VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

School of Computer Science and Engineering

CURRICULUM AND SYLLABI

(2018 - 2019)

B.Tech. Computer Science and Engg with Specialization in Bioinformatics

School of Computer Science and Engineering

B.Tech (CSE) with Specialization in Bioinformatics

CURRICULUM AND SYLLABI

(2018 - 2019 Admitted Students)

VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

Index

VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

- Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

- ***World class Education:*** Excellence in education, grounded in ethics and critical thinking, for improvement of life.
- ***Cutting edge Research:*** An innovation ecosystem to extend knowledge and solve critical problems.
- ***Impactful People:*** Happy, accountable, caring and effective workforce and students.
- ***Rewarding Co-creations:*** Active collaboration with national & international industries & universities for productivity and economic development.
- ***Service to Society:*** Service to the region and world through knowledge and compassion.

VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

VISION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

- To be a world-renowned centre of education, research and service in computing and allied domains.

MISSION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

- To offer computing education programs with the goal that the students become technically competent and develop lifelong learning skill.
- To undertake path-breaking research that creates new computing technologies and solutions for industry and society at large.
- To foster vibrant outreach programs for industry, research organizations, academia and society.

VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

School of Computer Science and Engineering

B.Tech – CSE with Specialization in Bioinformatics

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates will be engineering practitioners and leaders, who would help solve industry's technological problems.
2. Graduates will be engineering professionals, innovators or entrepreneurs engaged in technology development, technology deployment, or engineering system implementation in industry.
3. Graduates will function in their profession with social awareness and responsibility.
4. Graduates will interact with their peers in other disciplines in industry and society and contribute to the economic growth of the country.
5. Graduates will be successful in pursuing higher studies in engineering or management.
6. Graduates will pursue career paths in teaching or research.

VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

School of Computer Science and Engineering

B.Tech – CSE with Specialization in Bioinformatics

PROGRAMME OUTCOMES (POs)

1. Having an ability to apply mathematics and science in engineering applications.
2. Having a clear understanding of the subject related concepts and of contemporary issues.
3. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints.
4. Having an ability to design and conduct experiments, as well as to analyze and interpret data.
5. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice.
6. Having problem solving ability- solving social issues and engineering problems.
7. Having adaptive thinking and adaptability.

8. Having a clear understanding of professional and ethical responsibility.
9. Having cross cultural competency exhibited by working in teams.
10. Having a good working knowledge of communicating in English.
11. Having a good cognitive load management [discriminate and filter the available data] skills.
12. Having interest in lifelong learning.

VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

School of Computer Science and Engineering

B.Tech – CSE with Specialization in Bioinformatics

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. The ability to formulate mathematical models and problem-solving skills through programming techniques for addressing real-time problems using appropriate data structures and algorithms.
2. The ability to design hardware and software through system programming skills based on the knowledge acquired in the system software and hardware courses.
3. The ability to interpret relationships among living things and analyze the biological problems, from molecular to ecosystem level, solving them using basic biological concepts, algorithms, and tools available in computer science and to facilitate the biological database system.

VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

School of Computer Science and Engineering

B.Tech – CSE with Specialization in Bioinformatics

CREDIT STRUCTURE

Category Wise Credit Distribution

Category	*Credits*
University Core (UC)	70
Programme Core (PC)	58
Programme Elective (PE)	40
University Elective (UE)	12
Bridge Course (BC)	-
Non Credit Course	-
Total Credits	**180**

Programme Core	Programme Elective	University Core	University Elective	Total Credits
58	40	70	12	180

Course Code	Course Title	Course Type	L	T	P	J	C
PROGRAMME CORE							
BIT1004	Cell Biology and Biochemistry	ETL	3	0	2	0	4
BIT2001	Analytical Bioinformatics	ETL	3	0	2	0	4
CSE1003	Digital Logic and Design	ETL	3	0	2	0	4
CSE1005	Software Design and Development	ETLP	2	0	2	4	4
CSE2001	Computer Architecture and Organization	TH	3	0	0	0	3
CSE2003	Data Structures and Algorithms	ETLP	2	0	2	4	4
CSE2004	Database Management Systems	ETLP	2	0	2	4	4
CSE2005	Operating Systems	ETLP	2	0	2	4	4
CSE2006	Microprocessor and Interfacing	ETL	3	0	2	0	4
CSE3002	Internet and Web Programming	ETLP	2	0	2	4	4
CSE4001	Parallel and Distributed Computing	ETLP	2	0	2	4	4
EEE1001	Basic Electrical and Electronics Engineering	ETL	2	0	2	0	3
MAT1014	Discrete Mathematics and Graph Theory	TH	3	2	0	0	4
MAT2002	Applications of Differential and Difference Equations	ETL	3	0	2	0	4
MAT3004	Applied Linear Algebra	TH	3	2	0	0	4
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**J**	**C**
PROGRAMME ELECTIVE							
BIT1031	System Biology	TH	3	0	0	0	3
BIT2002	Biological Database	ETLP	3	0	0	4	4
BIT2003	Genomics and Proteomics	ETP	3	0	0	4	4
BIT3001	Computational Biology	ETP	3	0	0	4	4
BIT3002	Molecular Modelling and Drug Design	ETP	3	0	0	4	4
BIT3003	Molecular Evolution and Phylogeny	TH	3	0	0	0	3
CSE1004	Network and Communication	ETL	3	0	2	0	4
CSE1007	Java Programming	ETL	3	0	2	0	4
CSE2002	Theory of Computation and Compiler Design	TH	4	0	0	0	4
CSE3003	Micro Kernel OS	ETP	3	0	0	4	4
CSE3004	Storage Technologies	ETLP	2	0	2	4	4

Course Code	Course Title	Course Type	L	T	P	J	C
CSE3005	Advanced Computer Architecture	ETP	3	0	0	4	4
CSE3006	Embedded System Design	ETP	3	0	0	4	4
CSE3007	Foundation Skills in Product Development	ETP	3	0	0	4	4
CSE3008	Integrated Digital Design	ETP	3	0	0	4	4
CSE3009	Internet of Things	ETP	3	0	0	4	4
CSE3010	Real Time Systems	ETP	3	0	0	4	4
CSE3011	Robotics and its Applications	ETP	3	0	0	4	4
CSE3012	Algorithms for Computational Biology	ETP	3	0	0	4	4
CSE3013	Artificial Intelligence	ETP	3	0	0	4	4
CSE3014	Bio Inspired Computing	ETP	3	0	0	4	4
CSE3015	Business Intelligence	ETP	3	0	0	4	4
CSE3016	Computer Graphics and Multimedia	ETLP	2	0	2	4	4
CSE3017	Computer Vision	ETP	3	0	0	4	4
CSE3018	Content Based Image and Video Retrieval	ETLP	2	0	2	4	4
CSE3019	Data Mining	ETLP	2	0	2	4	4
CSE3020	Data Visualization	ETLP	2	0	2	4	4
CSE3021	Social and Information Networks	ETP	3	0	0	4	4
CSE3022	Soft Computing	ETP	3	0	0	4	4
CSE3023	Speech Technology	ETP	3	0	0	4	4
CSE3024	Web Mining	ETL	3	0	2	0	4
CSE3025	Large Scale Data Processing	ETLP	2	0	2	4	4
CSE3026	E-Learning Technologies	ETP	3	0	0	4	4
CSE3027	Electronic and Mobile Commerce	ETP	3	0	0	4	4
CSE3028	Functional Programming	ETLP	2	0	2	4	4
CSE3029	Game Programming	ETLP	2	0	2	4	4
CSE3030	Open Source Software	ETLP	2	0	2	4	4
CSE3031	Software Testing	ETLP	2	0	2	4	4
CSE3032	Software Project Management	ETP	3	0	0	4	4
CSE3033	Web Security	ELP	0	0	2	4	4
CSE3034	Nature Inspired Computing	ETP	2	0	0	4	3
CSE3501	Information Security Analysis and Audit	ETLP	2	0	2	4	4
CSE3502	Information Security Management	ETLP	2	0	2	4	4
CSE4002	Adhoc Wireless Networks	ETP	3	0	0	4	4
CSE4003	Cyber Security	ETP	3	0	0	4	4
CSE4004	Digital Forensics	ETL	3	0	2	0	4

Course Code	Course Title	Course Type	L	T	P	J	C
CSE4005	Green and Energy aware Computing	ETP	3	0	0	4	4
CSE4006	Haptic Technology	ETP	3	0	0	4	4
CSE4007	Mobile Computing	ETP	3	0	0	4	4
CSE4008	Mobile Pervasive Computing	ETP	3	0	0	4	4
CSE4009	Network Management System	ETP	3	0	0	4	4
CSE4010	Parallel Algorithms	ETP	3	0	0	4	4
CSE4011	Virtualization	ETP	3	0	0	4	4
CSE4012	Digital Signal Processing	ETP	3	0	0	4	4
CSE4013	Embedded Programming	ETLP	2	0	2	4	4
CSE4014	High Performance Computing	ETP	3	0	0	4	4
CSE4015	Human Computer Interaction	ETP	3	0	0	4	4
CSE4016	Multi-Core Architecture and Operating System	ETP	3	0	0	4	4
CSE4017	Software Hardware Co-Design	ETP	3	0	0	4	4
CSE4018	Advanced Analytics	ETLP	2	0	2	4	4
CSE4019	Image Processing	ETP	3	0	0	4	4
CSE4020	Machine Learning	ETLP	2	0	2	4	4
CSE4021	Modelling and Simulation	ETP	3	0	0	4	4
CSE4022	Natural Language Processing	ETP	3	0	0	4	4
CSE4023	Pattern Recognition	ETP	3	0	0	4	4
CSE4024	Advanced Java Programming	ETLP	2	0	2	4	4
CSE4025	Design Patterns	ETP	3	0	0	4	4
CSE4026	Intelligent Tutoring Systems	ETP	3	0	0	4	4
CSE4027	Mobile Programming	ETLP	2	0	2	4	4
CSE4028	Object Oriented Software Development	ETLP	2	0	2	4	4
CSE4029	Quantum Computing	ETP	3	0	0	4	4
CSE4030	Abstraction and its Applications	ETP	3	0	0	4	4
CSE4031	Game Theory	ETP	3	0	0	4	4
CSE4032	Search Technologies	ETP	3	0	0	4	4
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**J**	**C**
UNIVERSITY CORE							
BIT1003	Biology for Engineers	ETL	3	0	2	0	4
CHY1002	Environmental Sciences	TH	3	0	0	0	3
CHY1701	Engineering Chemistry	ETL	3	0	2	0	4
CSE1001	Problem Solving and Programming	LO	0	0	6	0	3

Course Code	Course Title	Course Type	L	T	P	J	C
CSE1002	Problem Solving and Object Oriented Programming	LO	0	0	6	0	3
CSE3099	Industrial Internship	PJT	0	0	0	0	2
CSE3999	Technical Answers for Real World Problems (TARP)	ETP	1	0	0	4	3
CSE4098	Comprehensive Examination	PJT	0	0	0	0	2
CSE4099	Capstone Project	PJT	0	0	0	0	20
ENG1011	English for Engineers	LO	0	0	4	0	2
ESP1001	ESPANOL FUNDAMENTAL	TH	2	0	0	0	2
ESP2001	ESPANOL INTERMEDIO	ETL	2	0	0	0	3
EXC1001	Service to the Society	ECA	0	0	0	0	2
EXC1002	Youth Red Cross	ECA	0	0	0	0	2
EXC1002	Red Cross	ECA	0	0	0	0	2
EXC1003	ABCD-AnyBody Can Dance	ECA	0	0	0	0	2
EXC1004	Entrepreneurs Cell	ECA	0	0	0	0	2
EXC1004	Building Entrepreneurship Competencies and Skills	ECA	0	0	0	0	2
EXC1005	Energy and Environmental Protection Club	ECA	0	0	0	0	2
EXC1006	Music - The Art of Culture	ECA	0	0	0	0	2
EXC1007	Sports for Healthy Life	ECA	0	0	0	0	2
EXC1008	Instrumentation for Engineers	ECA	0	0	0	0	2
EXC1009	Debating Skills	ECA	0	0	0	0	2
EXC1010	Mobility Engineering- Land, Air and Sea	ECA	0	0	0	0	2
EXC1011	Skills in Competitive Coding	ECA	0	0	0	0	2
EXC1012	Basics of Space Sciences	ECA	0	0	0	0	2
EXC1013	Roadmap to a Connected World	ECA	0	0	0	0	2
EXC1014	Dramatics Club	ECA	0	0	0	0	2
EXC1014	The Art of Acting	ECA	0	0	0	0	2
EXC1016	ASCE - VIT Student Chapter	ECA	0	0	0	0	2
EXC1017	Health Club	ECA	0	0	0	0	2
EXC1017	Health and Wellness	ECA	0	0	0	0	2
EXC1018	IETE - Student Chapter	ECA	0	0	0	0	2
EXC1018	Electronics and Telecommunication for Skill Development	ECA	0	0	0	0	2
EXC1019	The Fine Arts Club	ECA	0	0	0	0	2
EXC1019	Basic Art and Craft Techniques	ECA	0	0	0	0	2

Course Code	Course Title	Course Type	L	T	P	J	C
EXC1020	Skills on Creativity	ECA	0	0	0	0	2
EXC1021	Computer Society of India	ECA	0	0	0	0	2
EXC1021	Computer in Society	ECA	0	0	0	0	2
EXC1023	Hindi Literary Association	ECA	0	0	0	0	2
EXC1023	Hindi Arts and Literature	ECA	0	0	0	0	2
EXC1025	Toastmasters International - VIT Chapter	ECA	0	0	0	0	2
EXC1027	Power and Energy for Societal Development	ECA	0	0	0	0	2
EXC1028	VIT Community Radio	ECA	0	0	0	0	2
EXC1030	Make a Difference	ECA	0	0	0	0	2
EXC1030	Child Empowerment and Development	ECA	0	0	0	0	2
EXC1032	Fifth Pillar	ECA	0	0	0	0	2
EXC1032	Building Blocks of Democracy	ECA	0	0	0	0	2
EXC1033	Robotics for Engineers	ECA	0	0	0	0	2
EXC1034	Techloop	ECA	0	0	0	0	2
EXC1035	Association for Computing Machinery	ECA	0	0	0	0	2
EXC1035	Computing in Science and Engineering	ECA	0	0	0	0	2
EXC1049	Innovation for Engineering Applications	ECA	0	0	0	0	2
EXC1054	The Art and Skills of Photography	ECA	0	0	0	0	2
EXC1061	Skill Development in Manufacturing	ECA	0	0	0	0	2
EXC1068	Discussion through Media	ECA	0	0	0	0	2
EXC1069	Fep-Si	ECA	0	0	0	0	2
EXC1070	Working to Engineer a Better World	ECA	0	0	0	0	2
EXC1071	Culinary Crusade	ECA	0	0	0	0	2
EXC1072	VIT Film Society	ECA	0	0	0	0	2
EXC1072	The Art and Skills of Film Making	ECA	0	0	0	0	2
EXC1073	Women Engineers and Society	ECA	0	0	0	0	2
EXC1075	The Institution of Engineers (India)	ECA	0	0	0	0	2
EXC1075	ENGINEERING SKILLSET	ECA	0	0	0	0	2
EXC1076	Tamil Arts and Literature	ECA	0	0	0	0	2
EXC1077	National Cadet Corps (NCC)	ECA	0	0	0	0	2
EXC1078	VIT Spartans	ECA	0	0	0	0	2
EXC1078	Learning with Spartans	ECA	0	0	0	0	2
EXC1079	Anokha	ECA	0	0	0	0	2
EXC1079	Inception of Change	ECA	0	0	0	0	2
EXC1080	American Society of Mechanical Engineers	ECA	0	0	0	0	2

Course Code	Course Title	Course Type	L	T	P	J	C
EXC1081	Open Source Development for Google Applications	ECA	0	0	0	0	2
EXC1082	Telugu Literary Association	ECA	0	0	0	0	2
EXC1083	Mozilla Firefox	ECA	0	0	0	0	2
EXC1083	Open Source User Interface	ECA	0	0	0	0	2
EXC1084	Apple Developers Group	ECA	0	0	0	0	2
EXC1084	IOS Platform	ECA	0	0	0	0	2
EXC1085	Technology And Gaming Club (TAG)	ECA	0	0	0	0	2
EXC1087	Engineering in Medicine and Biology	ECA	0	0	0	0	2
EXC1088	Energy for Societal Development	ECA	0	0	0	0	2
EXC1090	Economic Development and Commercial Sciences	ECA	0	0	0	0	2
EXC1095	Skills in Financial Investment	ECA	0	0	0	0	2
EXC1097	Practical Fundamentals of Chemical Engineering	ECA	0	0	0	0	2
EXC1100	Experiential Learning of Energy Engineers	ECA	0	0	0	0	2
EXC1101	Mathsomania	ECA	0	0	0	0	2
EXC1102	Art of Research and Publication	ECA	0	0	0	0	2
EXC1107	Skills on Chemical Engineering	ECA	0	0	0	0	2
EXC1110	Engineering for Industrial Applications	ECA	0	0	0	0	2
EXC1111	TechEd	ECA	0	0	0	0	2
EXC1112	Research for Biotechnology	ECA	0	0	0	0	2
EXC1114	Communication in Technology and Networking	ECA	0	0	0	0	2
EXC1120	Creativity Club	ECA	0	0	0	0	2
EXC1121	Social Entrepreneurship	ECA	0	0	0	0	2
EXC1124	Humanitarian Service	ECA	0	0	0	0	2
EXC1126	Health and Literature for Society	ECA	0	0	0	0	2
EXC1127	Debating on Internal Issues	ECA	0	0	0	0	2
EXC1129	Uddeshya	ECA	0	0	0	0	2
EXC1129	Peer Educator Training Programme	ECA	0	0	0	0	2
EXC1132	The way of Living	ECA	0	0	0	0	2
EXC1134	Child Care and Education	ECA	0	0	0	0	2
EXC1135	Kannada Arts and Literature	ECA	0	0	0	0	2
EXC1157	Trekking Club	ECA	0	0	0	0	2
EXC4097	Co/Extra Curricular	ECA	0	0	0	0	2
FRE1001	Francais quotidien	TH	2	0	0	0	2
FRE2001	Francais progressif	ETL	3	0	2	0	4

Course Code	Course Title	Course Type	L	T	P	J	C
GER1001	Grundstufe Deutsch	TH	2	0	0	0	2
GER2001	Mittelstufe Deutsch	ETL	3	0	2	0	4
GRE1001	Modern Greek	TH	2	0	0	0	2
HUM1021	Ethics and Values	TH	2	0	0	0	2
JAP1001	Japanese for Beginners	TH	2	0	0	0	2
MAT1011	Calculus for Engineers	ETL	3	0	2	0	4
MAT2001	Statistics for Engineers	ETL	3	0	2	0	4
MGT1022	Lean Start-up Management	ETP	1	0	0	4	2
PHY1701	Engineering Physics	ETL	3	0	2	0	4
PHY1999	Introduction to Innovative Projects	TH	1	0	0	4	2
RUS1001	Russian for Beginners	TH	2	0	0	0	2
STS1001	Introduction to Soft Skills	SS	3	0	0	0	1
STS1002	Introduction to Business Communication	SS	3	0	0	0	1
STS1101	Fundamentals of Aptitude	SS	3	0	0	0	1
STS1102	Arithmetic Problem Solving	SS	3	0	0	0	1
STS1201	Introduction to Problem Solving	SS	3	0	0	0	1
STS1202	Introduction to Quantitative, Logical and Verbal Ability	SS	3	0	0	0	1
STS2001	Reasoning Skill Enhancement	SS	3	0	0	0	1
STS2002	Introduction to Etiquette	SS	3	0	0	0	1
STS2101	Getting Started to Skill Enhancement	SS	3	0	0	0	1
STS2102	Enhancing Problem Solving Skills	SS	3	0	0	0	1
STS2201	Numerical Ability and Cognitive Intelligence	SS	3	0	0	0	1
STS2202	Advanced Aptitude and Reasoning Skills	SS	3	0	0	0	1
STS3001	Preparedness for External Opportunities	SS	3	0	0	0	1
STS3004	Data Structures and Algorithms	SS	3	0	0	0	1
STS3005	Code Mithra	SS	3	0	0	0	1
STS3006	Preparedness for External Opportunities	SS	3	0	0	0	1
STS3007	Preparedness for Career Opportunit	SS	3	0	0	0	1
STS3101	Introduction to Programming Skills	SS	3	0	0	0	1
STS3104	Enhancing Programming Ability	SS	3	0	0	0	1
STS3105	Computational Thinking	SS	3	0	0	0	1
STS3201	Programming Skills for Employment	SS	3	0	0	0	1
STS3204	JAVA Programming and Software Engineering Fundamentals	SS	3	0	0	0	1

Course Code	Course Title	Course Type	L	T	P	J	C
STS3205	Advanced JAVA Programming	SS	3	0	0	0	1
STS3301	JAVA for Beginners	SS	3	0	0	0	1
STS3401	Foundation to Programming Skills	SS	3	0	0	0	1
STS5002	Preparing for Industry	SS	3	0	0	0	1
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**J**	**C**
BRIDGE COURSES							
BIT1001	Introduction to Life Sciences	TH	4	0	0	0	4
ENG1002	Effective English	LO	0	0	4	0	2
ENG1702	Effective English	LO	0	0	4	0	2
MAT1001	Fundamentals of Mathematics	TH	3	2	0	0	4

PROGRAMME CORE

(2018 - 2019)

B.Tech. Computer Science and Engg with Specialization in Bioinformatics

Course Code	Course Title	L	T	P	J	C
BIT1004	Cell biology and Biochemistry	3	0	2	0	4
Pre-requisite	NIL	Syllabus version				
		1.1				

Course Objectives:

1. Analyze cell structure and its functions
2. Illustrate the structure and functions of biomolecules
3. Distinguish the concept of central dogma, cell cycle and cell signaling

Expected Course Outcome:

1. Define and recall the cell structure and functions
2. Classify the cell constituents and biomolecules
3. Demonstrate the characteristic features, properties and types of macromolecules
4. Formulate the basic concepts of enzymes and its regulations
5. Elaborate the principles and regulations of replication, transcription and translation mechanism
6. Appraise the skills of cell cycle events and signal transduction process in cell, tissue and organlevel

Module:1	**Cell structure and Functions**	**6 hours**
Prokaryotic and eukaryotic cell structure; biomembrane, Transport across cell membranes – passive diffusion, facilitated diffusion, co-transport and active transport. Cell organelles, cytoskeleton structure and functions.		
Module:2	**Biomolecules**	**6 hours**
Types of macro molecules, metabolites and products. Properties of water. Cellular carbohydrates,lipids and their classification.		
Module:3	**Proteins**	**6 hours**
Classification and properties of amino acids. Peptides and structure of proteins.		
Module:4	**Enzymes**	**7 hours**
Classification, catalysis, properties, cofactors, coenzymes and inhibitors. Thermodynamics andkinetics - Michaelis-Menten equation. Regulatory enzymes.		
Module:5	**Nucleic acids**	**4 hours**
DNA and RNAs. Nucleoside and nucleotides. Structure, function and properties of nucleic acids.		
Module:6	**Central dogma**	**7 hours**
Transcription, translation and protein synthesis in organisms. Replication of DNA. Gene and chromosomal mutations.		
Module:7	**Cell cycle and signal transduction**	**7 hours**
Mitosis and meiosis. Cell cycle control system, regulation of check points by mitogens, cyclinsand cdks.		

Cell signaling and transport: Autocrine, paracrine and endocrine signaling molecules, secondary signaling molecules and signal transduction.

Module:8	**Contemporary issues :** Industrial expert lecture	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Harvey Lodish , Arnold Berk , Chris A. Kaiser , Monty Krieger, Anthony Bretscher, Hidde Ploegh, Angelika Amon ,Matthew P. Scott. 2012. Molecular Cell Biology 7th edition. W.H. Freeman. USA.

Reference Books

1.	Victor Rodwell, David Bender, Kathleen M. Botham, Peter J. Kennelly, P. Anthony Weil.2015. Harpers Illustrated Biochemistry 30th Edition. McGraw-Hill education, USA.
2.	Geoffrey M. Cooper and Robert E. Hausman. 2013. The Cell: A Molecular Approach. 6th edition. Sinauer Associates, Inc. USA.
3.	Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts and Peter Walter. 2014. Molecular Biology of the Cell. 6th edition. Garland Science, USA.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	Preparation of reagents, buffers and basic calculations.	3 hours
2.	Quantitative estimation of reducing sugars in samples.	3 hours
3.	Quantitative estimation of non-reducing sugars.	3 hours
4.	Quantitative estimation of proteins.	3 hours
5.	Functioning of microscopes; studying the diversity of cells using permanentslides.	3 hours
6.	Subjecting cells to different pH, concentrations and analyzing the structuralchanges occurring due to osmosis.	3 hours
7.	Growing root tips of different plants and comparing the chromosome number by fixing at metaphase stage.	3 hours
8.	Comparison of various stages of Meiosis I and Meiosis II during microsporogenesis of Rheo discolor.	3 hours
9.	Extraction of genomic DNA from a microbe/plant/animal cell.	3 hours
10	Quantification of DNA/RNA	3 hours
	Total Laboratory Hours	**30hours**

Mode of evaluation: Written examinations, assignments and quizzes

Recommended by Board of Studies	**03-08-2017**		
Approved by Academic Council	**No. 46**	**Date**	**23-08-2017**

Course Code	Course Title	L	T	P	J	C
BIT2001	Analytical Bioinformatics	3	0	2	0	4
Pre-requisite	Nil	Syllabus version				
		1.1				

Course Objectives:

1. Adapt basic knowledge on various techniques and areas of applications in bioinformatics.
2. Analyze common problem in bioinformatics, alignment techniques, ethical issues, publicdata sources, and evolutionary modelling.
3. Discover the practical use of tools for specific bioinformatic areas.

Expected Course Outcome:

1. Apply knowledge of bioinformatics in a practical project.
2. Develop the ability for critical assessment of scientific research publications in bioinformatics.
3. Build an understanding of the research process in general, such as research methods, scientific writing, and research ethics.
4. Evaluate the main databases at the NCBI and EBI resources
5. Compare the databases, tools, repositories and be able to use each one to extract specificinformation
6. Demonstrate the selected tools at NCBI and EBI to run simple analyses on genomic sequences.

Module:1	**Introduction to bioinformatics**	**3 hours**

Scope and applications of bioinformatics, Alignment of pairs of sequences; Introduction- Definition of sequence alignment, Methods - Dot matrix sequence comparison

Module:2	**Pairwise sequence alignment**	**6 hours**

Dynamic programming algorithm for sequence alignment – Global Alignment: Needleman- Wunsch, Local Alignment: Smith-Waterman , Gap penalty, Assessing the significance of analignment

Module:3	**Multiple sequence alignment**	**6 hours**

Dynamic programming, progressive methods, Iterative methods, MSA using CLUSTAL W,PILEUP and CLUSTAL X, purpose and applications of multiple sequence alignment

Module:4	**Scoring matrices**	**6 hours**

Similarity searches - PAM and BlOSUM matrix, Dayhoff mutation matrix, construction of PAM and BLOSUM matrix. Differences between PAM & BLOSUM

Module:5	**Database search methods**	**7 hours**

Database searching for similar sequences. Sequence similarity search, FASTA sequence databasesimilarity search, BLAST sequence database similarity search, other methods of comparing database of sequences and patterns.

Module:6	**Neural Networks**	**7 hours**

The Theory -Introduction – Priors & likelihoods - Learning algorithms: backpropagation - Neural Networks: Applications - Sequence encoding & output interpretation- Sequence correlations & neural

networks		
Module:7	**Hidden Markov Models**	**8 hours**
The Theory - Introduction -Prior information & initialization -Likelihood & basic algorithms -Learning algorithms -Applications of HMMs: general aspects -Protein applications		
Module:8	**Contemporary issues:** Industry Expert Lecture	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Bioinformatics: Sequence and Genome Analysis David W.Mount, David Mount
2.	Bioinformatics: the Machine Learning Approach – PierreBaldi and Søren Brunak Publisher: MIT Press.

Reference Books

1.	Hooman H Rashidi, Lukas K Buehler. Bioinformatics Basics -2000.
2.	Per Jambeck, Cynthia Gibas. Developing Bioinformatics Computer Skills. Computers – 2001.
3.	Bioinformatics Methods and Protocols: Methods and Protocols. edited by Stephen Misener, Stephen A Krawetz - Science – 1999.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	Retrieval of Data from Biological Database	3 hours
2.	Protein Sequence Retrieval – Uniprot	3 hours
3.	Retrieve all the mitochondrial nucleotide sequence and the GenBank details of the organism Indian muntjac using Entrez.	3 hours
4.	Global Pairwise Alignment	3 hours
5.	Smith-Waterman Algorithm - Local Alignment of Sequences	3 hours
6.	DotPlot esr1_human.	3 hours
7.	Detecting Repeats	3 hours
8.	Create a dotplot of gcr_human	3 hours
9.	BLAST Procedure	3 hours
10.	Multiple Sequence Alignment	3 hours
	Total Laboratory Hours	**30 hours**

Mode of Assessment : Assessments /Mid-Term/FAT			
Recommended by Board of Studies	**03-08-2017**		
Approved by Academic Council	**No. 46**	**Date**	**23-08-2017**

Course Code	Course Title	L	T	P	J	C
CSE1003	DIGITAL LOGIC AND DESIGN	3	0	2	0	4
Pre-requisite	NIL	Syllabus version				
		1.0				

Course Objectives:

1. Introduce the concept of digital and binary systems.
2. Analyze and Design combinational and sequential logic circuits.
3. Reinforce theory and techniques taught in the classroom through experiments in the laboratory.

Expected Course Outcome:

1. Comprehend the different types of number system.
2. Evaluate and simplify logic functions using Boolean Algebra and K-map.
3. Design minimal combinational logic circuits.
4. Analyze the operation of medium complexity standard combinational circuits like the encoder, decoder, multiplexer, demultiplexer.
5. Analyze and Design the Basic Sequential Logic Circuits
6. Outline the construction of Basic Arithmetic and Logic Circuits
7. Acquire design thinking capability, ability to design a component with realistic constraints, to solve real world engineering problems and analyze the results.

Module:1	**Introduction**	**3 hours**
Number System - Base Conversion - Binary Codes - Complements(Binary and Decimal)		
Module:2	**Boolean Algebra**	**8 hours**
Boolean algebra - Properties of Boolean algebra - Boolean functions - Canonical and Standard forms - Logic gates - Universal gates – Karnaugh map - Don't care conditions - Tabulation Method		
Module:3	**Combinational Circuit - I**	**4 hours**
Adder - Subtractor - Code Converter - Analyzing a Combinational Circuit		
Module:4	**Combinational Circuit –II**	**6 hours**
Binary Parallel Adder- Look ahead carry - Magnitude Comparator - Decoders – Encoders - Multiplexers –Demultiplexers.		
Module:5	**Sequential Circuits – I**	**6 hours**
Flip Flops - Sequential Circuit: Design and Analysis - Finite State Machine: Moore and Mealy model - Sequence Detector.		
Module:6	**Sequential Circuits – II**	**7 hours**
Registers - Shift Registers - Counters - Ripple and Synchronous Counters - Modulo counters -Ring and Johnson counters		
Module:7	**Arithmetic Logic Unit**	**9 hours**
Bus Organization - ALU - Design of ALU - Status Register - Design of Shifter - Processor Unit -Design of specific Arithmetic Circuits Accumulator - Design of Accumulator.		

Module:8	**Contemporary Issues: Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	M. Morris Mano and Michael D.Ciletti– Digital Design: With an introduction to Verilog HDL, Pearson Education – 5th Edition- 2014. ISBN:9789332535763.

Reference Books

1.	Peterson, L.L. and Davie, B.S., 2007. Computer networks: a systems approach. Elsevier.
2.	Thomas L Floyd. 2015. Digital Fundamentals. Pearson Education. ISBN: 9780132737968
3.	Malvino, A.P. and Leach, D.P. and Goutam Saha. 2014. Digital Principles and Applications (SIE). Tata McGraw Hill. ISBN: 9789339203405.
4.	Morris Mano, M. and Michael D.Ciletti. 2014. Digital Design: With an introduction to Verilog HDL. Pearson Education. ISBN:9789332535763

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	Realization of Logic gates using discrete components, verification of truth table for logic gates, realization of basic gates using NAND and NOR gates	4.5 hours
2.	Implementation of Logic Circuits by verification of Boolean laws and verification of De Morgans law	3 hours
3.	Adder and Subtractor circuit realization by implementation of Half-Adder and Full-Adder, and by implementation of Half-Subtractor and Full-Subtractor	4.5 hours
4.	Combinational circuit design i. Design of Decoder and Encoder ii. Design of Multiplexer and De multiplexer iii. Design of Magnitude Comparator iv. Design of Code Converter	4.5 hours
5.	Sequential circuit design i. Design of Mealy and Moore circuit ii.Implementation of Shift registers iii. Design of 4-bit Counter iv. Design of Ring Counter	4.5 hours
6.	Implementation of different circuits to solve real world problems: A digitally controlled locker works based on a control switch and two keys which are entered by the user. Each key has a 2-bit binary representation. If the control switch is pressed, the locking system will pass the difference of two keys into the controller unit. Otherwise, the locking system will pass the sum of the two numbers to the controller unit. Design a circuit to determine the input to the controller unit.	4.5 hours
7.	Implementation of different circuits to solve real world problems: A bank queuing system has a capacity of 5 customers which serves on first come first served basis. A display unit is used to display the number of customers waiting in the queue. Whenever a customer leaves the queue, the count is reduced by one and the count is increased by one if a customer joins a queue. Two sensors (control signals) are used to sense customers leaving and joining the queue respectively. Design a circuit that displays the number of customers waiting in the queue in binary format using LEDs. Binary 1 is represented by LED glow and 0 otherwise.	4.5 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: Project/Activity			
Recommended by Board of Studies	28-02-2017		
Approved by Academic Council	No. 46	Date	24-08-2017

Course Code	Course Title	L	T	P	J	C
CSE1005	Software Design and Development	2	0	2	4	4
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives :

1. To provide basic elements of software engineering principles, design and development.
2. To apply the basic theoretical software design principles to a group software development project.
3. To impart the knowledge in UML artifacts for requirements gathering, analysis as well as design phases using an object-oriented methodology.

Expected Course Outcome :

1 Comprehend the principles of the engineering processes in software development life cycle.
2 Implement the software development processes activities from requirements toImplementation.
3 Manage software projects through activities of planning and scheduling.
4 Familiarize themselves with the situations and motivations that call for using a range of design principles.
5 Apply good design and modern software development tools to work on the software projects.
6 Work in a team of on a small-to-medium-size software development project.

Module:1	**Introduction To Software Engineering**	**3 hours**
Software Engg. – Process, project and product – Process models: Classical and evolutionary.		
Module:2	**Introduction To Software Project Management**	**3 hours**
Planning – Scheduling – milestones – deliverables – risk assessment.		
Module:3	**Requirements Modeling**	**5 hours**
Requirements Elicitation – functional requirement – nonfunctional requirements – basics of object, class, instance – use case model – activity diagram-SRS standards.		
Module:4	**Introduction To Design**	**4 hours**
Introduction to Design: Basics of Design: Object oriented concepts – abstraction – modularity – cohesion –coupling – design principles.		
Module:5	**Structural Design**	**4 hours**
Structural Design : Architecture design – Data flow diagrams – User interface design – applications of DFD		
Module:6	**Object Based Design**	**4 hours**
Object Based Design: Introduction to sequence – state-class diagrams – Basics of components and design patterns – MVC pattern with applications – Basics of Software Architecture – Software Design Document (SDD) standards.		
Module:7	**Implementation, Deployment AndMaintenance**	**5 hours**
Mapping Design (Models) to Code – Testing - Usability – Deployment - Configuration Management – Maintenance		
Module:8	**Recent Trends In Software Design**	**2 hours**
Total Lecture hours:	**30 hours**	

Text Book(s)

1.	Roger Pressman, Software Engineering: A Practitioner's Approach, 7th Edition, McGraw-Hill, 2010.
2.	Carol Britton and Jill Doake, A Student Guide to Object-Oriented Development (Oxford: Elsevier, 2005)

Reference Books

1.	Ian Sommerville,Software Engineering, 9th Edition, Addision-Wesley, 2016 2) Pankaj Jalote, A Concise Introduction to Software Engineering, Springer, 2008
2.	Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, "Design patterns: Elements of Reusable object-oriented software", Addison-Wesley, 1995.
3.	Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 2nd Edition, Pearson Education, 2004.

Mode of Evaluation: CAT 1, CAT 2 & FAT

List of Challenging Experiments (Indicative)

1	Planning for the software development – Planning & Scheduling	3 hours
2	Data flow diagram for specific application.	3 hours
3	Entity Relationship Diagram, Context flow diagram, DFD (Structural Modelling and Functional Modelling)	3 hours
4	Use case model for specific application- Software requirements Specification – IEEE Standards.	3 hours
5	Activity diagram and its specifications	3 hours
6	Class diagram for specific application.	3 hours
7	Sequence diagram for specific application.	4 hours
8	Software Design Document with IEEE standards for specific applications.	4 hours
9	Implementation of a module in the design with tools and technology.	4 hours
	Total Laboratory Hours	**30 hours**

Mode of evaluation: Review 1, Review 2 & FAT

Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**No. 37**	**Date**	**16-06-2015**

Course Code	Course Title	L	T	P	J	C
CSE2001	Computer Architecture and Organization	3	0	0	0	3
Pre-requisite	CSE1003 Digital Logic Design	Syllabus version				
		1.0				

Course Objectives:

1. To acquaint students with the basic concepts of fundamental component, architecture, register organization and performance metrics of a computer.
2. To impart the knowledge of data representation in binary and understand implementation of arithmetic algorithms in a typical computer.
3. To teach students how to describe machine capabilities and design an effective data path design for instruction execution. To introduce students to syntax and semantics of machinelevel programming.
4. To make students understand the importance of memory systems, IO interfacing techniques and external storage and their performance metrics for a typical computer. Andexplore various alternate techniques for improving the performance of a processor.

Expected Course Outcome:

1. Differentiate Von Neumann, Harvard, and CISC and RISC architectures. Analyze theperformance of machines with different capabilities.
2. Illustrate binary format for numerical and characters. Validate efficient algorithm for arithmetic operations.
3. Construct machine level program for given expression on n-address machine. Analyze and calculate memory traffic for a program execution. Design an efficient data path for an instruction format for a given architecture.
4. Explain the importance of hierarchical memory organization. Able to construct larger memories. Analyze and suggest efficient cache mapping technique and replacement algorithms for given design requirements. Demonstrate hamming code for error detectionand correction.
5. Understand the need for an interface. Compare and contrast memory mapping and IO mapping techniques. Describe and Differentiate different modes of data transfer. Appraisethe synchronous and asynchronous bus for performance and arbitration.
6. Understand the structure and read write mechanisms for different storage systems. Illustrate and suggest appropriate use of RAID levels. Assess the performance of IO andexternal storage systems.
7. Classify parallel machine models. Illustrate typical 6-stage pipeline for overlapped execution. Analyze the hazards and solutions.

Module:1	Introduction and overview of computer architecture	3 hours

Introduction to computer systems - Overview of Organization and Architecture -Functionalcomponents of a computer -Registers and register files-Interconnection of components- Organization of the von Neumann machine and Harvard architecture-Performance of processor

Module:2	Data Representation And Computer Arithmetic	6 hours

Fixed point representation of numbers-algorithms for arithmetic operations: multiplication (Booths, Modified Booths) - division (restoring and non-restoring) - Floating point representation with IEEE standards and algorithms for common arithmetic operations- Representation of non-numeric data

(character codes).

Module:3	Fundamentals of Computer Architecture	11 hours

Introduction to ISA (Instruction Set Architecture)-Instruction formats- Instruction types and addressing modes- Instruction execution (Phases of instruction cycle)- Assembly language programming-Subroutine call and return mechanisms-Single cycle Data path design-Introduction to multi cycle data path-Multi cycle Instruction execution.

Module:4	Memory System Organization and Architecture	9 hours

Memory systems hierarchy-Main memory organization-Types of Main memory-memory inter- leaving and its characteristics and performance- Cache memories: address mapping-line size- replacement and policies- coherence- Virtual memory systems- TLB- Reliability of memory systems- error detecting and error correcting systems.

Module:5	Interfacing and Communication	7 hours

I/O fundamentals: handshaking, buffering-I/O techniques: programmed I/O, interrupt-driven I/O, DMA- Interrupt structures: vectored and prioritized-interrupt overhead- Buses: Syn- chronous and asynchronous- Arbitration.

