Ignatova, Israel Matinez-perez, Karl-heinz Zimmermann, *DNA Computing Models,* Springer 2008.
3. Martyn Amos, *Theoretical and Experimental DNA Computation,* Springer, 2005.

CS471 **ADVANCED COMPUTER NETWORKS** (3-0-0)3

Wireless LAN, 802.11, DHCP, outing in the Internet, MOSTF DVMRP, IP Over ATM, Storage Area Networks, Traffic Engineering Planning, WAP, Tiny OS, NEST Cellular Network, Multimedia Over Internet, RTP, RSVP, Tuning RED for Web Traffic, XCP, Skype, Internet Telephony, Enterprise Network Secuirty, SNAT, DNAT.

Reading:

1. J. Walrend, *High Performance Communication Networks,* 2nd Edition, Maurgan Kauffmann, 1999.
2. D.E. Comer, *TCP/IP - Vol : I, II and III,* Pearson Education, 2008.

CS472 **COMPUTER VISION** (3-0-0)3

Human and Computer Vision. Introduction to Computer Vision and Image Processing. Image Representation and Modelling, Line and Edge detection, labelling, Image Segmentation. Object recognition, Scene and activity interpretation. Texture, color, stereo, and motion descriptors. Disambiguation and the achievement of invariances when inferring object properties from images. Approaches to face detection face recognition and facial interpretation, Wavelets, Robotic Vision.

Reading:

1. L. Shapiro and G. Stockman, Computer Vision, Prentice Hall, 2001.
2. David A. Forsyth, Jean Ponce, Computer Vision, PHI, 2003.

CS473 **SECURITY AND PRIVACY** (3-0-0)3

Introduction: Basic concepts: number theory, Formal analysis and design of algorithms and protocols. Provable Security, Cryptosystems; Privacy: Foundations of Privacy, Differential Privacy: Definitions and Early Uses, Privacy Regulations, Noiseless Differential Privacy, Privacy preserving Data Mining techniques.

Reading:

1. J. Thomas Shaw, *Information Security and Privacy,* ABA, 2012.
2. Matthew Bailey, *Complete Guide to Internet Privacy,* Anonymity & Security, Nerel Online, 2011.

CS474 **INFORMATION SECURITY AND AUDITING** (3-0-0)3

Computer Auditing: System Access Control, Data Access Control, Security Administration, System Design; Hardware Security Auditing, Software Security Auditing and controls - Security Policies. Database Security Auditing, Network and Telecommunication Security Auditing, Microcomputer Security Auditing.

Reading:

1. Deborah Russell, *Computer Security Basics,* O'Reilly & Associate, 1991.
2. Karen A. Forcht, *Computer Security Management,* Boyd & Fraser Publishing Co., 1994.
3. Donald A. Watne, Peter B.B. Turney, *Auditing EDP Systems,* 2nd Edition, PH 1990.

CS475 **REAL TIME SYSTEMS** (3-0-0)3

Real-Time Systems, Typical Real-Time Applications, Hard Versus Soft Real-Time Systems, A Reference Model of Real-Time Systems, Commonly Used Approaches to Hard Real-Time Scheduling, Clock-Driven Scheduling, Priority-Driven Scheduling of Periodic Tasks, Scheduling Aperiodic and Sporadic Jobs in Priority-Driven Systems, Resources and Resource Access Control, Multiprocessor Scheduling and Resource Access Control, Scheduling Flexible Computations and Tasks with Temporal Distance Constraints, Real-Time Communications, Operating Systems.

Reading:

1. Jane Liu, *Real-Time Systems,* Prentice Hall, 2000.
2. Philip.A.Laplante, *Real Time System Design and Analysis*, 3rd Edition, PHI, 2004.

CS481 **CLOUD COMPUTING** (3-0-0) 3

Introduction - SaaS - PaaS - HaaS - IaaS - Google Cloud Infrastructure - Google File System - Search engine - MapReduce - Amazon Web Services - REST APIs - SOAP API - Query API - User Authentication - Connecting to the Cloud - OpenSSH Keys - Tunneling / Port Forwarding - Simple Storage Service - S3, EC2 - Amazon Elastic Block Storage - EBS - Ubuntu in the Cloud - Apache Instances in EC2 - Amazon Cloud Services, EC2 Applications - Web application design - AWS EC2 Capacity Planning - Apache Servers - Mysql Servers - Amazon Cloud Watch - Monitoring Tools.