Module:6	Device Subsystems	4 hours

External storage systems-organization and structure of disk drives: Electronic- magnetic and optical technologies- RAID Levels- I/O Performance

Module:7	Performance Enhancements	4 hours

Classification of models - Flynns taxonomy of parallel machine models (SISD, SIMD, MISD, MIMD)- Introduction to Pipelining- Pipelined data path-Introduction to hazards

Module:8	Contemporary issues: Recent Trends	1 hour

Multiprocessor architecture: Overview of Shared Memory architecture, Distributed architecture.

Total Lecture hours:	45 hours

Text Book(s)

1. David A. Patterson and John L. Hennessy Computer Organization and Design-The Hardware/Software Interface 5th edition, Morgan Kaufmann, 2013.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer organization, Mc Graw Hill, Fifth edition, Reprint 2011.

Reference Books

1. W. Stallings, Computer organization and architecture, Prentice-Hall, 8th edition, 2013

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	04-04-2014		
Approved by Academic Council	No. 37	Date	16-06-2015

Course code	Course Title	L	T	P	J	C
CSE2003	Data Structures and Algorithms	3	0	2	0	4
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

1. To understand the basic concepts of data structures and algorithms.
2. To differentiate linear and non-linear data structures and the operations upon them.
3. Ability to perform sorting and searchingin a given set ofdata items.
4. To comprehend the necessity of time complexity in algorithms.

Expected Course Outcome:

1. Understanding the fundamental analysis and time complexity for a given problem.
2. Articulate linear data structures and legal operations permitted on them.
3. Articulate non-linear data structures and legal operations permitted on them.
4. Applyinga suitable algorithm for searching and sorting.
5. Understanding graph algorithms, operations, and applications.
6. Understanding the importance of hashing.
7. Applying the basic data structures to understand advanced data structure operations and applications.
8. Application ofappropriate data structures to find solutions to practical problems.

Module:1	Introduction to Algorithms and Analysis	6 hours

Overview and importance of algorithms and data structures. Fundamentals of algorithm analysis, Space and time complexity of an algorithm, Types of asymptotic notations and orders of growth, Algorithm efficiency – best case, worst case, average case, Analysis of non-recursive and recursive algorithms, Asymptotic analysis for recurrence relation – Recursive Tree Method.

Module:2	Linear Data Structures	8 hours

Array- 1D and 2D array , Stack - Applications of stack: Expression Evaluation - Conversion of Infix to postfix and prefix expression, Tower of Hanoi.
Queue - Types of Queue: Circular Queue, Double Ended Queue (deQueue), Applications – Priority Queue using Arrays - List - Singly linked lists – Doubly linked lists - Circular linked lists, Applications - Polynomial Manipulation - Josephus problem(permutation)

Module:3	Sorting and Search Techniques	8 hours

Searching - Linear Search and binary search, Applications - Finding square root of 'n'-Longest Common Prefix Sorting – Insertion sort - Selection sort – Bubble sort – (Counting Sort) - Quick sort- Merge sort , Analysis, Applications - Finding the 'n' closest pair's

Module:4	Non-linear Data Structures - Trees	6 hours

Tree - Terminology, Binary Tree – Terminology and Properties, Tree Traversals, Expression Trees – Binary Search Trees – operations in BST – insertion, deletion, finding min and max, Finding the kth minimum element in a BST, Applications – Dictionary

Module:5	Non-linear Data Structures - Graphs	6 hours

Graph – basic definition and Terminology – Representation of Graph – Graph Traversal: Breadth First

Search (BFS), Depth First Search (DFS) - Minimum Spanning Tree: Prim's, Kruskal's- Single Source Shortest Path: Dijkstra's Algorithm.		
Module:6	**Hashing**	**4 hours**
Hash functions, open hashing-separate chaining, closed hashing - linear probing, quadratic probing, double hashing, random probing, rehashing, extendible hashing, Applications – Dictionary-Telephone directory		
Module:7	**Heaps and Balanced Binary Search Trees**	**5 hours**
Heaps - Heap sort, Applications -Priority Queue using Heaps AVL trees – Terminology - basic operations(rotation, insertion and deletion		
Module:8	**Recent Trends**	**2 hours**
Recent trends in algorithms and data structures		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms, Third edition, MIT Press, 2009.
2	Mark A. Weiss,Data Structures & Algorithm Analysis in C++, 3rd edition, 2008, PEARSON.
Reference Books	
1.	Kurt Mehlhorn, and Peter Sanders – Algorithms and Data Sturctures The Basic Toolbox, Springer-Verlag Berlin Heidelberg, 2008.
2.	Horowitz, Sahni, and S. Anderson-Freed , Fundamentals of Data Structures in C UNIVERSITIES PRESS, Second Edition, 2008.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Experiments (Indicative)

1.	Implementation of Stack and its applications	4 hours
2.	Implementation of queue and its applications	4 hours
3.	Linked List	4 hours
4.	Searching algorithm	2 hours
5.	Sorting algorithm – insertion, bubble, selection etc.	2 hours
6.	Randomized Quick sort and merge sort	2 hours
7.	Binary Tree traversals	2 hours
8.	Binary search tree	2 hours
9.	DFS, BFS	3 hours
10.	Minimum Spanning Tree – Prim's and Kruskal's	3hours
11.	Single source shortest path algorithm – Connected Components and finding a cycle in a graph	2 hours
	Total Laboratory Hours	**30 hours**

Mode of evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**09-09-2020**		
Approved by Academic Council	**No. 59**	**Date**	**24-09-2020**

Course Code	Course Title	L	T	P	J	C
CSE2004	Database Management System	2	0	2	4	4
Pre-requisite	NIL	Syllabus version				
		1.0				

Course Objectives:

1. To understand the concept of DBMS and ER Modeling.
2. To explain the normalization, Query optimization and relational algebra.
3. To apply the concurrency control, recovery, security and indexing for the real time data.

Expected Course Outcome:

1. Explain the basic concept and role of DBMS in an organization.
2. Illustrate the design principles for database design, ER model and normalization.
3. Demonstrate the basics of query evaluation and heuristic query optimization techniques.
4. Apply Concurrency control and recovery mechanisms for the desirable database problem.
5. Compare the basic database storage structure and access techniques including B Tree, B+Tress and hashing.
6. Review the fundamental view on unstructured data and its management.
7. Design and implement the database system with the fundamental concepts of DBMS.

Module:1	Database Systems Concepts And Architecture	5 hours

History and motivation for database systems -characteristics of database approach - Actors on the scene - Workers behind the scene - Advantages of using DBMS approach– Data Models, Schemas, and Instances– Three-Schema Architecture and Data Independence– The Database System Environment– Centralized and Client/Server Architectures for DBMSs– Classification of database management systems.

Module:2	Data Modeling	4 hours

Entity Relationship Model : Types of Attributes, Relationship, Structural Constraints – Relational Model, Relational model Constraints - Mapping ER model to a relational schema - Integrity constraints

Module:3	Schema Refinement	6 hours

Guidelines for Relational Schema – Functional dependency; Normalization, Boyce Codd NormalForm, Multi-valued dependency and Fourth Normal form; Join dependency and Fifth Normal form.

Module:4	Query Processing AndTransaction Processing	5 hours

Translating SQL Queries into Relational Algebra - heuristic query optimization - Introduction to Transaction Processing - Transaction and System concepts – Desirable properties of Transactions - Characterizing schedules based on recoverability - Characterizing schedules based on serializability

Module:5	Concurrency Control And Recovery Techniques	4 hours

Two-Phase Locking Techniques for Concurrency Control – Concurrency Control based on timestamp – Recovery Concepts – Recovery based on deferred update – Recovery techniques based on immediate update - Shadow Paging.

Module:6	Physical Database Design	3 hours

Indexing: Single level indexing, multi-level indexing, dynamic multilevel Indexing

Module:7	Recent Trends - Nosql Database Management	3 hours
Introduction, Need of NoSQL, CAP Theorem, different NoSQL data models: Key-value stores, Column families, Document databases, Graph databases		
Total Lecture hours:		30 hours

Text Book(s)

1.	R. Elmasri S. B. Navathe, Fundamentals of Database Systems, Addison Wesley, 2015
2.	Raghu Ramakrishnan, Database Management Systems, Mcgraw-Hill, 4th edition, 2015.

Reference Books

1.	A. Silberschatz, H. F. Korth S. Sudershan, Database System Concepts, McGraw Hill, 6th Edition 2010.
2.	Thomas Connolly, Carolyn Begg, Database Systems: A Practical Approach to Design, Implementation and Management,6th Edition,2012.
3.	Pramod J. Sadalage and Marin Fowler, NoSQL Distilled: A brief guide to merging world of Polyglot persistence, Addison Wesley, 2012.
4.	Shashank Tiwari, Professional NoSql,Wiley ,2011

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	DDL and DML	3 hours
2.	Single row and aggregate functions	3 hours
3.	Joins and Sub queries	3 hours
4.	Anonymous blocks and control structures	3 hours
5.	Iterations	3 hours
6.	Cursors	3 hours
7.	Functions and Procedures	3 hours
8.	Exception Handling and triggers	3 hours
9.	DBA Concepts	3 hours
10.	XML, DTD, XQuery Representations	3 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: Assessment/Mid-Term/FAT

Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**No. 37**	**Date**	**16-06-2015**

Course Code	Course Title	L	T	P	J	C
CSE2005	Operating Systems	2	0	2	4	4
Pre-requisite	NIL	Syllabus version				
		1.0				

Course Objectives:

1. To introduce the concept of Operating system concepts and designs and provide the skills required to implement the services.
2. To describe the trade-offs between conflicting objectives in large scale system design.
3. To develop the knowledge for application of the various design issues and services.

Expected Course Outcome:

1. Interpret the evolution of OS functionality, structures and layers.
2. Apply various types of system calls and to find the stages of various process states.
3. Design a model scheduling algorithm to compute various scheduling criteria.
4. Apply and analyze communication between inter process and synchronization techniques.
5. Implement page replacement algorithms, memory management problems and segmentation.
6. Differentiate the file systems for applying different allocation and access techniques.
7. Representing virtualization and Demonstrating the various Operating system tasks and the principle algorithms for enumerating those tasks.

Module:1	Introduction	2 hours

Introduction to OS: - Functionality of OS - OS Design issues - Structuring methods (monolithic, layered, modular, micro-kernel models) - Abstractions, processes, and resources - influence of security, networking, multimedia.

Module:2	OS Principles	3 hours

System Calls System/Application Call Interface - Protection User/Kernel modes – Interrupts Processes and Threads - Structures (Process Control Block, Ready List etc).

Module:3	Scheduling	5 hours

Processes Scheduling - CPU Scheduling - Pre-emptive non-pre-emptive - Resource allocation and management - Deadlocks Deadlock Handling Mechanisms.

Module:4	Concurrency	4 hours

Inter-process communication Synchronization - Implementing Synchronization Primitives Semaphores - Monitors - Multiprocessors and Locking - Scalable Locks - Lock-free Coordination.

Module:5	Memory management	5 hours

Main Memory management Memory allocation strategies Caching -Virtual Memory Hardware TLB - Virtual Memory OS techniques Paging Segmentation Page Faults Page Replacement ThrashingWorking Set.

Module:6	Virtualization	4 hours

Virtual Machines Virtualization (Hardware/Software, Server, Service, Network) Hypervisors -OS - Container Virtualization - Cost of virtualization.

Module:7	**File systems**	**3 hours**
File system interface - file system implementation File system recovery Journaling - Soft updatesLFS - Distributed file system.		
Module:8	**Security Protection and trends**	**4 hours**
Security and Protection - Mechanism Vs Policies Access and authentication - models of protection Memory Protection Disk Scheduling - OS performance, Scaling OS - Mobile OS: Recent Trends: - Future directions in Mobile OS / Multi-core Optimization /Power efficient Scheduling		
Total Lecture hours:		**30 hours**

Text Book(s)

1.	Abraham Silberschatz, Peter B.Galvin, Greg Gagne-Operating System Concepts, Wiley (2012).

Reference Books

1.	Ramez Elmasri, A Carrick, David Levine, Operating Systems, A Spiral Approach McGrawHill Science Engineering Math (2009).
2.	Remzi H. Arpaci-Dusseau, Andrea C. Arpaci-Dusseau, Operating Systems, Three Easy Pieces,Arpaci-Dusseau Books, Inc (2015).

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	Write a boot loader - to load a particular OS say TinyOS/ KolibriOS image - code to access from BIOS to loading the OS - involves little assembly code may use QEMU/virtual machines for emulation of hardware.	3 hours
2.	Allocate/free memory to processes in whole pages, find max allocatable pages, incorporate address translation into the program.	3 hours
3.	Create an interrupt to handle a system call and continue the previously running process after servicing the interrupt.	3 hours
4.	Write a Disk driver for the SATA interface. Take care to check readiness of the controller, locked buffer cache, accept interrupts from OS during the period, interrupting the OS again once done and clearing buffers.	3 hours
5.	Demonstrate the use of locks in conjunction with the IDE driver.	3 hours
6.	Run an experiment to determine the context switch time from one process to another and one kernel thread to another. Compare the findings.	3 hours
7.	Determine the latency of individual integer access times in main memory, L1 Cache and L2 Cache. Plot the results in log of memory accessed vs average latency.	3 hours
8.	Compare the overhead of a system call with a procedure call. What is the cost of a minimal system call?	3 hours
9.	Compare the task creation times. Execute a process and kernel thread, determine the time taken to create and run the threads.	3 hours
10.	Determine the file read time for sequential and random access based of varying sizes of the files. Take care not to read from cached data - used theraw device interface. Draw a graph log/log plot of size of file vs average per-block time.	3 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: Assessment/Mid-Term/FAT			
Recommended by Board of Studies	04-04-2014		
Approved by Academic Council	No. 37	Date	16-06-2015

Course Code	Course Title	L	T	P	J	C
CSE2006	Microprocessor And Interfacing	3	0	2	0	4
Pre-requisite	CSE1003-Digital Logic Design, CSE2001-Computer Architecture and Organization	Syllabus version				
		1.0				

Course Objectives:

1. Students will gain knowledge on architecture, accessing data and instruction from memory for processing.
2. Ability to do programs with instruction set and control the external devices through I/Ointerface
3. Generate a system model for real world problems with data acquisition, processing and decision making with aid of micro controllers and advanced processors.

Expected Course Outcome:

1. Recall the basics of processor, its ways of addressing data for operation by instruction set.
2. Execute basic and advanced assembly language programs.
3. Learn the ways to interface I/O devices with processor for task sharing.
4. Recall the basics of co-processor and its ways to handle float values by its instruction set.
5. Recognize the functionality of micro controller, latest version processors and its applications.
6. Acquire design thinking capability, ability to design a component with realistic constraints, to solve real world engineering problems and analyze the results.

Module:1	**Introduction To 8086 Microprocessor**	**6 hours**
Introduction to 8086, Pin diagram, Architecture, addressing mode and Instruction set		
Module:2	**Introduction To ALP**	**5 hours**
Tools- Assembler Directives, Editor, assembler, debugger, simulator and emulator. E.g., ALP Programs-Arithmetic Operations and Number System Conversions, Programs using Loops, If then else, for loop structures		
Module:3	**Advanced ALP**	**2 hours**
Interrupt programming using DOS BIOS function calls, File Management		
Module:4	**Introduction to Peripheral Interfacing-I**	**5 hours**
PPI 8255, Timer 8253, Interrupt controller-8259		
Module:5	**Introduction to Peripheral Interfacing- II**	**4 hours**
IC 8251 UART, Data converters (A/D and D/A Converter), seven segment display and key- board interfacing		
Module:6	**Co-Processor**	**4 hours**
Introduction to 8087, Architecture, Instruction set and ALP Programming		
Module:7	**Introduction to Arduino Boards**	**2 hours**
Introduction to Microcontroller- Quark SOC processor, programming, Arduino Boards using GPIO (LED, LCD, Keypad, Motor control and sensor), System design application and case study.		
Module:8	**Contemporary issues**	**2 hours**
Architecture of one of the advanced processors such as Multicore, Snapdragon, ARM processor iniPad		
Total Lecture hours:		**30 hours**

Text Book(s)	
1.	A.K. Ray and K.M. Bhurchandi Advanced Microprocessors and Peripherals, third Edition, Tata McGraw Hill, 2012.
2.	Barry B Bray, The Intel Microprocessor 8086/8088, 80186, 80286, 80386 and 80486 Arcitecture, programming and interfacing, PHI, 8th Edition, 2009.
Reference Books	
1.	Douglas V. Hall, SSSP Rao Microprocessors and Interfacing Programming and Hardware. Tata McGraw Hill, Third edition, 2012.
2.	Mohamed Rafiquazzaman, Microprocessor and Microcomputer based system design, Universal Book stall, New Delhi, Second edition, 1995
3.	K Uday Kumar, B S Umashankar, Advanced Micro processors IBM-PC Assembly Language Programming, Tata McGraw Hill, 2002.
4.	Massimo Banzi, Getting Started with Arduino, First Edition, pub. Weily, 2008.
5.	John Uffenbeck and 8088 Family. 1997. The 80x86 Family: Design, Programming, and Interfacing (2nd ed.). Prentice Hall PTR, Upper Saddle River, NJ, USA.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	Arithmetic operations 8/16 bit using different addressing modes.	2.5 hours
2.	Finding the factorial of an 8 /16 bit number.	2.5 hours
3.	(a) Solving nCr and nPr (b) Compute nCr and nPr using recursive procedure. Assume that n and r are non-negative integers	2.5 hours
4.	Assembly language program to display Fibonacci series	2.5 hours
5.	Sorting in ascending and descending order	2.5 hours
6.	(a) Search a given number or a word in an array of given numbers. (b) Search a key element in a list of n 16-bit numbers using the Binary search algorithm.	2.5 hours
7.	To find the smallest and biggest numbers in a given array.	2.5 hours
8.	ALP for number system conversions.	2.5 hours
9.	(a) String operations(String length, reverse, comparison, concatenation,palindrome)	2.5 hours
10.	ALP for Password checking	2.5 hours
11.	Convert a 16-bit binary value (assumed to be an unsigned integer) to BCD and display it from left to right and right to left for specified number of times	2.5 hours
12.	ALP to interface Stepper motor using 8086/ Intel Galileo Board	2.5 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: Assessments/Mid-Term/FAT

Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**No. 37**	**Date**	**16-06-2015**

Course Code	Course Title	L	T	P	J	C
CSE3002	Internet and Web Programming	2	0	2	4	4
Pre-requisite	CSE2004-Database Management System	Syllabus version				
		1.0				

Course Objectives:

1. To comprehend and analyze the basic concepts of web programming and internet protocols.
2. To describe how the client-server model of Internet programming works.
3. To demonstrates the uses of scripting languages and their limitations.

Expected Course Outcome:

After successfully completing the course the student should be able to

1. Differentiate web protocols and web architecture.
2. Apply JavaScript, HTML and CSS effectively to create interactive and dynamic websites.
3. Implement client side scripting using JavaScript.
4. Develop applications using Java.
5. Implement server side script using PHP, JSP and Servlets.
6. Develop XML based web applications.
7. Develop application using recent environment like Node JS, Angular JS, JSON and AJAX.

Module:1	Introduction To Internet	2 hours

Internet Overview- Networks - Web Protocols — Web Organization and Addressing - Web Browsers and Web Servers -Security and Vulnerability-Web System Architecture – URL – Domain Name – Client-side and server-side scripting.

Module:2	Web Designing	4 hours

HTML5 – Form elements, Input types and Media elements, CSS3 - Selectors, Box Model, Backgrounds and Borders, Text Effects, Animations, Multiple Column Layout, User Interface.

Module:3	Client-Side Processing And Scripting	7 hours

JavaScript Introduction –Functions – Arrays – DOM, Built-in Objects, Regular Expression, Exceptions, Event handling, Validation- AJAX - JQuery.

Module:4	Server Side Processing And Scripting – PHP	5 hours

Introduction to PHP – Operators – Conditionals – Looping – Functions – Arrays- Date and Time Functions – String functions - File Handling - File Uploading – Email Basics - Email with attachments.

Module:5	PHP Session Management And Database Connectivity	3 hours

Sessions-Cookies-MySQL Basics – Querying single and multiple MySQL Databases with PHP - PHP Data Objects.

Module:6	XML	4 hours

XML Basics – XSL, XSLT, XML Schema - JSON.

Module:7	Application Development using Node JS	4 hours

Introduction to Node.js- Installing Node.js - Using Events, Listeners, Timers, and Callbacks in Node.js – Introduction to Mongo DB- Accessing MongoDB from Node.js.

Module:8	**Industry Expert Talk**	**1 hour**
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	Paul Deitel, Harvey Deitel, Abbey Deitel, Internet & World Wide Web - How to Program, 5th edition, Pearson Education, 2012.
2.	Kogent Learning Solutions Inc, Web Technologies Black Book, Dream Tech press, 2013.
3.	Brad Dayley, Brendan Dayley, and Caleb Dayley , Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications, 2nd Edition, Pearson Education, 2018

Reference Books

1.	Lindsay Bassett, Introduction to JavaScript Object Notation, 1st Edition, O'Reilly Media, 2015
2.	Fritz Schneider, Thomas Powell , JavaScript – The Complete Reference, 3rd Edition, Mc-Graw Hill, 2017
3.	Steven Holzener , PHP – The Complete Reference, 1st Edition, Mc-Graw Hill, 2017
4.	Sandeep Kumar Patel, Developing Responsive Web Applications with AJAX and JQuery, Packt Publications, 2014

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	HTML basic tags, HTML forms, table, list, HTML frames and CSS internal,external and inline	4 hours
2.	JavaScript validation, DOM and Ajax	6 hours
3.	Java, Servlet and JSP	8 hours
4.	PHP : Forms and File handling, Session Management and Cookies,Databases	8 hours
5.	XML	4 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: Project/Activity

Recommended by Board of Studies	**19-11-2018**		
Approved by Academic Council	**No. 53**	**Date**	**13-12-2018**

Course Code	Course Title	L	T	P	J	C
CSE4001	Parallel and Distributed Computing	2	0	2	4	4
Pre-requisite	NIL	Syllabus version				
		1.0				

Course Objectives:

1. To introduce the fundamentals of parallel and distributed computing architectures and paradigms.
2. To understand the technologies, system architecture, and communication architecture that propelled the growth of parallel and distributed computing systems.
3. To develop and execute basic parallel and distributed application using basic programming models and tools.

Expected Course Outcome:

Students who complete this course successfully are expected to:

1. Design and implement distributed computing systems.
2. Asses models for distributed systems.
3. Design and implement distributed algorithms.
4. Experiment with mechanisms such as client/server and P2P algorithms, remote procedure calls (RPC/RMI), and consistency.
5. Analyse the requirements for programming parallel systems and critically evaluate the strengths and weaknesses of parallel programming models.
6. Differentiate between the major classes of parallel processing systems.
7. Analyse the efficiency of a parallel processing system and evaluate the types of application for which parallel programming is useful.

Module:1	Parallelism Fundamentals	2 hours

Motivation – Key Concepts and Challenges – Overview of Parallel computing – Flynn's Taxonomy – Multi-Core Processors – Shared vs Distributed memory.

Module:2	Parallel Architectures	3 hours

Introduction to OpenMP Programming – Instruction Level Support for Parallel Programming – SIMD – Vector Processing – GPUs.

Module:3	Parallel Algorithm and Design	5 hours

Preliminaries – Decomposition Techniques – Characteristics of Tasks and Interactions – Mapping Techniques for Load balancing – Parallel Algorithm Models.

Module:4	Introduction To Distributed Systems	4 hours

Introduction – Characterization of Distributed Systems – Distributed Shared Memory – Message Passing – Programming Using the Message Passing Paradigm – Group Communication – Case Study (RPC and Java RMI).

Module:5	Coordination	6 hours

Time and Global States – Synchronizing Physical Clocks – Logical Time and Logical Clock – Coordination and Agreement – Distributed Mutual Exclusion – Election Algorithms – Consensus and Related Problems.

Module:6	**Distributed Transactions**	**6 hours**
Transaction And Concurrency Control – Nested Transactions – Locks – Optimistic Concurrency Control – Timestamp Ordering Distributed Transactions – Flat and Nested – Atomic – Two Phase Commit Protocol – Concurrency Control.		
Module:7	**Distributed System Architecture and its Variants**	**2 hours**
Distributed File System: Architecture – Processes – Communication Distributed Web-based System: Architecture – Processes – Communication. Overview of Distributed Computing Platforms.		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, "Distributed Systems: Concepts and Design", 5th Edition, Pearson / Addison – Wesley, 2012
2.	Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, "Introduction to Parallel Computing", Pearson, 2nd Edition, 2008.

Reference Books

1.	Andrew S. Tanenbaum and Maarten Van Steen, "Distributed Systems: Principles and Paradigms", Pearson, 2nd Edition, 2006
2.	Pradeep K. Sinha, "Distributed Operating System: Concepts and Design", PHI Learning Pvt. Ltd., 2007

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	OpenMP – Basic programs such as Vector addition, Dot Product	2 hours
2.	OpenMP – Loop work-sharing and sections work-sharing	2 hours
3.	OpenMP – Combined parallel loop reduction and Orphaned parallel loop reduction	2 hours
4.	OpenMP – Matrix multiply (specify run of a GPU card, large scale data … Complexity of the problem need to be specified)	3 hours
5.	MPI – Basics of MPI	3 hours
6.	MPI – Communication between MPI process	3 hours
7.	MPI – Advanced communication between MPI process	3 hours
8.	MPI – Collective operation with 'synchronization'	3 hours
9.	MPI – Collective operation with 'data movement'	3 hours
10.	MPI – Collective operation with 'collective computation'	3 hours
11.	MPI – Non-blocking operation	3 hours
	Total Laboratory Hours	**30hours**

Mode of assessment: Project/Activity

Recommended by Board of Studies	**19-11-2018**		
Approved by Academic Council	**No. 53**	**Date**	**13-12-2018**

Course Code	Course Title	L	T	P	J	C
EEE1001	Basic Electrical and Electronics Engineering	2	0	2	0	3
Pre-requisite	NIL	Syllabus version				
		1.0				

Course Objectives:

1. To understand the various laws and theorems applied to solve electric circuits and networks
2. To provide the students with an overview of the most important concepts in Electrical and Electronics Engineering which is the basic need for every engineer

Expected Course Outcome:

1. Solve basic electrical circuit problems using various laws and theorems
2. Analyze AC power circuits and networks, its measurement and safety concerns
3. Classify and compare various types of electrical machines
4. Design and implement various digital circuits
5. Analyze the characteristics of semiconductor devices and comprehend the various modulation techniques in communication engineering
6. Design and conduct experiments to analyze and interpret data

Module:1	**DC circuits**	**5 hours**
Basic circuit elements and sources, Ohms law, Kirchhoff's laws, series and parallel connection of circuit elements, Node voltage analysis, Mesh current analysis, Thevenin's and Maximum power transfer theorem		
Module:2	**AC circuits**	**6 hours**
Alternating voltages and currents, AC values, Single Phase RL, RC, RLC Series circuits, Power in AC circuits-Power Factor- Three Phase Systems – Star and Delta Connection- Three Phase Power Measurement – Electrical Safety –Fuses and Earthing, Residential wiring		
Module:3	**Electrical Machines**	**7 hours**
Construction, Working Principle and applications of DC Machines, Transformers, Single phase and Three-phase Induction motors, Special Machines-Stepper motor, Servo Motor and BLDC motor		
Module:4	**Digital Systems**	**5 hours**
Basic logic circuit concepts, Representation of Numerical Data in Binary Form- Combinational logic circuits, Synthesis of logic circuits		
Module:5	**Semiconductor devices and Circuits**	**7 hours**
Conduction in Semiconductor materials, PN junction diodes, Zener diodes, BJTs, MOSFETs, Rectifiers, Feedback Amplifiers using transistors. Communication Engineering: Modulation and Demodulation - Amplitude and Frequency Modulation		
Total Lecture hours:		**30 hours**

Text Book(s)

1. John Bird, 'Electrical circuit theory and technology ', Newnes publications, 4th Edition, 2010.

Reference Books

1. Allan R. Hambley, 'Electrical Engineering -Principles & Applications' Pearson Education, First Impression, 6/e, 2013

2.	Simon Haykin, 'Communication Systems', John Wiley & Sons, 5 t h Edition, 2009.
3.	Charles K Alexander, Mathew N O Sadiku, 'Fundamentals of Electric Circuits', Tata McGraw Hill, 2012.
4.	Batarseh, 'Power Electronics Circuits', Wiley, 2003
5.	H. Hayt, J.E. Kemmerly and S. M. Durbin, 'Engineering Circuit Analysis', 6th Edition, Tata McGraw Hill, New Delhi, 2011.
6.	Fitzgerald, Higgabogan, Grabel, 'Basic Electrical Engineering', 5th Edition, McGraw Hill, 2009.
7.	S.L.Uppal, 'Electrical Wiring Estimating and Costing ', Khanna publishers, NewDelhi, 2008.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	Thevenin's and Maximum Power Transfer Theorems – Impedance matching of source and load	3 hours
2.	Sinusoidal steady state Response of RLC circuits	3 hours
3.	Three phase power measurement for ac loads	3 hours
4.	Staircase wiring circuit layout for multi storey building	3 hours
5.	Fabricate and test a PCB layout for a rectifier circuit	3 hours
6.	Half and full adder circuits.	3 hours
7.	Full wave Rectifier circuits used in DC power supplies. Study the characteristics of the semiconductor device used	3 hours
8.	Regulated power supply using zener diode. Study the characteristics of the Zener diode used	3 hours
9.	Lamp dimmer circuit (Darlington pair circuit using transistors) used in cars. Study the characteristics of the transistor used	3 hours
10.	Characteristics of MOSFET	3 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	**29/05/2015**		
Approved by Academic Council	**37th AC**	Date	**16/06/2015**

Course Code	Course Title	L	T	P	J	C
MAT1014	Discrete Mathematics and Graph Theory	3	2	0	0	4
Pre-requisite	Nil	Syllabus Version				
		1.0				

Course Objectives:

1. To address the challenge of the relevance of lattice theory, coding theory and algebraic structures to computer science and engineering problems.
2. To use number theory, in particular congruence theory to cryptography and computer science problems.
3. To understand the concepts of graph theory and related algorithm concepts.

Expected Course Outcome:

At the end of this course, students are expected to

1. form truth tables, proving results by truth tables, finding normal forms,
2. learn proof techniques and concepts of inference theory
3. understand the concepts of groups and application of group codes, use Boolean algebra for minimizing Boolean expressions.
4. learn basic concepts of graph theory, shortest path algorithms, concepts of trees and minimum spanning tree and graph colouring, chromatic number of a graph.
5. Solve Science and Engineering problems using Graph theory.

Module:1	**Mathematical Logic and Statement Calculus**	**6 hours**
Introduction-Statements and Notation-Connectives–Tautologies–Two State Devices and Statement logic -Equivalence - Implications–Normal forms - The Theory of Inference for the Statement Calculus.		
Module:2	**Predicate Calculus**	**4 hours**
The Predicate Calculus - Inference Theory of the Predicate Calculus.		
Module:3	**Algebraic Structures**	**5 hours**
Semigroups and Monoids - Groups – Subgroups – Lagrange's Theorem Homomorphism – Properties-Group Codes.		
Module:4	**Lattices**	**5 hours**
Partially Ordered Relations -Lattices as Posets – Hasse Digram – Properties of Lattices.		
Module:5	**Boolean algebra**	**5 hours**
Boolean algebra - Boolean Functions-Representation and Minimization of Boolean Functions-Karnaugh map – McCluskey algorithm.		
Module:6	**Fundamentals of Graphs**	**6 hours**
Basic Concepts of Graph Theory – Planar and Complete graph - Matrix representation of Graphs – Graph Isomorphism – Connectivity–Cut sets-Euler and Hamilton Paths–Shortest Path algorithms.		
Module:7	**Trees, Fundamental circuits, Cut sets, Graph colouring, covering, Partitioning**	**12 hours**
Trees – properties of trees – distance and centres in tree –Spanning trees – Spanning tree algorithms-Tree traversals- Fundamental circuits and cut-sets. Bipartite graphs - Chromatic number – Chromatic		

partitioning – Chromatic polynomial - matching – Covering– Four Colour problem.

Module:8	**Contemporary Issues** - Industry Expert Lecture	**2 hours**
	Total Lecture hours:	**45 hours**
Tutorial	• A minimum of 10 problems to be worked out by students in every Tutorial class. • Another 5 problems per Tutorial Class tobe given as home work.	**15 hours**

Mode of Evaluation : Individual Exercises, Team Exercises, Online Quizzes, Online, Discussion Forums

Text Book(s)

1.	Discrete Mathematical Structures with Applications to Computer Science, J .P. Trembley and R. Manohar, Tata McGraw Hill-35th reprint, 2017.
2.	Graph theory with application to Engineering and Computer Science, Narasing Deo, Prentice Hall India 2016.

Reference Books

1.	Discrete Mathematics and its applications, Kenneth H. Rosen, 8th Edition, Tata McGraw Hill,2019.
2.	Discrete Mathematical Structures, Kolman, R.C.Busby and S.C.Ross, 6th Edition, PHI, 2018.
3.	Discrete Mathematics, Richard Johnsonbaugh, 8th Edition, Prentice Hall, 2017.
4.	Discrete Mathematics, S. Lipschutz and M. Lipson, McGraw Hill Education (India) 2017.
5.	Elements of Discrete Mathematics–A Computer Oriented Approach, C.L.Liu, Tata McGraw Hill, Special Indian Edition, 2017.
6.	Introduction to Graph Theory, D. B. West, 3rd Edition, Prentice-Hall, Englewood Cliffs, NJ, 2015

Mode of Evaluation: Digital Assignments, Quiz, Continuous Assessments, Final Assessment Test

Recommended by Board of Studies	**03-06-2019**		
Approved by Academic Council	**No.55**	**Date**	**13-06-2019**

Course Code	Course Title	L	T	P	J	C
MAT2002	Applications of Differential and DifferenceEquations	3	0	2	0	4
Pre-requisite	MAT1011 - Calculus for Engineers	Syllabus Version				
		v1.0				

Course Objectives:

The course is aimed at

1. Presenting the elementary notions of Fourier series, which is vital in practical harmonic analysis
2. Imparting the knowledge of eigenvalues and eigen vectors of matrices and the transform techniques to solve linear systems, that arise in sciences and engineering
3. Enriching the skills in solving initial and boundary value problems
4. Impart the knowledge and application of difference equations and the Z-transform in discrete systems, that are inherent in natural and physical processes

Expected Course Outcomes:

At the end of the course the student should be able to

1. Employ the tools of Fourier series to find harmonics of periodic functions from the tabulated values
2. Apply the concepts of eigenvalues, eigen vectors and diagonalisation in linear systems
3. Know the techniques of solving differential equations
4. Understand the series solution of differential equations and finding eigen values, eigen functions of Strum-Liouville's problem
5. Know the Z-transform and its application in population dynamics and digital signal processing
6. Demonstrate MATLAB programming for engineering problems

Module:1	Fourier series	6 hours

Fourier series - Euler's formulae - Dirichlet's conditions - Change of interval - Half range series – RMS value – Parseval's identity – Computation of harmonics

Module:2	Matrices	6 hours

Eigenvalues and Eigen vectors - Properties of eigenvalues and eigen vectors – Cayley- Hamilton theorem - Similarity of transformation - Orthogonal transformation and nature ofquadratic form

Module:3	Solution of ordinary differential equations	6 hours

Linear second order ordinary differential equation with constant coefficients – Solutions of homogenous and non-homogenous equations - Method of undetermined coefficients – method of variation of parameters – Solutions of Cauchy-Euler and Cauchy-Legendredifferential equations

Module:4	Solution of differential equations throughLaplace transform and matrix method	8 hours

Solution of ODE's - Nonhomogeneous terms involving Heaviside function, Impulse function - Solving nonhomogeneous system using Laplace transform – Reduction of nth order differential equation to first order system - Solving nonhomogeneous system of first order differential equation

Module:5	Strum Liouville's problems and power series Solutions	6 hours

The Strum-Liouville's Problem - Orthogonality of Eigen functions - Series solutions of differential equations about ordinary and regular singular points - Legendre differential equation - Bessel's differential equation

Module:6	**Z-Transform**	**6 hours**
Z-transform -transforms of standard functions - Inverse Z-transform: by partial fractions and convolution method		
Module:7	**Difference equations**	**5 hours**
Difference equation - First and second order difference equations with constant coefficients -Fibonacci sequence - Solution of difference equations - Complementary function - Particularintegral by the method of undetermined coefficients - Solution of simple difference equations using Z-transform		
Module:8	**Contemporary Issues :** Industry Expert Lecture	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, John Wiley India, 2015

Reference Books

1.	Higher Engineering Mathematics, B. S. Grewal, 43rd Edition, Khanna Publishers,India, 2015
2.	Advanced Engineering Mathematics by Michael D. Greenberg, 2nd Edition, Pearson Education, Indian edition, 2006

Mode of Evaluation : Digital Assignments (Solutions by using soft skills), Continuous Assessment Tests, Quiz, Final Assessment Test

1.	Solving Homogeneous differential equations arising in engineering problems	2 hours
2.	Solving non-homogeneous differential equations and Cauchy, Legendre equations	2 hours
3.	Applying the technique of Laplace transform to solve differentialequations	2 hours
4.	Applications of Second order differential equations to Mass springsystem (damped, undamped, Forced oscillations), LCR circuits etc.	2 hours
5.	Visualizing Eigen value and Eigen vectors	2 hours
6.	Solving system of differential equations arising in engineeringapplications	2 hours
7.	Applying the Power series method to solve differential equations arising in engineering applications	3 hours
8.	Applying the Frobenius method to solve differential equations arising in engineering applications	3 hours
9.	Visualising Bessel and Legendre polynomials	3 hours
10.	Evaluating Fourier series-Harmonic series	3 hours
11.	Applying Z-Transforms to functions encountered in engineering	3 hours
12.	Solving Difference equations arising in engineering applications	3 hours
	Total Laboratory Hours	**30 hours**

Mode of Evaluation: Weekly Assessment, Final Assessment Test

Recommended by Board of Studies	**25-02-2017**		
Approved by Academic Council	**No. 47**	**Date**	**05-10-2017**

Course Code	Course Title	L	T	P	J	C
MAT3004	Applied Linear Algebra	3	1	0	0	4
Pre-requisite	MAT2002 Applications of Differential and Difference Equations	Syllabus Version				
		1.0				

Course Objectives

1. Understanding basic concepts of linear algebra to illustrate its power and utility through applications to computer science and Engineering.
2. Apply the concepts of vector spaces, linear transformations, matrices and inner product spaces in engineering.
3. Solve problems in cryptography, computer graphics and wavelet transforms

Expected Course Outcomes

At the end of this course the students are expected to learn

1. The abstract concepts of matrices and system of linear equations using decomposition methods
2. The basic notion of vector spaces and subspaces
3. Apply the concept of vector spaces using linear transforms which is used in computer graphics and inner product spaces
4. Applications of inner product spaces in cryptography
5. Use of wavelet in image processing.

Module:1	**System of Linear Equations**	**6 hours**
Gaussian elimination and Gauss Jordan methods - Elementary matrices- permutation matrix - inverse matrices - System of linear equations - LU factorizations.		
Module:2	**Vector Spaces**	**6 hours**
The Euclidean space and vector space- subspace –linear combination - span- linearly dependent-independent- bases – dimensions - finite dimensional vector space.		
Module:3	**Subspace Properties**:	**6 hours**
Row and column spaces -Rank and nullity – Bases for subspace – invertibility- Application in interpolation.		
Module:4	**Linear Transformations and applications**	**7 hours**
Linear transformations – Basic properties-invertible linear transformation - matrices of linear transformations - vector space of linear transformations – change of bases – similarity		
Module:5	**Inner Product Spaces**	**6 hours**
Dot products and inner products – the lengths and angles of vectors – matrix representations of inner products- Gram-Schmidt orthogonalisation		
Module:6	**Applications of Inner Product Spaces**	**6 hours**
QR factorization- Projection - orthogonal projections – relations of fundamental subspaces – Least Square solutions in Computer Codes		
Module:7	**Applications of Linear equations**	**6 hours**
An Introduction to coding - Classical Cryptosystems –Plain Text, Cipher Text, Encryption, Decryption and Introduction to Wavelets (only approx. of Wavelet from Raw data)		

Module:8	**Contemporary Issues**	**2 hours**
Industry Expert Lecture		
Total Lecture hours:		**45 hours**
Tutorial	• A minimum of 10 problems to be worked out by students in every Tutorial Class • Another 5 problems per Tutorial Class to be given as home work.	**15 hours**

Text Book(s)

1.	Linear Algebra, Jin Ho Kwak and Sungpyo Hong, Second edition Springer (2004).
2.	Introductory Linear Algebra- An applied first course, Bernard Kolman and David, R. Hill, 9th Edition Pearson Education, 2011.