Reading:

1. Anothony T Velte, Toby J Velte, Robert Elsenpeter, *Cloud Computing: A Practical Approach,* MGH, 2010.
2. Gautam Shroff, *Enterprise Cloud Computing,* Cambridge, 2010.
3. Ronald Krutz and Russell Dean Vines, *Cloud Security,* 1st Edition, Wiley, 2010.

CS482 **SOCIAL NETWORK ANALYSIS** (3-0-0)3

Social Media- Descriptions and Definitions, Social Media Marketing - Theory and Practice, Online Marketing - Search Engine Marketing, Social Media Marketing (including Viral Marketing), Mobile Marketing, Web Analytics, Social Media Analytics - Criteria of Effectiveness , Metrics, Techniques (e.g., Social Network Analysis, Semantic Analysis, Online Sentiment Analysis),Tools, Social Media Management, Search engine optimization, Managing Big Data, Case Studies.

Reading:

1. Hansen, Derek, Ben Sheiderman, Marc Smith, *Analyzing Social Media Networks with NodeXL: Insights from a Connected World,* Morgan Kaufmann, 2011.
2. Avinash Kaushik, *Web Analytics 2.0: The Art of Online Accountability,* Sybex, 2009.
3. Marshall Sponder, *Social Media Analytics: Effective Tools for Building, Interpreting and Using Metrics,* 1st Edition, MGH, 2011.

CS483 **INTELLIGENT AGENTS** (3-0-0) 3

Introduction - Intelligent Agents- Solving problems by search - A* search-constraint satisfaction - adversarial search - logical agents - First order logic- inference using first order logic -Uncertainty-Probabilistic reasoning - Statistical learning methods- Bayesian learning - Learning with hidden variables - EM algorithm.

Reading:

1. Stuart Russell, Peter Norvig, *Artificial Intelligence - A Modern Approach,* 2nd Edition, Pearson, 2003.
2. Nils J Nilsson, *Artificial Intelligence : A New Synthesis,* Morgan Kaufmann Publications, 2000.

CS484 **BIG DATA ANALYSIS** (3-0-0)3

Overview of Big Data, Stages of analytical evolution, State of the Practice in Analytics, The Data Scientist, Big Data Analytics in Industry Verticals, Data Analytics Lifecycle, Operationalizing Basic Data Analytic Methods Using R, Advanced Analytics - Analytics for Unstructured Data - Map Reduce and Hadoop, The Hadoop Ecosystem, In-database Analytics, Data Visualization Techniques, Stream Computing Challenges, Systems architecture, Main memory data management techniques, energy-efficient data processing, Benchmarking, Security and Privacy, Failover and reliability.

Reading:

1. Bill Franks, *Taming The Big Data Tidal Wave,* 1st Edition, Wiley, 2012.
2. Frank J. Ohlhorst, *Big Data Analytics,*1st Edition, Wiley, 2012.

OPEN ELECTIVES

CE390 **ENVIRONMENTAL IMPACT ASSESSMENT** (3-0-0)3

Environment and its interaction with human activities Environmental imbalances, Concept of Environmental Impact Assessment (EIA), Environmental Impact Statement, EMP, Environmental Indicators Environmental issues of developmental projects, Environmental Issues in Industrial Development, Environmental impact of Highways, Mining and Energy development, Methodologies.

Reading:

1. Jain, R.K., Urban, L.V., Stracy, G.S., *Environmental Impact Analysis,* Van Nostrand Reinhold Co., New York, 1991.
2. Rau, J.G. and Wooten, D.C., *Environmental Impact Assessment,* McGraw Hill Pub. Co., New York, 1996.