Reference Books

1.	Elementary Linear Algebra, Stephen Andrilli and David Hecker, 5th Edition,Academic Press(2016)
2.	Applied Abstract Algebra, Rudolf Lidl, Guter Pilz, 2nd Edition, Springer 2004.
3.	Contemporary linear algebra, Howard Anton, Robert C Busby, Wiley 2003
4.	Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Cengage Learning (2015).

Mode of Evaluation: Digital Assignments, Continuous Assessments, Final Assessment Test			
Recommended by Board of Studies	**25-02-2017**		
Approved by Academic Council	**No. 47**	**Date**	**05-10-2017**

PROGRAMME ELECTIVE

(2018 - 2019)

B.Tech. Computer Science and Engg with Specialization in Bioinformatics

Course Code	Course Title	L	T	P	J	C
BIT1031	SYSTEM BIOLOGY	3	0	0	0	3
Pre-requisite	BIT1005	Syllabus version				
		1.0				

Course Objectives:

1. Understand biological systems as a system, structure and dynamics of cellular andorganism function.
2. Develop knowledge on biological interaction networks and genome-level cellular metabolism.
3. Apply mathematics, statistics and computing in an integrated way to analyse biological systems.

Expected Course Outcome:

1. Adapt the biological knowledge with data analysis
2. Evaluate and handle various bioinformatics tools
3. Build group and compare data, to gain information about single molecules compared to similar molecules
4. Explain how genomic, transcriptomic and proteomic techniques work, and discuss their strengths and limitations.
5. Interpret the results of biological studies by making use of bioinformatic techniques.
6. Develop basic scripts and pipelines for automating and repeating analyses

Module:1	System-level Understanding of BiologicalSystems	6 hours

Introduction - system level understanding of biological systems - Biological systems: Example. Advanced measurement systems - cell lineage and its application

Module:2	Modeling the Activity of Single Genes	6 hours

Modeling the activity of single genes - Chemical reactions- Physical chemistry, The Basics of Transcription, a probabilistic model of a prokaryotic gene and its regulation

Module:3	Modeling biochemical networks	6 hours

Atomic - level simulation and modeling of bio-macromolecules - molecular dynamics – the force field, molecular dynamics methods – Monte Carlo methods

Module:4	Kinetic Models	6 hours

Kinetic models of excitable membranes and synaptic interactions - Kinetic models of ion channels - Voltage-dependent Ion channels – Ligand gated synaptic ion channels

Module:5	Stochastic Models	6 hours

Stochastic simulation of cell signaling pathways – Limitations of deterministic models. A novelstochastic simulator, Multistate molecules, signalling complex and allostery

Module:6	Virtual Biology Laboratory	6 hours

Modeling large biological systems from functional genomic data: Parameter estimation, cellular simulation, towards a virtual biology laboratory, computational cell biology, the stochastic approach.

Module:7	Simulation of the Whole Cell	7 hours
Computer simulation of the whole cell, computer simulation of the cell, human erythrocyte model and its application, software for modeling and simulation, E-cell, and V-cell.		
Module:8	**Contemporary issues:**	**2 hours**
Lecture by Industrial Expert		
Total Lecture hours:		**45 hours**

Text Book(s)

1.	Hiroaki Kitano. Foundations of Systems Biology. (Editor), MIT Press, 2012.
2.	Computational Modeling of Genetic and Biochemical Networks, James M. Bower, Hamid Bolouri, MIT Press, 2000.3.
3.	Gene Regulation and Metabolism: Postgenomic Computational Approaches, Julio Collado- Vides (Editor), Ralf Hofestadt (Editor),MIT Press,2002

Reference Books

1.	Lars Skyttner General Systems Theory. Science. 2001.
2.	Dynamical Systems and Their Applications in Biology by Fields Institute for Research in Mathematical Sciences. Science. 2003.

Mode of evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**03-08-2017**		
Approved by Academic Council	**No. 46**	**Date**	**23-08-2017**

Course Code	Course Title	L	T	P	J	C
BIT2002	Biological Databases	3	0	0	4	4
Pre-requisite	BIT 1005	Syllabus version				
		1.0				

Course objectives:

1. Develop basic knowledge on the available online biological databases.
2. Experiment with of all kinds of nucleotide and protein databases and the best use of it throughout their course.
3. Discover the area of interest from the available database information

Expected Course Outcomes :

1. Analyze nucleotide and protein sequence from various databases.
2. Build an extensive knowledge of model organisms and to browse genome databases to retrieve useful information's which will be helpful for their research work.
3. Distinguish the intersection of life and information sciences, information theory, gene expression, and database queries
4. Apply existing software effectively to extract information from large databases and to use this information in computer modeling.
5. Demonstrate critical thinking and research methods in Bioinformatics to understand computational and experimentaldata.
6. Evaluate sequence, structural, and functional analysis of biomolecules.

Module:1	Sequence submission tools	6 hours

Introduction –Relational database- Motivation of biological database - Central dogma of life - Submission of sequences to the database, sequence formats, conversion of one sequenceinto another.

Module:2	Nucleotide sequence databases	6 hours

European Molecular Biology Laboratory (EMBL) - NCBI GenBank – DNA Data Bank of Japan (DDBJ), Genes and genetic disorders : COSMIC, Clinvar, HUMSAVAR- SNP database (DbSNP).

Module:3	Protein amino acid sequence databases	6 hours

Databases – UniProt Knowledgebase : SwissProt/TrEMBL - Protein Information Resource (PIR)

Module:4	Protein structure databases	7 hours

History of structural biology - Protein Data Bank (PDB), contents of a PDB file- SCOP : SCOP: Structural Classification of Proteins - CATH : Protein Structure Classification database

Module:5	Protein function and pathway database	6 hours

Pfam-protein family database - GO-gene ontology, PROSITE-protein function pattern and profile, ENZYME-Enzyme commission, KEGG Pathway database

Module:6	Genome and Micro array databases	6 hours

ENSEMBL Human - UCSC Human Genome Browser Gateway and other vertebrate genome databases. DNA microarray: database and basic tools, Gene Expression Omnibus (GEO) andSAGE databases.

Module:7	**Protein-protein interactions**	**6 hours**
BioGRID: Database of Protein, Chemical, and Genetic Interactions, STRING : functional protein association networks, DIP - Database of Interacting Proteins		
Module:8	**Contemporary issues** - Lecture by Industrial experts	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Attwood TK and Parry-Smith DJ (2014) Introduction to bioinformatics, Pearson Education.
2.	Baxevanis A., Ouellette F.B.F. (Eds.) Bioinformatics: a practical guide to the analysis ofgenes and proteins. John Wiley and Sons, New York (1998).

Reference Books

1.	Mount D (2014) Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor

Mode of Evaluation: Project/Activity			
Recommended by Board of Studies	**08-03-2018**		
Approved by Academic Council	**No. 46**	**Date**	**23-08-2017**

Course Code	Course Title	L	T	P	J	C
BIT2003	GENOMICS AND PROTEOMICS	3	0	0	4	4
Pre-requisite	BIT 1005	Syllabus version				
		1.0				

Course Objectives:

1. Build basic and applications knowledge on genomics and proteomics
2. Discover the techniques involved in the analysis of genomics and proteomics
3. Analyze genomic and proteomic studies in various biological models.

Expected Course Outcome:

At the end of the course the student should be able to

1. Analyze the principle of sequencing and its significance
2. Compare genomics and gene expression profiling
3. Distinguish the principle of functional and structural genomics
4. Identify and isolate principle of proteins and their functional and structural properties
5. Illustrate the basic informations on protein interaction network
6. Apply the genomic and proteomic patterns in industrial and medicinal diagnostics and treatment

Module:1	Gene structure and sequencing	8 hours

Sequence complexity – introns and exons – genome structure in viruses and prokaryotes – organelle genomes and nuclear DNA in eukaryotes – chain terminator sequencing – automated DNA sequencing – high throughput sequencing – alternate DNA sequencing methods.

Module:2	Comparative genomics and Global expressionprofiling	8 hours

Protein evolution by exon shuffling – comparative genomics of prokaryotes and eukaryotes horizontal and lateral gene transfer – Traditional approaches to expression profiling- global analysi of RNA expression: spotted DNA arrays, printed oligonucleotide chips – data acquisition and analysis – serial analysis of gene expression – massively parallel signature sequencing.

Module:3	Functional and structural genomics	8 hours

Functional genomics by systematic gene knockout – genome wide random mutagenesis – use of chemical mutagens and pheno-copy libraries – Determining gene function by sequence comparison– X-ray crystallography, NMR and Cryo EM in high throughput structure determination – structure prediction methods – domain fusion method for functional annotation.

Module:4	Proteome sequencing	5 hours

Gel electrophoresis (1DE and 2DE), liquid chromatography and mass spectrometers for protein and peptide analysis – routes in proteome analysis - protein digestion techniques - protein identification by mass finger printing

Module:5	Protein mining	4 hours

Sequence analysis by tandem mass spectrometry – data bases and algorithms in protein identification.

Module:6	**Protein Expression analysis**	**4 hours**
Comparative proteomics – use of isotope tags – yeast two hybrid systems - immunoprecipitation and western blot analysis – short gun identification of multiprotein complex – bait and reverse bait analysis		
Module:7	**Protein interaction network and modifications**	**6 hours**
Protein interaction network – sample enrichment for detecting protein modifications – integration of different algorithms to map protein modification- glycoprotein analysis – protein arrays. Intrinsically disordered proteins and their importance in understanding disease processes.		
Module:8	**Contemporary Issues:** Lecture by experts	**2 hours**
Total Lecture hours:		**45 hours**

Text Book(s)

1.	Principles of genome analysis and genomics – SB Primrose and RM Twyman, 3rd edition, Blackwell publishing, 2003.
2.	Introduction to proteomics: tools for the new biology – Daniel C Liebler, Humana Press, 2002.

Reference Books

1.	Discovering genomics, proteomics and bioinformatics, A Malcolm Campbell and Laurie J Heyer, Cold Spring Harbour Laboratory Press, 2002.

Mode of Evaluation : CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	**03-08-2017**		
Approved by Academic Council	**No. 46**	**Date**	**23-08-2017**

Course Code	Course Title	L	T	P	J	C
BIT3001	Computational Biology	3	0	0	4	4
Pre-requisite	BIT2004	Syllabus version				
		1.0				

Course Objectives:

1. Students will learn about the computational problems in the emerging areas of Bioinformatics, Computational Biology, and Genomics.
2. The students will gain insights from varied backgrounds of engineering, computer science,and the life sciences

Expected Course Outcome:

At the end of the course, students should be able to:

1. Explain mathematical concepts involved in biology
2. Gain basic knowledge of modern molecular biology and genomics
3. Develop an algorithm for analysis of biological sequences.
4. Gain knowledge to identify and develop in silico models appropriate to the different biological projects
5. Apply molecular methods to study genetic variation within and between species
6. Explain and evaluate different phylogenetic optimal criteria
7. Correctly select systems biology tools that will help them in re-constructing and redefining complex biological processes

Module:1	Introduction	6 hours

How the genome is studied, maps and sequences, specific techniques, the human genome project, sequence databases. Strings, graphs, and algorithms - Understanding the Basics of NGS: From Mechanism to Variant Calling

Module:2	Sequence Comparison and Database Searchalgorithms	6 hours

Comparing two sequences, global comparison the basic algorithm, database search, pam matrices, blast, fast, other issues, similarity and distance, parameter choice in sequence comparison, string matching and exact sequence comparison.

Module:3	Fragment Assembly of DNA -I	7 hours

The ideal case, complications, alternative methods for DNA sequencing, shortest common superstring, reconstruction, multicontig, algorithms, representing overlaps, paths originating

Module:4	Fragment Assembly of DNA-II	7 hours

Superstrings, shortest superstrings as paths, heuristics, findx5gding overlaps, ordering fragments, alignment and consensus, The Maximum Overlap Graph, Graph formulation of SCS

Module:5	Physical Mapping of DNA - I	7 hours

Restriction enzymes - Restriction site mapping, hybridization mapping, models, restriction site models, interval graph models, the consecutive ones property, algorithmic implications

Module:6	**Physical Mapping of DNA - II**	**5 hours**
An algorithm for the cp problem, an approximation for hybridization mapping with errors, a graph model, a guarantee, computational practice, heuristics for hybridization mapping. Enhanced Double Digest Problem		
Module:7	**Phylogenetic tree construction algorithms**	**5 hours**
Character states and the perfect phylogeny problem, binary character states, two characters, parsimony and compatibility in phylogenies, algorithms for distance matrices, reconstructing additive trees, reconstructing ultrametric trees, agreement between phylogenies.		
Module:8	**Contemporary issues:** Lecture by Industrial Expert	**2 hours**
Total Lecture hours:		**45 hours**

Text Book(s)

1.	João Meidanis & João Carlos Setubal PWS Publishing Company, Boston. 1997

Reference Books

1.	Konopka, Andrzej K Konopka, M James C Crabbe Compact Handbook of Computational Biology-Science – 2004.
2.	Dan Gusfield Algorithms on Strings, Trees, and Sequences: Computer Science and Computational Biolog - Computers - 1997
3.	Michael S Waterman Introduction to Computational Biology: Maps, Sequences, and Genomes by - Science - 1995

Mode of evaluation : CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**03-08-2017**		
Approved by Academic Council	**No. 46**	**Date**	**23-08-2017**

Course Code	Course Title	L	T	P	J	C
BIT3002	Molecular Modeling and Drug Design	3	0	0	4	4
Pre-requisite	BIT 1004 and BIT 2001	Syllabus version				
		1.0				

Course Objectives:

1. To understand the theoretical background of molecular mechanics force fields and basic background of drug designing concept
2. To understand their application using tools and software's

Expected Course Outcome:

At the end of the course the student should be able to

1. Understand molecular mechanics force fields and concept of drug designs computationally
2. Learn the Quantum mechanics & concepts in molecular modeling
3. Use simple molecular mechanics force field and general features
4. Apply Molecular Structures & Modeling for biological databases
5. Deriving and using 3D pharmacophores

Module:1	Quantum mechanics & concepts in molecularmodeling	8 hours

Introduction – coordinate systems, potential energy surfaces. Introduction to quantum mechanics: Schrodinger wave equation, Born-Oppenheimer approximation. Introduction to computer hardware and software

Module:2	Biomolecules	7 hours

Overview of Biomolecules - protein structures and classifications, Protein folding and Ramachandran plot

Module:3	Force Fields	7 hours

The simple molecular mechanics force field and general features; bond stretching; angle bending; torsional terms; non-bonded interactions; electrostatic interactions; van der Waals interactions; steepest descent method, conjugate gradient method

Module:4	Analysis and Properties	6 hours

Geometry optimization, Vibrational frequencies: potential energy surface, harmonicvs. fundamental frequencies, zero-point vibrational energies (ZPVE's).

Module:5	Molecular Structures & Modeling	5 hours

Protein and nucleic acid structures, the molecular basis, stability, molecular complexes. Steps in homology modeling, tools, databases, side chain modeling, loop modeling. Predicting Protein Structures by Threading

Module:6	Drug design	5 hours

Deriving and using 3D pharmacophores. Structure-based methods to identify lead compounds: finding lead compounds by searching 3D databases; de novo ligand design

Module:7	**Molecular Docking**	**5 hours**
Docking - molecular modeling in drug design – structure based drug design, AUTODOCK and HEX. Visualization tools for molecular systems : Visualizing Molecular Dynamics trajectories, VMD, YASARA, PyMOL		
Module:8	**Contemporary issues:** Lecture by Industrial Expert	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Andrew R. Leach, Molecular Modeling, Principles & Applications, 2nd Edition (DorlingKindersley (india) (P)Ltd with pearson education Ltd, UK, 2010

Reference Books

1.	R.K. Prasad, Quantum Chemistry, 4th Edition (New Age international (P) Ltd, ND, 2010)
2.	Alan Hinchliffe, Molecular Modelling for Beginners, 2nd Edition, John-Wiley, 2010
3.	S. C. Rastogi, Namita Mendiratta, Parag Rastogi, Bioinformatics: Methods And Applications: (Genomics, Proteomics and Drug Discovery), 3rd Edition, PHI learning (P) Ltd, 2010

Mode of Evaluation : CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**06-03-2018**		
Approved by Academic Council	**No.49**	**Date**	**15.03.2018**

Course Code	Course Title	L	T	P	J	C
BIT3003	Molecular Evolution and Phylogeny	3	0	0	0	3
Pre-requisite	BIT2001	Syllabus version				
		2.0				

Course Objectives:

1. To demonstrate the basic models for comparative genome research including the analysis ofobserved DNA base and amino acid mutation patterns.
2. To apply the use of mathematical models in phylogenetic reconstruction and statistical methods for the comparison of different models.
3. To reconstruct and infer the biological data in a meaningful way complimentary to biologicalresearch.

Expected Course Outcome:

At the end of this course students will be able to:

1. Analyze the present the mathematical models in the study of molecular evolution and to illustrate how to use them in actual data analysis.
2. Solve the biological processes that shape evolution at the molecular level and the improved ability to infer from sequence data the story of the evolution of life on earth.
3. Explore and analyze nucleotide and protein data and infer evolutionary relationships
4. Develop skills to challenge the upcoming NGS big-data content analysis using tree basedapproach.
5. Identify unique data from biology and perform pattern search and bridge ontological information in research.

Module:1	**Molecular Archeology**	**7 hours**
Introduction to molecular evolution, driving forces in evolution, evolutionary changes in nucleotide sequences.		
Module:2	**Phylogenetic Trees**	**7 hours**
Molecular phylogenetics, phylogenetic trees, trees and distances.		
Module:3	**Phylogeny Algorithms**	**7 hours**
Measuring genetic change, Genetic distance-Measuring evolutionary change on tree- kinds ofdata.		
Module:4	**Methods of reconstruction**	**6 hours**
Distance matrix methods, Maximum parsimony methods, Maximum likelihood methods		
Module:5	**Evolutionary Analysis**	**6 hours**
Models of Molecular evolution, Functional constraints and the rate of substitution patterns of codon usage and base composition.		
Module:6	**Molecular Evolution theory**	**5 hours**
Evolutionary clocks, Neutral theory, Genetic variation within species, Natural selection.		

Module:7	**Applications of molecular phylogenetics**	**5 hours**
Organismal phylogeny, what does evolutionary medicine to offer, host parasite co-specification.		
Module:8	**Contemporary issues:** Lecture by Industrial Expert	**2 hours**
Total Lecture hours:		**45 hours**

Text Book(s)

1.	Lindell Bromham, An Introduction to Molecular Evolution and Phylogenetics, 2016, 2nd Edition, Oxford University press, UK.

Reference Books

1.	Graur Dan, Molecular and Genome Evolution, 2016, Sinauer Associates Inc. USA
2.	Alexei J. Drummond, Remco R. Bouckaert, Bayesian Evolutionary Analysis with BEAST, 2015, Cambridge University Press, England.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	**03-08-2017**		
Approved by Academic Council	**No. 46**	**Date**	**23-08-2017**

Course Code	Course Title	L	T	P	J	C
CSE1004	Network and Communication	3	0	2	0	4
Pre-requisite	NIL	Syllabus version				
		1.0				

Course Objectives:

1. To build an understanding among students about the fundamental concepts of computer networking, protocols, architectures, and applications.
2. To help students to acquire knowledge in design, implement and analyze performance of OSI and TCP-IP based Architectures.
3. To implement new ideas in Networking through assignments.

Expected Course Outcome:

1. Interpret the different building blocks of Communication network and its architecture.
2. Contrast different types of switching networks and analyze the performance of network
3. Identify and analyze error and flow control mechanisms in data link layer
4. Design subnetting and analyze the performance of network layer
5. Construct and examine various routing protocols
6. Compare various congestion control mechanisms and identify appropriate Transport layer protocol for real time applications
7. Identify the suitable Application layer protocols for specific applications and its respective security mechanisms

Module:1	Networking Principles and layered architecture	6 hours

Data Communications and Networking: A Communications Model – Data Communications - Evolution of network, Requirements , Applications, Network Topology (Line configuration, Data Flow), Protocols and Standards, Network Models (OSI, TCP/IP)

Module:2	Circuit and Packet switching	7 hours

Switched Communications Networks – Circuit Switching – Packet Switching – Comparison of Circuit Switching and Packet Switching – Implementing Network Software, Networking Parameters(Transmission Impairment, Data Rate and Performance)

Module:3	Data Link Layer	10 hours

Error Detection and Correction – Hamming Code , CRC, Checksum- Flow control mechanism – Sliding Window Protocol - GoBack - N - Selective Repeat - Multiple access Aloha - Slotted Aloha - CSMA, CSMA/CD – Multiple Access Networks (IEEE 802.3), Token Ring(IEEE 802.5) andbWireless Networks (IEEE 802.11, 802.15)

Module:4	Network Layer	6 hours

IPV4 Address Space – Notations – Classful Addressing – Classless Addressing – Network Address Translation – IPv6 Address Structure – IPv4 and IPv6 header format.

Module:5	Routing Protocols	4 hours

Routing-Link State and Distance Vector Routing Protocols- Implementation – Performance Analysis- Packet Tracer.

Module:6	**Transport Layer**	**7 hours**
TCP and UDP-Congestion Control-Effects of Congestion-Traffic Management-TCP Congestion Control-Congestion Avoidance Mechanisms-Queuing Mechanisms-QoS Parameters		
Module:7	**Application Layer**	**3 hours**
Application layer-Domain Name System-Case Study : FTP-HTTP-SMTP-SNMP		
Module:8	**Recent Trends in Network Security**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Computer Networks: A Systems Approach, Larry Peterson and Bruce Davie, 5th Edition, The Morgan Kaufmann Series, Elsevier, 2011.
2.	Computer Networking: A Top-Down Approach Featuring the Internet, J.F. Kurose and K.W.Ross, 6th Edition., Pearson Education, 2012.

Reference Books

1.	Data Communications and Networking, Behrouz A. Forouzan, McGraw Hill Education, 5th Edition, 2012.
2.	TCP/IP Protocol Suite, Behrouz A. Forouzan, McGraw-Hill Education, 4 Edition. 2009.
3.	Data and Computer Communications, William Stallings, Pearson Education, 10th Edition, 2013.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1	Demo session of all networking hardware and Functionalities	3 Hours
2	Network configuration commands using Linux	3 Hours
3	Error detection and correction mechanisms	3 Hours
4	Flow control mechanisms	3 Hours
5	IP addressing Classless addressing	3 Hours
6	Observing Packets across the network and Performance Analysis of Routing protocols	3 Hours
7	Socket programming(TCP and UDP) Multi client chatting	3 Hours
8	Simulation of unicast routing protocols	3 Hours
9	Simulation of Transport layer Protocols and analysis of congestion control techniques in network	3 Hours
10	Develop a DNS client server to resolve the given host name or IP address	3 Hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: Project/Activity			
Recommended by Board of Studies	**28-02-2017**		
Approved by Academic Council	**No. 46**	**Date**	**24-08-2017**

Course Code	Course Title	L	T	P	J	C
CSE1007	Java Programming	3	0	2	0	4
Pre-requisite	NIL	Syllabus version				
		1.0				

Course Objectives:

1. To impart the core language features of Java and its Application Programming Interfaces (API).
2. To demonstrate the use of threads, exceptions, files and collection frameworks in Java.
3. To familiarize students with GUI based application development and database connectivity.

Expected Course Outcome:

1. Comprehend Java Virtual Machine architecture and Java Programming Fundamentals.
2. Design applications involving Object Oriented Programming concepts such as inheritance, association, aggregation, composition, polymorphism, abstract classes and interfaces.
3. Design and build multi-threaded Java Applications.
4. Build software using concepts such as files, collection frameworks and containers.
5. Design and implement Java Applications for real world problems involving DatabaseConnectivity.
6. Design Graphical User Interface using JavaFX.
7. Design, Develop and Deploy dynamic web applications using Servlets and Java Server Pages.

Module:1	Java Fundamentals	4 hours

Java Basics: Java Design goal - Features of Java Language - JVM - Bytecode - Java source file structure basic programming constructs Arrays one dimensional and multi-dimensional enhanced for loop String package

Module:2	Object Oriented Programming	5 hours

Class Fundamentals - Object Object reference array of objects constructors methods over- loading this reference static block - nested class inner class garbage collection finalize() Wrapper classes Inheritance types - use of super - Polymorphism abstract class interfaces packages and sub packages.

Module:3	Robustness and Concurrency	6 hours

Exception Handling - Exceptions Errors - Types of Exception - Control Flow in Exceptions - Use of try, catch, finally, throw, throws in Exception Handling - user defined exceptions - Multithreading Thread creation sharing the workload among threads synchronization inter thread communication deadlock.

Module:4	Files, Streams and Object serialization	7 hours

Data structures: Java I/O streams Working with files Serialization and deserialization of objects Lambda expressions, Collection framework List, Map, Set Generics Annotations

Module:5	GUI Programming and Database Connectivity	7 hours

GUI programming using JavaFX, exploring events, controls and JavaFX menus Accessing databases using JDBC connectivity.

Module:6	Servlet	7 hours

Introduction to servlet - Servlet life cycle - Developing and Deploying Servlets - Exploring Deployment Descriptor (web.xml) - Handling Request and Response - Session Tracking Management.

Module:7	**Java Server Pages**	**7 hours**
JSP Tags and Expressions - JSP Expression Language (EL) - Using Custom Tag - JSP with JavaBean.		
Module:8	**Latest Trends**	**2 hours**
Industry Expert talk		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Herbert Schildt, The Complete Reference -Java, Tata McGraw-Hill Education, Tenth Edition, 2017.
2.	Paul J. Deitel, Harvey Deitel ,Java SE8 for Programmers (Deitel Developer Series) 3rd Edition, 2014
3.	Y. Daniel Liang, Introduction to Java programming-comprehensive version-Tenth Edition, Pearson ltd 2015

Reference Books

1.	Paul Deitel Harvey Deitel , Java, How to Program, Prentice Hall; 9th edition , 2011.
2.	Cay Horstmann BIG JAVA, 4th edition, John Wiley Sons,2009
3.	Nicholas S. Williams, Professional Java for Web Applications, Wrox Press, 2014.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	Write a program to demonstrate the use of multidimensional arrays and looping constructs.	2 hours
2.	Write a program to demonstrate the application of String handling functions.	2 hours
3.	Write a program to demonstrate the use of Inheritance.	2 hours
4.	Write a program to demonstrate the application of user-defined packages and sub-packages.	2 hours
5.	Write a program to demonstrate the use of Java Exception handling methods.	2 hours
6.	Write a program to demonstrate the use of threads in Java.	2 hours
7.	Demonstrate with a program the use of File handling methods in Java.	2 hours
8.	Demonstrate the use of Java collection frameworks in reducing application development time.	2 hours
9.	Build a GUI application using JavaFX	2 hours
10.	Write a program to register students data using JDBC with MySQLDatabase.	2 hours
11.	Write a program that uses Servlets to perform basic banking tasks.	2 hours
12.	Write a web application using JSP and demonstrate the use of http request and response methods.	2 hours
13.	Write a JSP program for an order management system.	2 hours
14.	Write a JSP program that using JDBC and MySQL database to store the user data.	2 hours
15.	JSP with Java Bean	2 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: Project/Activity

Recommended by Board of Studies	**10-08-2018**		
Approved by Academic Council	**No. 52**	**Date**	**14-09-2018**

Course Code	Course Title	L	T	P	J	C
CSE2002	Theory of Computation and Compiler Design	4	0	0	0	4
Pre-requisite	NIL	Syllabus version				
		v1.1				

Course Objectives:

1. Provides required theoretical foundation for a computational model and compiler design
2. Discuss Turing machines as a abstract computational model
3. Compiler algorithms focus more on low level system aspects.

Expected Course Outcome:

On successful completion of the course, the student should be able to:

1. Design computational models for formal languages
2. Design scanners and parsers using top-down as well as bottom-up paradigms
3. Design symbol tables and use them for type checking and other semantic checks
4. Implement a language translator
5. Use tools such as lex, YACC to automate parts of implementation process

Module:1	Introduction To Languages and Grammers	3 hours

Overview of a computational model - Languages and grammars – alphabets – Strings – Operations on languages, Introduction to Compilers - Analysis of the Source Program - Phases of a Compiler

Module:2	Regular Expressions and Finite Automata	9 hours

Finite automata – DFA – NFA – Equivalence of NFA and DFA (With Proof) - Regularexpressions – Conversion between RE and FA (With Proof) Lexical Analysis - Recognition of Tokens - Designing a Lexical Analyzer using finite automata

Module:3	Myhill-Nerode Theorem	4 hours

Myhill-Nerode Theorem - Minimization of FA – Decision properties of regular languages - Pumping lemma for Regular languages (With Proof)

Module:4	CFG, PDAs and Turing Machines	15 hours

CFG – Chomsky Normal Forms - NPDA – DPDA - Membership algorithm for CFG. Syntax Analysis - Top-Down Parsing - Bottom-Up Parsing - Operator-Precedence Parsing - LR Parsers

Module:5	Turing Machines	5 hours

Turing Machines – Recursive and recursively enumerable languages – Linear bounded automata - Chomsky's hierarchy – Halting problem

Module:6	Intermediate Code Generation	10 hours

Intermediate Code Generation - Intermediate Languages – Declarations - Assignment Statements - Boolean Expressions - Case Statements – Backpatching - Procedure Calls.

Module:7	Code Optimization	7 hours

Code Optimization - Basic Blocks and Flow Graphs – The DAG Representation of Basic Blocks - The Principal Sources of Optimization - Optimization of Basic Blocks - Loops in Flow Graphs -Peephole Optimization - Introduction to Global Data-Flow Analysis

Module:8	Code Generation	7 hour
Code Generation – Issues in the Design of a Code Generator - The Target Machine - Run-Time Storage Management - Next-Use Information - Register Allocation and Assignment - A Simple Code Generator - Generating Code from DAG Recent Trends – Just-in-time compilation with adaptive optimization for dynamic languages - Parallelizing Compilers		
Total Lecture hours:		**60 hours**

Text Book(s)

1.	Introduction to Automata Theory, Languages, and Computation (3rd Edition), John E Hopcroft, Rajeev Motwani, Jeffery D. Ullman, Pearson education, 2013.
2.	Principles of Compiler Design, Alferd V. Aho and Jeffery D. Ullman, Addison Wesley, 2006

Reference Books

1.	Introduction to Languages and the Theory of Computation, John Martin, McGraw-Hill Higher Education,2010
2.	Modern Compiler Implementation in Java, 2nd ed., Andrew W. Appel Cambrdige University Press, 2012.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies			
Approved by Academic Council	**No. 47**	**Date**	**05.10.2017**

Course Code	Course Title	L	T	P	J	C
CSE3006	Embedded Systems Design	3	0	4	4	4
Pre-requisite	CSE2006-Microprocessor and Interfacing	Syllabus version				
		1.0				

Course Objectives:

1. To expose students to various challenges and and constraints of special purpose computingsystems in terms of resources and functional requirements.
2. To introduce students to various components of typical embedded systems viz., sensors and actuators, data converters, UART etc., their interfacing, programming environment fordeveloping any smart systems and various serial communication protocols for optimal components interfacing and communication.
3. To make students understand the importance of program modeling, optimization techniques and debugging tools for product development and explore various solutions forreal time scheduling issues in terms of resources and deadline.

Expected Course Outcome:

1. Identify the challenges in designing an embedded system using various microcontrollers and interfaces.
2. To differentiate and outline various requirements for conventional computing systems andembedded systems.
3. Summarize the functionality of any special purpose computing system and by proposing smart solutions at prototype level to solve engineering problems.
4. To elucidate the working principle and interfacing of typical components of an embeddedsystem.
5. Design program models, apply various optimization techniques and demonstrate thedebugging tools in simulation environment.
6. To analyze the pros and cons of real time scheduling algorithms and suggest appropriatesolution for various issues.
7. To evaluate the working principle of serial communication protocols and their appropriateusage.

Module:1	Introduction	5 hours

Overview of Embedded Systems, Design challenges, Embedded processor technology, Hardware Design, Micro-controller architecture -8051, PIC, and ARM.

Module:2	Conventional Computing System	4 hours

Internal architecture of PC laptop server - higher end computing system, Requirement of Conventional Computing, Pros cons of Conventional computing.

Module:3	Architecture of Special PurposeComputing system	6 hours

ATM, Handheld devices, Data Compressor, Image Capturing Devices Architecture and Requirements, Challenges Constraints of special purpose computing system.

Module:4	I/O interfacing techniques	8 hours

Memory interfacing, A/D, D/A, timers, watch-dog timer, counters, encoder decoder, UART, Sensors and actuators interfacing.

Module:5	**Programming tools**	**7 hours**
Evolution of embedded programming tools, Modeling programs, Code optimization, Logic analyzers, Programming environment.		
Module:6	**Real time operating system**	**8 hours**
Classification of Real time system, Issues challenges in RTS, Real time scheduling schemes-EDF-RMS Hybrid techniques, eCOS, POSIX, Protothreads.		
Module:7	**Embedded Networking protocols**	**5 hours**
Inter Integrated Circuits (I2C), Controller Area Network, Embedded Ethernet Controller, RS232, Bluetooth, Zigbee, Wifi.		
Module:8	**Recent Trends**	**2 hours**
Total Lecture hours:		**45 hours**

Text Book(s)

1.	Embedded System Design A Unified HW/SW Introduction, by Vahid G Frank and Givargis Tony, John Wiley Sons, 2006.
2.	Wayne Wolf, Computers as Components Principles of Embedded Computing System Design, Morgan Kaufman Publishers, 2008.
3.	Embedded Systems Architecture, Programming and Design, by Raj Kamal, TMH, 2011.

Reference Books

1.	Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill, 2009.
2.	Embedded Systems Lyla, Pearson, 2013.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**No. 47**	**Date**	**05-10-2017**

Course Code	Course Title	L	T	P	J	C
CSE3009	Internet of Things	3	0	0	4	4
Pre-requisite	NIL	Syllabus version				
		1.0				

Course Objectives:

1. To apprise students with basic knowledge of IoT that paves a platform to understandphysical, logical design and business models
2. To teach a student how to analyze requirements of various communication models andprotocols for cost-effective design of IoT applications on different IoT platforms.
3. To explain the students how to code for an IoT application and deploy for real-timescenario.

Expected Course Outcome:

1. Describe various layers of IoT protocol stack and describe protocol functionalities.
2. Evaluate efficiency trade-offs among alternative communication models for an efficient IoT application design.
3. Comprehend advanced IoT applications and technologies from the basics of IoT.
4. Understand working principles of various sensor for different IoT platforms.
5. Estimate the cost of hardware and software for low cost design IoT applications.
6. Compare various application business models of different domains.
7. Solve real-time problems and demonstrate IoT applications in various domains using prototype models.

Module:1	Introduction To Internet of Things	5 hours

Definition & Characteristics of IoT - Challenges and Issues - Physical Design of IoT, Logical Design of IoT - IoT Functional Blocks, Security.

Module:2	Components In Internet of Things	7 hours

Control Units Communication modules Bluetooth Zigbee Wifi GPS- IOT Protocols (IPv6, 6LoWPAN, RPL, CoAP etc), MQTT, Wired Communication, Power Sources.

Module:3	Technologies Behind IoT	7 hours

Four pillars of IOT paradigm, - RFID, Wireless Sensor Networks, SCADA (Supervisory Control and Data Acquisition), M2M - IOT Enabling Technologies - BigData Analytics, Cloud Computing, Embedded Systems.

Module:4	Programming The Microcontroller For IoT	8 hours

Working principles of sensors IOT deployment for Raspberry Pi /Arduino /Equivalent platform Reading from Sensors, Communication: Connecting microcontroller with mobile devices, communication through Bluetooth, wifi and USB - Contiki OS- Cooja Simulator.

Module:5	Resource Management in IoT	4 hours

Clustering, Clustering for Scalability, Clustering Protocols for IOT.

Module:6	From The Internet Of Things To The Web Of Things	6 hours

The Future Web of Things Set up cloud environment Cloud access from sensors Data Analytics forIoT-Case studies- Open Source e-Health sensor platform Be Close Elderly monitoring Other recent projects.

Module:7	**IoT Applications**	**6 hours**
Business models for the internet of things, Smart city, smart mobility and transport, smart buildings and infrastructure, smart health, environment monitoring and surveillance.		
Module:8	**Recent Trends**	**2 hours**
Total Lecture hours:		**45 hours**

Text Book(s)

1.	Dieter Uckelmann et.al, Architecting the Internet of Things, Springer, 2011
2.	Arshdeep Bahga and Vijay Madisetti, Internet of Things A Hand-on Approach, Universities press, 2015

Reference Books

1.	Charalampos Doukas , Building Internet of Things with the Arduino, Create space, April 2002
2.	Dr. Ovidiu Vermesan and Dr. Peter Friess, Internet of Things: From research and innovation to market deployment, River Publishers 2014.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**No. 37**	**Date**	**16-06-2015**

Course Code	Course Title	L	T	P	J	C
CSE3011	Robotics and its Applications	3	0	0	4	4
Pre-requisite	NIL	Syllabus version				
		1.0				

Course Objectives:

1. To introduce basic concepts, parts of robots and types of robots
2. To make the students familiar with various drive systems of robots, sensors and their applications in programming of robots
3. To discuss the applications of robots, and implementations of robots

Expected Course Outcome:

1. Explain the basic concepts of working of robot
2. Analyze the function of sensor in robot and design the robotic arm with various tools
3. Program the robot for a typical application and path planning using robotic vision
4. Understand the various robot programming languages
5. Conduct and design the experiments for various robot operations
6. Use the advanced techniques for robot processing

Module:1	**Introduction**	**3 hours**
Introduction, brief history, types, classification and usage, science and technology of robots, Artificial Intelligence in Robotics, some useful websites, textbooks and research journals.		
Module:2	**Elements of Robots-Joints, Links, Actuators, and Sensors**	**7 hours**
Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kind of actuators, stepper-DC-servo-and brushless motors- model of a DC servo motor-types of transmissions-purpose of sensor-internal and external sensor-common sensors-encoders-tachometers-strain gauge based force torque sensor-proximity and distance measuring sensors-and vision		
Module:3	**End Effectors**	**5 hours**
Classification of end effectors-tools as end effectors-drive system for grippers-mechanical adhesive-vacuum magnetic-grippers-hooks and scoops-gripper force analysis-and gripper design-active and passive grippers		
Module:4	**Planning and Navigation**	**6 hours**
Introduction, path planning-overview-road map path planning-cell decomposition path planning-potential field path planning-obstacle avoidance-case studies.		
Module:5	**Vision system**	**6 hours**
Robotic vision systems - image representation - object recognition - and categorization - depth measurement- image data compression-visual inspection-software considerations.		
Module:6	**Robot Programming**	**7 hours**
Introduction to robot languages-VAL-RAPID-language-basic commands-motion instructions- pick and place operation using industrial robot manual mode-automatic mode-subroutine command based programming-move master command language-introduction-syntax-simple problems.		

Module:7	**Field and service robots / Industrial Robots**	**9 hours**
Ariel robots-collision avoidance robots for agriculture-mining-exploration-underwater-civilian- and military applications-nuclear applications-space applications-Industrial robots-artificial intelligence in robots-application of robots in material handling-continuous arc welding-spot welding-spray painting-assembly operation-cleaning-etc		
Module:8	**Contemporary issues**	**2 hours**
Total Lecture hours:		**45 hours**

Text Book(s)

1.	Richared D.Klafter.Thomas Achmielewski and Mickael Negin, Robotic Engineering an Integrated approach prentice hall India- newdelhi-2001
2.	Saeed B.Nikku, Introduction to Robotics, analysis, control and applications Wiley-India 2nd edition-2011

Reference Books

1.	Industrial robotic technology-programming and application by M.P.Groover et al, McGrawhill 2008
2.	Robotics technology and flexible automation by S.R. Deb, TMH2009
3.	ABB reference manual

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**No. 37**	**Date**	**16-06-2015**

Course Code	Course Title	L	T	P	J	C
CSE3013	Artificial Intelligence	3	0	0	4	4
Pre-requisite	NIL	Syllabus version				
		1.0				

Course Objectives:

1. To impart artificial intelligence principles, techniques and its history
2. To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering problems.
3. To develop intelligent systems by assembling solutions to concrete computational problems

Expected Course Outcome:

1. Evaluate Artificial Intelligence (AI) methods and describe their foundations.
2. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.
3. Demonstrate knowledge of reasoning and knowledge representation for solving real worldproblems
4. Analyze and illustrate how search algorithms play vital role in problem solving
5. Illustrate the construction of learning and expert system
6. Discuss current scope and limitations of AI and societal implications.

Module:1	**Artificial Intelligence and its Issues**	**9 hours**
Definitions - Importance of AI, Evolution of AI - Applications of AI, Classification of AI systems with respect to environment, Knowledge Inferring systems and Planning, Uncertainty and towards Learning Systems.		
Module:2	**Overview to Problem Solving**	**5 hours**
Problem solving by Search, Problem space - State space, Blind Search - Types, Performance measurement.		
Module:3	**Heuristic Search**	**4 hours**
Types, Game playing mini-max algorithm, Alpha-Beta Pruning		
Module:4	**Knowledge Representation and Reasoning**	**7 hours**
Logical systems Knowledge Based systems, Propositional Logic Constraints, Predicate Logic First Order Logic, Inference in First Order Logic, Ontological Representations and applications		
Module:5	**Uncertainty and knowledge Reasoning**	**7 hours**
Overview Definition of uncertainty, Bayes Rule Inference, Belief Network, Utility Based System, Decision Network		
Module:6	**Learning Systems**	**4 hours**
Forms of Learning Types - Supervised, Unsupervised, Reinforcement Learning, Learning DecisionTrees		
Module:7	**Expert Systems**	**7 hours**
Expert Systems - Stages in the development of an Expert System - Probability based Expert Systems - Expert System Tools - Difficulties in Developing Expert Systems - Applications of Expert Systems		
Module:8	**Recent Trends**	**2 hours**
Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall.
2.	Poole, D. and Mackworth, A. 2010. Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press.
Reference Books	
1.	Ric, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGraw Hill.
2.	Luger, G.F. 2008. Artificial Intelligence -Structures and Strategies for Complex Problem Solving, 6th edition, Pearson.
3.	Brachman, R. and Levesque, H. 2004. Knowledge Representation and Reasoning, Morgan Kaufmann.
4.	Alpaydin, E. 2010. Introduction to Machine Learning. 2nd edition, MIT Press.
5.	Sutton R.S. and Barto, A.G. 1998. Reinforcement Learning: An Introduction, MIT Press.
6.	Padhy, N.P. 2009. Artificial Intelligence and Intelligent Systems, Oxford University Press.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**No. 37**	**Date**	**16-06-2015**

Course Code	Course Title	L	T	P	J	C
CSE3016	Computer Graphics and Multimedia	2	0	2	4	4
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

1. To comprehend the fundamental concepts of graphics and multimedia.
2. To gain and apply the acquired knowledge pertaining to 2D and 3D concepts in graphics programming.
3. To understand the basic 3D modeling and rendering techniques.
4. To realize the importance of multimedia towards building the virtual environment and communication.

Expected Course Outcome:

1. To enumerate the functionalities of pixels and coordinate systems pertaining to graphics manipulation.
2. Design and demonstrate the 2D and 3D objects using graphics algorithms.
3. Have the ability to model and render 3D objects by comprehending the complexities ofillumination in virtual scenes.
4. To realize and grasp the intricacies involved with various AR/VR devices.
5. Appraise and interpret the various multimedia communication standards, applications and basic principles.
6. To implement various graphics algorithms and devise the 2D/3D computer animation.
7. To design and develop 3D objects in the virtual space

Module:1	Basic Concepts & Techniques	3 hours

Pixels-Replicating Pixels, Pixel Interpolation, Pixel Art Scaling. Bi-linear Interpolation, Vector -Scaling, Magnitude, Normalization, Dot Product, Cartesian and Polar co-ordinate system.

Module:2	Two Dimensional Graphics Primitives	4 hours

Bresenham's Line Algorithm, Mid-point circle Algorithm, Liang-Barsky line clipping Algorithm, Weiler and Atherton polygon clipping Algorithm, Halftoning

Module:3	Geometric Transformations &Projections	5 hours

Basic 2D Transforms, Basic 3D Transforms, Composite transformation matrices, Co-ordinate transform, Projections - Orthographic, Axonometric,1 Point Perspective Projection

Module:4	Modeling	4 hours

Fractal models - Lindenmayer system Models, Deterministic self-similar fractals. Viewing -Drawing the Canonical View Volume, Computer Animation methods, Morphing techniques

Module:5	Rendering Techniques	5 hours

Antialiasing, Texture Mapping- MipMap, Visible surface determination - Back face detection, ZBuffer method, Shading Model - Gouraud and Phong Shading.

Module:6	Augmented And Virtual Reality	4 hours
Understanding the Human Senses and their relationship to Output / Input Devices - Component Technologies of Head-Mounted Displays. Google Glass and Related Augmenting Displays, Sensors for Tracking Position, Orientation and Motion, Devices to Enable Interaction with Data.		
Module:7	**Multimedia Communication Standards**	**3 hours**
JPEG, MPEG-7 standardization process of Multimedia content description, MPEG-21 Multimedia framework, ITU-T standardization process, Audio-visual systems(H.322, H.324), Video coding standards (H.261, H.26L)		
Module:8	**Contemporary issues (To be handled byexperts from industry)**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	K.R. Rao, Zoran S. Bojkovic and Dragorad A. Milovanovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Pearson Prentice Hall, 2014, ISBN-978- 81203-2145-8 2
2.	Donald Hearn, Pauline Baker, "Computer Graphics with OPENGL - C Version", 4th Edition, Pearson Education, 201

Reference Books

1.	J. Vince ,"Mathematics for Computer Graphics, Undergraduate Topics in Computer Science ", DOI 10.1007/978-1-84996-023-6 14, Springer-Verlag
2.	F.S.Hill,Computer Graphics using OPENGL, Second edition, Pearson Education, 2009
3.	Kamisetty Rao, Zoran Bojkovic, Dragorad Milovanovic, "Introduction to Multimedia Communications: Applications, Middleware, Networking ", Wiley, ISBN: 978-0-471-46742-7
4.	James D. Foley, Andries Van Dam, Steven K. Feiner, John F. Hughes, "Computer Graphics-Principles and practice", 2nd Edition, Pearson Education, 2007
5.	John F. Hughes, Andries Van Dam, Morgan Mc Guire, David F. Sklar, James D. Foley, Steven K. Feiner and Kurt Akeley, “Computer Graphics: Principles and Practice”, 3rd Edition, AddisonWesley Professional, 2013.
6.	Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR, Steve Aukstakalnis, Addison-Wesley Professional, 2016, ISBN 0134094352, 9780134094359

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	Learning of Graphics Programming Environment and usage of Graphics APIs. Modelling and visualization of real-world /artificial scene using 2D graphics primitives	2 hours
2.	Implementation of Line Drawing algorithms	2 hours
3.	Implementation of Circle Drawing algorithm.	2 hours
4.	Implementation of Line clipping algorithms against the given rectangular window.	2 hours
5.	Implement the 2-D transformations functions on 2-D graphic objects. Write a sample program to demonstrate the use of the various 2-D transformation	3 hours
6.	Implement the function for the following 3-D transformation of a 3-Dobject ○ Translation ○ Rotation	3 hours

7.	Write down function to display a 3D object using o Orthographic Projection o Perspective Projection	3 hours
8.	Write an application to demonstrate the use of the 3D transformations andprojections.	2 hours
9.	Use a audio processing software and perform the audio editing tasks – Import audio, Select and edit the sound, Create fade-in fade-out effects, Label audio segments, Use noise remove filter, Mix audio, Change stereo to mono tracks, Export audio to different format and save.	2 hours
10.	Use a video processing Software to perform – Trim video clips, crop video, rotate video, join video, add subtitles, and edit video dimension, bit rate, frame rate, sample rate, channel on a video.	3 hours
11.	Application development to Augmented and Virtual Reality - Science and Engineering	3 hours
12.	Create a 3D animation using a 3D modeling software.	3 hours
	Total Laboratory Hours	**30hours**

Mode of evaluation: Project/Activity			
Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**No. 37**	**Date**	**16-06-2015**

Course Code	Course Title	L	T	P	J	C
CSE3018	Content Based Image and Video Retrieval	2	0	2	4	4
Pre-requisite	NIL	Syllabus version				
		1.0				

Course Objectives:

1. To understand the fundamentals of images and key image features for image and video retrieval.
2. To provide the exposure on importance of similarity measures in content-based image and video retrieval.
3. To design the algorithm for content-based image retrieval and classify images usingmachine learning algorithms.

Expected Course Outcome:

1. Understand the basic feature extraction methods used in Content based Image and Video retrieval to build the robust feature vectors for the Images.
2. Extract the features based on various color models and apply on image and video retrieval.
3. Apply texture and shape features for retrieval using various texture and shape models.
4. Classify videos and image frames based on motion features.
5. Apply similarity metrics to compute the distance between two images or videos.
6. Use high level features using SIFT, SURF, color histograms and wavelets for image andvideo retrieval.
7. Explore the computer vision tool box for object detection, tracking and processing videos.

Module:1	Fundamentals of Content-based image and video retrieval	3 hours

History of CBIVR-Importance of CBIVR -Visual information retrieval system first generation VIR system 2nd generation VIR system a typical CBVIR system architecture - CBIVR techniques Query techniques: Semantic Retrieval - Relevance feedback iterative techniques machine learning techniques.

Module:2	Image Content descriptors-Key Frame features Color	4 hours

Color Space Color momentum color histogram color coherence vector-color correlogram Invariant color features

Module:3	Image Content descriptors Key framefeatures- Texture, Shape	4 hours

Tamura features- Wold features-Simultaneous Auto-Regressive (SAR) Model-Wavelet transform features- Shape: Moment invariants Turning angles Fourier descriptors-Spatial information

Module:4	Motion features	3 hours

Background foreground extraction - Camera based motion features object based motion features-object features Gabor features

Module:5	Similarity Measures and IndexingSchemes	4 hours

Minkowski-form distance Quadratic form distance Mahalanobis distance- Kullback-Leibler (KL) Divergence and Jeffrey-Divergence (JD)

Module:6	Feature Extraction techniques	5 hours

Histogram of Oriented Gradients (HOG), Speeded Up Robust Features (SURF), Local Binary Patterns (LBP), Haar wavelets, and color histograms.

Module:7	**Feature Extraction Techniques and Computer Vision Toolboxes**	**5 hours**
Scalar invariant feature transform Gray level co-occurrence matrix Principal component Analysis Toolboxes: Feature detection, extraction, and matching; object detection and tracking; motion estimation; and video processing.		
Module:8	**Recent Trends - Case studies**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	Gerald Schaefer - Advances in Intelligent and Soft Computing - Chapter - Content based image retrieval – Springer Book.
2.	Long, F., Zhang, H., Feng, D. D. (2003). Multimedia information retrieval and management. Technological Fundamentals and Applications.
3.	Poornima, Y., Hiremath, P. S. (2013). Survey on Content Based Image Retreival System and Gap Analysis for Visual Art Image Retreival System. International Journal of Computer Science Issues (IJCSI), 10(3), 23.

Reference Books

1.	Research Papers in various journals.
2.	Duda, R. O., Hart, P. E., Stork, D. G. (2012). Pattern classification. John Wiley Sons.
3.	HWebb, A. R. (2003). Statistical pattern recognition. John Wiley Sons.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	CBIR using color momentum.	2 hours
2.	CBIR using color histogram.	4 hours
3.	CBIR using texture tamura features.	4 hours
4.	CBIR using shape - moment invariants.	4 hours
5.	CBIR with similarity measure.	4 hours
6.	CBIR with GLCM.	4 hours
7.	Foreground extraction using background subtraction.	4 hours
8.	Object detection using SIFT and SURF.	4 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: Project/Activity

Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**No. 37**	**Date**	**16-06-2015**

Course Code	Course Title	L	T	P	J	C
CSE 3019	Data Mining	2	0	2	4	4
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

1. To introduce the concept of Data Mining and Data Preprocessing
2. To develop the knowledge for application of the mining algorithms for association,clustering
3. To explain the algorithms for mining data streams and the features of recommendation systems.

Expected Course Outcome:

1. Interpret the contribution of data warehousing and data mining to the decision-support systems
2. Apply the various classifications techniques to find the similarity between data items
3. Design the model to sample, filter and mine the Streaming data
4. Apply the link analysis and frequent item-set algorithms to identify the entities on the real world data
5. Evaluate and report the results of the recommended systems
6. Analyse the various data mining tasks and the principle algorithms for addressing the tasks
7. Create the working model as a team to solve the challenging data mining problems

Module:1	**Introduction**	**3 hours**
Data Mining – Data ware housing-OLAP-Data Preprocessing		
Module:2	**Classification Techniques And Finding Similar Items**	**5 hours**
Classification Techniques: Decision Tree,ID3,K-Nearest Neighbour Classifier, Naive Bayes- Near Neighbour Search – Shingling of Documents - Similarity Preserving – Locality Sensitive Hashing(LSH) – Application and Variance of LSH – Distance Measures – High degrees of similarity		
Module:3	**Mining Data Streams**	**4 hours**
Stream Data model - Sampling Data in a Stream – Filtering Streams – Counting distinct elements in a stream – Estimating Moments – Counting Ones in a window – Decaying windows		
Module:4	**Link Analysis**	**4 hours**
Page Rank – Link Spam – Hubs and Authorities		
Module:5	**Frequent Item Sets**	**4 hours**
Market-Basket Model – A-priori Algorithm – Handling larger datasets – Counting Frequent items in a stream – Limited Pass Algorithms		
Module:6	**Clustering**	**4 hours**
Hierarchical Clustering – K-means Algorithm – Clustering in Non-Euclidean spaces, Clustering for Streams and Parallelism		
Module:7	**Recommendation Systems**	**4 hours**
Content based – Collaborative Filtering – Dimensionality reduction-Case study		
Module:8	**Contemporary issues**	**2 hours**
Total Lecture hours:		**30 hours**

Text Book(s)

1. Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann , 2011

Reference Books	
1.	Jiawei Han, Micheline Kamber and Jian Pei, Data Mining: Concepts and Techniques, Morgan Kaufmann 2011
2.	J. Leskovec, A. Rajaraman, and Jeffrey D. Ullman. Mining of Massive Datasets. Cambridge University Press, 2014.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Challenging Experiments (Indicative)		
1.	Introduction to exploratory data analysis using R	3 hours
2.	Demonstrate the Descriptive Statistics for a sample data like mean, median, variance and correlation etc.,	3 hours
3.	Demonstrate Missing value analysis and different plots using sample data.	3 hours
4.	Demonstration of apriori algorithm on various data sets with varyingconfidence (%) and support (%).	3 hours
5.	Demo on Classification Techniques using sample data Decision Tree, ID3 or CART.	3 hours
6.	Demonstration of Clustering Techniques K-Mean and Hierarchical.	3 hours
7.	Simulation of Page Rank Algorithm and Demonstration on Hubs and Authorities.	3 hours
8.	Demo on Classification Technique using KNN.	3 hours
9.	Demonstration on Document Similarity Techniques and measurements.	3 hours
10.	Design and develop a recommendation engine for the given application.	3 hours
	Total Laboratory Hours	**30hours**

Mode of evaluation: Project/Activity			
Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**No. 37**	**Date**	**16-06-2015**

Course Code	Course Title	L	T	P	J	C
CSE3020	Data Visualization	2	0	2	4	4
Pre-requisite	Data Mining CSE3019	Syllabus version				
		1.1				

Course Objectives:

1. To understand the various types of data, apply and evaluate the principles of data visualization.
2. Acquire skills to apply visualization techniques to a problem and its associated dataset.
3. To apply structured approach to create effective visualizations thereby building visualization dashboard to support decision making.

Expected Course Outcome:

1. Identify the different data types, visualization types to bring out the insight. Relate the visualization towards the problem based on the dataset.
2. Identify the different attributes and showcasing them in plots. Identify and create various visualizations for geospatial and table data.
3. Ability to visualize categorical, quantitative and text data. Illustrate the integration of visualization tools with hadoop.
4. Ability to visualize categorical, quantitative and text data.
5. Design visualization dashboard to support the decision-making on large scale data.
6. Match the knowledge gained with the industries latest technologies.
7. Ability to create and interpret plots using R/Python.

Module:1	**Introduction to Data Visualization**	**4 hours**
Overview of data visualization - Data Abstraction -Analysis: Four Levels for Validation- Task Abstraction - Analysis: Four Levels for Validation		
Module:2	**Visualization Techniques**	**5 hours**
Scalar and point techniques Color maps Contouring Height Plots - Vector visualization techniques Vector properties Vector Glyphs Vector Color Coding Stream Objects.		
Module:3	**Visual Analytics**	**3 hours**
Visual Variables- Networks and Trees - Map Color and Other Channels- Manipulate View		
Module:4	**Visual Analytics**	**3 hours**
Arrange Tables Geo Spatial data Reduce Items and Attributes		
Module:5	**Visualization Tools and Techniques**	**5 hours**
Introduction to data visualization tools- Tableau - Visualization using R		
Module:6	**Diverse Types Of Visual Analysis**	**4 hours**
Time- Series data visualization Text data visualization Multivariatedata visualization and case studies		
Module:7	**Visualization Dashboard Creations**	**4 hours**
Dashboard creation using visualization tools for the use cases: Finance-marketing-insurance-healthcare etc.,		
Module:8	**Recent Trends :** Industry Expert talk	**2 hours**
Total Lecture hours:		**30 hours**

Text Book(s)	
1.	Tamara Munzer, Visualization Analysis and Design - CRC Press 2014
2.	AlexandruTelea, Data Visualization Principles and Practice CRC Press 2014.
3.	Paul J. Deitel, Harvey Deitel, Java SE8 for Programmers (Deitel Developer Series) 3rd Edition, 2014.
4.	Y. Daniel Liang, Introduction to Java programming-comprehensive version-Tenth Edition, Pearson ltd 2015.
Reference Books	
1.	Paul Deitel Harvey Deitel ,Java, How to Program, Prentice Hall; 9th edition , 2011.
2.	Cay Horstmann BIG JAVA, 4th edition,John Wiley Sons,2009
3.	Nicholas S. Williams, Professional Java for Web Applications, Wrox Press, 2014.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)		
1.	Acquiring and plotting data	6 hours
2.	Statistical Analysis such as Multivariate Analysis, PCA, LDA,Correlation, regression and analysis of variance	4 hours
3.	Time-series analysis stock market	4 hours
4.	Visualization on Streaming dataset	4 hours
5.	Dashboard Creation	6 hours
6.	Text visualization	6 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: Project/Activity

Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**No. 37**	**Date**	**16-06-2015**

Course Code	Course Title	L	T	P	J	C
CSE3021	Social and Information Networks	3	0	0	4	4
Pre-requisite	Data Mining CSE3019	Syllabus version				
		1.0				

Course Objectives:

1. Understand the components of social networks.
2. Model and visualize social networks.
3. Understand the role of semantic web in social networks.
4. Familiarize with the security concepts of social networks.
5. Find out various applications of social networks.

Expected Course Outcome:

1. Illustrate the basic components of social networks.
2. Analyze the different measurements and metrics of social networks.
3. Apply different techniques to detect and evaluate communities in social networks.
4. Apply various types of social network models.
5. Apply semantic web format to represent social networks.
6. Develop social network applications using visualization tools.
7. Usage of the security features in social and information networks for various practical applications.

Module:1	Introduction	4 hours

Introduction to social network analysis Fundamental concepts in network analysis social network data notations for social network data Graphs and Matrices.

Module:2	Measures & Metrics	5 hours

Strategic network formation - network centrality measures: degree, betweenness, closeness,eigenvector - network centralizationdensity reciprocity transitivity ego network measures for ego network - dyadic network triadic network - cliques - groups- clustering search.

Module:3	Community networks	6 hours

Community structure - modularity, overlapping communities - detecting communities in social networks – Discovering communities: methodology, applications - community measurement - evaluating communities – applications.

Module:4	Models	7 hours

Small world network - WattsStrogatz networks - Statistical Models for Social Networks - Network evolution models: dynamical models, growing models - Nodal attribute model: expo- nential random graph models Preferential attachment - Power Law - random network model: Erdos-Renyi and Barabasi-AlbertEpidemics - Hybrid models of Network Formation.

Module:5	Semantic Web	7 hours

Modelling and aggregating social network data developing social semantic application evaluation of web-based social network extraction Data Mining Text Mining in social network Toolscase study.

Module:6	Visualization	8 hours
Visualization of social networks novel visualizations and interactions for social networks applications of social network analysis tools - sna: R Tools for Social Network Analysis - Social Networks Visualiser (SocNetV) - Pajek.		
Module:7	**Security & Applications**	**6 hours**
Managing Trust in online social network Security and Privacy in online social network security requirement for social network in Web 2.0 - Say It with Colors: Language-Independent Gender Classification on Twitter - Friends and Circles - TUCAN: Twitter User Centric ANalyzer.		
Module:8	**Recent Trends :** Industry Expert talk	**2 hours**
Total Lecture hours:		**45 hours**

Text Book(s)

1.	Stanley Wasserman, Katherine Faust, Social network analysis: Methods and applications, Cambridge university press, 2009.
2	John Scott, Social network analysis, 3rd edition, SAGE, 2013.

Reference Books

1.	Borko Furht, Handbook of Social Network Technologies and applications, Springer, 2010.
2.	Jalal Kawash, Online Social Media Analysis and Visualization (Lecture Notes in Social Networks), 2015.
3.	Charu Aggarwal, Social Network data analysis, Springer, 2011.
4.	Easley and Kleinberg, Networks, Crowds, and Markets: Reasoning about a highly connected world. Cambridge University Press, 2010.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**No. 37**	**Date**	**16-06-2015**

Course Code	Course Title	L	T	P	J	C
CSE3024	Web Mining	3	0	2	0	4
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

1. To acquire the knowledge of Web search, indexing and query processing
2. To perform web content mining for retrieving most relevant documents
3. Analyze on web structure and usage patterns

Expected Course Outcome:

1. Recognize the components of a web page and its related security issues
2. Build crawler and index the retrieved pages
3. Perform analysis on web structure and its content
4. Analyze social media data using Machine Learning techniques
5. Rene query terms for query expansion
6. Design a system to harvest information available on the web to build recommender systems

Module:1	Introduction	5 hours

Introduction of WWW – Architecture of the WWW – Web Document Representation- Web Search Engine – Challenges - Web security overview and concepts, Web application security, Basic web security model -Web Hacking Basics HTTP & HTTPS URL, Web Under the Cover Overview of Java security Reading the HTML source

Module:2	Web Crawling	5 hours

Basic Crawler Algorithm: Breadth-First/ depth-First Crawlers, - Universal Crawlers- Preferential Crawlers: Focused Crawlers – Topical Crawlers.

Module:3	Indexing	5 hours

Static and Dynamic Inverted Index– Index Construction and Index Compression- Latent Semantic Indexing. Searching using an Inverted Index: Sequential Search - Pattern Matching - Similarity search.

Module:4	Web Structure Mining	8 hours

Link Analysis - Social Network Analysis - Co-Citation and Bibliographic Coupling - Page Rank- Weighted Page Rank- HITS - Community Discovery - Web Graph Measurement and Modelling- Using Link Information for Web Page Classification.

Module:5	Web Content Mining	8 hours

Classification: Decision tree for Text Document- Naive Bayesian Text Classification - Ensemble of Classifiers. Clustering: K-means Clustering - Hierarchical Clustering – Markov Models - Probability-Based Clustering. Vector Space Model – Latent semantic Indexing – Automatic Topic Extraction from Web Documents.

Module:6	**Web Usage Mining**	**9 hours**
Web Usage Mining - Click stream Analysis - Log Files - Data Collection and Pre-Processing - Data Modelling for Web Usage Mining - The BIRCH Clustering Algorithm - Modelling web user interests using clustering- Affinity Analysis and the A Priori Algorithm – Binning –Web usage mining using Probabilistic Latent Semantic Analysis – Finding User Access Pattern via Latent Dirichlet Allocation Model.		
Module:7	**Query Processing**	**3 hours**
Relevance Feedback and Query Expansion - Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency		
Module:8	**Recent Trends :** Industry Expert talk	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Bing Liu, " Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data- Centric Systems and Applications)", Springer; 2nd Edition 2009
2	Zdravko Markov, Daniel T. Larose, "Data Mining the Web: Uncovering Patterns in Web Content, Structure, and Usage", John Wiley & Sons, Inc., 2007

Reference Books

1.	Guandong Xu ,Yanchun Zhang, Lin Li, "Web Mining and Social Networking: Techniques and Applications", Springer; 1st Edition.2010
2.	Soumen Chakrabarti, "Mining the Web: Discovering Knowledge from Hypertext Data", Morgan Kaufmann; edition 2002

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1	To develop the Search Engine for retrieval process	4 Hours
2	Develop Search engine using indexing	4 Hours
3	Increase the eefficiency document classification using Opinion Mining	3 Hours
4	Prepare inverted indexing for the retrieved document and represent it as tries	4 Hours
5	Fetch the document with highest similarity for the given query	3 Hours
6	Compare various ranking schemes of document retrieval	4 Hours
7	To develop the effective query refinement mechanism based on queryalgebra.	4 Hours
8	Personalized web search using log analysis	4 Hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: Project/Activity

Recommended by Board of Studies	**28-02-2017**		
Approved by Academic Council	**No. 46**	**Date**	**24-08-2017**

Course Code	Course Title	L	T	P	J	C
CSE3025	Large Scale Data Processing	2	0	2	4	4
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

1. To understand the different characteristics and requirement of big data frameworks.
2. To explain the concepts of distributed file system and Map Reduce programming.
3. To apply the exposure on inverted indexing and graph data analytic.

Expected Course Outcome:

1. Define the characteristics of big data and explain the data science life cycle.
2. Differentiate between conventional and contemporary distributed framework and characterize storage and processing of large data.
3. Implement and demonstrate the use of the hadoop eco-system.
4. Compare scalable frameworks for large data.
5. Decompose a problem into map and reduce operations for implementation.
6. Design programs to analyze large scale text data.
7. Identify problems suitable for use of graph mining in large data processing.

Module:1	**Introduction To Big Data And Analytics**	**4 hours**
Big Data Overview Characteristics of Big Data Business Intelligence vs Data Analytics.		
Module:2	**Need of Data Analytics**	**4 hours**
Data Analytics Life Cycle Data Analytics in Industries Exploring Big data Challenges in handling Big Data.		
Module:3	**Big Data Tools**	**4 hours**
Need of Big data tools - understanding distributed systems - Overview of Hadoop comparing SQL databases and Hadoop Hadoop Eco System - Distributed File System: HDFS, Design of HDFS writing files to HDFS Reading files from HDFS.		
Module:4	**Hadoop Architecture**	**6 hours**
Hadoop Daemons - Hadoop Cluster Architecture YARN Advantages of YARN.		
Module:5	**Introduction to MapReduce**	**6 hours**
Developing MapReduce Program Anatomy of MapReduce Code - Simple Map Reduce Program-counting things Map Phase shuffle and sort - Reduce Phase Master slave architecture Job Processing in hadoop Map Reduce Pipelining.		
Module:6	**MapReduce Programming Concepts**	**3 hours**
Use of Combiner - Block vs Split Size - working with Input and output format Key, Text, Sequence, NLine file format, XML file format.		
Module:7	**Inverted Indexing and Graph Analytics**	**3 hours**
Web crawling inverted index Baseline and revised implementation - Graph Representation Parallel Breadth first search page rank issues with graph processing.		
Total Lecture hours:		**30 hours**

Text Book(s)		
1.	Tom White, Hadoop The Definitive Guide, O'Reilly, 4th Edition, 2015.	
Reference Books		
1.	Alex Holmes, Hadoop in Practice, Manning Shelter Island, 2012.	
2.	Chuck Lam, Hadoop in Action. Manning Shelter Island, 2011.	
3.	Jimmy Lin and Chris Dyer, Data-Intensive Text Processing with Map Reduce, 2010.	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Challenging Experiments (Indicative)		
1.	Extract the features based on various color models and apply on image and video retrieval	2 hours
2.	Counting things using MapReduce	2 hours
3.	Command line interface with HDFS	2 hours
4.	MapReduce Program to show the need of Combiner	2 hours
5.	MapReduce I/O Formats key- value, text	2 hours
6.	MapReduce I/O Formats Nline	2 hours
7.	Multiline I/O.	2 hours
8.	Parallel Breadth First Search.	2 hours
9.	Sequence file Input / Output Formats	2 hours
10.	Baseline Inverted Indexing using MapReduce	2 hours
11.	Revised Inverted Indexing using MapReduce	2 hours
12.	Matrix Factorization using MapReduce	4 hours
13.	Video Processing using MapReduce	2 hours
14.	BioInformatics (Protien/Gene Sequence etc) processing with MapReduce	2 hours
	Total Laboratory Hours	**30 hours**
Mode of Assessment: Project/Activity		
Recommended by Board of Studies	**04-04-2014**	
Approved by Academic Council	**No. 37**	**Date** **16-06-2015**

Course Code	Course Title	L	T	P	J	C
CSE3029	GAME PROGRAMMING	2	0	2	4	4
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

1. To provide an in-depth introduction to technologies and techniques used in the gameindustry.
2. To recognize the processes, mechanics, issues in game design and game enginedevelopment.
3. To integrate various technologies such as multimedia, artificial intelligence and physics engine into a cohesive, interactive game application.

Expected Course Outcome: Upon Completion of the course, the students will be able to

1. Identify the human roles involved in the game industry and describe their responsibilities.
2. Create and produce digital components, games and documentation using a variety of Game Engines.
3. Design the graphics based games and learn to manage the graphics devices.
4. Construct the game using artificial intelligence and physics based modeling.
5. Create various types of games with different types of modes and perspectives.
6. Develop, test, and evaluate procedures of the creation, design and development of games.
7. Design unique gaming environments, levels and characters.

Module:1	**Introduction to Game Programming**	**1 hours**
Overview of game programming, game industry		
Module:2	**Game Engine Architecture**	**5 hours**
Engine Support, Resource Management, Real Time Game Architecture,		
Module:3	**Graphics**	**6 hours**
Graphics Device Management, Tile-Based Graphics and Scrolling, GUI programming for games,		
Module:4	**Artificial Intelligence and Physics**	**6 hours**
Artificial Intelligence in games, Physics based modeling, Path finding algorithms, Collision detection		
Module:5	**Game design**	**8 hours**
Game design, Differing game types, modes, and perspectives, scripting, audio engineering, Sound and Music, level design, render threading		
Module:6	**Project management**	**3 hours**
Game project management, Game design documentation, Rapid prototyping and game testing		
Module:7	**Recent Trends**	**1 hours**
Total Lecture hours:		**30 hours**

Text Book(s)

1. Game Engine Architecture, 2nd Edition, Jason Gregory, A K Peters, 2014 ISBN 9781466560017

Reference Books

1. Best of Game Programming Gems, Mark DeLoura, Course Technology, Cengage Learning, 2014, ISBN10:1305259785

2.	Rules of Play: Game Design Fundamentals, Katie Salen and Eric Zimmerman, MIT Press, 2003, ISBN 0-262-24045-9
3.	Real-Time Collision Detection, Christer Ericson, Morgan Kaufmann, 2005, ISBN9781558607323
4.	XNA Game Studio 4.0 Programming. Tom Miller and Dean Johnson, Addison-Wesley Professional, 2010 ISBN-10:0672333457
5.	Introduction to Game Development, Second Edition, Steve Rabin, Charles River Media; 2009 ISBN-10: 1584506792
6.	Game Coding Complete, Mike McShaffry and David Graham, Fourth Edition, 2012 Cengage Learning PTR, ISBN-10: 1133776574
7.	Beginning Game Programming, Jonathan S. Harbour, Cengage Learning PTR; 4th edition, 2014, ISBN-10: 1305258959
8.	Fundamentals of Game Design, 3rd Edition, Ernest Adams, New Riders; 2013 ISBN-10: 0321929675
9.	Game Design Foundations, Second Edition, Roger E. Pedersen, Jones & Bartlett Learning; 2009, ISBN-10: 1598220349
10.	Level Up! The Guide to Great Video Game Design, 2nd Edition, Scott Rogers, Wiley 2014, ISBN: 978-1-118-87716-6

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	Game development using game engines such as Unity	2 hours
2.	Analyze a game and describe it in terms of its core elements	2 hours
3.	Development of 2D games	2 hours
4.	Development of 3D games	4 hours
5.	Analyze the game mechanics of a given game and design the game mechanics of a new game	2 hours
6.	Understand collision detection in games	2 hours
7.	Understand physics simulation in games	2 hours
8.	Understand UI designin games	2 hours
9.	Write a game design document	2 hours
10.	Explore the role of AI in games	4 hours
11.	Scripting with Lua	2 hours
12.	Practice programming techniques and discuss the benefits and challenges of using different languages such as Python, C++, C, Java, etc	2 hours
13.	Students may use platforms such as Windows platform, DirectX SDK for rendering, APIs such as Lua scripting language, Box2D Physics Engine, tools such as Visual Studio IDE for software development, Tiled for map editing, RUBE for Box2D level editing, Gimp for sprite sheet creation, Audacity for sound recording and editing.	2 hours
	Total Laboratory Hours	**30 hours**

Mode of evaluation: Project/Activity			
Recommended by Board of Studies	04-04-2014		
Approved by Academic Council	No. 37	Date	16-06-2015

Course Code	Course Title	L	T	P	J	C
CSE3034	Nature-Inspired Computing	2	0	0	4	3
Prerequisite		Syllabus Version				
		1.0				

Course Objective :

1. This course introduces different nature-based meta-heuristic algorithms such as Simulated Annealing, Ant and Bee colony optimization algorithms, Genetic Algorithms, Particle Swarm optimization algorithms, firefly algorithm and cuckoo search algorithm.

Expected Course Outcome:

After successfully completing the course the student should be able to

1. Differentiate the difficulties of hard problems and how to tackle them
2. Apply nature-inspired computing models for a given problem
3. Design their own algorithm for solving practical problems usingnature inspired computing models.

Module 1	**Introduction to computational problems, NP problems**	**3 Hours**
Computational Problems, Decision Problem, Optimization Problem, Why optimization problems are difficult?, Hardness In Optimization Problem, NP class, NP-Hard, examples for NP-Hard problems, tacklingNP-Hard problems, Rationale for seeking inspiration from nature		
Module 2	**Genetic Algorithm**	**5 Hours**
Introduction, Genetic algorithm, choice of choosing parameter and iterations, example problems with demonstration		
Module 3	**Simulated Annealing (SA)**	**3 Hours**
Annealing and Boltzmann Distribution, parameters, SA algorithm, SAimplementation		
Module 4	**Ant colony optimization and Bee colony optimization**	**5 Hours**
Behaviour of ants, Ant colony optimization, virtual ant algorithms, Behaviour of honeybees, virtual (honey)bee algorithms, Artificial bee colony optimization, example problems and implementation		
Module 5	**Bat algorithm**	**3 Hours**
Echolocation of bat, behaviour of micro-bats, Bat algorithm, Movements of virtual bats, loudness and pulse emission, validation anddiscussion, implementation		
Module 6	**Swarm Optimization**	**4 Hours**
Swarm Intelligence, PSO algorithms, Accelerated PSO, exampleproblems and implementation		
Module 7	**Cuckoo Search and firefly algorithms**	**5 Hours**
Cuckoo breeding behaviour, Levy flights, Cuckoo search, choice ofparameters, implementation		
Module 8	**Recent trends**	**2 Hours**
Total lecture hours		30 **Hours**

Reference Books

1. Xin-She Yang, Nature Inspired Metaheuristic algorithms, 2nd Edition, Luniver Press, 2010
2. Ke-Lin Du and M.N.S. Swamy, Search and Optimization by Metaheuristics: Techniques and Algorithms Inspired by Nature, Birkhauser Basel Publisher,Springer, 1st editon, 2016

3.	Raymond Chiong (Ed.), Nature-Inspired Algorithms for Optimisation, Studies in Computational Intelligence, Vol. 193, Springer, 2009.
4.	Anupam Shukla and Ritu Tiwari,Discrete Problems in Nature-Inspired Algorithms, 1st EditionCRC Press, Dec 2017
5.	Omid Bozorg-Haddad, (Ed.), Advanced Optimization by Nature-Inspired Algorithms, Studies in Computational Intelligence, Vol. 720, Springer 2018
6.	Xin-She Yang,Nature-inspired optimization algorithms, Elsevier, 201
7.	Xin-She Yang (Ed.), Nature-Inspired Algorithms and Applied Optimization, Springer, 2018

Project J Component: A team of 3-4 students can be grouped and asked to implement any new real-world hard problem usingnature-inspired meta-heuristic algorithms.

Recommended by Board of Studies			
Approved by Academic Council	**No.:53**	**Date:**	**13.12.2018**

Course Code	Course Title	L	T	P	J	C
CSE3501	Information Security Analysis and Audit Job Role: SSC/Q0901	2	0	2	4	4
Pre-requisite	NIL	Syllabus version				
		1.0				

Course Objective:

1. To introduce system security related incidents and insight on potential defenses, counter measures against common threat/vulnerabilities.
2. To provide the knowledge of installation, configuration and troubleshooting of information security devices.
3. To make students familiarize on the tools and common processes in information security audits and analysis of compromised systems.

Expected Course Outcome:

After successfully completing the course the student should be able to

1. Contribute to managing information security
2. Co-ordinate responses to information security incidents
3. Contribute to information security audits
4. Support teams to prepare for and undergo information security audits
5. Maintain a healthy, safe and secure working environment
6. Provide data/information in standard formats
7. Develop knowledge, skills and competence in information security

Module1	Information Security Fundamentals	7 hours

Definitions & challenges of security, Attacks & services, Security policies, Security Controls, Access control structures, Cryptography, Deception, Ethical Hacking, Firewalls, Identify and Access Management (IdAM).

Module 2	System Security	6 hours

System Vulnerabilities, Netw ork Sec urity S ys t ems, System Security, System Security Tools, Web Security, Application Security, Intrusion Detection Systems.

Module 3	Information Security Management	3 hours

Monitor systems and apply controls, security assessment using automated tools, backups of security devices, Performance Analysis, Root cause analysis and Resolution, Information Security Policies, Procedures, Standards and Guidelines

Module 4	Incident Management	5 hours

Security requirements, Risk Management, Risk Assessment, Security incident management, third party security management, Incident Components, Roles.

Module 5	Incident Response	4 hours

Incident Response Lifecycle, Record, classify and prioritize information security incidents using standard templates and tools, Responses to information security incidents, Vulnerability Assessment, Incident Analysis

Module 6	Conducting Security Audits	3 hours
Common issues in audit tasks and how to deal with these, Different systems and structures that may need information security audits and how they operate, including: servers and storage devices, infrastructure and networks, application hosting and content management, communication routes such as messaging, Features, configuration and specifications of information security systems and devices and associated processes and architecture, Common audit techniques, Record and report audit tasks, Methods and techniques for testing compliance.		
Module 7	**Information Security Audit Preparation**	**2 hours**
Establish the nature and scope of information security audits, Roles and responsibilities, Identify the procedures/guidelines/checklists, Identify the requirements of information security, audits and prepare for audits in advance, Liaise with appropriate people to gather data/information required for information security audits.		
Module 8	**Self and Work Management**	**2 hours**
Establish and agree work requirements with appropriate people, Keep the immediate work area clean and tidy, utilize time effectively, Use resources correctly and efficiently, Treat confidential information correctly, Work in line with organization's policies and procedures, Work within the limits of their job role.		
Total Lecture hours:		**30 hours**

Text Book(s)

1.	William Stallings, Lawrie Brown, Computer Security: Principles and Practice, 3rd edition, 2014.
2.	Nina Godbole, Information Systems Security: Security Management, Metrics, Frameworks and Best Practices, Wiley, 2017
3.	Nina Godbole, Sunit Belapure, Cyber Security- Understanding cyber-crimes, computer forensics and legal perspectives, Wiley Publications, 2016
4.	Andrew Vladimirov Michajlowski, Konstantin, Andrew A. Vladimirov, Konstantin V. Gavrilenko, Assessing Information Security: Strategies, Tactics, Logic and Framework, IT Governance Ltd, O'Reilly, 2010.