EE390 **LINEAR CONTROL SYSTEMS** (3-0-0)3

Introduction- control system, types, feedback and its effects-linearization Mathematical Modelling of Physical Systems. Block diagram Concept and use of Transfer function. Signal Flow Graphs- signal flow graph, Mason's gain formula. Time Domain Analysis of Control Systems-, BIBO stability, absolute stability, Routh-Hurwitz Criterion. P, PI and PID controllers Root Locus Techniques- Root loci theory, Application to system stability studies. Frequency Domain Analysis of Control Systems- polar plots, Nyquist stability criterion, Bode plots, application of Bode plots.

Reading:

1. B.C. Kuo, *Automatic Control Systems*, 7th Edition, Prentice Hall of India, 2009.
2. I.J. Nagarath and M.Gopal: *Control Systems Engineering*, 2nd Edition, New Age Pub. Co. 2008.

ME390 **AUTOMOTIVE MECHANICS** (3-0-0)3

Automotive Engine Types and Classification, Engine Construction, Transmission System, Steering System, Suspension System, Fuel Injection System, Carburettors, Ignition System, Cooling System, Lubrication System, Fuel Feed System, Engine Testing and Performance, Emission Control System, Automotive electrical and Electronic Equipment, Engine Service System.

Reading:

1. Crouse, W. H., *Automotive Mechanics,* TMH, 2006.
2. Heitner Joseph, *Automotive Mechanics: Principles And Practices,* 2nd Edition, CBS Publishers, 2002.
3. James E. Duffy, *Modern Automotive Technology,* Goodheart-Wilcox Publisher, 2009.

ME391 **ROBUST DESIGN** (3-0-0)3

Fundamental of Experimentation, Simple comparative experiments, Experiments with single factor, ANOVA, Factorial and Fractional Factorial experiments, Orthogonal Arrays, Response Surface Methodology and Taguchi's Parameter Design.

Reading:

1. Ross P.J., *Taguchi Techniques for Quality Engineering,* McGraw-Hill Book Company, New York, 2008.
2. Montgomery D.C., *Design and Analysis of Experiments,* 7th Edition, John Wiley & Sons, New York, 2008.

ME392 **ENTREPRENEURSHIP DEVELOPMENT** (3-0-0)3

Entrepreneurship and Factors Affecting Entrepreneurial Growth. Role and qualities of entrepreneurs. Entrepreneurial development process and motivation, Small Enterprises, Sources of Finance; Identification of opportunities - Product planning and Development; Financial, Marketing and Project Management; Project Formulation - Techno-economic Feasibility, Business plan, Business Laws.

Reading:

1. G.G. Meredith, R.E. Nelson and P.A. Neek, *The Practice of Entrepreneurship*, ILO, 1982.
2. Desai, Vasant, *Management of Small Scale Enterprises,* Himalaya Publishing House, 2004.
3. *A Handbook for New Entrepreneurs*, Entrepreneurship Development Institute of India, Ahmedabad, 1989.

EC390/EC440 **COMMUNICATION SYSTEMS** (3-0-0)3

Classification of Signals, Fourier transform, Spectral density, Auto Correlation, Transmission of Signals through Linear Systems, Amplitude modulation, Angle modulation, Pulse analog modulation, Pulse digital modulation, Passband digital modulation schemes, Information theory, Error control coding.

Reading:

1. S. Haykin, *Communication Systems,* 2nd Edition, Wiley Eastern, 2001.
2. K.Sam Shanmugam, *Digital and Analog Communication Systems,* John Wiley & Sons, 2008
3. Wayne Tomasi, *Electronic Communication Systems,* 4th Edition, PHI/Pearson, 2004.

EC391/EC441 **MICROPROCESSOR SYSTEMS** (3-0-0)3

Over view of Micro Computer Structure and Operation, Microprocessor Evolution, 8086 Architecture, Memory Segmentation, addressing modes, Instruction set, Assembly language programming, Pin Descriptions,8086 Minimum Mode and Maximum Mode, Timing and Bus cycles, Memory interfacing. Interrupt Structure, Types,

Responses, Peripheral Interfacing- PPI, Hex keypad Interfacing, Display Interfacing, Interfacing A/D and D/A converters, Programmable Interval Timer (8254), Programmable Interrupt Controller (8259), DMA Technique, and Programmable Communication Interface (8251).

Reading:

1. Douglas V. Hall, *Microprocessors and Interfacing,* TMH, 2000.
2. Ray and Bhurchandi, A*dvanced Microprocessors and Peripherals,* 2nd Edition, Tata McGraw Hill Publishing Company, 2004.

EC392/EC442 **ELECTRONIC MEASUREMENTS AND INSTRUMENTATION SYSTEMS** (3-0-0)3

Measurement, Instrumentation and Calibration, classification of transducers, applications of measurement instrumentation, performance characteristics, errors in measurements, standards, static and dynamic characteristics of instruments, Transducer selection criteria, smart sensors, Measurement of displacement, strain, pressure, Acceleration, force, Torque, Temperature, flow, level and miscellaneous measurements, Signal Conditioning Circuits: Bridge circuits, Operational Amplifier circuits, Instrumentation Amplifier, filters, feedback fundamentals, Temperature balance, self balancing, servo operated, feedback Accelerometer systems. Introduction to PID controllers, Data Acquisition Display and Recording systems, Analog and digital converters, ROM, RAM, virtual Instrumentation

Reading:

1. D. V. S. Murty, *Transducers and Instrumentation,* PHI, 2004.
2. Arun K Ghosh, *Introduction to Measurements and Instrumentation,* PHI 2009.
3. H S Kalsi, *Electronic Instrumentation,* 3rd Edition, McGraw Hill Pub, 2001.

MM 390 **METALLURGY FOR NON-METALLURGISTS** (3-0-0)3

Structure of Metals and Alloys, Mechanical Properties and strengthening mechanisms, discovering metals-overview of metals, modern alloy production, fabrication and finishing of metal products, testing and inspection of metals, quality, steel products and properties, cast irons, heat treatment, tool steels and high speed steels, stainless steels, nonferrous metals, corrosion, durability of metals and alloys, the materials selection process.

Reading:

1. M.F. Ashby: *Engineering Materials,* 4th Edition, Elsevier, 2005.
2. R Balasubramaniam (Adapted): *Callister's Materials Science and Engineering,* 7th Edition, Wiley India (P) Ltd, 2007.
3. Reza Abbaschian, Lara Abbaschian, R E Reed-Hill: *Physical Metallurgy Principles,* Affiliated East-West Press, 2009.
4. V Raghavan: *Elements of Materials Science and Engineering - A First Course,* 5th Edition, PHI Publications, 2006.

CH390 **NANOTECHNOLOGY AND APPLICATIONS** (3-0-0)3

Introduction to nano sizes & properties, Quantum Mechanics, Chemical Kinetics at nanoscale, Nanomaterials: Fabrication, Nanomaterials: Characterization, Applications in electronics, Applications in chemical engineering, Nanobiology.

Reading:

1. Stuart M. Lindsay, *Introduction to Nanoscience,* Oxford University Press, 2009.
2. Sulabha K. Kulkarni, *Nanotechnology: Principles and Practices,* Capital Publishing Company, 2007.
3. Robert Kelsall, Ian Hamley, Mark Geoghegan, *Nanoscale Science and Technology,* John Wiley & Sons, 2005.

CH391 **INDUSTRIAL SAFETY AND HAZARDS** (3-0-0)3

Introduction - Toxicology - Relative toxicity - Industrial hygiene - Source models - Toxic release and dispersion models - Design basis - Pasquill-Gifford model - Fires and Explosions - The fire triangle - Sprays and Mists - Designs to prevent fires and explosions-Introduction to reliefs-Relief systems - Relief sizing - Process Hazards - Identification - Risk Assessment - Fault trees - Accident investigations - Layered investigations - Investigation Summary - Case Studies-System designs.

Reading:

1. D. A. Crowl and J.F. Louvar, *Chemical Process Safety (Fundamentals with Applications),* Prentice Hall, 2011.
2. R.K. Sinnott, Coulson and Richardson's *Chemical Engineering,* Vol. 6, Elsevier India, 2006.