Reference Books

1.	Charles P. Pfleeger, Security in Computing, 4th Edition, Pearson, 2009.
2.	Christopher J. Alberts, Audrey J. Dorofee , Managing Information Security Risks, Addison - Wesley Professional, 2004
3.	Peter Zor, The Art of Computer Virus Research and Defense, Pearson Education Ltd, 2005
4.	Lee Allen, Kevin Cardwell, Advanced Penetration Testing for Highly-Secured Environments - Second Edition, PACKT Publishers, 2016
5.	Chuck Easttom , System Forensics Investigation and Response, Second Edition, Jones & Bartlett Learning, 2014
6.	David Kennedy, Jim O'Gorman, Devon Kearns, and Mati Aharoni, Metasploit The Penetration Tester's Guide, No Starch Press, 2014
7	Practical Malware Analysis by Michael Sikorski and Andrew Honig, No Starch Press, 2015
8.	Ref Links: https://www.iso.org/isoiec-27001-information-security.html https://csrc.nist.gov/publications/detail/sp/800-55/rev-1/final https://www.sans.org/reading-room/whitepapers/threats/paper/34180 https://www.sscnasscom.com/qualification-pack/SSC/Q0901/

List of Experiments (Indicative)	

1. Install and configure information security devices
2. Security assessment of information security systems using automated tools.
3. Vulnerability Identification and Prioritization
4. Working with Exploits
5. Password Cracking
6. Web Application Security Configuration
7. Patch Management
8. Bypassing Antivirus Software
9. Static Malware Analysis
10. Dynamic Malware Analysis
11. Penetration Testing
12. MySQL SQL Injection
13. Risk Assessment
14. Information security incident Management
15. Exhibit Security Analyst Role

	Total Laboratory Hours	30 hours	
Recommended by Board of Studies	05.02.2020		
Approved by Academic Council	58	Date	26.02.2020

Course Code	Course Title	L	T	P	J	C
CSE3502	Information Security Management Job Role: SSC/Q0901	2	0	2	4	4
Pre-requisite	NIL	Syllabus version				
		1.0				

Course Objective :

1. To introduce system security related incidents and insight on potential defenses, counter measures against common threat/vulnerabilities.
2. To provide the knowledge of installation, configuration and troubleshooting of information security devices
3. To make students familiarize on the tools and common processes in information security audits and analysis of compromised systems.

Expected Outcome:

After successfully completing the course the student should be able to

1. Contribute to managing information security
2. Co-ordinate responses to information security incidents
3. Contribute to information security audits
4. Support teams to prepare for and undergo information security audits
5. Maintain a healthy, safe and secure working environment
6. Provide data/information in standard formats
7. Develop knowledge, skills and competence in information security

Module 1	Information Security Devices	5 hours

Identify And Access Management (IdAM), Networks (Wired And Wireless) Devices, Endpoints/Edge Devices, Storage Devices, Servers, Infrastructure Devices (e.g. Routers, Firewall Services) , Computer Assets, Servers And Storage Networks, Content management, IDS/IPS

Module 2	Security Device Management	6 hours

Different types of information security devices and their functions, Technical and configuration specifications, architecture concepts and design patterns and how these contribute to the security of design and devices.

Module 3	Device Configuration	5 hours

Common issues in installing or configuring information security devices, Methods to resolve these issues, Methods of testing installed/configured information security devices,

Module 4	Information Security Audit Preparation	5 hours

Establish the nature and scope of information security audits, Roles and responsibilities, Identify the procedures/guidelines/checklists, Identify the requirements of information security, audits and prepare for audits in advance, Liaise with appropriate people to gather data/information required for information security audits. Security Audit Review - Organize data/information required for information security audits using standard templates and tools, Audit tasks, Reviews, Comply with the organization's policies, standards, procedures, guidelines and checklists, Disaster Recovery Plan

Module 5	Team Work and Communication	2 hours
Communicate with colleagues clearly, concisely and accurately , Work with colleagues to integrate their work effectively, Pass on essential information to colleagues in line with organizational requirements, Identify any problems they have working with colleagues and take the initiative to solve these problems, Follow the organization's policies and procedures for working with colleagues		
Module 6	**Managing Health and Safety**	**2 hours**
Comply with organization's current health, safety and security policies and procedures, Report any identified breaches in health, safety, and Security policies and procedures, Identify, report and correct any hazards, Organization's emergency procedures, Identify and recommend opportunities for improving health, safety, and security.		
Module 7	**Data and Information Management**	**3 hours**
Fetching the data/information from reliable sources, Checking that the data/information is accurate, complete and up-to-date, Rule-based analysis of the data/information, Insert the data/information into the agreed formats, Reporting unresolved anomalies in the data/information.		
Module 8	**Learning and Self Development**	**2 hours**
Identify accurately the knowledge and skills needed, Current level of knowledge, skills and competence and any learning and development needs, Plan of learning and development activities to address learning needs, Feedback from appropriate people, Review of knowledge, skills and competence regularly and appropriate action taken		
Total Lecture hours:		**30 hours**

Text Book(s)

1.	Information Systems Security: Security Management, Metrics, Frameworks and Best Practices, Nina Godbole, Wiley, 2017
2.	Rhodes-Ousley, Mark. Information Security: The Complete Reference, Second Edition, Information Security Management: Concepts and Practice. New York, McGraw-Hill, 2013.
3.	Christopher J. Alberts, Audrey J. Dorofee , Managing Information Security Risks, Addison-Wesley Professional, 2004

Reference Books

1.	Andrew Vladimirov Michajlowski, Konstantin, Andrew A. Vladimirov, Konstantin V. Gavrilenko, Assessing Information Security: Strategies, Tactics, Logic and Framework, IT Governance Ltd, O'Reilly 2010
2.	Christopher J. Alberts, Audrey J. Dorofee , Managing Information Security Risks, Addison-Wesley Professional, 2004
3.	Chuck Easttom , System Forensics Investigation and Response, Second Edition, Jones & Bartlett Learning, 2014
4.	David Kennedy, Jim O'Gorman, Devon Kearns, and Mati Aharoni, Metasploit The Penetration Tester's Guide, No Starch Press, 2014
5.	Ref Links: https://www.iso.org/isoiec-27001-information-security.html https://www.sans.org/reading-room/whitepapers/threats/paper/34180 https://csrc.nist.gov/publications/detail/sp/800-40/version-20/archive/2005-11-16 https://www.sscnasscom.com/qualification-pack/SSC/Q0901/

List of Experiments (Indicative)			
1. Install and configure information security devices 2. Penetration Testing 3. MySQL SQL Injection 4. Information security incident Management 5. Intrusion Detection/Prevention 6. Port Redirection and Tunneling 7. Exploring the Metasploit Framework 8. Working with Commercial Tools like HP Web Inspect and IBM AppScan etc., 9. Explore Open Source tools like sqlmap, Nessus, Nmap etc 10. Documentation with Security Templates from ITIL 11. Carry out backups of security devices and applications in line with information security policies, procedures and guidelines 12. Information security audit Tasks - Procedures/guidelines/checklists for the audit tasks			
		Total Laboratory Hours	30 hours
Method of Evaluation :Project/activity			
Recommended by Board of Studies	**05.02.2020**		
Approved by Academic Council	**No. 58**	**Date**	**26.02.2020**

Course Code	Course Title	L	T	P	J	C
CSE4003	CYBER SECURITY	3	0	0	4	4
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

1. To learn the concepts of number theory, cryptographic techniques.
2. To understand integrity and authentication process.
3. To familiarize various cyber threats, attacks, vulnerabilities, defensive mechanisms, security policies and practices.

Expected Course Outcome:

1. Know the fundamental mathematical concepts related to security.
2. Implement the cryptographic techniques to real time applications.
3. Comprehend the authenticated process and integrity, and its implementation
4. Know fundamentals of cybercrimes and the cyber offenses.
5. Realize the cyber threats, attacks, vulnerabilities and its defensive mechanism.
6. Design suitable security policies for the given requirements.
7. Exploring the industry practices and tools to be on par with the recent trends

Module:1	**Introduction to Number Theory**	**6 hours**
Finite Fields and Number Theory: Modular arithmetic, Euclidian Algorithm, Primality Testing Fermats and Eulers theorem, Chinese Reminder theorem, Discrete Logarithms		
Module:2	**Cryptographic Techniques**	**9 hours**
Symmetric key cryptographic techniques: Introduction to Stream cipher, Block cipher: DES, AES,IDEA Asymmetric key cryptographic techniques: principles, RSA, ElGamal, Elliptic Curve cryptography, Key distribution and Key exchange protocols.		
Module:3	**Integrity and Authentication**	**5 hours**
Hash functions,Secure Hash Algorithm (SHA)Message Authentication, Message Authentica- tionCode (MAC), Digital Signature Algorithm : RSA ElGamal based		
Module:4	**Cybercrimes and cyber offenses**	**7 hours**
Classification of cybercrimes, planning of attacks, social engineering:Human based, Computer based: Cyberstalking, Cybercafe and Cybercrimes		
Module:5	**Cyber Threats, Attacks and Prevention**	**9 hours**
Phishing, Password cracking, Keyloggers and Spywares, DoS and DDoS attacks, SQL Injection Identity Theft (ID) : Types of identity theft, Techniques of ID theft		
Module:6	**Cybersecurity Policies and Practices**	**7 hours**
What security policies are: determining the policy needs, writing security policies, Internet andemail security policies, Compliance and Enforcement of policies, Review		
Module:7	**Recent Trends**	**2 hours**
Total Lecture hours:		**45 hours**

Text Book(s)	
1.	Cryptography and Network security, William Stallings, Pearson Education, 7th Edition, 2016
2.	Cyber Security, Understanding cyber crimes, computer forensics and legal perspectives, Nina Godbole,Sunit Belapure, Wiley Publications, Reprint 2016
3.	Writing Information Security Policies, Scott Barman, New Riders Publications, 2002
Reference Books	
1.	Cybersecurity for Dummies, Brian Underdahl, Wiley, 2011
2.	Cryptography and Network security, Behrouz A. Forouzan , Debdeep Mukhopadhyay, Mcgraw Hill Education, 2 nd Edition, 2011

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**No. 37**	**Date**	**16-06-2015**

Course Code	Course Title	L	T	P	J	C
CSE4004	DIGITAL FORENSICS	3	0	2	0	4
Pre-requisite	Nil	Syllabus version				
		v1.0				

Course Objectives:

1. To learn about examination, preventing and fighting digital crimes
2. To model about data acquisition and storing digital evidence
3. To explore operating system file structure, file system and mobile device forensics and its acquisition procedures

Expected Course Outcome:

1. Infer the role of a Computer forensics profession for investigation.
2. Summarize the requirements for use of data acquisition.
3. Identify the need of Process crime and Incident scenes for digital evidence.
4. Choose suitable data Recover techniques in windows environment.
5. Analyze various validation techniques of forensics data.
6. Experiment with current computer forensics hardware and software tools for E-mail investigation and mobile device forensics.
7. Prioritize the challenges associated with real time forensics applications/tools.

Module:1	**Computer Forensics and Investigation**	**6 hours**
Understanding computer forensics, Preparing for Computer Investigations, Corporate High Tech Investigation		
Module:2	**Data Acquisition and Recovery**	**6 hours**
Storage formats, Using acquisition tools, Data Recovery: RAID Data acquisition.		
Module:3	**Processing Crime and Incident Scene**	**8 hours**
Identifying and collecting evidence, Preparation for search, Seizing and Storing Digital evidence		
Module:4	**Computer Forensics tools (Encase) and Windows Operating System**	**8 hours**
Understanding file structure and file system, NTFS disks, Disk Encryption and Registry Manipulation. Computer Forensics software and hardware tools		
Module:5	**Computer Forensics Analysis andValidation**	**7 hours**
Data collection and analysis, validation of forensics data, Addressing – data hiding technique		
Module:6	**Email Investigation and Mobile device Forensics**	**6 hours**
Investigation e-mail crimes and Violations, Using specialized E-mail forensics tools. Understanding mobile device forensics and Acquisition procedures.		
Module:7	**Role of Digital Forensics in Real timeapplications**	**2 hours**
SANS SIFT Investigative tool, PRO Discover Basic, Voltality, Sleuth Kit, CAINE investigative environment		
Module:8	**Industry Trends**	**2 hours**
Total Lecture hours:		**45 hours**

Text Book(s)	
1.	Bill Nelson, Amelia Philips, Christopher Steuart, Guide to Computer Forensics and Investigations, Fourth Edition, Cengage Learning, 2016
Reference Books	
1.	David Lilburn Watson, Andrew Jones, Digital Forensics Processing and Procedures, Syngress, 2013.
2.	Cory Altheide, Harlan Carvey, Digital Forensics with Open Source Tools, British Library Cataloguing-in-Publication Data, 2011
3.	Greg Gogolin,Digital Forensics Explained,CRC Press, 2013.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)		
1.	Computer Forensics Investigation Process	2 Hours
2.	Computer Forensics Lab	2 Hours
3.	Understanding Hard Disks and File Systems	3 Hours
4.	Windows Forensics	2 Hours
5.	Data Acquisition and Duplication	3 Hours
6.	Recovering Files and Partitions	2 Hours
7.	Forensics Investigation Using Encase	2 Hours
8.	Stenography and Image file Forensics	2 Hours
9.	Application Password Cracker	2 Hours
10.	Log Capturing and Event Correlation	2 Hours
11.	Network Forensics, Investigating log and Network Traffic	2 Hours
12.	Tracking and Investigating Email Crimes	3 Hours
13.	Mobile Forensics	3 Hours
	Total Laboratory Hours	**30 Hours**

Mode of assessment: Project/Activity

Recommended by Board of Studies	**28-02-2017**		
Approved by Academic Council	**No. 46**	**Date**	**24-08-2017**

Course Code	Course Title	L	T	P	J	C
CSE4011	VIRTUALIZATION	3	0	0	4	4
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

1. To identify and select suitable hypervisor for a cloud environment.
2. To acquire the knowledge of various virtualization techniques and tools.
3. To understand the process of data center automation and secure virtualized environment.

Expected Course Outcome:

1. Illustrate the process of virtualization.
2. Create and configure the hypervisors in cloud.
3. Apply the virtualization concepts in server and manage the storage capacity.
4. Analyze, identify and select suitable type of virtualization.
5. Use the management tools for managing the virtualized cloud infrastructure.
6. Apply suitable automation and security methods on data centre

Module:1	**INTRODUCTION**	**4 hours**
Virtualization definition – virtual machine basics – benefits – need for virtualization – limitations – traditional vs. contemporary virtualization process – virtual machines – taxonomy – challenges.		
Module:2	**HYPERVISORS**	**7 hours**
Introduction to Hypervisors – Type 1 Hypervisors – Type 2 Hypervisors – comparing hypervisors – virtualization considerations for cloud providers.		
Module:3	**HARDWARE VIRTUALIZATION**	**7 hours**
Full virtualization - para virtualization - server virtualization - OS level virtualization - emulation – binary translation techniques – managing storage for virtual machines.		
Module:4	**TYPES OF VIRTUALIZATION**	**8 hours**
Application virtualization - desktop virtualization - network virtualization - storage virtualization - comparing virtualization approaches.		
Module:5	**VIRTUALIZATION MANAGEMENT**	**6 hours**
Management life cycle - managing heterogeneous virtualization environment – customized and modifying virtual machines – virtual machine monitoring – management tools.		
Module:6	**AUTOMATION**	**6 hours**
Benefits of data center automation – virtualization for autonomic service provisioning – softwaredefined data center - backup - disaster recovery.		
Module:7	**SECURITY**	**5 hours**
Mapping Design (Models) to Code – Testing - Usability – Deployment – Configuration Management – Maintenance		
Module:8	**RECENT TRENDS**	**2 hours**
Total Lecture hours:		**45 hours**

Text Book(s)

1. Nelson Ruest, Danielle Ruest, Virtualization, A beginners guide, 2009, MGH.

2.	Nadeau,Tim Cerng, Je Buller, Chuck Enstall, Richard Ruiz, Mastering Microsoft Virtualization, Wiley Publication, 2010.
Reference Books	
1.	William Von Hagen, Professional Xen Virtualization, Wiley Publication, 2008.
2	Matthew Portney, Virtualization Essentials, John Wiley & Sons, 2012.
3.	Dave Shackleford, Virtualization security, protecting virtualized environment, John Wiley, 2012.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**No. 37**	**Date**	**16-06-2015**

Course Code	Course Title	L	T	P	J	C
CSE4014	HIGH PERFORMANCE COMPUTING	3	0	0	4	4
Pre-requisite	Nil	Syllabus version				
		v1.0				

Course Objectives:

1. To provide knowledge on high performance computing concepts to the students.
2. To comprehend the students how to analyze the parallel programming through OpenMP, MPI, CUDA.
3. To teach the student how to apply job management techniques and evaluate the performance.

Expected Course Outcome:

1. To knowledge the overview and analyze the performance metrics of high performancecomputing.
2. To comprehend the various High Performance Computing Paradigms and Job Management Systems.
3. To design and develop various applications with OpenMP, MPI and CUDA.
4. To analyze the benchmarks of high performance computing.
5. To demonstrate the various emerging trends of high performance computing.
6. To apply high performance computing concepts in problem solving.

Module:1	Introduction to High Performance Computing (HPC)	4 hours

Overview of Parallel Computers and high performance computing (HPC), History of HPC, Numerical and HPC libraries, Performance metrics.

Module:2	HPC Paradigms	6 hours

Supercomputing, Cluster Computing, Grid Computing, Cloud Computing, Many core Computing, Petascale Systems

Module:3	Parallel Programming - I	7 hours

Introduction to OpenMP, Parallel constructs, Runtime Library routines, Work-sharing constructs, Scheduling clauses, Data environment clauses, atomic, master Nowait Clause, Barrier Construct, overview of MPI, MPI Constructs, OpenMP vs MPI.

Module:4	Job Management Systems	8 hours

Batch scheduling: Condor, Slurm, SGE, PBS, Light weight Task Scheduling: Falkon, Sparrow

Module:5	Parallel Programming - II	7 hours

Introduction to GPU Computing, CUDA Programming Model, CUDA API, Simple Matrix, Multiplication in CUDA , CUDA Memory Model, Shared Memory Matrix Multiplication, Additional CUDA API Features

Module:6	Achieving Performance	6 hours

Measuring performance, Identifying performance bottlenecks, Partitioning applications forheterogeneous resources, Using existing libraries and frameworks

Module:7	HPC Benchmarks	5 hours

HTC, MTC (Many Task Computing), Top 500 Super computers in the world, Top 10 Super Computer architectural details, Exploring HPC Bechmarks: HPL, Stream.

Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Victor Eijkhout, Edmond Chow, Robert van de Geijn, Introduction to High Performance Scientific Computing, 2nd edition, revision 2016
2.	Rob Farber, CUDA Application Design and Development, Morgan Kaufmann Publishers, 2013

Reference Books

1.	Zbigniew J. Czech, Introduction to parallel computing, 2nd edition, Cambridge University Press,2016

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**No. 37**	**Date**	**16-06-2015**

Course Code	Course Title	L	T	P	J	C
CSE4015	HUMAN COMPUTER INTERACTION	3	0	0	4	4
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

1. To provide the basic knowledge on the levels of interaction, design models, techniques andvalidations focusing on the different aspects of human-computer interface and interactions
2. To make the learners to think in design perspective and to evaluate interactive design
3. To use the concepts and principles of HCI to analyze and propose solution for real lifeapplications
4. To become familiar with recent technology trends and challenges in HCI domain

Expected Course Outcome:

1. Enumerate the basic concepts of human, computer interactions
2. Create the processes of human computer interaction life cycle
3. Analyze and design the various interaction design models
4. Apply the interface design standards/guidelines for evaluating the developed interactions
5. Establish the different levels of communication across the application stakeholders
6. Apply product usability evaluations and testing methods
7. Demonstrate the principles of human computer interactions through the prototype modelling

Module:1	HCI Foundations	6 hours

Input–output channels, Human memory, Thinking: reasoning and problem solving, Emotion, Individual differences, Psychology and the design of interactive systems, Text entry devices, Positioning, pointing and drawing, Display devices, Devices for virtual reality and 3D interaction, Physical controls, sensors and special devices, Paper: printing and scanning

Module:2	Designing Interaction	6 hours

Overview of Interaction Design Models, Discovery - Framework, Collection - Observation, Elicitation, Interpretation - Task Analysis, Storyboarding, Use Cases, Primary Stakeholder Profiles, Project Management Document

Module:3	Interaction Design Models	8 hours

Model Human Processor - Working Memory, Long-Term Memory, Processor Timing, Keyboard Level Model - Operators, Encoding Methods, Heuristics for M Operator Placement, What the Keyboard Level Model Does Not Model, Application of the Keyboard Level Model, GOMS - CMN-GOMS Analysis, Modeling Structure, State Transition Networks - Three-State Model, Glimpse Model, Physical Models, Fitts' Law

Module:4	Guide Lines in HCI	6 hours

Shneideman's eight golden rules, Norman's Sever principles, Norman's model of interaction, Nielsen's ten heuristics, Heuristic evaluation, contextual evaluation, Cognitive walk-through

Module:5	Collaboration And Communication	5 hours

Face-to-face Communication, Conversation, Text-based Communication, Group working, Dialog design notations, Diagrammatic notations, Textual dialog notations, Dialog semantics, Dialog analysis and design

Module:6	**Human Factors And Security**	**6 hours**
Groupware, Meeting and decision support systems, Shared applications and artifacts, Frameworks for groupware Implementing synchronous groupware, Mixed, Augmented and Virtual Reality		
Module:7	**Validation And Advanced Concepts**	**6 hours**
Validations - Usability testing, Interface Testing, User Acceptance Testing Past and future of HCI: the past, present and future, perceptual interfaces, context-awareness and perception		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	A Dix, Janet Finlay, G D Abowd, R Beale., Human-Computer Interaction, 3rd Edition, Pearson Publishers,2008

Reference Books

1.	Shneiderman, Plaisant, Cohen and Jacobs, Designing the User Interface: Strategies for Effective Human Computer Interaction, 5th Edition, Pearson Publishers, 2010.
2.	Hans-Jorg Bullinger, "Human-Computer Interaction", Lawrence Erlbaum Associates, Publishers
3.	Jakob Nielsen,"Advances in Human-computer Interaction",Ablex Publishing Corporation
4.	Thomas S. Huang," Real-Time Vision for Human-Computer Interaction", Springer
5.	Preece et al, Human-Computer Interaction, Addison-Wesley, 1994

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**No. 37**	**Date**	**16-06-2015**

Course Code	Course Title	L	T	P	J	C
CSE4019	IMAGE PROCESSING	3	0	0	4	4
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

1. To provide the basic knowledge on image processing concepts.
2. To develop the ability to apprehend and implement various image processing algorithms.
3. To facilitate the students to comprehend the contextual need pertaining to various image processing applications.

Expected Course Outcome:

1. Ascertain and describe the basics of image processing concepts through mathematical interpretation.
2. Acquire the knowledge of various image transforms and image enhancement techniques involved.
3. Demonstrate image restoration process and its respective filters required.
4. Experiment the various image segmentation and morphological operations for a meaningfulpartition of objects.
5. Design the various basic feature extraction and selection procedures and illustrate the various image compression techniques and their applications.
6. Analyze and implement image processing algorithms for various real-time applications.

Module:1	Introduction - Digital Image, its Representation	6 hours

Image Representation and Image Processing Paradigm - Elements of digital image processing- Image model. Sampling and quantization-Relationships between pixels- Connectivity, Distance Measures between pixels - Color image (overview, various color models)-Various image formats - bmp, jpeg, tiff, png, gif, etc.

Module:2	Digital Image Properties - Operations on Digital Images	6 hours

Topological Properties of Digital Images-Histograms, Entropy, Eigen Values-Image Quality Metrics-Noise in Images Sources, types. Arithmetic operations - Addition, Subtraction, Multi- plication, Division-Logical operations NOT, OR, AND, XOR-Set operators-Spatial operations Single pixel, neighbourhood, geometric-Contrast Stretching-Intensity slicing-Bit plane slicing Power Law transforms

Module:3	Image Enhancement	6 hours

Spatial and Frequency domain-Histogram processing-Spatial filtering-Smoothening spatial filters-Sharpening spatial filters- Discrete Fourier Transform-Discrete Cosine Transform-Haar Trans- form – Hough Transform-Frequency filtering-Smoothening frequency filters-Sharpening frequency filters-Selective filtering.

Module:4	Digital Image Restoration- Digital Image Registration	7 hours

Noise models - Degradation models-Methods to estimate the degradation-Image de-blurring-Restoration in the presence of noise only spatial filtering-Periodic noise reduction by frequency domain filtering-Inverse filtering-Wiener Filtering. Geometrical transformation-Point based methods- Surface based methods-Intensity based methods.

Module:5	Feature Extraction	6 hours
Region of interest (ROI) selection - Feature extraction: Histogram based features – Intensity features-Color, Shape features-Contour extraction and representation-Homogenous region extraction and representation-Texture descriptors - Feature Selection: Principal Component Analysis (PCA).		
Module:6	Image Segmentation- Morphological Image Processing	6 hours
Discontinuity detection-Edge linking and boundary detection. Thresholding-Region oriented segmentation- Histogram based segmentation. Object recognition based on shape descriptors. Dilation and Erosion-Opening and Closing-Medial axis transforms-Objects skeletons-Thinningboundaries.		
Module:7	Image Coding and Compression	6 hours
Lossless compression versus lossy compression-Measures of the compression efficiency- Huffmann coding-Bitplane coding-Shift codes-Block Truncation coding-Arithmetic coding-Predictive coding techniques-Lossy compression algorithm using the 2-D. DCT transform-The JPEG 2000 standard Baseline lossy JPEG, based on DWT.		
Module:8	Recent Trends	2 hours
	Total Lecture hours:	45 hours

Text Book(s)

1.	Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Third Ed., Prentice- Hall, 2008.

Reference Books

1.	William K. Pratt, Digital Image Processing, John Wiley, 4th Edition, 2007
2.	Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 1997
3.	Sonka, Fitzpatrick, Medical Image Processing and Analysis, 1st Edition, SPIE, 2000.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**No. 37**	**Date**	**16-06-2015**

Course Code	Course Title	L	T	P	J	C
CSE4020	MACHINE LEARNING	3	0	2	0	4
Pre-requisite	MAT2001	Syllabus version				
		1.1				

Course Objectives:

1. Basic ability to understand the concept of supervised and unsupervised learning techniques
2. Differentiate regression, classification and clustering techniques and to implement thesealgorithms.
3. To analyze the performance of various machine learning techniques
4. To select appropriate features for training machine learning algorithms and to reduce thedimension of the dataset.
5. To find an efficient method to handle missing and imbalanced data and to combinedifferent machine learning algorithms to achieve a better results.

Expected Course Outcome:

1. Recognize the characteristics of machine learning that makes it useful to solve real-worldproblems.
2. Provide solution for classification and regression approaches in real-world applications.
3. Gain knowledge to combine machine learning models to achieve better results.
4. Choose an appropriate clustering technique to solve real world problems.
5. Realize methods to reduce the dimension of the dataset used in machine learningalgorithms.
6. Choose a suitable machine learning model, implement and examine the performance of the chosen model for a given real world problems.
7. Understand cutting edge technologies related to machine learning applications.

Module:1	**Introduction to Machine Learning**	**4 hours**
What is Machine Learning, Examples of Various Learning Paradigms, Perspectives and Issues, Version Spaces, Finite and Infinite Hypothesis Spaces, PAC Learning.		
Module:2	**Supervised Learning - I**	**7 hours**
Learning a Class from Examples, Linear, Non-linear, Multi-class and Multi-label classification, Generalization error bounds: VC Dimension, Decision Trees: ID3, Classification and RegressionTrees, Regression: Linear Regression, Multiple Linear Regression, Logistic Regression.		
Module:3	**Supervised Learning - II**	**7 hours**
Neural Networks: Introduction, Perceptron, Multilayer Perceptron, Support vector machines: Linear and Non-Linear, Kernel Functions, K-Nearest Neighbors.		
Module:4	**Ensemble Learning**	**6 hours**
Ensemble Learning Models, Combination Schemes, Voting, Error-Correcting Output Codes, Bagging: Random Forest Trees, Boosting: Adaboost, Stacking.		
Module:5	**Unsupervised Learning**	**8 hours**
Introduction to clustering, Hierarchical: AGNES, DIANA, Partitional: K-means clustering, K- Mode Clustering, Self-Organizing Map, Expectation Maximization, Gaussian Mixture Models.		
Module:6	**Dimensionality Reduction Techniques**	**6 hours**
Principal components analysis (PCA), Locally Linear Embedding (LLE), Factor Analysis.		

Module:7	**Machine Learning in Practice**	**7 hours**
Machine Learning in Practice Design, Analysis and Evaluation of Machine Learning Experiments, Feature selection Mechanisms, Other Issues: Imbalanced data, Missing Values, Outliers.		
Module:8	**Recent Trends in Machine Learning**	**2 hours**
Industry Expert talk		
Total Lecture hours:	**45 hours**	

Text Book(s)

1.	Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition 2014.

Reference Books

1.	Sergios Theodoridis, Konstantinos Koutroumbas, "Pattern Recognition", Academic Press, 4th edition, 2008, ISBN:9781597492720
2.	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning", MIT Press, 2012.
3.	Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 1997.
4.	Charu C. Aggarwal, "Data Classification Algorithms and Applications", CRC Press,2014.
5.	Charu C. Aggarwal, "Data Clustering Algorithms and Applications", CRC Press,2014.
6.	Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	Implement Decision Tree learning	2 hours
2.	Implement Logistic Regression	2 hours
3.	Implement classification using Multilayer perceptron	2 hours
4.	Implement classification using SVM	2 hours
5.	Implement Adaboost	2 hours
6.	Implement Bagging using Random Forests	2 hours
7.	Implement Ensemble techniques (Combine any methods of your own choice and use voting method)	2 hours
8.	Implement Hierarchical clustering	2 hours
9.	Implement K-Means and K-Mode Clustering to find natural patterns in data	2 hours
10.	Implement Principle Component Analysis for dimensionality reduction	2 hours
11.	Implemention of Factor Analysis technique	2 hours
12.	Implement Gaussian Mixture Model Using the Expectation Maximization	2 hours
13.	Evaluating ML algorithm with balanced and unbalanced datasets	2 hours
14.	Comparison of Machine Learning algorithms	2 hours
15.	Implement k-nearest neighbors algorithm	2 hours
	Total Laboratory Hours	**30hours**

Mode of assessment: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	**09-09-2020**		
Approved by Academic Council	**No. 59**	**Date**	**24-09-2020**

Course Code	Course Material	L	T	P	J	C
CSE4027	MOBILE PROGRAMMING	2	0	2	4	4
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

1. Students able to learn to write both web apps and native apps for Android using Eclipse and the Android SDK, to write native apps for iPhones, iPod Touches, and iPads using Xcode and the iOS SDK, and to write web apps for both platforms.
2. The course also touches on Windows 8 application programming, so as to provide students with a stepping stone for application development in the mobile operating system of their choice. Additional topics covered include application deployment and availability on the corresponding app stores and markets, application security, efficient power management, and mobile device security

Expected Course Outcome:

1. Exposed to technology and business trends impacting mobile applications.
2. Competent with the characterization and architecture of mobile applications.
3. Competent with designing and developing mobile applications using one application development framework.

Module:1	Introduction to Mobile Devices	4 hours

Mobile vs.desktop devices and architecture -Power Management-Screen resolution -Touch interfaces -Application deployment -App Store, Google Play, Windows Store –Development environments-X Code-Eclipse -VS2012-Phone GAP-Native vs. web applications

Module:2	HTML5/JS/CSS3	4 hours

Quick recap of technologies -Mobile-specific enhancements -Browser- detection-Touch interfaces -Geolocation -Screen orientation-Mobile browser "interpretations"(Chrome/Safari/Gecko/IE)- Case studies.

Module:3	Mobile OS Architecture	3 hours

Comparing and Contrasting architectures of all three – Android, iOS and Windows-Underlying OS (Darwin vs. Linux vs. Win 8) -Kernel structure and native level programming -Runtime (Objective-C vs. Dalvik vsWinRT) -Approaches to power management - Security

Module:4	Android/iOS/Win 8 Survival and basic	3 hours

Building Application(IOS, Window, Android).- App structure, built-in Controls, file access, basic graphics Android/iOS/Win8 inbuilt APP- DB access, network access, contacts/photos

Module:5	Underneath the frameworks	4 hours

Native level programming on Android -Low-level programming on (jailbroken) iOS-Windows low level APIs

Module:6	Power Management	4 hours

Wake locks and assertions -Low-level OS support -Writing power - smart applications

Module:7	Augmented Reality(AR) and Mobile Security	6 hours

Web and AR - User interface - Mobile AR-evaluation of AR- standardization – GPS - Accelerometer - Camera - Mobile malware - Device protections - Mobile Secuirty - overview of the current mobile threat

landscape-An assessment of your current mobile security solution- complete analysis of your current risks- Recommendations on how to secure your company's mobile devices from advanced threats and targeted attacks

Module:8	**Recent Trends :** Industry Expert talk	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	Rajiv Ramnath, Roger Crawfis, and Paolo Sivilotti, Android SDK3 for Dummies,Wiley, 2011.

Reference Books

1.	Valentino Lee, Heather Schneider, and Robbie Schell, Mobile Applications: Architecture, Design, and Development, Prentice Hall, 2004.
2.	Brian Fling, Mobile Design and Development O'Reilly Media, 2009
3.	Maximiliano Firtman Programming the Mobile Web, O'Reilly Media, 2010.
4.	Christian Crumlish and Erin Malone Designing Social Interfaces, O'Reilly Media, 2009

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	1. Get the HelloVIT midlet on the "getting started" page working.
	2. Make some changes - e.g. the text of the String item.
	3. Put in an error - e.g. divide by zero, to see how the development environment attempts to point out on the PC when a runtime error occurs on the phone emulator.
	4. Get the MIDlet "First MIDlet Progam" in the handout working (ok, so it's really our second MIDlet). Copy the code from the handout.
	5. Modify the MIDlet by additing these additional items to the form e.g. TexField, DateField, Gauge. Look up the lcdui package to see what Items can be added and the parameters needed..
	6. You can output to the PC console while the program is running e.g. place this code in the constructor: System.out.println("in Constructor"); // This will ouput on the PC console, not on the phone
	7. Now add: System.out.println("in CommandAction method"); to the Command Action method to see when that method is running.
	8. Add moreSytem.out.println'sin the following methods:
	1. startApp
	2. pauseApp
	3. destroyApp
	9. Note the sequence of method calls from MID let start to end.
		4 Hours

2.	**First MIDlet - adding a new command** 1. Continue to add to 2.0 First MIDlet by adding an "OK" command (look up the API command class) 2. Have the"OK" command display on the phone's screen. 3. Add code to process the "OK" command 4. In the actionCommand method display the contents of the TextFriend using System.out.println ( )	4 Hours

	5. Add two more commands e.g. Send, Spell Check. 6. Where were they placed? 7. Add code to check for these commands - add System.out.println's to show when that code is being executed. 8. Now use System.out.prinln in the OK processing code ad see the text being modified while the program runs. 9. Add another System.out.prinln in the OK to display the value of the gauge (if it's not interactive, go back to the API to see how to make it interactive)	
3	**Additon MIDlet** 1. Create a MIDlet that allows you to enter a number. The number is then added to any prevous number and the running total result is displayed. Use a TextBox to recieve text from the user (instead of a Form as in the previous example). 2. Can you crash the program by entering text instead of numbers? If you can then constrain the user input to numbers only.	4 Hours
4	**Additon MIDlet on a real phone** 1. For the addition MIDlet : Use the IDE to Create a JAR file. 2. (Optionally) Transfer the JAR file to you phone and test. See handout on how to create and deploy a JAR file.	4 Hours
5	**Battery Status** Create an MIDlet that displays a coloured bar to display a car battery's status. The battery voltage is entered into the MIDlet as a floating point number. Display a bar graph as follows: 0-9.5 - Red (battery dead) >9.6 <12 - Yellow (battery poor) >12 <14.4 - Green (battery good) >14.4 - Blue (Alternator faulty)	4 Hours
6	**Secret Text** Develop an MIDlet that has a TextField and Label GUI components. When a piece of text is entered the MIDlet 'encrypts' the text by replacing each letter using the following mapping: **MLKJIHGFEDCBA** **NOPQRSTUVWXYZ** So A -> Z, N-> M, B-> Y, O->L etc Display the encrypted text back in the TextField (so pressing enter should give you back the original text). Display the length of the entered text using the Label. Develop an MIDlet that has a TextField and Label GUI components. When a piece of text is entered the MIDlet 'encrypts' the text by replacing eachletter using the following mapping: **MLKJIHGFEDCBA** **NOPQRSTUVWXYZ** So A -> Z, N-> M, B-> Y, O->L etc Display the encrypted text back in the TextField (so pressing enter should give you back the original text). Display the length of the entered text using the Label.	5 Hours

7	**Missing Letter Game** Develop an MIDlet or application that displays a word at random with a randomletter(s) missing. The user has to guess the missing letter(s) by entering it/them into a text field(s). You can use an array or vector to store some words internally in the program.	5 hours
	Total Laboratory Hours	**30hours**

Mode of assessment: Project/Activity			
Recommended by Board of Studies	**13-05-2016**		
Approved by Academic Council	**No. 41**	**Date**	**17-06-2016**

Course Code	Course Material	L	T	P	J	C
CSE4028	OBJECT ORIENTED SOFTWARE DEVELOPMENT	2	0	2	4	4
Pre-requisite	Nil	Syllabus Version				
		1.0				

Course Objectives :

1. To make the students understand the essential and fundamental aspects of object oriented concepts along with their applications.
2. To discuss and explore different analysis models, design and implement models of object-oriented software systems by means of a mid-sized project.
3. To teach the students a solid foundation on different software development life cycle of Object-Oriented solutions for Real-World Problems

Expected Course Outcome :

1. Identify and select suitable Process Model for the given problem and have a thorough understanding ofvarious Software Life Cycle models.
2. Analyze the requirements of the given software project and produce requirement specifications.
3. Apply the knowledge of object-oriented modelling concepts and design methods with a clear emphasison Unified Modelling Language for a moderately realistic object oriented system.
4. Apply various software architectures, including frameworks and design patterns, when developing software projects.
5. Evaluate the software project using various Testing techniques.
6. Predict the deployment strategy of the software project.
7. Recognize the Configuration Management strategies of the software project

Module:1	**Introduction To Software Development**	**4 hours**
The Challenges of Software Development – An Engineering Perspective – Object-Orientation – Iterative Development Processes		
Module:2	**Process Models**	**3 hours**
Life cycle models – Unified Process – Iterative and Incremental – Workflow – Agile Processes		
Module:3	**Modeling – OO Systems**	**4 hours**
Requirements Elicitation – Use Cases – Unified Modeling Language, Tools		
Module:4	**Analysis**	**4 hours**
Analysis Object Model (Domain Model) – Analysis Dynamic Models – Non-functional requirements – Analysis Patterns.		
Module:5	**Design**	**4 hours**
System Design, Architecture – Design Principles - Design Patterns – Dynamic Object Modeling – Static Object Modeling – Interface Specification – Object Constraint Language		
Module:6	**Design Patterns**	**5 hours**
Introduction – Design Patterns in Smalltalk MVC – Describing Design patterns –Catalog of Design Patterns- Organizing the Catalog –How Design Patterns Solve Design Problems – How to select a Design Pattern – How to use a Design Pattern – What makes a pattern? – Pattern Categories – Relationship between Patterns – Patterns and Software Architecture		

Module:7	**Implementation, Deployment And Maintenance**	**4 hours**
Mapping Design (Models) to Code – Testing - Usability – Deployment – Configuration Management – Maintenance		
Module:8	**Recent Trends**	**2 hours**
Recent Trends in Object oriented Software Development		
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	Carol Britton and Jill Doake, A Student Guide to Object-Oriented Development (Oxford: Elsevier, 2005).

Reference Books

1.	Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, "Design patterns: Elements of Reusable object-oriented software", Addison-Wesley, 1995.
2	Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 2nd Edition, Pearson Education, 2004.
3.	Ivar Jacobson, Grady Booch, James Rumbaugh, The Unified Software Development Process, Pearson Education, 1999.
4.	Alistair Cockburn, Agile Software Development 2nd Edition, Pearson Education, 2007.

Mode of Evaluation: CAT 1, CAT 2 & FAT

List of Challenging Experiments (Indicative)

1.	Lab (Indicative List of Experiments (in the areas of)	
	Introduction and project definition	3 Hours
	Software requirements Specification	3 Hours
	Introduction to UML and use case diagrams	3 Hours
	System modelling (DFD and ER)	3 Hours
	OO analysis: discovering classes	3 Hours
	Software Design: software architecture and object oriented design	3 Hours
	Flow of events and activity diagram	3 Hours
	State Transition Diagram	3 Hours
	Component and deployment diagrams	3 Hours
	Software testing (RFT,SCM Tools)	3 Hours
	Total Laboratory Hours	**30 Hours**

Mode of evaluation: Review 1, Review 2 & FAT

Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**No. 37**	**Date**	**16-06-2015**

UNIVERSITY CORE

(2018 - 2019)

B.Tech. Computer Science and Engg with Specialization in Bioinformatics

Course Code	Course Title	L	T	P	J	C
BIT1003	Biology For Engineers	3	0	2	0	4
Pre-requisite	NIL	Syllabus version				2

Course Objectives:

1. Build a basic understanding of biology for engineers
2. Make up future-ready engineers to invent new biological tools.