BT390 **GREEN TECHNOLOGY** (3-0-0)3

Biomass energy, sources, uses, science and engineering aspects of Biomass energy, biomass electricity, production, storage and uses of biomass fuels. Market Barriers of Biomass fuels, Biomass fuel Standardization. Biomass fuel Life Cycle, Sustainability of Biomass fuels, Economics of Biomass fuels, Consideration of Co-Products.

Reading:

1. Ayhan Demirbas, *Green Energy and Technology, Biofuels, Securing the Planet's Future Energy Needs,* 1st Edition, Springer, 2009.
2. Jay Cheng, *Biomass to Renewable Energy Processes,* 1st Edition, CRC Press; 2009.
3. Samir K. Khanal, Rao Y. Surampalli, Tian C. Zhang, Buddhi P. Lamsal, R. D. Tyagi, C. M. Kao, *Bioenergy and Biofuel from Biowastes and Biomass,* 1st Edition, American Society of Civil Engineers, 2010.

SM 390 **MARKETING MANAGEMENT** (3-0-0)3

Nature and Scope of Marketing; Major Market oriented strategic planning. Corporate Mission and Vision. Concepts of strategic business units. BCG matrix and GE model; SWOT Analysis. Analyzing needs and trends in Macro environment. Marketing Information systems. Consumer Behavior and STP concept. New Product development process, product Life cycle, product and Branding Strategy, products mix and line decisions Brand decisions - Building brand.Pricing - Strategies and programmes, Marketing Channels - Distribution channels, Channel Design and Management decisions. Retailing Wholesaling and Logistics, Electronic Channels. Marketing promotion.

Reading:

1. Philip Kottler, *Marketing Management,* PHI, 2011.
2. William Stanton and Etzel, *Marketing Management,* TMH, 2010.
3. Ramaswami and Namakumari, *Marketing Management,* McMillan Publication, 2010.

MA390 **NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS** (3-0-0)3

Multistep methods - Linear and nonlinear BVP, Shooting methods - Finite difference methods for BVP - Classification of partial differential equations - Finite difference methods for Parabolic equations, Hyperbolic Equations, Laplace equation, Poisson equation.

Reading :

1. M.K. Jain, *Numerical Solution of Differential Equations,* Wiley Eastern, 1984.
2. G.D. Smith, *Numerical Solution of Partial Differential Equations,* Oxford Univ. Press, 2004.
3. M.K. Jain, S.R.K. Iyengar and R.K.Jain, *Computational Methods for Partial Differential Equations*, Wiley Eastern, 2005.

MA391 **FUZZY MATHEMATICS AND APPLICATIONS** (3-0-0)3

Crisp set theory - Fuzzy set theory - Propositional Logic - Predicate Logic - Fuzzy Relations - Fuzzy Logic - Switching functions and Switching circuits - Applications of fuzzy mathematics.

Reading:

1. M. Ganesh, *Introduction to Fuzzy Sets and Fuzzy Logic*, PHI, 2001.
2. G.J. Klir and B.Yuan, *Fuzzy Sets and Fuzzy Logic-Theory and Applications,* PHI, 1997.
3. T.J. Ross, *Fuzzy Logic with Engineering Applications,* McGraw-Hill, 1995.

PH390 **MEDICAL INSTRUMENTATION** (3-0-0)3

Human body - an overview - Cell - Body fluids. Origin of bio potentials- Electrical activity of Excitable cells. Electrocardio graph: heart and the circulatory system. Bio fluid mechanics- Pressures in the body. Blood pressure: direct measurement of blood pressure H_2O manometers. Blood flow volume and oxygenation measurement: Blood flow, dilution methods.

Reading:

1. Brown, B.H. et. al, *Medical Physics and Biomedical Engineering,* Institute of Physics Publishing, 1999.
2. John. G. Webster, *Medical Instrumentation: Application and Design,* 2nd Edition, John Wiley & Sons, New York, 1995.

PH391 **ADVANCED MATERIALS** (3-0-0)3

Nano Materials - Nano biology; Biomaterials - ceramics, dental materials; Composites; Optical materials - solar cells, CCDs, lasers; Super conducting materials - SQUIDS; Smart materials; SAW Materials and Electrets.

Reading:

1. T. Pradeep, *Nano: The Essentials;* Tata McGraw-Hill, 2008.
2. B.S. Murthy et al., *Textbook of Nano Science and Nanotechnology,* Universities Press, 2012.

CY390 **INSTRUMENTAL METHODS IN CHEMICAL ANALYSIS** (3-0-0)3

UV-visible spectrometry, Fluorescence, Atomic spectroscopy, Atomic absorption, X-ray fluorescence methods, Separation techniques, chromatographic techniques, High performance liquid chromatography, Size, exclusion chromatography, Capillary electrophoresis, Thermo gravimetric analysis, Differential thermal analysis, DSC, Electroanalytical methods, Molecular absorption spectroscopy, Mass spectrometry.

Reading:

1. Mendham, Denny, Barnesand Thomas, Vogel: *Text Book of Quantitative Chemical Analysis,* Pearson Education, 6th Edition, 2007.
2. Donald L. Pavia, Gary M Lanyman, *Introduction to Spectroscopy,* 3rd Edition, Thompson Publishers, 2008.
3. Krishan K Chawla, *Composite Materials;* 2nd Edition, Springer 2006.

CY391 **CHEMICAL ASPECTS OF ENERGY SYSTEMS** (3-0-0)3

Energy as the Key of Civilisation; Thermochemistry of Energy Sources and Kinteics of Energy Tapping; Conventional and Finite Energy Sources; Coal Based Energy Sources and Coal Carbonisation; Petroleum and Natural Gas; Biomass and Gobar Gas; Primary and Secondary Batteries, Reserve Batteries, Solid State and Molten Solvent Batteries, Lithium Ion Batteries;, Solar Energy Harnessing, Photogalvanic and Photovoltaic Energy Storage; Fuel Cells; Hydrogen as Future Fuel; Photochemical Water Cleavage; Green Energies.

Reading:

1. Tokio Ohta, *Energy Systems,* Elsevier Science, 2000.
2. R. Narayan and B. Viswanathan, *Chemical and Electrochemical Energy Systems,* Universities Press, 1998.

HS390 **SOFT SKILLS** (3-0-0)3

Soft Skills - definition - scope and importance - workplace communi-cation, process and barriers- Interpersonal and Intra-personal communi-cation skills- team building- emotional intelligence- developing self-esteem- time and stress management- group discussions, interviews, and presentation skills-résumé-writing - campus to company- dressing and grooming- Entrepreneurial Skills Development- Project.

Reading:

1. Robert M. Sheffield, Montgomery and Moody, *Developing Soft Skills,* F4th Edition, Pearson, 2009.
2. K. Alex, Soft Skills: *Know Yourself and Know the World,* S. Chand, 2009.
3. Gopalaswamy Ramesh, Mahadevan Ramesh, *The Ace of Soft Skills: Attitude, Communication and Etiquette for Success,* Pearson, 2010.

CE440 **BUILDING TECHNOLOGY** (3-0-0)3

Buildings - Grouping and circulation - lighting and ventilation - Termite proofing of buildings - Lightning protection of buildings - Fire protection of buildings - Vertical transportation - Prefabrication systems in residential buildings: Modular Coordination - Earthquake resistant structures - Air-conditioning and heating - Acoustics and Sound insulation - Plumbing services.

Reading:

1. Varghese - *Building Construction*, PHI Learning Pvt. Ltd., 2008.
2. Punmia B. C., Jain A. J. and Jain A.J., *Building, Construction*, Laxmi Publications, 2005.
3. *National Building Code of India*, Bureau of Indian Standards, 2005.

ME440 **ALTERNATIVE SOURCES OF ENERGY** (3-0-0)3

Non-conventional sources of energy, solar energy, basic sun-earth relationships, coordinates of the sun, solar radiation measurement and prediction,, solar thermal devices, photovoltaic power, fuel cells, wind energy, hydrogen energy, other forms of energy, nuclear, biomass, ocean and geothermal energy.

Reading:

1. Sukhatme S.P. and J.K.Nayak, *Solar Energy - Principles of Thermal Collection and Storage,* Tata- McGraw Hill, New Delhi, 2008.
2. Khan B.H., *Non-Conventional Energy Resources,* Tata McGraw Hill, New Delhi, 2006.
3. J.A. Duffie and W.A. Beckman, *Solar Energy - Thermal Processes,* John Wiley, 2001.