Expected Course Outcome:

1. Interpret biological concepts
2. Classify and compare evolving systems
3. Relate biology ,chemistry and physics in modern perspective
4. Distinguish different and allied fields of biology
5. Make use of biological knowledge in industries
6. Discover biology in various fields

Module:1	**Introduction to Biology and Evolution**	**6 hours**

Science of biology and contributions from various fields (Nobel Laureates). Biological complexity from viruses to complex eukaryotes, Biological diversity and bio-inspired designs. Evolution of life, Darwinism, molecular-evolution, neo Darwinism.

Module:2	**Chemistry and Complexity**	**6 hours**

Nano world of cells, Membrane bound and non-membranous organelles of cells, Central dogma and molecules involved, Cell structures, Organelles, Tissues, Organs and organ systems, Physiological constraints.

Module:3	**Physics of Biology**	**7 hours**

Biological transformation, storage and modulation of various energies: Light, Mechanical and Electrical energy; Thermodynamic principles in ecology (first and second laws of thermodynamics,open and closed systems, dissipative structures). Introduction to quantum biology.

Module:4	**Introduction to biological research**	**5 hours**

Biosafety and biohazards. Different scales of research. Major areas: food and agriculture, biomedical, environmental and energy.

Module:5	**Microbes as threats and tools in biology**	**6 hours**

Infectious diseases, Current epidemics, Microbes used for genetic engineering.

Module:6	**Antibody and allied technology**	**5 hours**

Antibody and immune system. Vaccines, large scale antibody production, antibody based detection and diagnostic systems, antibody as drug.

Module:7	**Human cell culture and computationalBiology**	**8 hours**
Basic cell culture technology, Cancer cell culture and drug discovery, Stem cells, Human on chip-concept, Regenerative medicine. Introduction to bioinformatics, molecular modelling, drug design and drug discovery, Systems biology, Bioinspired algorithms, DNA computation.		
Module:8	**Contemporary issues:** Lecture by Industrial Expert	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Arthur T. Johnson, Biology for Engineers, 27-Jun-2011 - Medical - 775 pages, CRC Press
2.	Editors: Björn, Lars Olof (Ed.)., Photobiology, The Science of Light and Life, 2015

Reference Books

1.	Christopher H. M. Jenkins, Bio-Inspired Engineering, 2011, Momentum Press
2.	Jacobs CR, Huang H, Kwon RY, Introduction to Cellular Mechanics and Mechanobiology. New York: Garland Science, 2012. Print
3.	Nagatomi J, Mechanobiology Handbook. Florida, 2011, CRC Press, Print.
4.	Ronald R. Pethig, Stewart Smith, John Wiley & Sons, Introductory Bioelectronics: ForEngineers and Physical Scientists, 22-Aug-2012 - Science - 464 pages

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	Virtual lab of cellular length scales	3 hours
2.	Exploration of PDB	2 hours
3.	Protein ligand docking experiment in silico	3 hours
4.	Evolutionary algorithm (e.g. game of life)	3 hours
5.	Virtual lab on photosynthesis and respiration	3 hours
6.	Glucose sensing mechanism of glucometer	3 hours
7.	Computational fluid dynamics in relevance to biological processes	2 hours
8.	3D printing in relevance to biological research	2 hours
9.	Bioelectricity experiment	3 hours
10.	Potato osmometer and osmotic processes	2 hours
11.	DNA isolation from fruits	2 hours
12.	Glucose sensing and dissection of Glucometer chip.	2 hours
	Total Laboratory Hours	**30 hours**

Mode of evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	**03-08-2017**		
Approved by Academic Council	**No. 46**	**Date**	**23-08-2017**

Course Code	Course Title	L	T	P	J	C
CHY1002	Environmental Sciences	3	0	0	0	3
Pre-requisite	Chemistry of 12th standard or equivalent	Syllabus version				1.1

Course Objectives:

1. To make students understand and appreciate the unity of life in all its forms, theimplications of life style on the environment.
2. To understand the various causes for environmental degradation.
3. To understand individuals contribution in the environmental pollution.
4. To understand the impact of pollution at the global level and also in the local environment.

Expected Course Outcome:

Students will be able to

1. Students will recognize the environmental issues in a problem oriented interdisciplinary perspectives
2. Students will understand the key environmental issues, the science behind those problems and potential solutions.
3. Students will demonstrate the significance of biodiversity and its preservation
4. Students will identify various environmental hazards
5. Students will design various methods for the conservation of resources
6. Students will formulate action plans for sustainable alternatives that incorporate science, humanity, and social aspects
7. Students will have foundational knowledge enabling them to make sound life decisions aswell as enter a career in an environmental profession or higher education.

Module:1	Environment and Ecosystem	7 hours

Key environmental problems, their basic causes and sustainable solutions. IPAT equation. Ecosystem, earth – life support system and ecosystem components; Food chain, food web, Energy flow in ecosystem; Ecological succession- stages involved, Primary and secondary succession, Hydrarch, mesarch, xerarch; Nutrient, water, carbon, nitrogen, cycles; Effect of human activities on these cycles.

Module:2	Biodiversity	6 hours

Importance, types, mega-biodiversity; Species interaction - Extinct, endemic, endangered and rare species; Hot-spots; GM crops- Advantages and disadvantages; Terrestrial biodiversity and Aquatic biodiversity – Significance, Threats due to natural and anthropogenic activities and Conservation methods.

Module:3	Sustaining Natural Resources and Environmental Quality	7 hours

Environmental hazards – causes and solutions. Biological hazards – AIDS, Malaria, Chemical hazards- BPA, PCB, Phthalates, Mercury, Nuclear hazards- Risk and evaluation of hazards. Water footprint; virtual water, blue revolution. Water quality management and its conservation. Solid and hazardous waste – types and waste management methods.

Module:4	**Energy Resources**	**6 hours**
Renewable - Non renewable energy resources- Advantages and disadvantages - oil, Natural gas,Coal, Nuclear energy. Energy efficiency and renewable energy. Solar energy, Hydroelectric power, Ocean thermal energy, Wind and geothermal energy. Energy from biomass, solar- Hydrogen revolution.		
Module:5	**Environmental Impact Assessment**	**6 hours**
Introduction to environmental impact analysis. EIA guidelines, Notification of Government of India (Environmental Protection Act – Air, water, forest and wild life). Impact assessment methodologies. Public awareness. Environmental priorities in India.		
Module:6	**Human Population Change and Environment**	**6 hours**
Urban environmental problems; Consumerism and waste products; Promotion of economic development – Impact of population age structure – Women and child welfare, Women empowerment. Sustaining human societies: Economics, environment, policies and education.		
Module:7	**Global Climatic Change and Mitigation**	**5 hours**
Climate disruption, Green house effect, Ozone layer depletion and Acid rain. Kyoto protocol,Carbon credits, Carbon sequestration methods and Montreal Protocol. Role of Information technology in environment-Case Studies.		
Module:8	**Contemporary issues :** Lecture by Industry Experts	**2 hours**
Total Lecture hours:		**45 hours**

Text Books

1.	G. Tyler Miller and Scott E. Spoolman (2016), Environmental Science, 15th Edition, Cengage learning.
2.	George Tyler Miller, Jr. and Scott Spoolman (2012), Living in the Environment – Principles, Connections and Solutions, 17th Edition, Brooks/Cole, USA.

Reference Books

1.	David M.Hassenzahl, Mary Catherine Hager, Linda R.Berg (2011), Visualizing Environmental Science, 4th Edition, John Wiley & Sons, USA.

Mode of evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT			
Recommended by Board of Studies	**12.08.2017**		
Approved by Academic Council	**No. 46**	**Date**	**24.08.2017**

Course Code	Course Title	L	T	P	J	C
CHY1701	Engineering Chemistry	3	0	2	0	4
Pre-requisite	Chemistry of 12th standard or equivalent	Syllabus version				1.1

Course Objectives:

1. To impart technological aspects of applied chemistry
2. To lay foundation for practical application of chemistry in engineering aspects

Expected Course Outcomes:

Students will be able to

1. Recall and analyze the issues related to impurities in water and their removal methods and apply recent methodologies in water treatment for domestic and industrial usage
2. Evaluate the causes of metallic corrosion and apply the methods for corrosion protectionof metals
3. Evaluate the electrochemical energy storage systems such as lithium batteries, fuel cells andsolar cells, and design for usage in electrical and electronic applications
4. Assess the quality of different fossil fuels and create an awareness to develop the alternative fuels
5. Analyze the properties of different polymers and distinguish the polymers which can bedegraded and demonstrate their usefulness
6. Apply the theoretical aspects: (a) in assessing the water quality; (b) understanding the construction and working of electrochemical cells; (c) analyzing metals, alloys and soil using instrumental methods; (d) evaluating the viscosity and water absorbing properties of polymeric materials

Module:1	Water Technology	5 hours

Characteristics of hard water - hardness, DO, TDS in water and their determination – numerical roblems in hardness determination by EDTA; Modern techniques of water analysis for industrialuse - Disadvantages of hard water in industries.

Module:2	Water Treatment	8 hours

Water softening methods: - Lime-soda, Zeolite and ion exchange processes and their applications. Specifications of water for domestic use (ICMR and WHO); Unit processes involved in water treatment for municipal supply - Sedimentation with coagulant- Sand Filtration - chlorination; Domestic water purification – Candle filtration- activated carbon filtration; Disinfection methods Ultrafiltration, UV treatment, Ozonolysis, Reverse Osmosis; Electro dialysis.

Module:3	Corrosion	6 hours

Dry and wet corrosion - detrimental effects to buildings, machines, devices & decorative art forms, emphasizing Differential aeration, Pitting, Galvanic and Stress corrosion cracking; Factors that enhance corrosion and choice of parameters to mitigate corrosion.

Module:4	Corrosion Control	4 hours

Corrosion protection - cathodic protection – sacrificial anodic and impressed current protection methods; Advanced protective coatings: electroplating and electroless plating, PVD and CVD. Alloying for corrosion protection – Basic concepts of Eutectic composition and Eutectic mixtures - Selected examples – Ferrous and non-ferrous alloys.

Module:5	Electrochemical Energy Systems	6 hours

Brief introduction to conventional primary and secondary batteries; High energy electrochemical energy systems: Lithium batteries – Primary and secondary, its Chemistry, advantages and applications.

Fuel cells – Polymer membrane fuel cells, Solid-oxide fuel cells- working principles, advantages, applications.
Solar cells – Types – Importance of silicon single crystal, polycrystalline and amorphous silicon solar cells, dye sensitized solar cells - working principles, characteristics and applications.

Module:6	Fuels and Combustion	8 hours

Calorific value - Definition of LCV, HCV. Measurement of calorific value using bomb calorimeter and Boy's calorimeter including numerical problems. Controlled combustion of fuels - Air fuel ratio – minimum quantity of air by volume and by weight- Numerical problems-three way catalytic converter-selective catalytic reduction of NOX; Knocking in ICengines-Octane and Cetane number - Antiknocking agents.

Module:7	Polymers	6 hours

Difference between thermoplastics and thermosetting plastics; Engineering application of plastics - ABS, PVC, PTFE and Bakelite; Compounding of plastics: moulding of plastics for Car parts, bottle caps (Injection moulding), Pipes, Hoses (Extrusion moulding), Mobile Phone Cases, Battery Trays, (Compression moulding), Fibre reinforced polymers, Composites (Transfer moulding), PET bottles (blow moulding); Conducting polymers- Polyacetylene- Mechanism of conduction – applications (polymers in sensors,self-cleaning windows)

Module:8	**Contemporary issues:** Lecture by Industry Experts	2 hours
	Total Lecture hours:	45 hours

Text Book(s)

1.	Sashi Chawla, A Text book of Engineering Chemistry, Dhanpat Rai Publishing Co., Pvt.Ltd., Educational and Technical Publishers, New Delhi, 3rd Edition, 2015.
2.	O.G. Palanna, McGraw Hill Education (India) Private Limited, 9th Reprint, 2015.
3.	B. Sivasankar, Engineering Chemistry 1st Edition, Mc Graw Hill Education (India), 2008
4.	"Photovoltaic solar energy: From fundamentals to Applications", AngÃ¨le Reinders, Pierre Verlinden, Wilfried van Sark, Alexandre Freundlich, Wiley publishers, 2017.

Reference Books

1.	O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.
2.	S. S. Dara, A Text book of Engineering Chemistry, S. Chand & Co Ltd., New Delhi, 20th Edition, 2013.

Mode of Evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT

List of Experiments

1.	Water Purification: Estimation of water hardness by EDTA method and its removal by ion-exchange resin	1 hours 30 min
2. 3.	Water Quality Monitoring: Assessment of total dissolved oxygen in different water samples by Winkler's method Estimation of sulphate/chloride in drinking water by conductivity method	3 hours
4/5.	Material Analysis: Quantitative colorimetric determination of divalent metal ions of Ni/Fe/Cu using conventional and smart phone digital- imaging	3hours

	methods	
6.	Analysis of Iron in carbon steel by potentiometry	1 hours 30 min
7.	Construction and working of an Zn-Cu electrochemical cell	1 hours 30 min
8.	Determination of viscosity-average molecular weight of different natural/synthetic polymers	1 hours 30 min
9.	Arduino microcontroller based sensor for monitoring pH/temperature/ conductivity in samples.	1 hours 30 min
	Total Laboratory Hours	**17 hours**

Mode of Evaluation: Viva-voce and Lab performance & FAT			
Recommended by Board of Studies	**31-05-2019**		
Approved by Academic Council	**No. 54**	**Date**	**13-06-2019**

Course code	Course title	L	T	P	J	C
CSE1001	PROBLEM SOLVING AND PROGRAMMING	0	0	6	0	3
Pre-requisite	NIL	Syllabus version				
		1.0				

Course Objectives:

1. To develop broad understanding of computers, programming languages and their generations
2. Introduce the essential skills for a logical thinking for problem solving
3. To gain expertise in essential skills in programming for problem solving using computer

Expected Course Outcome:

1. Understand the working principle of a computer and identify the purpose of a computer programming language.
2. Learn various problem solving approaches and ability to identify an appropriate approach to solve the problem
3. Differentiate the programming Language constructs appropriately to solve any problem
4. Solve various engineering problems using different data structures
5. Able to modulate the given problem using structural approach of programming
6. Efficiently handle data using flat files to process and store data for the given problem

List of Challenging Experiments (Indicative)

1	Steps in Problem Solving Drawing flowchart using yEd tool/Raptor Tool	4 Hours
2	Introduction to Python, Demo on IDE, Keywords, Identifiers, I/O Statements	4 Hours
3	Simple Program to display Hello world in Python	4 Hours
4	Operators and Expressions in Python	4 Hours
5	Algorithmic Approach 1: Sequential	4 Hours
6	Algorithmic Approach 2: Selection (if, elif, if.. else, nested if else)	4 Hours
7	Algorithmic Approach 3: Iteration (while and for)	6 Hours
8	Strings and its Operations	6 Hours
9	Regular Expressions	6 Hours
10	List and its operations	6 Hours
11	Dictionaries: operations	6 Hours
12	Tuples and its operations	6 Hours
13	Set and its operations	6 Hours
14	Functions, Recursions	6 Hours
15	Sorting Techniques (Bubble/Selection/Insertion)	6 Hours
16	Searching Techniques : Sequential Search and Binary Search	6 Hours
17	Files and its Operations	6 Hours
	Total hours:	**90 hours**

Text Book(s)

1. John V. Guttag., 2016. Introduction to computation and programming using python: with applications to understanding data. PHI Publisher.

Reference Books	
1.	Charles Severance. 2016. Python for everybody: exploring data in Python 3, Charles Severance.
2.	Charles Dierbach. 2013. Introduction to computer science using python: a computational problem-solving focus. Wiley Publishers.

Mode of Evaluation: PAT / CAT / FAT			
Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**No. 38**	**Date**	**23-10-2015**

Course Code	Course Title	L	T	P	J	C
CSE1002	PROBLEM SOLVING AND OBJECT ORIENTED PROGRAMMING	0	0	6	0	3
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

1. To emphasize the benefits of object oriented concepts.
2. To enable students to solve the real time applications using object oriented programming features
3. To improve the skills of a logical thinking and to solve the problems using any processing elements

Expected Course Outcome:

1. Demonstrate the basics of procedural programming and to represent the real world entities as programming constructs.
2. Enumerate object oriented concepts and translate real-world applications into graphical representations.
3. Demonstrate the usage of classes and objects of the real world entities in applications.
4. Discriminate the reusability and multiple interfaces with same functionality based features to solve complex computing problems.
5. Illustrate possible error-handling constructs for unanticipated states/inputs and to use generic programming constructs to accommodate different datatypes.
6. Validate the program against file inputs towards solving the problem.

List of Challenging Experiments (Indicative)

1.	**Postman Problem** A postman needs to walk down every street in his area in order to deliver the mail. Assume that the distances between the streets along the roads are given. The postman starts at the post office and returns back to the post office after delivering all the mails. Implement an algorithm to help the postman to walk minimum distance for the purpose.	10 hours
2.	**Budget Allocation for Marketing Campaign** A mobile manufacturing company has got several marketing options such as Radio advertisement campaign, TV non peak hours campaign, City top paper network, Viral marketing campaign, Web advertising. From their previous experience, they have got a statistics about paybacks for each marketing option. Given the marketing budget (rupees in crores) for the current year and details of paybacks for each option, implement an algorithm to determine the amount that shall spent on each marketing option so that the company attains the maximum profit.	15 hours
3.	**Missionaries and Cannibals** Three missionaries and three cannibals are on one side of a river, along with a boat that can hold one or two people. Implement an algorithm to find a way to get everyone to the other side of the river, without ever leaving a group of missionaries in one place outnumbered by the cannibals in that place.	10 hours

4.	**Register Allocation Problem** A register is a component of a computer processor that can hold any type of data and can be accessed faster. As registers are faster to access, it is desirable to use them to the maximum so that the code execution is faster. For each code submitted to the processor, a register interference graph (RIG) is constructed. In a RIG, a node represents a temporary variable and an edgeis added between two nodes (variables) t1 and t2 if they are live simultaneously at some point in the program. During register allocation, two temporaries can be allocated to the same register if there is no edge connecting them. Given a RIG representing the dependencies between variables in a code, implement an algorithm to determine the number of registers required to store the variables and speed up the code execution	15 hours
5.	**Selective Job Scheduling Problem** A server is a machine that waits for requests from other machines and responds to them. The purpose of a server is to share hardware and software resources among clients. All the clients submit the jobs to the server for execution and the server may get multiple requests at a time. In such a situation, the server schedule the jobs submitted to it based on some criteria and logic. Each job contains two values namely time and memory required for execution. Assume that there are two servers that schedules jobs based on time and memory. The servers are named as Time Schedule Server and memory Schedule Server respectively. Design a OOP model and implement the time Schedule Server and memory Schedule Server. The Time Schedule Server arranges jobs based on time required for execution in ascending order whereas memory Schedule Server arranges jobs based on memory required for execution in ascending order	15 hours
6.	**Fragment Assembly in DNA Sequencing** DNA, or deoxyribonucleic acid, is the hereditary material in humans and almost all other organisms. The information in DNA is stored as a code made up of four chemical bases: adenine (A), guanine (G), cytosine (C), and thymine (T). In DNA sequencing, each DNA is sheared into millions of small fragments (reads) which assemble to form a single genomic sequence (superstring). Each read is a small string. In such a fragment assembly, given a set of reads, the objective is to determine the shortest superstring that contains all the reads. For example, given a set of strings, 000, 001, 010, 011, 100, 101, 110, 111 the shortest superstring is 0001110100. Given a set of reads, implement an algorithm to find the shortest superstring that contains all the given reads.	15 hours
7.	**House Wiring** An electrician is wiring a house which has many rooms. Each room has many power points in different locations. Given a set of power points and the distances between them, implement an algorithm to find the minimum cable required.	10 hours
	Total Laboratory Hours	**90 hours**

Text Book(s)

1.	Stanley B Lippman, Josee Lajoie, Barbara E, Moo, C++ primer, Fifth edition, Addison- Wesley, 2012.

2	Ali Bahrami, Object oriented Systems development, Tata McGraw - Hill Education, 1999.
3	Brian W. Kernighan, Dennis M. Ritchie, The C programming Language, 2nd edition, Prentice Hall Inc., 1988.
Reference Books	
1.	Bjarne stroustrup, The C++ programming Language, Addison Wesley, 4th edition, 2013
2.	Harvey M. Deitel and Paul J. Deitel, C++ How to Program, 7th edition, Prentice Hall, 2010
3.	Maureen Sprankle and Jim Hubbard, Problem solving and Programming concepts, 9th edition, Pearson Eduction, 2014.

Mode of assessment: PAT / CAT / FAT			
Recommended by Board of Studies	**29-10-2015**		
Approved by Academic Council	**No. 39**	**Date**	**17-12-2015**

Course Code	Course Title	L	T	P	J	C
CSE3099	Industrial Internship	0	0	0	0	2
Pre-requisite	Completion of minimum of Two semesters					

Course Objectives:

1. The course is designed so as to expose the students to industry environment and to take up on-site assignment as trainees or interns.

Expected Course Outcome:

At the end of this internship the student should be able to:

1. Have an exposure to industrial practices and to work in teams
2. Communicate effectively
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. Develop the ability to engage in research and to involve in life-long learning
5. Comprehend contemporary issues
6. Engage in establishing his/her digital footprint

Contents	4	Weeks
Four weeks of work at industry site. Supervised by an expert at the industry.		

Mode of Evaluation: Internship Report, Presentation and Project Review

Recommended by Board of Studies	28-02-2016		
Approved by Academic Council	No. 37	Date	16-06-2015

Course code	Course Title	L	T	P	J	C
CSE3999	Technical Answers for Real World Problems (TARP)	1	0	0	4	3
Pre-requisite	PHY1999 and 115 Credits Earned	Syllabus version				
		1.0				

Course Objectives:

1. To help students to identify the need for developing newer technologies for industrial / societalneeds
2. To train students to propose and implement relevant technology for the development of the prototypes / products
3. To make the students learn to the use the methodologies available for analysing the developed prototypes / products

Expected Course Outcome:

At the end of the course, the student will be able to

1. Identify real life problems related to society
2. Apply appropriate technology(ies) to address the identified problems using engineering principles and arrive at innovative solutions

Module:1	1. Identification of real life problems 2. Field visits can be arranged by the faculty concerned 3. 6 – 10 students can form a team (within the same / different discipline) 4. Minimum of eight hours on self-managed team activity 5. Appropriate scientific methodologies to be utilized to solve the identified issue 6. Solution should be in the form of fabrication/coding/modeling/product design/process design/relevant scientific methodology(ies) 7. Consolidated report to be submitted for assessment 8. Participation, involvement and contribution in group discussions during the contact hours will be used as the modalities for the continuous assessment of the theory component 9. Project outcome to be evaluated in terms of technical, economical, social, environmental, political and demographic feasibility 10. Contribution of each group member to be assessed 11. The project component to have three reviews with the weightage of 20:30:50	**15 hours**

Mode of Evaluation: (No FAT) Continuous Assessment the project done – Mark weightage of 20:30:50 – project report to be submitted, presentation and project reviews

Recommended by Board of Studies	**28-02-2016**		
Approved by Academic Council	**No.37**	**Date**	**16-06-2015**

Course Code	Course Title	L	T	P	J	C
CSE4098	Comprehensive Examination	0	0	0	0	2
Pre-requisite		Syllabus version				
		1.00				

Digital Logic and Microprocessor

Simplification of Boolean functions using K-Map – Combinational logic: Adder, subtractor,encoder, decoder, multiplexer, de-multiplexer – Sequential Logic: Flip flops- 8086 Microprocessor: instructions – peripherals: 8255, 8254, 8257.

Computer Architecture and Organization

Instructions - Instruction types- Instruction Formats - Addressing Modes- Pipelining- Data Representation - Memory Hierarchy- Cache memory-Virtual Memory- I/O Fundamentals- I/O Techniques - Direct Memory Access - Interrupts-RAID architecture

Programming, Data Structures and Algorithms

Programming in C; Algorithm Analysis – Iterative and Recursive Algorithms; ADT - Stack and its Applications - Queue and its Applications; Data Structures – Arrays and Linked Lists; Algorithms - Sorting – Searching; Trees – BST, AVL; Graphs – BFS , DFS , Dijkstra's Shortest Path Algorithm.

Theory of Computation

Deterministic Finite Automata, Non deterministic Finite Automata, Regular Expressions, Context Free Grammar, Push down Automata and Context Free Languages, Turing Machines.

Web Technologies

Web Architecture- JavaScript – objects String, date, Array, Regular Expressions, DHTML-HTML DOM Events; Web Server – HTTP- Request/Response model-RESTful methods- State Management – Cookies , Sessions – AJAX.

Operating Systems

Processes, Threads, Inter-process communication, CPU scheduling, Concurrency and synchronization, Deadlocks, Memory management and Virtual memory & File systems.

Database Management System

DBMS, Schema, catalog, metadata, data independence, pre-compiler; Users-naïve, sophisticated, casual ;ER Model- Entity, attributes, structural constraints; Relational Model-Constraints,Relational Algebra operations; SQL- DDL, DML, TCL, DCL commands, basic queries and Top Nqueries; Normalization-properties, 1NF, 2NF, 3NF, BCNF; Indexing-different types, Hash Vs B- tree Index; Transaction-problems, Concurrency Control-techniques, Recovery-methods.

Data Communication and Computer Networks

Circuit Switching, Packet Switching, Frame Relay, Cell Switching, ATM , OSI Reference model, TCP\IP, Network topologies, LAN Technologies, Error detection and correction techniques, Internet protocols, IPv4/IPv6, Routing algorithms, TCP and UDP, Sockets, Congestion control, Application Layer Protocols, Network Security: Basics of public and private key cryptosystems- Digital Signatures and Hash codes, Transport layer security, VPN, Firewalls.

Recommended by Board of Studies	05-03-2016		
Approved by Academic Council	No. 40	Date	18-03-2016

Course Code	Course Title	L	T	P	J	C
CSE4099	Capstone Project	0	0	0	0	20
Pre-requisite	As per the academic regulations	Syllabus version				
		1.0				

Course Objectives:

1. To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Expected Course Outcome:

At the end of the course the student will be able to

1. Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
2. Perform literature search and / or patent search in the area of interest.
3. Conduct experiments / Design and Analysis / solution iterations and document the results.
4. Perform error analysis / benchmarking / costing
5. Synthesise the results and arrive at scientific conclusions / products / solution
6. Document the results in the form of technical report / presentation

Contents

1. Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.
2. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.
3. Can be individual work or a group project, with a maximum of 3 students.
4. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.
5. Carried out inside or outside the university, in any relevant industry or research institution.
6. Publications in the peer reviewed journals / International Conferences will be an added advantage

Mode of Evaluation: Periodic reviews, Presentation, Final oral viva, Poster submission

Recommended by Board of Studies	10.06.2015		
Approved by Academic Council	No.37	Date	16.06.2015

Course Code	Course Title	L	T	P	J	C
ENG1011	English for Engineers	0	0	4	0	2
Pre-requisite	EPT/ENG1002	Syllabus version				
		v. 2.2				

Course Objectives:

1. To facilitate effective language skills for academic purposes and real-life situations.
2. To enhance students' language and communication with focus on placement skillsdevelopment.
3. To aid students apply language and communication skills in professional reading and reporting.

Expected Course Outcome:

1. Apply language skills with ease in academic and real-life situations.
2. Build up a job winning digital foot print and learn to face interviews confidently.
3. Develop good interpreting and reporting skills to aid them in research.
4. Comprehend language and communication skills in academic and social contexts.
5. Acquire vocabulary and learn strategies for error-free communication.

Module:1	**Listening**	**4 hours**
Casual and Academic		
Module:2	**Speaking**	**4 hours**
Socializing Skills - Introducing Oneself- His / Her Goals & SWOT		
Module:3	**Reading**	**2 hours**
Skimming and Scanning		
Module:4	**Writing**	**2 hours**
Error-free sentences, Paragraphs		
Module:5	**Listening**	**4 hours**
News (Authentic Material): Analyzing General and Domain Specific Information		
Module:6	**Speaking**	**4 hours**
Group Discussion on factual, controversial and abstract issues		
Module:7	**Reading:**	**2 hours**
Extensive Reading		
Module:8	**Writing**	**2 hours**
Email Etiquette with focus on Content and Audience		
Module:9	**Listening**	**4 hours**
Speeches : General and Domain Specific Information		
Module:10	**Speaking**	**4 hours**
Developing Persuasive Skills - Turncoat and Debate		
Module:11	**Reading**	**2 hours**
Intensive Reading		
Module:12	**Writing**	**2 hours**
Data Transcoding		

Module:13	**Cross Cultural Communication**	**4 hours**
Understanding Inter and Cross-Cultural Communication Nuances		
Module:14	**Speaking**	**4 hours**
Public Speaking/Extempore /Monologues		
Module:15	**Reading for research**	**2 hours**
Reading Scientific/Technical Articles		
Module:16	**Writing**	**2 hours**
Creating a Digital/Online Profile – LinkedIn (Résumé/Video Profile)		
Module:17	**Speaking:**	**4 hours**
Mock Job/Placement Interviews		
Module:18	**Writing**	**2 hours**
Report Writing		
Module:19	**Speaking**	**4 hours**
Presentation using Digital Tools		
Module:20	**Vocabulary**	**2 hours**
Crossword Puzzles/Word games		
	Total Lecture hours:	**60 hours**

Text Book(s)

1. Clive Oxenden and Christina Latham-Koenig, New English File: Advanced: Teacher's Book with Test and Assessment CD-ROM: Six-level general English course for adults Paperback –Feb 2013, Oxford University Press, UK.
2. Clive Oxenden and Christina Latham-Koenig, New English File: Advance Students Book Paper back – Feb 2012, Oxford University Press, UK.
3. Michael Vince, Language Practice for Advanced – Students Book, Feb.2014, 4th Edition, Macmillan Education, Oxford, United Kingdom

Reference Books

1. Steven Brown, Dorolyn Smith, Active Listening 3, 2011, 3rd Edition, Cambridge University Press,UK
2. Tony Lynch, Study Listening, 2013, 2nd Edition, Cambridge University Press, UK
3. Liz Hamp-Lyons, Ben Heasley, Study Writing, 2010, 2nd Edition, Cambridge UniversityPress, UK
4. Kenneth Anderson, Joan Maclean, Tony Lynch, Study Speaking, 2013, 2nd Edition, Cambridge, University Press, UK
5. Eric H. Glendinning, Beverly Holmstrom, Study Reading, 2012, 2nd Edition Cambridge University Press, UK
6. Michael Swan, Practical English Usage (Practical English Usage), Jun 2017, 4th edition, Oxford University Press, UK
7. Michael McCarthy, Felicity O'Dell, English Vocabulary in Use Advanced (South Asian Edition), May 2015, Cambridge University Press, UK
8. Michael Swan, Catherine Walter, Oxford English Grammar Course Advanced, Feb 2012, 4thEdition, Oxford University Press, UK
9. Heather Silyn-Roberts, Writing for Science and Engineering: Papers, Presentations and Reports, Jun 2016, 2nd Edition, Butterworth-Heinemann, UK

Mode of Evaluation: Assignment and FAT- Mini Project, Flipped Class Room, Lecture, PPT's, Role play, Assignments Class/Virtual Presentations, Report and beyond the classroom activities		
List of Challenging Experiments (Indicative)		
1.	Create a Digital or Online Profile or a Digital Footprint	6 hours
2.	Prepare a video resume	8 hours
3.	Analyse a documentary critically	4 hours
4.	Turn Coat- Speaking for and against the topic / Activities through VIT Community Radio	6 hours
5.	Present a topic using 'Prezi'	6 hours
6.	Analyse a case on cross cultural communication critically	6 hours
7.	Create a list of words relating to your domain	4 hours
8.	Listen to a conversation of native speakers of English and answer the following questions	6 hours
9.	Read an article and critically analyse the text in about 150 words	6 hours
10.	Read an autobiography and role play the character in class by taking an excerpt from the book	8 hours
	Total Practical Hours	**60 hours**

Mode of assessment: Quizzes, Presentation, Discussion, Role play, Assignments and FAT			
Recommended by Board of Studies	**22-07-2017**		
Approved by Academic Council	**No. 47**	**Date**	**24.08.2017**

Course Code	Course Title	L	T	P	J	C
ESP1001	ESPAÑOL FUNDAMENTAL	2	0	0	0	2
Pre-requisite	Nil	Syllabus version 1.0				

Course Objectives:

The course gives students the necessary background to:

1. Demonstrate Proficiency in reading, writing, and speaking in basic Spanish. Learning vocabulary related to profession, education centres, day today activities, food, culture, sports and hobby, family set up, workplace, market and classroom activities is essential.
2. Demonstrate the ability to describe things and will be able to translate into English and vice versa.
3. Describe in simple terms (both in written and oral form) aspects of their background, immediate environment and matters in areas of immediate need.

Expected Course Outcome:

The students will be able to

1. Remember greetings, giving personal details and Identify genders by using correct articles
2. Apply the correct use of SER, ESTAR and TENER verb for describing people, place and things
3. Create opinion about time and weather conditions by knowing months, days and seasons in Spanish
4. Create opinion about people and places by using regular verbs
5. Apply reflexive verbs for writing about daily routine and create small paragraphs about hometown, best friend and family

Module: 1	**Abecedario, Saludos y Datos personales: Origen, Nacionalidad, Profesión**	**3 hours**
Competencia Gramática: Vocales y Consonantes. Artículos definidos e indefinidos (Numero y Genero). Competencia Escrita: Saludos y Datos personales		
Module: 2	**Edad y posesión. Números (1-20)**	**3 hours**
Competencia Gramática: Pronombres personales. Adjetivos. Los verbos SER y TENER. Competencia Escrita: Escribe sobre mismo/a y los compañeros de la clase		
Module: 3	**Vocabulario de Mi habitación. Colores. Descripción de lugares y cosas**	**5 hours**
Competencia Gramática: Adjetivos posesivos. El uso del verbo ESTAR. Diferencia entre SER y ESTAR. Competencia Escrita: Mi habitación		
Module: 4	**Mi familia. Números (21-100). Direcciones.Expresar la hora. Los meses del año.**	**5 hours**
Competencia Gramática: Frases preposicionales. Uso del HAY. La diferencia entre MUY yMUCHO. Uso del verbo GUSTAR Competencia Escrita: Mi familia. Dar opiniones sobre tiempo		
Module: 5	**Expresar fechas y el tiempo. Dar opiniones sobre personas y lugares.**	**5 hours**
Competencia Gramática: Los verbos regulares (-AR, -ER, -IR) en el presente. Adjetivosdemostrativos. Competencia Escrita: Mi mejor amigo/a. Expresar fechas. Traducción ingles a español y Español a Ingles.		

Module: 6	**Describir el diario. Las actividades cotidianas.**	**3 hours**
Competencia Gramática: Los Verbos y pronombres reflexivos. Los verbos pronominales con e/ie,o/ue, e/i, u/ue. Competencia Escrita: El horario. Traducción ingles a español y Español a Ingles.		
Module: 7	**Dar opiniones sobre comidas y bebidas. Decir lo que está haciendo. Describir mi ciudad y Ubicar los sitios en la ciudad.**	**4 hours**
Competencia Gramática: Los verbos irregulares. Estar + gerundio. Poder + Infinitivo. Competencia Escrita: Conversación en un restaurante. Traducción ingles a español y Español a Ingles. Mi ciudad natal. Mi Universidad. La clase.Mi fiesta favorita.		
Module: 8	**Guest Lectures / Native Speakers**	**2 hours**
	Total Lecture hours	**30 hours**

Text Book(s)

1.	Text Book: "Aula Internacional 1", Jaime Corpas, Eva Garcia, Agustin Garmendia, Carmen Soriano Goyal Publication; reprinted Edition, (2010)

Reference Books

1.	"¡Acción Gramática!" Phil Turk and Mike Zollo, Hodder Murray, London 2006. "Practice makes perfect: Spanish Vocabulary", Dorothy Richmond, McGraw Hill Contemporary, USA, 2012.
2.	"Practice makes perfect: Basic Spanish", Dorothy Richmond, McGraw Hill Contemporary, USA 2009.
3.	"Pasaporte A1 Foundation", Matilde Cerrolaza Aragón, Óscar Cerrolaza Gili, Begoña Llovet Barquero, Edelsa Grupo, España, 2010.

Recommended by Board of Studies	**22.02.2016**		
Approved by Academic Council	**No.41**	**Date**	**17.06.2016**

Course Code	Course Title	L	T	P	J	C
ESP2001	ESPAÑOL INTERMEDIO	2	0	2	0	3
Pre-requisite		Syllabus version		1.0		

Course Objectives:

The course gives students the necessary background to:

1. enable students to read, listen and communicate in Spanish in their day to day life.
2. enable students to describe situations by using present, past and future tenses in Spanish.
3. enable to develop the comprehension skill in Spanish language.

Expected Course Outcome:

The students will be able to

1. create sentences in near future and future tenses and correctly using the prepositions like POR and PARA
2. create sentences in preterito perfecto and correctly use the direct and indirect object pronouns
3. create sentences related to likes and dislikes and also give commands in formal and informal way
4. create sentences in past tense by using imperfecto and idefinido forms and describe past events
5. create conversations in Spanish at places like restaurants, hotels, Shops and Railway stations
6. understand about different Spanish speaking countries and its culture and traditions.

Module:1	**Números (101 – 1 millón). Expresar los planesfuturos. Los números ordinales.**	**7 hours**

Competencia Gramática: Futuros cercanos (Ir+a+Infinitivo). Futuros (Verbos regulares e irregulares). Uso del POR y PARA.
Competencia Escrita: Traducción ingles a español y español a Ingles.
Comprensión - Los textos y Videos

Module:2	**Las ropas, colores y tamaños. Costar, valer,descuentos y rebajas**	**8 hours**

Competencia Gramática: Pronombres objetivos directos e indirectos. El verbo Gustar y Disgustar.
Competencia Escrita: Traducción ingles a español y español a Ingles. Comprensión - Los textos y Videos

Module:3	**Escribir un Correo electrónico formal einformal.**	**7 hours**

Competencia Gramática: Imperativos formales e informales. Pretérito perfecto. Competencia Escrita: Traducción ingles a español y español a Ingles.
Comprensión - Los textos y Videos

Module:4	**Currículo Vitae. Presentarse en unaentrevista informal.**	**6 hours**

Competencia Gramática: Pretérito imperfecto. Pretérito indefinido.
Competencia Escrita: Traducción ingles a español y español a Ingles.
Comprensión - Los textos y Videos

Module:5	**Introducción personal, Expresar losplanes futuros.**	**5 hours**

Comprensión oral: Introducción personal, Expresar los planes futuros. ¿Qué vas a hacer en laspróximas vacaciones?
Comprensión auditiva: Las preguntas sobre un cuento auditivo. Relacionar el audio con lasimágenes. Las preguntas basadas en canciones.
Medio de transporte: Comprar y Reservar billetes.

Module:6	**Diálogos entre dos**	**5 hours**
Comprensión oral: Diálogos entre dos (cliente y tendero de ropas, pasajero y empleado, en un restaurante, Reservación de habitación en un hotel). Presentación en una entrevista. Comprensión auditiva: Las preguntas basadas en canciones. Las preguntas basadas en diálogos.		
Module:7	**Presentación de los países hispánicos.**	**5 hours**
Comprensión oral: Dialogo entre un médico y paciente. Presentación de los países hispánicos. Describir su infancia. Describir vacaciones últimas o las actividades de último fin de semana. Comprensión auditiva: Rellenar los blancos del cuento en pasado. Las preguntas basadas en elcuento. Las preguntas basadas en un anuncio		
Module:8	**Guest Lectures/ Native Speakers**	**2 hours**
Total Lecture hours:		**45 hours**

Text Book(s)

1.	"Aula Internacional 1", Jaime Corpas, Eva Garcia, Agustin Garmendia, Carmen Soriano Goyal Publication; reprinted Edition, Delhi (2010).

Reference Books

1.	"¡AcciónGramática!", Phil Turk and Mike Zollo, Hodder Murray, London 2006.
2.	"Practice makes perfect: Spanish Vocabulary", Dorothy Richmond, McGraw Hill Contemporary, USA, 2012.
3.	"Practice makes perfect: Basic Spanish", Dorothy Richmond, McGraw Hill Contemporary,USA 2009
4.	"Pasaporte A1 Foundation", Matilde Cerrolaza Aragón, Óscar Cerrolaza Gili, Begoña Llovet Barquero, Edelsa Grupo, España, 2010.