MM 440 **MATERIALS FOR ENGINEERING APPLICATIONS** (3-0-0)3

Classification of materials and properties, metallurgical aspects of materials, Significance of microstructural features, effect of cooling and heating rates and ageing materials for mechanical load bearing applications, corrosion resistant materials, materials for electrical, electronic, civil, biomedical applications.

Reading:

1. M.F. Ashby: *Engineering Materials,* 4th Edition, Elsevier, 2005.
2. M.F. Ashby: *Materials Selection in Mechanical Design,* Butterworth Heinemann, 2005.
3. ASM Publication Vol.20: *Materials Selection and Design,* ASM, 1997.
4. Pat L. Mangonon: *The Principles of Materials Selection and Design,* Prentice Hall International, Inc, 1999.

CH440 **INDUSTRIAL POLLUTION CONTROL** (3-0-0)3

Introduction- Air pollution- Meteorological aspects of air pollution- Air pollution sampling and measurement- Air pollution control methods and equipment- Control of specific gaseous pollutants- Sources and classification of water pollutants- sampling Waste water and analysis- Waste water treatment- Solid waste management - Hazardous waste management.

Reading:

1. Rao C.S., *Environmental Pollution Control Engineering,* Wiley Eastern Limited, India, 2006.
2. Noel de Nevers, *Air Pollution and Control Engineering,* McGraw Hill, 2010.
3. Glynn Henry J. and Gary W. Heinke, *Environmental Science and Engineering,* 2nd Edition, Prentice Hall of India, 2004.

CH441 **FUEL CELL TECHNOLOGY** (3-0-0)3

Overview of Fuel Cells, Fuels for Fuel Cells, Fuel Cell Process Design, Along the Electrode Models; Stack Design and Systems Integration.

Reading:

1. Gregor Hoogers, *Fuel Cell Technology Hand Book*, CRC Press, 2003.
2. Karl Kordesch and Gunter Simader, *Fuel Cells and their Applications,* VCH Publishers, NY, 2001.

BT440 **BIOSENSORS** (3-0-0)3

Introduction to Biosensors, Advantages and limitations, various components of biosensors, Types of Biosensors, Types of membranes used in biosensor constructions. Transducers in Biosensors: Various types of transducers; principles and applications of Biosensors.

Reading:

1. Donald G. Buerk, *Biosensors: Theory and Applications,* 1st Edition, CRC Press, 2009.
2. Jon Cooper, Tony Cass, *Biosensors: A Practical Approach*, 2nd Edition, Oxford University Press, 2004.
3. Bilitewski, U. Turner, A.P.F., *Biosensors for Environmental Monitoring,* 1st Edition, Harwood, 2006.

SM440 **HUMAN RESOURCE MANAGEMENT** (3-0-0)3

Introduction, Job Analysis, Employee Involvement, and Flexible Work Schedules, Human resource Planning, Recruitment and Careers, Employee Selection, Training and Development, Appraising and Improving Performance, Managing Compensation, Industrial relations, Disputes, Grievances and Discipline, International Human Resources Management.

Reading:

1. Gary Dessler and Biju Varkkey, *Human Resource Management,* Pearson Edition, 2011.
2. Bohlander George W, Snell Scott A, Veena Vohra, *Human Resource Management,* Cengage Learning. 2010.
3. Aswathappa, *Human Resource Management,* TMH, 2011.

MA440 **OPTIMIZATION TECHNIQUES** (3-0-0)3

Formulation of a LPP - Graphical Method - Simplex method - duality - dual simplex method - sensitivity analysis, transportation and assignment problems, traveling salesman problem - Lagrange multipliers and Kuhn-Tucker conditions - quadratic programming problem - Dynamic Programming - Integer Linear Programming.

Reading:

1. J.C.Pant, *Introduction to Optimization,* Jain Brothers, 2008.
2. S.S.Rao, *Optimization Theory and Applications,* Wiley Eastern, 2004.
3. K.V.Mittal, *Optimization Methods,* Wiley Eastern , 2003.
4. H.A.Taha, *Operations Research,* Pearson, 2007.