Recommended by Board of Studies			
Approved by Academic Council	**No.41**	**Date**	**17.06.2016**

Course Code	Course Title	L	T	P	J	C
FRE1001	FRANÇAIS QUOTIDIEN	2	0	0	0	2
Pre-requisite	NIL	Syllabus version				1.0

Course Objectives:

The course gives students the necessary background to:

1. Learn the basics of French language and to communicate effectively in French in their day to day life.
2. Achieve functional proficiency in listening, speaking, reading and writing
3. Recognize culture-specific perspectives and values embedded in French language.

Expected Course Outcome:

The students will be able to :

1. Identify in French language the daily life communicative situations via personal pronouns, emphatic pronouns, salutations, negations and interrogations.
2. Communicate effectively in French language via regular / irregular verbs.
3. Demonstrate comprehension of the spoken / written language in translating simple sentences.
4. Understand and demonstrate the comprehension of some particular new range of unseen written materials
5. Demonstrate a clear understanding of the French culture through the language studied

Module: 1	Expressions simples	3 hours

Les Salutations, Les nombres (1-100), Les jours de la semaine, Les mois de l'année, Les Pronoms Sujets, Les Pronoms Toniques, La conjugaison des verbes irréguliers- avoir / être / aller / venir / faire etc.

Savoir-faire pour: Saluer, Se présenter, Présenter quelqu'un, Etablir des contacts

Module: 2	La conjugaison des verbes réguliers	3 hours

La conjugaison des verbes réguliers, La conjugaison des verbes pronominaux, La Négation, L'interrogation avec 'Est-ce que ou sans Est-ce que'.

Savoir-faire pour: Chercher un(e) correspondant(e), Demander des nouvelles d'une personne.

Module: 3	La Nationalité du Pays, L'article (défini/ indéfini), Les prépositions	6 hours

La Nationalité du Pays, L'article (défini/ indéfini), Les prépositions (à/en/au/aux/sur/dans/avec etc.), L'article contracté, Les heures en français, L'adjectif (La Couleur, L'adjectif possessif, L'adjectif démonstratif/ L'adjectif interrogatif (quel/quelles/quelle/quelles), L'accord des adjectifs avec le nom, L'interrogation avec Comment/ Combien / Où etc.

Savoir-faire pour: Poser des questions, Dire la date et les heures en français,

Module: 4	La traduction simple	4 hours

La traduction simple :(français-anglais / anglais –français), Savoir-faire pour : Faire des achats, Comprendre un texte court, Demander et indiquer le chemin.

Module: 5	L'article Partitif, Mettez les phrases aux pluriels	5 hours

L'article Partitif, Mettez les phrases aux pluriels, Faites une phrase avec les mots donnés,Trouvez les questions.

Savoir-faire pour : Répondez aux questions générales en français, Exprimez les phrases données au

Masculin ou au Féminin, Associez les phrases.		
Module: 6	**Décrivez**	**3 hours**
Décrivez: La Famille / La Maison / L'université / Les Loisirs / La Vie quotidienne etc.		
Module: 7	**Dialogue**	**4 hours**
Dialogue: 1. Décrire une personne. 2. Des conversations à la cafeteria. 3. Des conversations avec les membres de la famille 4. Des dialogues entre les amis.		
Module: 8	**Guest lecures** : Guest lectures / Native speakers	**2 hours**
	Total Lecture hours	**30 hours**

Text Book(s)

1.	Fréquence jeunes-1, Méthode de français, G. Capelle et N.Gidon, Hachette, Paris, 2010.
2.	Fréquence jeunes-1, Cahier d'exercices, G. Capelle et N.Gidon, Hachette, Paris, 2010.

Reference Books

1.	CONNEXIONS 1, Méthode de français, Régine Mérieux, Yves Loiseau, Les Éditions Didier, 2010.
2.	CONNEXIONS 1, Le cahier d'exercices, Régine Mérieux, Yves Loiseau, Les Éditions Didier, 2010
3.	ALTER EGO 1, Méthode de français, Annie Berthet, Catherine Hugo, Véronique M. Kizirian, Béatrix Sampsonis, Monique Waendendries, Hachette livre Paris 2011
4.	ALTER EGO 1, Le cahier d'activités, Annie Berthet, Catherine Hugo, Béatrix Sampsonis, Monique Waendendries, Hachette livre, Paris 2011

Mode of Evaluation: CAT / Assignment / Quiz / Seminar / FAT			
Recommended by Board of Studies	**26.02.2016**		
Approved by Academic Council	**No.41**	**Date**	**17.06.2016**

Course Code	Course Title	L	T	P	J	C
FRE2001	Français Progressif	2	0	1	0	3
Pre-requisite	Français quotidien	Syllabus version				
		1.0				

Course Objectives:

The course gives students the necessary background to:

1. understand isolated sentences and frequently used expressions in relation to immediate priorityareas (personal or family information, shopping, close environment, work).
2. communicate in simple and routine tasks requiring only a simple and direct exchange ofinformation on familiar and habitual topics.
3. enable students to describe with simply means his training, his immediate environment and evoke familiar and habitual subjects, evoke subjects that correspond to immediate needs.

Expected Course Outcome:

The students will be able to :

1. understand expressions in French.
2. create senteces by using frequent lexicon related to himself, his family, his close environment(family, shopping, work, school, etc).
3. understand simple, clear messages on internet, authentic documents.
4. analyse predictable information in common documents, such as advertisements, flyers, menus, schedules, simple personal letters.
5. create simple and routine tasks.
6. create simple and direct exchange of information on familiar activities and topics.

Module:1	Expressions simples	8 hours

La vie quotidiennes - Le verbe pronominal - Le passé composé avec l'auxiliaire - avoir et être- le passérécent : venir de + infinitif - Le comparatif - Le superlatif - Les mots interrogatifs (les trois formes)
Savoir-faire pour : Faire des achats, faire des commandes dans un restaurant, poser des questions.

Module:2	Les activitiés quotidiennes	6 hours

La vie privée et publique (Les achats, Les voyages, les transports-La nourriture, etc.) - Les lieux de la ville -Les mots du savoir-vivre - Les pronoms indéfinis - Les pronoms démonstratifs - Les pronoms complémentsobjets directs/ indirects - La formation du future simple et future proche
Savoir-faire pour: Réserver les billets pour le voyage, réserver les chambres dans un hôtel, S'informer surles lieux de la ville, indiquer la direction à un étranger.

Module:3	Les activités de loisirs	7 hours

Les loisirs (sports/spectacles/activités) - Les moments de la journée, de l'année- La fête indienne et française – Les goûts - L'impératif - La négation de l'impératif-La place du pronom à l'impératif avec un verbe pronominal.
Savoir-faire pour: Parler de ses goûts, raconter les vacances, formuler des phrases plus compliquées, Raconter les souvenirs de l'enfance, parler sur la tradition de son pays natal.

Module:4	**La Francophonie**	**7 hours**
L'espace francophone - Première approche de la société française – La consommation alimentaire – caractériser un objet – décrire une tenue - Le pronom relatif (qui/que/dont/où) Savoir-faire pour : Articles de la presse-Portrait d'une personne-Cartes et messages d'invitation, d'acceptation ou de refus -Article de presse - rédaction d'un événement.		
Module:5	**La culture française**	**5 hours**
Parler de ses activités quotidiennes - les fêtes en France – Parler de sa famille – réserver un billet à l'agence - la gastronomie française		
Module:6	**La description**	**5 hours**
Décrire physiquement une personne – les vacances – les achats – réserver une chambre dans un hôtel – les plus grands français - raconter des évènements passés		
Module:7	**S'exprimer**	**5 hours**
Parler du climat - parcours francophone – placer une commande au restaurant –- la mode - parler de son projet d'avenir.		
Module:8	Guest lecures : Guest lecures/ Native speakers	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Alter Ego 1, Méthode de français, Annie Berthet, Hachette, Paris 2010.
2.	Alter Ego 1, Cahier d'exercices, Annie Berthet, Hachette, Paris 2010.

Reference Books

1.	CONNEXIONS 1, Méthode de français, Régine Mérieux, Yves Loiseau, Les Éditions Didier, 2010.
2	CONNEXIONS 1, Le cahier d'exercices, Régine Mérieux, Yves Loiseau, Les Éditions Didier, 2010
3	Fréquence jeunes-1, Méthode de français, G. Capelle et N.Gidon, Hachette, Paris, 2010.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies			
Approved by Academic Council	**No.41**	**Date**	**17.06.2016**

Course Code	Course Title	L	T	P	J	C
GER1001	GRUNDSTUFE DEUTSCH	2	0	0	0	2
Pre-requisite	Nil	Syllabus version 1.0				

Course Objectives:

The course gives students the necessary background to:

1. Demonstrate Proficiency in reading, writing, and speaking in basic German. Learning vocabulary related to profession, education centres, day-to-day activities, food, culture, sportsand hobby, family set up, workplace, market and classroom activities are essential.
2. Make the students industry oriented and make them adapt in the German culture.

Expected Course Outcome:

The students will be able to

1. Remember greeting people, introducing oneself and understanding basic expressions inGerman.
2. Understand basic grammar skills to use these in a meaning way.
3. Remember beginner's level vocabulary
4. Create sentences in German on a variety of topics with significant precision and in detail.
5. Apply good comprehension of written discourse in areas of special interests.

Module: 1	3 hours

Begrüssung, Landeskunde, Alphabet, Personalpronomen, Verben- heissen, kommen, wohnen, lernen, Zahlen (1-100), W-Fragen, Aussagesätze, Nomen- Singular und Plural, der Artikel -Bestimmter- Unbestimmter Artikel)

Lernziel : Sich vorstellen, Grundlegendes Verständnis von Deutsch, Deutschland in Europa

Module: 2	3 hours

Konjugation der Verben (regelmässig /unregelmässig),das Jahr- Monate, Jahreszeiten und die Woche, Hobbys, Berufe, Artikel, Zahlen (Hundert bis eine Million), Ja-/Nein- Frage, Imperativ mit ‚Sie"

Lernziel: Sätze schreiben, über Hobbys, Berufe erzählen, usw

Module: 3	5 hours

Possessivpronomen, Negation, Kasus (Bestimmter- Unbestimmter Artikel) Trennbareverben, Modalverben, Uhrzeit, Präpositionen, Lebensmittel, Getränkeund Essen, Farben, Tiere

Lernziel : Sätze mit Modalverben, Verwendung von Artikel, Adjektiv beim Verb

Module: 4	5 hours

Übersetzung: (Deutsch – Englisch / Englisch – Deutsch)

Lernziel : Die Übung von Grammatik und Wortschatz

Module: 5	5 hours

Leserverständnis. Mindmap machen, Korrespondenz- Briefe und Email

Lernziel: Übung der Sprache, Wortschatzbildung

Module: 6	3 hours

Aufsätze : Die Familie, Bundesländer in Deutschland, Ein Fest in Deutschland,

Lernziel : Aktiver, selbständiger Gebrauch der Sprache

Module: 7		**4 hours**
Dialoge: a) Gespräche mit einem/einer Freund /Freundin. b) Gespräche beim Einkaufen ; in einem Supermarkt ; in einer Buchhandlung ; c) in einem Hotel - an der Rezeption ; ein Termin beim Arzt. d) Ein Telefongespräch ; Einladung–Abendessen		
Module: 8		**2 hours**
Guest Lectures / Native Speakers Einleitung in die deustche Kultur und Politik		
Total Lecture hours		**30 hours**

Text Book(s)	
1.	Netzwerk Deutsch als Fremdsprache A1, Stefanie Dengler, Paul Rusch, Helen Schmtiz, Tanja Sieber, Klett-Langenscheidt Verlag, München : 2013
Reference Books	
1.	Lagune, Hartmut Aufderstrasse, Jutta Müller, Thomas Storz, 2012.
2.	Deutsche Sprachlehre für Ausländer, Heinz Griesbach, Dora Schulz, 2013
3.	Studio d A1, Hermann Funk, Christina Kuhn, CorneslenVerlag, Berlin: 2010
4.	Tangram Aktuell-I, Maria-Rosa, SchoenherrTil, Max Hueber Verlag, Muenchen: 2012
	www.goethe.de wirtschaftsdeutsch.dehueber.de klett-sprachen.de www.deutschtraning.org

Mode of Evaluation: CAT / Assignment / Quiz / Seminar / FAT			
Recommended by Board of Studies	04.03.2016		
Approved by Academic Council	No.41	**Date**	17.06.2016

Course Code	Course Title	L	T	P	J	C
GER2001	Mittelstufe Deutsch	2	0	1	0	3
Pre-requisite	Grundstufe Deutsch	Syllabus version				
		1.0				

Course Objectives:

The course gives students the necessary background to:

1. Improve the communication skills in German language
2. Improve the listening and understanding capability of German FM Radio, and TV Programmes, Films
3. Build the confidence of the usage of German language and better understanding of the culture

Expected Course Outcome:

The students will be able to

1. create proficiency in advanced grammar and rules
2. understand the texts including scientific subjects.
3. create the ability of listening and speaking in real time situations.
4. create the vocabulary in different context-based situations.
5. create written communication in profession life, like replying or sending E-mails and letters in a company.
6. create communication related to simple and routine tasks.

Module:1	Proficiency in Advanced Grammar	9 hours

Grammatik : Tempus- Perfekt, Präteritum, Plusquamperfekt, Futur-I, Futur-II, Wiederholung der Grundstufen grammatik
Lernziel: Sätzeschreiben in verschiedenen Zeiten.

Module:2	Understanding of Technical Texts	9 hours

Grammatik : Passiv, Personalpronomen (Nominativ, Akkusativ, Dativ)
Lernziel: Passiv, Formen des Personalpronomens

Module:3	Understanding of Scientific texts	9 hours

Adjektivdeklination, Nebensatz, Präpositionen mit Akkusativ und Dativ,Infinitiv Sätze
Lernziel: Verbindung zwischen Adjektiv beim Nomen

Module:4	Communicating in Real Time Situations	8 hours

Übersetzung :Technische Terminologie, wissenschaftliche, literarische Texte aus dem Deutschenins Englische und umgekehrt,
Lernziel : Übung von Grammatik und Wortschatz

Module:5	Acquisition of the Vocabulary of the advanced Level	7 hours

Hörverständnis durch Audioübung :Familie, Leben in Deutschland, Am Bahnhof,
Videos : Politik, Historie, Tagesablauf in eineranderen Stadt,
Lernziel : Übung der Sprache

Module:6	**Ability to Communicate in Professional Life**	**9 hours**
Hörverständnis durch Audioübung: Überberühmte Persönlichkeiten, Feste in Deutschland, Videos :Wetter, An der Universität,ein Zimmer buchen, Studentenleben,Städteund Landeskunde Lernziel : Hörverständnis, Landeskunde		
Module:7	**Ability to Communicate in Task-based Situations**	**7 hours**
Hörverständnis durch Audioübung: FM Radio aus Deutschlandd Videos: Fernseher aus Deutschland Lernziel : LSRW Fähigkeiten		
	Total Lecture hours:	**60 hours**

Text Book(s)

1.	Text Book:1. TangramAktuell II, Rosa Maria Dallapizza, Beate Blüggel, Max Hueber Verlag, München : 2010

Reference Books

1.	ThemenAktuell, Heiko Bock, Mueller Jutta, MaxHueber Verla, Muenchen : 2010
2.	Deutsch Sprachlehre fuer Auslaender, Schulz Griesbach, Max Hueber Verlag, Muenchen : 2012
3.	Lagune, Deutsch als Fremdsprache, Jutta Müller, Storz Thomas, Hueber Verlag, Ismaning : 2013
4.	Studio d A1, Hermann Funk, Christina Kuhn, Max HuerberVerlag, München : 2011

Mode of Evaluation: CAT / Assignment / Quiz / FAT			
Recommended by Board of Studies			
Approved by Academic Council	**No.41**	**Date**	**17.06.2016**

Course Code	Course Title	L	T	P	J	C
GRE1001	Modern Greek	2	0	0	0	2
Pre-requisite	NIL	Syllabus version				1.0

Course Objectives:

1. To master the Greek terminology widely used in their subjects of specialization
2. To communicate in Modern Greek in their day to day life
3. To provide general information about Greece (e.g. geography, weather, food etc.)

Expected Course Outcomes:

Students will be able:

1. To correctly pronounce Greek symbols and words, being more conscious and confident in the usage of their English vocabulary derived from Greek.
2. To make use of Modern Greek language in simple everyday conversation.
3. To understand contents from scientific texts that make use of Greek symbols and words, becoming familiar with fundamental linguistic aspects of the International Scientific Vocabulary as well as becoming able to formulate hypotheses about unknown compound words derived from Greek.
4. To be more aware about the evolution of Modern European languages, understanding the important connections between English and Greek/Neo-Latin languages.
5. To understand important socio-economic issues in contemporary Europe, developing their aptitude for critical thinking.

Module:1	Greek Alphabet: Correct usage and Pronunciation of Greek symbols	4 hours

vowels and phonetic rules of diphthongs: alpha-iota / epsilon-iota / omicron-iota / and upsilon / epsilon-upsilon; consonants and their correct pronunciation; double consonants and digraphs. alpha-Grammar skills: correct pronunciation of the 24 Greek letters; correct pronunciation of diphthongs digraphs.

Module:2	Greetings, introducing oneself; Proper Nouns and Proper Greek Names	3 hours

Communicative functions: using formal and informal greetings; introducing oneself using affirmative form.

Grammar skills: nominative case and vocative case (singular), personal pronouns, verbs είμαι (to be) and μελένε (to be called).

Written communication skills: introducing oneself using Greek letters and words.

Module:3	Nationality and Provenance	5 hours

Communicative functions: providing personal details such as nationality, address and telephone number; Being able to name a few relevant landmarks in a city.

Grammar skills: Common nouns (masculine in -ος/-ης/-ας; feminine in -α/-η; neuter in -ο/-ι); από / σε + accusative case; cardinal numerals from 1 to 10; verb μένω (simple present).

Written communication skills: introducing oneself providing specific details about country and city of origin, address, telephone number.

Module:4	**Family**	**5 hours**
Communicative functions: describing one's family and describing elementary physical traits (μικρός/μεγάλος – μελαχρινός/ξανθός – ψηλός/κοντός). Grammar skills: possessive pronouns (singular/plural); word accent Written communication skills: describing family and family members.		
Module:5	**In the classroom: introducing others, languages and nationality adjectives**	**4 hours**
Ccommunicative functions: introducing others by providing information on their nationality and spoken language(s); naming the objects in a classroom. Grammar skills: verb μιλώ (simple present); nationality adjectives. Written communication skills: introducing friends and relatives providing specific information about the language they speak.		
Module:6	**Months and seasons of the year; days of the week; time and weather**	**4 hours**
Communicative functions: defining time and date; talking about weather conditions. Grammar skills: cardinal numerals from 11 to 100; interrogative pronoun (ποιος-ποια-ποιο/τι); time adverbials (τώρα, σήμερα, χθες, αύριο, φέτος πέρσι, τουχρόνου, πότε); syntax: υποκείμενο/άμεσο αντικείμενο Written communication skills: describing weather conditions, defining time and date.		
Module:7	**Daily routine**	**3 hours**
Module content: communicative functions: describing one's daily routine and activities/hobbies. Grammar skills: verbs πάω, ακούω, λέω, τρώω, μπορώ (simple present); plural nouns (nominative case). Written communication skills: writing a simple letter describing a daily routine.		
Module:8	**Contemporary issues:**	**2 hours**
Social and Economic aspects of the 2009-2017 Greek government-debt crisis and of the 2015-2018 European Refugee Crisis.		
Total Lecture hours:		**30 hours**

Text Book(s):

1.	Maria Karakirgiou, V. Panagiotidou, Jay Schwartz, Kliksta Ellinika (A1), Center for the Greek Language Publishing, Thessaloniki & Athens, 2014.

Reference Book(s):

1.	Maria Kaliambou (Yale University, USA), The Routledge Modern Greek Reader, Routledge 2015.
2.	E. Georgantzi, E. Raftopoulou, Greek for You (Greek – English bilingual edition), Neohel, Athens, 2016.

Recommended by Board of Studies	**31.10.2018**		
Approved by Academic Council	**No. 53**	**Date**	**13.12.18**

Course Code	Course Title	L	T	P	J	C
HUM1021	ETHICS AND VALUES	2	0	0	0	2
Pre-requisite	Nil	Syllabus version				
		1.1				

Course Objectives:

1. To understand and appreciate the ethical issues faced by an individual in profession, society and polity
2. To understand the negative health impacts of certain unhealthy behaviors
3. To appreciate the need and importance of physical, emotional health and social health

Expected Course Outcome:

Students will be able to:

1. Follow sound morals and ethical values scrupulously to prove as good citizens
   Understand various social problems and learn to act ethically
2. Understand the concept of addiction and how it will affect the physical and mental health
3. Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects
4. Identify the main typologies, characteristics, activities, actors and forms of cybercrime

Module:1	**Being Good and Responsible**	**5 hours**
Gandhian values such as truth and non-violence – Comparative analysis on leaders of past and present – Society's interests versus self-interests - Personal Social Responsibility: Helping the needy, charity and serving the society		
Module:2	**Social Issues 1**	**4 hours**
Harassment – Types - Prevention of harassment, Violence and Terrorism		
Module:3	**Social Issues 2**	**4 hours**
Corruption: Ethical values, causes, impact, laws, prevention – Electoral malpractices; White collar crimes - Tax evasions – Unfair trade practices		
Module:4	**Addiction and Health**	**5 hours**
Peer pressure - Alcoholism: Ethical values, causes, impact, laws, prevention – Ill effects of smoking - Prevention of Suicides; Sexual Health: Prevention and impact of pre-marital pregnancy and Sexually Transmitted Diseases		
Module:5	**Drug Abuse**	**3 hours**
Abuse of different types of legal and illegal drugs: Ethical values, causes, impact, laws and prevention		
Module:6	**Personal and Professional Ethics**	**4 hours**
Dishonesty - Stealing - Malpractices in Examinations – Plagiarism		
Module:7	**Abuse of Technologies**	**3 hours**
Hacking and other cyber crimes, Addiction to mobile phone usage, Video games and Social networking websites		
Module:8	**Contemporary issues:** Guest lectures by Experts	**2 hours**
	Total Lecture hours:	**30 hours**

Reference Books	
1.	Dhaliwal, K.K , "Gandhian Philosophy of Ethics: A Study of Relationship between his Presupposition and Precepts, 2016, Writers Choice, New Delhi, India.
2.	Vittal, N, "Ending Corruption? - How to Clean up India?", 2012, Penguin Publishers, UK. Pagliaro,
3.	L.A. and Pagliaro, A.M, "Handbook of Child and Adolescent Drug and Substance Abuse: Pharmacological, Developmental and Clinical Considerations", 2012, Wiley Publishers, U.S.A.
4.	Pandey, P. K(2012), "Sexual Harassment and Law in India", 2012, Lambert Publishers, Germany.

Mode of Evaluation: CAT, Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	**26-07-2017**		
Approved by Academic Council	**No. 46**	**Date**	**24-08-2017**

Course Code	Course Title	L	T	P	J	C
JAP1001	JAPANESE FOR BEGINNERS	2	0	0	0	2
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

The course gives students the necessary background to:

1. Develop four basic skills related to reading, listening, speaking and writing Japanese language.
2. Instill in learners an interest in Japanese language by teaching them culture and generaletiquettes.
3. Recognize, read and write Hiragana and Katakana.

Expected Course Outcomes:

Students will be able to:

1. Remember Japanese alphabets and greet in Japanese.
2. Understand pronouns, verbs form, adjectives and conjunctions in Japanese.
3. Remember time and dates related vocabularies and express them in Japanese.
4. Create simple questions and its answers in Japanese.
5. Understand the Japanese culture and etiquettes.

Module: 1	Introduction to Japanese syllables and Greetings	4 hours

Introduction of Japanese language, alphabets; Hiragana, katakana, and Kanji Pronunciation, vowels and consonants. Hiragana – writing and reading; Vocabulary: 50 Nouns and 20 pronouns, Greetings.

Module: 2	Demonstrative Pronouns	4 hours

Grammar: N1 wa N2 desu, Japanese Numerals, Demonstrative pronoun - Kore, Sore, Are and Dore (This, That, Over there, which) Kono, sono, Ano and Dono (this, that, over there, which) Kochira, Sochira, Achira and Dochira. this way) Koko, Soko, Asoko and Doko (Here, There…. location)

Module: 3	Verbs and Sentence formation	4 hours

Classification of verbs Be verb desu Present and Present negative Basic structure of sentence (Subject+ Object + Verb) Katakana-reading and writing

Module: 4	Conjunction and Adjectives	4 hours

Conjunction-Ya…..nado Classification of Adjectives 'I' and 'na'-ending Set phrase – Onegaishimasu – Sumimasen, wakarimasen Particle –Wa, Particle-Ni 'Ga imasu' and 'Ga arimasu' for Existence of living things and non-living things Particle- Ka, Ni, Ga

Module: 5	Vocabulary and its Meaning	4 hours

Days/ Months /Year/Week (Current, Previous, Next, Next to Next) ; Nation, People and Language Relationship of family (look and learn); Simple kanji recognition

Module: 6	Forming questions and giving answers	4 hours

Classification of Question words (Dare, Nani, Itsu, Doyatte, dooshite, Ikutsu, Ikura); Classification of Te forms, Polite form of verbs

Module: 7	Expressing time, position and directions	4 hours

Classification of question words (Doko, Dore, Dono, Dochira); Time expressions (Jikan), Number of hours, Number of months, calendar of a month; Visit the departmental store, railway stations, Hospital (Byoki), office and University

Module: 8	**Guest Lecture by Experts**	**2 hours**
	Total Lecture hours	**30 hours**

Text Book(s):

1.	The Japan Foundation (2017), Marugoto Japanese Language and Culture Starter A1 Coursebook For Communicative Language Competences, New Delhi: Goyal Publishers (9788183078047)
2.	Banno, Eri et al (2011), Genki: An Integrated Course in Elementary Japanese I [Second Edition], Japan: The Japan Times.

Reference Book(s):

1.	Japanese for Busy people (2011) video CD, AJALT, Japan.
2.	Carol and Nobuo Akiyama (2010), The Fast and Fun Way, New Delhi: Barron's Publication

Mode of Evaluation: CAT , Quiz and Digital Assignments

Recommended by Board of Studies	**24.10.2018**		
Approved by Academic Council	**No.53**	**Date**	**13.12.2018**

Course Code	Course Title	L	T	P	J	C
MAT1011	Calculus for Engineers	3	0	2	0	4
Pre-requisite	10+2 Mathematics or MAT1001	Syllabus Version				
		1.0				

Course Objectives :

1. To provide the requisite and relevant background necessary to understand the other important engineering mathematics courses offered for Engineers and Scientists.
2. To introduce important topics of applied mathematics, namely Single and Multivariable Calculus and Vector Calculus etc.
3. To impart the knowledge of Laplace transform, an important transform technique for Engineers which requires knowledge of integration

Expected Course Outcomes:

At the end of this course the students should be able to

1. apply single variable differentiation and integration to solve applied problems inengineering and find the maxima and minima of functions
2. understand basic concepts of Laplace Transforms and solve problems with periodic functions, step functions, impulse functions and convolution
3. evaluate partial derivatives, limits, total differentials, Jacobians, Taylor series and optimization problems involving several variables with or without constraints
4. evaluate multiple integrals in Cartesian, Polar, Cylindrical and Spherical coordinates.
5. understand gradient, directional derivatives, divergence, curl and Greens', Stokes, Gauss theorems
6. demonstrate MATLAB code for challenging problems in engineering

Module:1	Application of Single Variable Calculus	9 hours

Differentiation- Extrema on an Interval-Rolle's Theorem and the Mean Value Theorem- Increasing and Decreasing functions and First derivative test - Second derivative test-Maxima and Minima-Concavity. Integration-Average function value - Area between curves – Volumes of solids of revolution - Beta and Gamma functions–interrelation

Module:2	Laplace transforms	7 hours

Definition of Laplace transform-Properties-Laplace transform of periodic functions - Laplace transform of unit step function, Impulse function-Inverse Laplace transform-Convolution.

Module:3	Multivariable Calculus	4 hours

Functions of two variables-limits and continuity-partial derivatives –total differential – Jacobian and its properties.

Module:4	Application of Multivariable Calculus	5 hours

Taylor's expansion for two variables–maxima and minima–constrained maxima and minima-Lagrange's multiplier method.

Module:5	Multiple integrals	8 hours

Evaluation of double integrals–change of order of integration–change of variables between Cartesian and polar co-ordinates-Evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical co-ordinates-evaluation of multiple integrals using gamma and beta functions.

Module:6	**Vector Differentiation**	**5 hours**
Scalar and vector valued functions – gradient, tangent plane–directional derivative-divergence and curl–scalar and vector potentials–Statement of vector identities-Simple problems		
Module:7	**Vector Integration**	**5 hours**
Line, surface and volume integrals - Statement of Green's, Stoke's and Gauss divergence theorems - verification and evaluation of vector integrals using them.		
Module:8	**Contemporary Issues:** Industry Expert Lecture	**2 hours**
Total Lecture hours:		**45 hours**

Text Book(s)

1.	Thomas' Calculus, George B.Thomas, D.Weir and J. Hass, 13th edition, Pearson, 2014.
2.	Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, Wiley India, 2015.

Reference Books

1.	Higher Engineering Mathematics, B.S. Grewal, 43rd Edition ,Khanna Publishers, 2015
2.	Higher Engineering Mathematics, John Bird, 6th Edition, Elsevier Limited, 2017.
3.	Calculus: Early Transcendentals, James Stewart, 8th edition, Cengage Learning, 2017.
4.	Engineering Mathematics, K.A.Stroud and Dexter J. Booth, 7th Edition, PalgraveMacmillan (2013)

Mode of Evaluation : Digital Assignments, Quiz, Continuous Assessments, Final Assessment Test

List of Challenging Experiments (Indicative)

1.	Introduction to MATLAB through matrices, and general Syntax	2 hours
2	Plotting and visualizing curves and surfaces in MATLAB – Symbolic computations using MATLAB	2 hours
3.	Evaluating Extremum of a single variable function	2 hours
4.	Understanding integration as Area under the curve	2 hours
5.	Evaluation of Volume by Integrals (Solids of Revolution)	2 hours
6.	Evaluating maxima and minima of functions of several variables	2 hours
7.	Applying Lagrange multiplier optimization method	2 hours
8.	Evaluating Volume under surfaces	2 hours
9.	Evaluating triple integrals	2 hours
10.	Evaluating gradient, curl and divergence	2 hours
11.	Evaluating line integrals in vectors	2 hours
12.	Applying Green's theorem to real world problems	2 hours
	Total Laboratory Hours	**24 hours**

Mode of Assessment: Weekly assessment, Final Assessment Test

Recommended by Board of Studies	**12-06-2015**		
Approved by Academic Council	**No. 37**	**Date**	**16-06-2015**

Course Code	Course Title	L	T	P	J	C
MAT2001	Statistics for Engineers	3	0	2	0	4
Prerequisites	MAT1011 – Calculus forEngineers	Syllabus Version:				1.0

Course Objectives :

1. To provide students with a framework that will help them choose the appropriate descriptive methods in various data analysis situations.
2. To analyse distributions and relationship of real-time data.
3. To apply estimation and testing methods to make inference and modelling techniques for decision making.

Expected Course Outcome:

At the end of the course the student should be able to:

1. Compute and interpret descriptive statistics using numerical and graphical techniques.
2. Understand the basic concepts of random variables and find an appropriate distribution for analysing data specific to an experiment.
3. Apply statistical methods like correlation, regression analysis in analysing, interpreting experimental data.
4. Make appropriate decisions using statistical inference that is the central to experimental research.
5. Use statistical methodology and tools in reliability engineering problems.
6. Demonstrate R programming for statistical data

Module: 1	Introduction to Statistics	6 hours
Introduction to statistics and data analysis-Measures of central tendency –Measures of variability-[Moments-Skewness-Kurtosis (Concepts only)].		
Module: 2	**Random variables**	**8 hours**
Introduction -random variables-Probability mass Function, distribution and density functions - joint Probability distribution and joint density functions- Marginal, conditional distribution and density functions- Mathematical expectation, and its properties Covariance, moment generating function – characteristic function.		
Module: 3	**Correlation and regression**	**4 hours**
Correlation and Regression – Rank Correlation- Partial and Multiple correlation- Multipleregression.		
Module: 4	**Probability Distributions**	**7 hours**
Binomial and Poisson distributions – Normal distribution – Gamma distribution – Exponential distribution – Weibull distribution.		
Module: 5	**Hypothesis Testing I**	**4 hours**
Testing of hypothesis – Introduction-Types of errors, critical region, procedure of testing hypothesis- Large sample tests- Z test for Single Proportion, Difference of Proportion, mean and difference of means.		
Module: 6	**Hypothesis Testing II**	**9 hours**
Small sample tests- Student's t-test, F-test- chi-square test- goodness of fit - independence of attributes- Design of Experiments - Analysis of variance – one and two way classifications - CRD-RBD- LSD.		

Module: 7	**Reliability**	**5 hours**
Basic concepts- Hazard function-Reliabilities of series and parallel systems- System Reliability - Maintainability-Preventive and repair maintenance- Availability.		
Module: 8	**Contemporary Issues**	**2 hours**
Industry Expert Lecture		
	Total Lecture hours	**45 hours**

Text book(s)

1.	Probability and Statistics for engineers and scientists, R.E.Walpole, R.H.Myers, S.L.Mayers and K.Ye, 9th Edition, Pearson Education (2012).
2.	Applied Statistics and Probability for Engineers, Douglas C. Montgomery, George C. Runger, 6th Edition, John Wiley & Sons (2016).

Reference books

1.	Reliability Engineering, E.Balagurusamy, Tata McGraw Hill, Tenth reprint 2017.
2.	Probability and Statistics, J.L.Devore, 8th Edition, Brooks/Cole, Cengage Learning (2012).
3.	Probability and Statistics for Engineers, R.A.Johnson, Miller Freund's, 8th edition, Prentice Hall India (2011).
4.	Probability, Statistics and Reliability for Engineers and Scientists, Bilal M. Ayyub and Richard H. McCuen, 3rd edition, CRC press (2011).

Mode of Evaluation: Digital Assignments, Continuous Assessment Tests, Quiz, Final Assessment Test.

List of Experiments (Indicative)	
1. Introduction: Understanding Data types; importing/exportingdata.	2 hours
2. Computing Summary Statistics /plotting and visualizing data using Tabulation and Graphical Representations	2 hours
3. Applying correlation and simple linear regression model to real dataset; computing and interpreting the coefficient of determination.	2 hours
4. Applying multiple linear regression model to real dataset; computing and interpreting the multiple coefficient of determination.	2 hours
5. Fitting the following probability distributions: Binomial Distribution	2 hours
6. Normal distribution, Poisson distribution	2 hours
7. Testing of hypothesis for One sample mean and proportion fromreal-time problems.	2 hours
8. Testing of hypothesis for Two sample means and proportionfrom real-time problems	2 hours
9. Applying the t test for independent and dependent samples	2 hours
10. Applying Chi-square test for goodness of fit test and Contingency test to real dataset	2 hours
11. Performing ANOVA for real dataset for Completely randomized design, Randomized Block design, Latin square Design	2 hours
Total laboratory hours	**22 hours**

Mode of Evaluation : Weekly Assessment, Final Assessment Test			
Recommended by Board of Studies	25-02-2017		
Approved by Academic Council	No. 47	Date:	05-10-2017

Course Code	Course Title	L	T	P	J	C
MGT1022	Lean Start up Management	1	0	0	4	2
Pre-requisite	Nil	Syllabus version				1.0

Course Objectives:

To develop the ability to

1. Learn methods of company formation and management.
2. Gain practical skills in and experience of stating of business using pre-set collection ofbusiness ideas.
3. Learn basics of entrepreneurial skills.

Expected Course Outcome:

On the completion of this course the student will be able to:

1. Understand developing business models and growth drivers
2. Use the business model canvas to map out key components of enterprise
4. Analyze market size, cost structure, revenue streams, and value chain
5. Understand build-measure-learn principles
3. Foreseeing and quantifying business and financial risks

Module:1		**2 Hours**
Creativity and Design Thinking (identify the vertical for business opportunity, understand your customers, accurately assess market opportunity)		
Module:2		**3 Hours**
Minimum Viable Product (Value Proposition, Customer Segments, Build- measure-learn process)		
Module:3		**3 Hours**
Business Model Development (Channels and Partners, Revenue Model and streams, Key Resources, Activities and Costs, Customer Relationships and Customer Development Processes, Businessmodel canvas –the lean model- templates)		
Module:4		**3 Hours**
Business Plan and Access to Funding(visioning your venture, taking the product/ service to market, Market plan including Digital & Viral Marketing, start-up finance - Costs/Profits & Losses/cash flow, Angel/VC,/Bank Loans and Key elements of raising money)		
Module:5		**3 Hours**
Legal, Regulatory, CSR, Standards, Taxes		
Module:6		**2 Hours**
Lectures by Entrepreneurs		
	Total Lecture	**15 hours**

Text Book(s)

1. The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company, SteveBlank, K & S Ranch; 1st edition (March 1, 2012)
2. The Four Steps to the Epiphany, Steve Blank, K&S Ranch; 2nd edition (July 17, 2013)
3. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Eric Ries, Crown Business; (13 September 2011)

Reference Books	
1.	Holding a Cat by the Tail, Steve Blank, K&S Ranch Publishing LLC (August 14, 2014)
2.	Product Design and Development, Karal T Ulrich, SD Eppinger, McGraw Hill
3.	Zero to One: Notes on Startups, or How to Build the Future, Peter Thiel, CrownBusiness(2014)
4.	Lean Analytics: Use Data to Build a Better Startup Faster (Lean Series), Alistair Croll& Benjamin Yoskovitz, O'Reilly Media; 1st Edition (March 21, 2013)
5.	Inspired: How To Create Products Customers Love, Marty Cagan, SVPG Press; 1st edition (June 18, 2008)
6.	**Website References:** 1. http://theleanstartup.com/ 2. https://www.kickstarter.com/projects/881308232/only-on-kickstarter-the-leaders-guide-by- eric-ries 3. http://businessmodelgeneration.com/ 4. https://www.leanstartupmachine.com/ 5. https://www.youtube.com/watch?v=fEvKo90qBns 6. http://thenextweb.com/entrepreneur/2015/07/05/whats-wrong-with-the-lean-startup-methodology/#gref 7. http://www.businessinsider.in/Whats-Lean-about-Lean-Startup/articleshow/53615661.cms 8. https://steveblank.com/tools-and-blogs-for-entrepreneurs/ 9. https://hbr.org/2013/05/why-the-lean-start-up-changes-everything 10. chventures.blogspot.in/ platformsandnetworks.blogspot.in/p/saas-model.html

Mode of Evaluation: Assignments; Field Trips, Case Studies; e-learning; Learning through research, TED Talks

Project		
1.	Project	60 hours
	Total Project	**60 hours**

Recommended by Board of Studies	**08-06-2015**		
Approved by Academic Council	**37**	**Date**	**16-06-2015**
Total Practical Hours			**60 hours**

Mode of evaluation: Mini Project, Flipped Class Room, Lecture, PPT's, Role play, Assignments, Class/Virtual Presentations, Report and beyond the classroom activities

Recommended by Board of Studies	**22-07-2017**		
Approved by Academic Council	**No. 47**	**Date**	**24.08.2017**

Course Code	Course Title	L	T	P	J	C
PHY1701	Engineering Physics	3	0	2	0	4
Pre-requisite	None	Syllabus version			2.1	

Course Objective:

1. To enable the students to understand the basics of the latest advancements in Physics viz., Quantum Mechanics, Nanotechnology, Lasers, Electro Magnetic Theory and Fiber Optics.

Expected Course Outcomes: Students will be able to

1. Comprehend the dual nature of radiation and matter.
2. Compute Schrodinger's equations to solve finite and infinite potential problems.
3. Analyze quantum ideas at the nanoscale.
4. Apply quantum ideas for understanding the operation and working principle of optoelectronic devices.
5. Recall the Maxwell's equations in differential and integral form.
6. Design the various types of optical fibers for different Engineering applications.
7. Explain concept of Lorentz Transformation for Engineering applications.
8. Demonstrate the quantum mechanical ideas

Module:1	Introduction to Modern Physics	6 hours

Planck's concept (hypothesis), Compton Effect, Particle properties of wave: Matter Waves, Davisson Germer Experiment, Heisenberg Uncertainty Principle, Wave function, and Schrodinger equation (time dependent & independent).