MA441 **OPERATIONS RESEARCH** (3-0-0)3

Formulation of a LPP - Graphical solution - Simplex method - revised simplex method - duality theory - Transportation problems - Single server queuing models - deterministic inventory control models - stochastic inventory control models.

Reading:

1. Kanti Swarup, Man Mohan and P.K.Gupta, *Introduction to Operations Research,* S. Chand & Co., 2006.
2. J.C.Pant, *Introduction to Operations Research,* Jain Brothers, New Delhi, 2008.
3. N.S.Kambo : *Mathematical Programming Techniques,* East-West Pub., Delhi, 1991.

PH440 **NANO MATERIALS AND TECHNOLOGY** (3-0-0)3

General properties of Nano materials - mechanical properties; Fullerenes and CNT's - Synthesis, physical properties; Investigation and manipulating materials in the Nanoscale - SAMs and clusters; Semi conducting Quantum Dots - Nanobiology- Nanosensors - Nanomedicines.

Reading:

1. T.Pradeep, *Nano: The Essentials;* TaTa McGraw-Hill, 2008.
2. W.R.Fahrner, *Nanotechnology and Nanoelectronics;* Springer, 2006.
3. B.S. Murthy et al., *Textbook of Nano Science and Nanotechnology,* Universities Press, 2012.
4. Rechard Booker and Earl Boysen, *Nanotechnology;* Willey, 2006.

PH441 **BIOMATERIALS AND TECHNOLOGY** (3-0-0)3

Overview of biomaterials; Structure and properties of biomaterials - surface properties of solids; Types of biomaterials - implant materials; Characterization of materials; Bio implantation materials - Materials in ophthalmology; Tissue response to implants.

Reading:

1. Joon park, R.S. Lakes, *Biomaterials - An Introduction*; 3rd Edition, Springer, 2007.
2. Sujatha V Bhat, *Biomaterials;* 2nd Edition, Narosa Publishing House, 2006.

CY440 **CORROSION SCIENCE** (3-0-0)3

Understanding Corrosion, types of corrosion, methods of corrosion monitoring, measurement of corrosion steel in reinforced cement concrete, corrosion rates of metals due to microbially induced corrosion, methods of corrosion prevention and control.

Reading:

1. R. Winston Revie, Herbert H. Uhlig, *Corrosion and Corrosion Control,* 4th Edition, Wiley Interscience, 2007.
2. Mc Caffety, Edward, *Introduction to Corrosion Science,* 1st Edition, Springer, 2010.

CY441 **CHEMISTRY OF NANOMATERIALS** (3-0-0)3

Synthesis, characterization, properties and applications of the following Nanomaterials, Fullerenes, Carbon nanotubes, Core-Shell Nanoparticles, Nanoshells, Self- assembled monolayers, and Monolayer Protected Metal Nanoparticles, Nanocrystalline materials, Magnetic Nanoparticles and Important properties in relation to nanomagnetic materials, Thermoelectric materials, Non-linear optical materials, liquid crystals.

Reading:

1. T Pradeep, *NANO: The Essentials,* MaGraw-Hill Edu., 2007.
2. Sulabha K. Kulakarni, *Nanotechnology (Principles, Properties and Applications),* Capital Pub.House, 2009.
3. C. N. R. Rao, *Nanomaterials Chemistry,* Achim Muller, K.Cheetham, Wiley-VCH, 2007.

HS440 **CORPORATE COMMUNICATION** (3-0-0)3

Importance of Communication in the Corporate World; Oral Communi-cation: a) Oral Fluency and Communication Techniques, b) Seminar skills and Presentation skills; Listening Skills; Writing for Career Purposes; Leadership Communication.

Reading:

1. Priyadarshi Patnaik, *Group Discussion and Interview Skills,* Cambridge University Press, 2011.
2. R.C. Sharma and Krishna Mohan, *Business Correspondence and Report Writing,* 3rd Edition, Tata McGraw-Hill, 2008
3. Patrick Hanks and Jim Corbett, *Business Listening Tasks,* Cambridge University Press, 1986.