Module:2	Applications of Quantum Physics	5 hours

Particle in a 1-D box (Eigen Value and Eigen Function), 3-D Analysis (Qualitative), Tunneling Effect (Qualitative) (AB 205), Scanning Tunneling Microscope (STM).

Module:3	Nanophysics	5 hours

Introduction to Nano-materials, Moore's law, Properties of Nano-materials, Quantum confinement, Quantum well, wire & dot, Carbon Nano-tubes (CNT), Applications of nanotechnology in industry.

Module:4	Laser Principles and Engineering Application	6 hours

Laser Characteristics, Spatial and Temporal Coherence, Einstein Coefficient & its significance, Population inversion, Two, three & four level systems, Pumping schemes, Threshold gain coefficient, Components of laser, Nd-YAG, He-Ne, CO2 and Dye laser and their engineering applications.

Module:5	Electromagnetic Theory and its application	6 hours

Physics of Divergence, Gradient and Curl, Qualitative understanding of surface and volume integral, Maxwell Equations (Qualitative), Wave Equation (Derivation), EM Waves, Phase velocity, Group velocity, Group index , Wave guide (Qualitative)

Module:6	Propagation of EM waves in Optical fibers and Optoelectronic Devices	10 hours

Light propagation through fibers, Acceptance angle, Numerical Aperture, Types of fibers - stepindex, graded index, single mode & multimode, Attenuation, Dispersion-intermodal and intramodal. Sources-LED & Laser Diode, Detectors-Photodetectors- PN & PIN - Applications of fiber optics in communication- Endoscopy.

Module:7	**Special Theory of Relativity**	**5 hours**
Frame of reference, Galilean relativity, Postulate of special theory of relativity, Simultaneity, length contraction and time dilation.		
Module:8	**Contemporary issues:** Lecture by Industry Experts	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Arthur Beiser et al., Concepts of Modern Physics, 2013, Sixth Edition, Tata McGraw Hill.
2.	William Silfvast, Laser Fundamentals, 2008, Cambridge University Press.
3.	D. J. Griffith, Introduction to Electrodynamics, 2014, 4th Edition, Pearson.
4.	Djafar K. Mynbaev and Lowell L.Scheiner, Fiber Optic Communication Technology,2011, Pearson

Reference Books

1.	Raymond A. Serway, Clement J. Mosses, Curt A. Moyer Modern Physics, 2010, 3rd Indian Edition Cengage learning.
2.	John R. Taylor, Chris D. Zafiratos and Michael A. Dubson, Modern Physics for Scientists and Engineers, 2011, PHI Learning Private Ltd.
3.	Kenneth Krane Modern Physics, 2010, Wiley Indian Edition.
4.	Nityanand Choudhary and Richa Verma, Laser Systems and Applications, 2011, PHI Learning Private Ltd.
5.	S. Nagabhushana and B. Sathyanarayana, Lasers and Optical Instrumentation, 2010, I.K. International Publishing House Pvt. Ltd.,
6.	R. Shevgaonkar, Electromagnetic Waves, 2005, 1st Edition, Tata McGraw Hill Principles of Electromagnetics, Matthew N.O. Sadiku, 2010, Fourth Edition, Oxford.
7.	Ajoy Ghatak and K. Thyagarajan, Introduction to Fiber Optics, 2010, Cambridge University Press.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Experiments

1.	Determination of Planck's constant using electroluminescence process	2 hours
2.	Electron diffraction	2 hours
3.	Determination of wavelength of laser source (He -Ne laser and diode lasers of different wavelengths) using diffraction technique	2 hours
4.	Determination of size of fine particle using laser diffraction	2 hours
5.	Determination of the track width (periodicity) in a written CD	2 hours
6.	Optical Fiber communication (source + optical fiber + detector)	2 hours
7.	Analysis of crystallite size and strain in a nano -crystalline film using X-raydiffraction	2 hours
8.	Numerical solutions of Schrödinger equation (e.g. particle in a box problem) (can be given as an assignment)	2 hours
9.	Laser coherence length measurement	2 hours
10.	Proof for transverse nature of E.M. waves	2 hours
11.	Quantum confinement and Heisenberg's uncertainty principle	2 hours
12.	Determination of angle of prism and refractive index for various colour – Spectrometer	2 hours
13.	Determination of divergence of a laser beam	2 hours

14.	Determination of crystalline size for nanomaterial (Computer simulation)	2 hours
15.	Demonstration of phase velocity and group velocity (Computer simulation)	2 hours
	Total Laboratory Hours	**30** hours

Mode of evaluation: CAT / FAT			
Recommended by Board of Studies	**04-06-2019**		
Approved by Academic Council	**No. 55**	**Date**	**13-06-2019**

Course code	Course title	L	T	P	J	C
PHY1999	Introduction to Innovative Projects	1	0	0	4	2
Pre-requisite	Nil	Syllabus version				1.0

Course Objectives:

This course is offered to the students in the 1st Year of B.Tech. in order to orient them towards independent, systemic thinking and be innovative.

1. To make students confident enough to handle the day to day issues.
2. To develop the "Thinking Skill" of the students, especially Creative Thinking Skills
3. To train the students to be innovative in all their activities
4. To prepare a project report on a socially relevant theme as a solution to the existing issues

Expected Course Outcome:

Students will be able to

1. Understand the various types of thinking skills.
2. Enhance the innovative and creative ideas.
3. Find out a suitable solution for socially relevant issues- J component

Module:1 A	Self Confidence	1 hour

Understanding self – Johari Window –SWOT Analysis – Self Esteem – Being a contributor – Case Study.

Project : Exploring self, understanding surrounding, thinking about how s(he) can be a contributor for the society, Creating a big picture of being an innovator – writing a 1000 words imaginary autobiography of self – Topic "Mr X – the great innovator of 2015" and upload. (4 non- contact hours)

Module:1 B	Thinking Skill	1 hour

Thinking and Behaviour – Types of thinking– Concrete – Abstract, Convergent, Divergent, Creative, Analytical, Sequential and Holistic thinking – Chunking Triangle – Context Grid – Examples – Case Study.

Project : Meeting at least 50 people belonging to various strata of life and talk to them / make field visits to identify a min of100 society related issues, problems for which they need solutions and categories them and upload along with details of people met and lessons learnt. (4 non-contact hours)

Module:1 C	Lateral Thinking Skill	1 hour

Blooms Taxonomy – HOTS – Outof the box thinking – deBono lateral thinking model –Examples

Project : Last weeks - incomplete portion to be done and uploaded

Module:2 A	Creativity	1 hour

Creativity Models – Walla – Barrons – Koberg & Begnall – Examples

Project: Selecting 5 out of 100 issues identified for future work. Criteria based approach for prioritisation, use of statistical tools & upload. (4 non- contact hours)

Module:2 B	Brainstorming	1 hour

25 brainstorming techniques and examples

Project: Brainstorm and come out with as many solutions as possible for the top 5 issuesidentified & upload. (4 non- contact hours)

Module:3	**Mind Mapping**	**1 hour**
Mind Mapping techniques and guidelines. Drawing a mind map Project: Using Mind Maps get another set of solutions forthe next 5 issues (issue 6 – 10) . (4non-contact hours)		
Module:4 A	**Systems thinking**	**1 hour**
Systems Thinking essentials – examples – Counter Intuitive condemns Project: Select 1 issue / problem for which the possible solutions are available with you. Apply Systems Thinking process and pick up one solution [explanation should be given why the other possible solutions have been left out]. Go back to the customer and assess the acceptability and upload. (4 non- contact hours)		
Module:4 B	**Design Thinking**	**1 hour**
Design thinking process – Human element of design thinking – case study Project: Apply design thinking to the selected solution, apply the engineering & scientific tinge to it. Participate in "design week" celebrations upload the weeks learning out come.		
Module:5 A	**Innovation**	**1 hour**
Difference between Creativity and Innovation – Examples of innovation –Being innovative. Project: A literature searches on prototyping of your solution finalized. Prepare a prototype model or process and upload. (4 non- contact hours)		
Module:5 B	**Blocks for Innovation**	**1 hour**
Identify Blocks for creativity and innovation – overcoming obstacles – Case Study Project: Project presentation on problem identification, solution, innovations – expected results – Interim review with PPT presentation. (4 non- contact hours)		
Module:5 C	**Innovation Process**	**1 hour**
Steps for Innovation – right climate for innovation Project: Refining the project, based on the review report and uploading the text. (4 non-contact hours)		
Module:6 A	**Innovation in India**	**1 hour**
Stories of 10 Indian innovations Project: Making the project better with add ons. (4 non- contact hours)		
Module:6 B	**JUGAAD Innovation**	**1 hour**
Frugal and flexible approach to innovation - doing more with less Indian Examples Project: Fine tuning the innovation project with JUGAAD principles and uploading credit for JUGAAD implementation). (4 non- contact hours)		
Module:7 A	**Innovation Project Proposal Presentation**	**1 hour**
Project proposal contents, economic input, ROI – Template Project: Presentation of the innovative project proposal and upload. (4 non- contact hours)		
Module:8 A	**Contemporary issue in Innovation**	**1 hour**
Contemporary issue in Innovation Project: Final project Presentation, Viva voce Exam (4 non- contact hours)		
	Total Lecture hours:	**15 hours**

Text Book(s)

1.	How to have Creative Ideas, Edward debone, Vermilon publication, UK, 2007
2.	The Art of Innovation, Tom Kelley & Jonathan Littman, Profile Books Ltd, UK, 2008

Reference Books	
1.	Creating Confidence, Meribeth Bonct, Kogan Page India Ltd, New Delhi, 2000
2.	Lateral Thinking Skills, Paul Sloane, Keogan Page India Ltd, New Delhi, 2008
3.	Indian Innovators, Akhat Agrawal, Jaico Books, Mumbai, 2015
4.	JUGAAD Innovation, Navi Radjou, Jaideep Prabhu, Simone Ahuja Random house India, Noida, 2012.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar /Three reviews with weightage of 25 : 25 : 50 along with reports			
Recommended by Board of Studies			
Approved by Academic Council	**No. 37**	**Date**	**16-06-2015**

Course Code	Course Title	L	T	P	J	C
RUS1001	Russian for Beginners	2	0	0	0	2
Pre- requisites	NIL					

Course Objective:

1. To enable the students to read and communicate in Russian in their day to day life to become industry-ready

Expected Outcome:

1. The students will be able to read and communicate the basics of Russian language in their day to day life.

Module 1	Topics	3 hours

Greetings and introductions in Russian; Russian alphabet, writing and reading the Cyrillic alphabet. The Students learn to: Greet each other in Russian (formal vs. informal; depending of the time of the day). Introduce someone in Russian. Read and write Cyrillic alphabet

Module 2	Topics	3 hours

Basic phrases (yes/no, gratitude, apologies, saying hello/goodbye, etc.); Numbers (1-100); Days of the week, Months of the year; Seasons. Gender of nouns, hard and soft stems, and exceptions. The Students learn to: Have a simple conversation. Know numbers, days of the week, months and seasons.

Module 3	Topics	6 hours

Family (family members and pets). Learn Russian names: last name, first name, and patronymic. House and apartment. Parts of the body and health. Personal pronouns; ты vs. вы. Asking Whose in Russian? The Possessive pronouns. Asking What and Who in Russian? Nominative case. Asking Where? Prepositional case. The Country and Nationality. Prepositions (in/at/on/with etc.). The adjectives (colors, age, appearance, etc.). The Students learn to: Ask questions and demonstrate basic ability to communicate in Russian.

Module 4	Topics	4 hours

Shopping. Food. Clothes. Demonstrative pronouns этот and тот. Dative case of personal pronouns, impersonal constructions. Simple translation (Russian-English-Russian). The Students learn to: Do shopping. Understand a short text in Russian.

Module 5	Topics	5 hours

Travelling. At the airport. Public transportation. Directions. Weather. Form a sentence with the given word. Place the sentences into plural form. Formulate questions. The Students learn to: Formulate and answer general questions in Russian. Express sentences given in Male or Female, Ask about and find a destination.

Module 6	Topics	3 hours

Studying and Teaching. Profession. About myself. The Students learn to: Be able to tell about themselves (family, university, house, leisure, etc.)

Module 7	Topics	4 hours

Dialogues: a) At the airport. b) In a cafeteria, grocery store, farmer's market, etc. About family - Between friends.

Module 8	Guest Lectures / native speakers	2 hours
	Total Lecture Hours	30

Mode of Evaluation : CAT , Quiz and Digital Assignments

Approved by Academic Council	No.41	Date	17.06.2016

Course code	Course title	L	T	P	J	C
STS1001	Introduction to Soft skills	3	0	0	0	1
Pre-requisite	None	Syllabus version				2.0

Course Objectives:

1. To enhance the ability to plan better and work as a team effectively
2. To boost the learning ability and to acquire analytical and research skills
3. To educate the habits required to achieve success

Expected Course Outcome:

1. Enabling students to know themselves and interact better with self and environment

Module:1	Lessons on excellence	10 hours

Ethics and integrity

Importance of ethics in life, Intuitionism vs Consequentialism, Non-consequentialism, Virtue ethics vs situation ethics, Integrity - listen to conscience, Stand up for what is right

Change management

Who moved my cheese?, Tolerance of change and uncertainty, Joining the bandwagon, Adaptingchange for growth - overcoming inhibition

How to pick up skills faster?

Knowledge vs skill, Skill introspection, Skill acquisition, "10,000 hours rule" and the converse

Habit formation

Know your habits, How habits work? - The scientific approach, How habits work? - The psychological approach, Habits and professional success, "The Habit Loop", Domino effect,Unlearning a bad habit

Analytic and research skills.

Focused and targeted information seeking, How to make Google work for you, Data assimilation

Module:2	Team skills	11 hours

Goal setting

SMART goals, Action plans, Obstacles -Failure management

Motivation

Rewards and other motivational factors, Maslow's hierarchy of needs, Internal and external motivation

Facilitation

Planning and sequencing, Challenge by choice, Full Value Contract (FVC), Experiential learningcycle, Facilitating the Debrief

Introspection

Identify your USP, Recognize your strengths and weakness, Nurture strengths, Fixing weakness, Overcoming your complex, Confidence building

Trust and collaboration

Virtual Team building, Flexibility, Delegating, Shouldering responsibilities

Module:3	Emotional Intelligence	12 hours

Transactional Analysis

Introduction, Contracting, Ego states, Life positions

Brain storming

Individual Brainstorming, Group Brainstorming, Stepladder Technique, Brain writing, Crawford's Slip writing approach, Reverse brainstorming, Star bursting, Charlette procedure, Round robin brainstorming

Psychometric Analysis

Skill Test, Personality Test

Rebus Puzzles/Problem Solving

More than one answer, Unique ways

Module:4	Adaptability	12 hours

Theatrix

Motion Picture, Drama, Role Play, Different kinds of expressions

Creative expression

Writing, Graphic Arts, Music, Art and Dance

Flexibility of thought

The 5'P' framework (Profiling, prioritizing, problem analysis, problem solving, planning)

Adapt to changes(tolerance of change and uncertainty)

Adaptability Curve , Survivor syndrome

Total Lecture hours:	45 hours

Text Book(s)

1.	Chip Heath, How to Change Things When Change Is Hard (Hardcover), 2010, First Edition, Crown Business.
2.	Karen Kindrachuk, Introspection, 2010, 1st Edition.
3.	Karen Hough, The Improvisation Edge: Secrets to Building Trust and Radical Collaboration at Work, 2011, Berrett-Koehler Publishers

Reference Books

1.	Gideon Mellenbergh, A Conceptual Introduction to Psychometrics: Development, Analysis and Application of Psychological and Educational Tests,2011, Boom Eleven International.
2.	Phil Lapworth, An Introduction to Transactional Analysis, 2011, Sage Publications (CA)

Mode of Evaluation: FAT, Assignments, Projects, Case studies, Role plays,3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	No. 45	Date	15/06/2017

Course Code	Course Title	L	T	P	J	C
STS1002	Introduction to Business Communication	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				2.0

Course Objectives:

1. To provide an overview of Prerequisites to Business Communication
2. To enhance the problem solving skills and improve the basic mathematical skills
3. To organize the thoughts and develop effective writing skills

Expected Course Outcome:

1. Enabling students enhance knowledge of relevant topics and evaluate the information

Module:1	Study skills	10 hours

Memory techniques

Relation between memory and brain, Story line technique, Learning by mistake, Image-name association, Sharing knowledge, Visualization

Concept map

Mind Map, Algorithm Mapping, Top down and Bottom Up Approach

Time management skills

Prioritization - Time Busters, Procrastination, Scheduling, Multitasking, Monitoring

Working under pressure and adhering to deadlines

Module:2	Emotional Intelligence (Self Esteem)	6 hours

Empathy : Affective Empathy and Cognitive Empathy

Sympathy : Level of sympathy (Spatial proximity, Social Proximity, Compassion fatigue)

Module:3	Business Etiquette	9 hours

Social and Cultural Etiquette

Value, Manners, Customs, Language, Tradition

Writing Company Blogs

Building a blog, Developing brand message, FAQs', Assessing Competition

Internal Communications

Open and objective Communication, Two way dialogue, Understanding the audience

Planning

Identifying, Gathering Information, Analysis, Determining, Selecting plan, Progress check, Typesof planning

Writing press release and meeting notes

Write a short, catchy headline, Get to the Point –summarize your subject in the first paragraph,Body – Make it relevant to your audience

Module:4	Quantitative Ability	4 hours

Numeracy concepts

Fractions, Decimals, Bodmas, Simplifications, HCF, LCM, Tests of divisibility

Beginning to Think without Ink

Problems solving using techniques such as: Percentage, Proportionality, Support of answer choices, Substitution of convenient values, Bottom-up approach etc.

Math Magic

Puzzles and brain teasers involving mathematical concepts

Speed Calculations

Square roots, Cube roots, Squaring numbers, Vedic maths techniques

Module:5	Reasoning Ability	3 hours

Interpreting Diagramming and sequencing information

Picture analogy, Odd picture, Picture sequence, Picture formation, Mirror image and water image

Logical Links

Logic based questions-based on numbers and alphabets

Module:6	Verbal Ability	3 hours

Strengthening Grammar Fundamentals

Parts of speech, Tenses, Verbs(Gerunds and infinitives)

Reinforcements of Grammar concepts

Subject Verb Agreement, Active and Passive Voice, Reported Speech

Module:7	Communication and Attitude	10 hours

Writing

Writing formal & informal letters, How to write a blog & knowing the format, Effective ways ofwriting a blog, How to write an articles & knowing the format, Effective ways of writing an articles, Designing a brochures

Speaking skills

How to present a JAM, Public speaking

Self managing

Concepts of self management and self motivation, Greet and Know, Choice of words, Giving feedback, Taking criticism

Total Lecture hours:	45 hours

Text Book(s)

1.	FACE, Aptipedia, Aptitude Encyclopedia, 2016, First Edition, Wiley Publications, Delhi.
2.	ETHNUS, Aptimithra, 2013, First Edition, McGraw-Hill Education Pvt. Ltd.

Reference Books

1.	Alan Bond and Nancy Schuman, 300+ Successful Business Letters for All Occasions, 2010, Third Edition, Barron's Educational Series, New York.
2.	Josh Kaufman, The First 20 Hours: How to Learn Anything Fast, 2014, First Edition, Penguin Books, USA.

Mode of Evaluation: FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	No. 45	Date	15/06/2017

Course Code	Course Title	L	T	P	J	C
STS1101	Fundamentals of Aptitude	3	0	0	0	1
Pre-requisite	NIL	Syllabus version			1.0	

Course Objectives:

1. To enhance the logical reasoning skills of the students and improve the problem-solvingabilities
2. To strengthen the ability to solve quantitative aptitude problems
3. To enrich the verbal ability of the students

Expected Course Outcome:

1. Students will be introduced to basic concepts of Quantitative Aptitude, Logical reasoningand Verbal ability
2. Students will be able to read and demonstrate good comprehension of text in areas of thestudent's interest
3. Students will be able to demonstrate the ability to resolve problems that occur in theirfield.

Module:1	Lessons on excellence	2hours

Skill introspection, Skill acquisition, consistent practice

Module:2	Logical Reasoning	16 hours

Thinking Skill

- Problem Solving
- Critical Thinking
- Lateral Thinking

Taught through thought-provoking word and rebus puzzles, and word-link builder questions

Coding & decoding, Series, Analogy, Odd man out and Visual reasoning

- Coding and Decoding
- Series
- Analogy
- Odd Man Out
- Visual Reasoning

Sudoku puzzles

Solving introductory to moderate level sudoku puzzles to boost logical thinking and comfortwith numbers

Attention to detail

Picture and word driven Qs to develop attention to detail as a skill

Module:3	Quantitative Aptitude	14 hours

Speed Maths

- Addition and Subtraction of bigger numbers
- Square and square roots
- Cubes and cube roots
- Vedic maths techniques
- Multiplication Shortcuts

- Multiplication of 3 and higher digit numbers
- Simplifications
- Comparing fractions
- Shortcuts to find HCF and LCM
- Divisibility tests shortcuts

Algebra and functions

Module:4	Recruitment Essentials	5hours

Looking at an engineering career through the prism of an effective resume

- Importance of a resume - the footprint of a person's career achievements
- How a resume looks like?
- An effective resume vs. a poor resume: what skills you must build starting today andhow?

Impression Management

Getting it right for the interview:

- Grooming, dressing
- Body Language and other non-verbal signs
- Displaying the right behavior

Module:5	Verbal Ability	8hours

Essential grammar for placements:

- Nouns and Pronouns
- Verbs
- Subject-Verb Agreement
- Pronoun-Antecedent Agreement
- Punctuations

Verbal Reasoning

Total Lecture hours:	45 hours

Mode of Evaluation: FAT, Assignments, 3 Assessments with Term End FAT (Computer Based Test)

Text Book(s):

1.	FACE, Aptipedia Aptitude Encyclopedia, 2016, 1stEdition, Wiley Publications, Delhi.
2.	ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.
3.	SMART, Place Mentor, 2018, 1st Edition, Oxford University Press.
4.	R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.

Reference Book(s):

1.	Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.

Recommended by Board of Studies			
Approved by Academic Council	No. 53	Date	13.12.2018

Course Code	Course Title	L	T	P	J	C
STS1102	Arithmetic Problem Solving	3	0	0	0	1
Pre-requisite	None	Syllabus version				
		1.0				

Course Objectives:

1. To enhance the logical reasoning skills of the students and improve the problem-solvingabilities
2. To strengthen the ability to solve quantitative aptitude problems
3. To enrich the verbal ability of the students for academic purpose

Expected course outcome:

1. Students will be able to show more confidence in solving problems of QuantitativeAptitude
2. Students will be able to show more confidence in solving problems of LogicalReasoning
3. Students will be able to show more confidence in understanding the questions of VerbalAbility

Module:1	Logical Reasoning	11 hours

Word group categorization questions

Puzzle type class involving students grouping words into right group orders of logical sense

Cryptarithmetic

Data arrangements and Blood relations

- Linear Arrangement
- Circular Arrangement
- Multi-dimensional Arrangement
- Blood Relations

Module:2	Quantitative Aptitude	18 hours

Ratio and Proportion

- Ratio
- Proportion
- Variation
- Simple equations
- Problems on Ages
- Mixtures and alligations

Percentages, Simple and Compound Interest

- Percentages as Fractions and Decimals
- Percentage Increase / Decrease
- Simple Interest
- Compound Interest
- Relation Between Simple and Compound Interest

Number System

- Number system
- Power cycle
- Remainder cycle

- Factors, Multiples
- HCF and LCM

Module:3	Verbal Ability	16hours

Essential grammar for placements

- Prepositions
- Adjectives and Adverbs
- Tenses
- Forms and Speech and Voice
- Idioms and Phrasal Verbs
- Collocations, Gerund and Infinitives

Reading Comprehension for placements

- Types of questions
- Comprehension strategies
- Practice exercises

Articles, Prepositions and Interrogatives

- Definite and Indefinite Articles
- Omission of Articles
- Prepositions
- Compound Prepositions and Prepositional Phrases
- Interrogatives

Vocabulary for placements

- Exposure to solving questions of
- Synonyms
- Antonyms
- Analogy
- Confusing words
- Spelling correctness

Total Lecture hours:	**45 hours**

Mode of Evaluation: FAT, Assignments, 3 Assessments with Term End FAT (Computer Based Test)

Text Book(s):

1.	FACE, Aptipedia Aptitude Encyclopedia, 2016, 1stEdition, Wiley Publications, Delhi.
2.	ETHNUS, Aptimithra, 2013, 1stEdition, McGraw-Hill Education Pvt.Ltd.
3.	SMART, Place Mentor, 2018, 1st Edition, Oxford University Press.
4.	R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.

Reference Book(s):

1. Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.

Recommended by Board of Studies			
Approved by Academic Council	**No. 53**	**Date**	**13.12.2018**

Course Code	Course Title	L	T	P	J	C
STS1201	Introduction to Problem Solving	3	0	0	0	1
Pre-requisite	None	Syllabus version				1.0

Course Objectives:

1. To enhance the logical reasoning skills of the students and improve the problem-solvingabilities
2. To strengthen the ability to solve quantitative aptitude problems
3. To enrich the verbal ability of the students for academic purpose

Expected Course Outcome:

1. Students will be introduced to basic concepts of Quantitative Aptitude, Logical reasoning and Verbal ability
2. Students will be able to read and demonstrate good comprehension of text in areas of the student's interest
3. Students will be able to demonstrate the ability to resolve problems that occur in their field.

Module:1	Lessons on excellence	2hours

Skill introspection, Skill acquisition, consistent practice

Module:2	Logical Reasoning	18 hours

Thinking Skill

- Problem Solving
- Critical Thinking
- Lateral Thinking

Taught through thought-provoking word and rebus puzzles, and word-link builder questions

Coding & decoding, Series, Analogy, Odd man out and Visual reasoning

- Coding and Decoding
- Series
- Analogy
- Odd Man Out
- Visual Reasoning

Sudoku puzzles : Solving introductory to moderate level sudoku puzzles to boost logical thinking and comfortwith numbers

Attention to detail : Picture and word driven Qs to develop attention to detail as a skill

Module:3	Quantitative Aptitude	14 hours

Speed Maths

- Addition and Subtraction of bigger numbers
- Square and square roots
- Cubes and cube roots
- Vedic maths techniques
- Multiplication Shortcuts
- Multiplication of 3 and higher digit numbers
- Simplifications

- Comparing fractions
- Shortcuts to find HCF and LCM
- Divisibility tests shortcuts

Algebra and functions

Module:4	Recruitment Essentials	5hours

Looking at an engineering career through the prism of an effective resume

- Importance of a resume - the footprint of a person's career achievements
- How a resume looks like?
- An effective resume vs. a poor resume: what skills you must build starting today andhow?

Impression Management

Getting it right for the interview:

- Grooming, dressing
- Body Language and other non-verbal signs
- Displaying the right behavior

Module:5	Verbal Ability	6hours

Grammar challenge

A practice paper with sentence based and passage-based questions on grammar discussed.Topics covered in questions are Nouns and Pronouns, Verbs, Subject-Verb Agreement, Pronoun-Antecedent Agreement, Punctuations

Verbal reasoning

Total Lecture hours:	45 hours

Mode of Evaluation: FAT, Assignments, 3 Assessments with Term End FAT (Computer Based Test)

Text Book(s):

1. FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2. ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.
3. SMART, PlaceMentor, 2018, 1st Edition, Oxford University Press.
4. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.

Reference Book(s):

1. Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.

Recommended by Board of Studies			
Approved by Academic Council	No. 53	Date	13.12.2018

Course Code	Course Title	L	T	P	J	C
STS1202	Introduction to Quantitative, Logical and Verbal Ability	3	0	0	0	1
Pre-requisite	Cleared the cut- off in end-of-sem 1 assessment	Syllabus version				
		1.0				

Course Objectives:

1. To enhance the logical reasoning skills of the students and improve the problem-solvingabilities
2. To strengthen the ability to solve quantitative aptitude problems
3. To enrich the verbal ability of the students for academic purpose

Expected Course Outcome:

1. Students will be able to show more confidence in solving problems of QuantitativeAptitude
2. Students will be able to show more confidence in solving problems of LogicalReasoning
3. Students will be able to show more confidence in understanding the questions of VerbalAbility

Module:1	Logical Reasoning	12 hours

Word group categorization questions

Puzzle type class involving students grouping words into right group orders of logical sense

Cryptarithmetic

Data arrangements and Blood relations

- Linear Arrangement
- Circular Arrangement
- Multi-dimensional Arrangement
- Blood Relations

Module:2	Quantitative Aptitude	20 hours

Ratio and Proportion

- Ratio
- Proportion
- Variation
- Simple equations
- Problems on Ages
- Mixtures and alligations: Problems involving multiple iterations of mixtures

Percentages, Simple and Compound Interest

- Percentages as Fractions and Decimals
- Percentage Increase / Decrease
- Simple Interest
- Compound Interest
- Relation Between Simple and Compound Interest

Number System

- Number system
- Power cycle
- Remainder cycle

- Factors, Multiples
- HCF and LCM

Module:3	Verbal Ability	13 hours

Reading Comprehension – Advanced

Grammar - application and discussion

A practice paper with sentence based and passage-based questions on grammar discussed. Topics covered in questions are Prepositions, Adjectives and Adverbs, Tenses, Forms and Speech and Voice, Idioms and Phrasal Verbs, Collocations, Gerund and Infinitives

Articles, Prepositions and Interrogatives

- Definite and Indefinite Articles
- Omission of Articles
- Prepositions
- Compound Prepositions and Prepositional Phrases
- Interrogatives

Vocabulary – Advanced : Exposure to challenging placement questions on vocabulary

Total Lecture hours:	45 hours

Mode of Evaluation: FAT, Assignments, 3 Assessments with Term End FAT (ComputerBased Test)

Text Book(s):

1.	FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2.	ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.
3.	SMART, PlaceMentor, 2018, 1st Edition, Oxford University Press.
4.	R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.

Reference Book(s):

1. Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.

Recommended by Board of Studies			
Approved by Academic Council	**No. 53**	**Date**	**13.12.2018**

Course code	Course Title	L	T	P	J	C
STS2001	Reasoning Skill Enhancement	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				2.0

Course Objectives:

1. To strengthen the social network by the effective use of social media and social interactions.
2. To identify own true potential and build a very good personal branding
3. To enhance the Analytical and reasoning skills.

Expected Course Outcome:

1. Understanding the various strategies of conflict resolution among peers and supervisors and respond appropriately

Module:1	Social Interaction and Social Media	6 hours

Effective use of social media

Types of social media, Moderating personal information, Social media for job/profession, Communicating diplomatically

Networking on social media

Maximizing network with social media, How to advertise on social media

Event management

Event management methods, Effective techniques for better event management

Influencing

How to win friends and influence people, Building relationships, Persistence and resilience,Tools for talking when stakes are high

Conflict resolution

Definition and strategies ,Styles of conflict resolution

Module:2	Non Verbal Communication	6 hours

Proximecs

Types of proximecs**,** Rapport building

Reports and Data Transcoding Types of reports

Negotiation Skill

Effective negotiation strategies

Conflict Resolution

Types of conflicts

Module:3	Interpersonal Skill	8 hours

Social Interaction

Interpersonal Communication,Peer Communication, Bonding,Types of social interaction

Responsibility

Types of responsibilities**,** Moral and personal responsibilities

Networking

Competition, Collaboration, Content sharing

Personal Branding

Image Building, Grooming, Using social media for branding

Delegation and compliance

Assignment and responsibility, Grant of authority, Creation of accountability

Module:4	Quantitative Ability	10 hours

Number properties

Number of factors, Factorials, Remainder Theorem, Unit digit position, Tens digit position

Averages

Averages, Weighted Average

Progressions

Arithmetic Progression, Geometric Progression, Harmonic Progression

Percentages

Increase & Decrease or successive increase

Ratios

Types of ratios and proportions

Module:5	Reasoning Ability	8 hours

Analytical Reasoning

Data Arrangement(Linear and circular & Cross Variable Relationship), Blood Relations, Ordering/ranking/grouping, Puzzletest, Selection Decision table

Module:6	Verbal Ability	7 hours

Vocabulary Building

Synonyms & Antonyms, One word substitutes, Word Pairs, Spellings, Idioms, Sentence completion, Analogies

Total Lecture hours:	45 hours

Text Book(s)

1. FACE, Aptipedia Aptitude Encyclopedia, 2016, First Edition, Wiley Publications, Delhi.
2. ETHNUS, Aptimithra, 2013, First Edition, McGraw-Hill Education Pvt.Ltd.
3. Mark G. Frank, David Matsumoto, Hyi Sung Hwang, Nonverbal Communication: Science and Applications, 2012, 1st Edition, Sage Publications, New York.

Reference Books

1. Arun Sharma, Quantitative aptitude, 2016, 7th edition, Mcgraw Hill Education Pvt. Ltd.
2. Kerry Patterson, Joseph Grenny, Ron McMillan, Al Switzler, Crucial Conversations: Tools for Talking When Stakes are High, 2001, 1st edition McGraw Hill Contemporary, Bangalore.
3. Dale Carnegie, How to Win Friends and Influence People, Latest Edition, 2016. Gallery Books, New York.

Mode of evaluation: FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	No. 45	Date	15/06/2017

Course code	Course Title	L	T	P	J	C
STS2002	Introduction to Etiquette	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				
		2.0				

Course Objectives:

1. To analyze social psychological phenomena in terms of impression management.
2. To control or influence other people's perceptions.
3. To enhance the problem solving skills

Expected Course Outcome:

Creating in the students an understanding of decision making models and generating alternatives using appropriate expressions.

Module:1	Impression Management	8 hours

Types and techniques

Importance of impression management, Types of impression management, Techniques and case studies, Making a good first impression in an interview (TEDOS technique) , How to recover from a bad impressions/experience, Making a good first impression online

Non-verbal communication and body language

Dressing, Appearance and Grooming, Facial expression and Gestures, Body language (Kinesics), Keywords to be used, Voice elements (tone, pitch and pace)

Module:2	Thinking Skills	4 hours

Introduction to problem solving process

Steps to solve the problem, Simplex process

Introduction to decision making and decision making process

Steps involved from identification to implementation**,** Decision making model

Module:3	Beyond Structure	4 hours

Art of questioning

How to frame questions, Blooms questioning pyramid, Purpose of questions

Etiquette

Business, Telephone etiquette, Cafeteria etiquette, Elevator etiquette, Email etiquette, Social media etiquette

Module:4	Quantitative Ability	9 hours

Profit and Loss

Cost Price & Selling Price, Margins & Markup

Interest Calculations

Simple Interest, Compound Interest, Recurring

Mixtures and solutions

Ratio & Averages, Proportions

Time and Work

Pipes & Cisterns, Man Day concept, Division Wages

Time Speed and Distance

Average speed, Relative speed, Boats and streams.

Proportions & Variations

Module:5	Reasoning Ability	11 hours

Logical Reasoning

Sequence and series, Coding and decoding, Directions

Visual Reasoning

Abstract Reasoning, Input Type Diagrammatic Reasoning, Spatial reasoning, Cubes

Data Analysis And Interpretation

DI-Tables/Charts/Text

Module:6	Verbal Ability	9 hours

Grammar

Spot the Errors, Sentence Correction, Gap Filling Exercise, Sentence Improvisations, Misc. Grammar Exercise

Total Lecture hours:	45 hours

Text Book(s)

1. Micheal Kallet, Think Smarter: Critical Thinking to Improve Problem-Solving and Decision-Making Skills, April 7, 2014, 1st Edition, Wiley, New Jersey.
2. MK Sehgal, Business Communication, 2008, 1st Edition, Excel Books, India.
3. FACE, Aptipedia Aptitude Encyclopedia, 2016, First Edition, Wiley Publications, Delhi.
4. ETHNUS, Aptimithra, 2013, First edition, McGraw-Hill Education Pvt. Ltd, Banglore.

Reference Books

1. Andrew J. DuBrin, Impression Management in the Workplace: Research, Theory andPractice, 2010, 1st edition, Routledge.
2. Arun Sharma, Manorama Sharma, Quantitative aptitude, 2016, 7th edition, McGraw Hill Education Pvt. Ltd, Banglore.
3. M. Neil Browne, Stuart M. Keeley, Asking the right questions, 2014, 11th Edition, Pearson, London.

Mode of Evaluation: FAT, Assignments, Projects, Case studies, Role plays,3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	No. 45	Date	15/06/2017

Course Code	Course Title	L	T	P	J	C
STS2101	Getting Started to Skill Enhancement	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				1.0

Course Objectives:

1. To develop the students' logical thinking skills and apply it in the real-life scenarios
2. To learn the strategies of solving quantitative ability problems
3. To enrich the verbal ability of the students

Expected Course Outcome:

1. Students will be able to demonstrate critical thinking skills, such as problem solving related to their subject matters
2. Students will be able to demonstrate competency in verbal, quantitative and reasoning aptitude
3. Students will be able to perform good written communication skills

Module:1	Logical Reasoning	11 hours

Clocks, calendars, Direction sense and Cubes

- Clocks
- Calendars
- Direction Sense
- Cubes

Data interpretation and Data sufficiency

- Data Interpretation – Tables
- Data Interpretation - Pie Chart
- Data Interpretation - Bar Graph
- Data Sufficiency

Module:2	Quantitative Aptitude	18 hours

Time and work

- Work with different efficiencies
- Pipes and cisterns
- Work equivalence
- Division of wages

Time, Speed and Distance

- Basics of time, speed and distance
- Relative speed
- Problems based on trains
- Problems based on boats and streams
- Problems based on races

Profit and loss, Partnerships and averages

- Basic terminologies in profit and loss
- Partnership
- Averages

- Weighted average

Module:3	Verbal Ability	13hours

Sentence Correction

- Subject-Verb Agreement
- Modifiers
- Parallelism
- Pronoun-Antecedent Agreement
- Verb Time Sequences
- Comparisons
- Prepositions
- Determiners

Sentence Completion and Para-jumbles

- Pro-active thinking
- Reactive thinking (signpost words, root words, prefix suffix, sentence structure clues)
- Fixed jumbles
- Anchored jumbles

Module:4	Writing skills for placements	3 hours

Essay writing

- Idea generation for topics
- Best practices
- Practice and feedback

Total Lecture hours:	45 hours

Mode of Evaluation: FAT, Assignments, 3 Assessments with Term End FAT (Computer Based Test)

Text Book(s):

1. FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2. ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.
3. SMART, PlaceMentor, 2018, 1st Edition, Oxford University Press.
4. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.

Reference Book(s):

1. Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.

Recommended by Board of Studies			
Approved by Academic Council	No. 53	Date	13.12.2018

Course Code	Course title	L	T	P	J	C
STS2102	Enhancing Problem Solving Skills	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				1.0

Course Objectives:

1. To develop the students' logical thinking skills and apply it in the real-life scenarios
2. To learn the strategies of solving quantitative ability problems
3. To enrich the verbal ability of the students
4. To strengthen the basic programming skills for placements

Expected Course Outcome:

1. The students will be able to interact confidently and use decision making models effectively
2. The students will be able to deliver impactful presentations
3. The students will be able to be proficient in solving quantitative aptitude and verbal ability questions effortlessly

Module:1	Logical Reasoning	5 hours

Logical connectives, Syllogism and Venn diagrams

- Logical Connectives
- Syllogisms
- Venn Diagrams – Interpretation
- Venn Diagrams – Solving

Module:2	Quantitative Aptitude	11 hours

Logarithms, Progressions, Geometry and Quadratic equations

- Logarithm
- Arithmetic Progression
- Geometric Progression
- Geometry
- Mensuration
- Coded inequalities
- Quadratic Equations

Permutation, Combination and Probability

- Fundamental Counting Principle
- Permutation and Combination
- Computation of Permutation
- Circular Permutations
- Computation of Combination
- Probability

Module:3	Verbal Ability	4 hours

Critical Reasoning

- Argument – Identifying the Different Parts (Premise, assumption, conclusion)
- Strengthening statement
- Weakening statement

- Mimic the pattern

Module:4	Recruitment Essentials	7 hours

Cracking interviews - demonstration through a few mocks

Sample mock interviews to demonstrate how to crack the:

- HR interview
- MR interview
- Technical interview

Cracking other kinds of interviews

- Skype/ Telephonic interviews
- Panel interviews
- Stress interviews

Resume building – workshop : A workshop to make students write an accurate resume

Module:5	Problem solving and Algorithmicskills	18 hours

- Logical methods to solve problem statements in Programming
- Basic algorithms introduced

Total Lecture hours:	45 hours

Mode of Evaluation: FAT, Assignments, Mock interviews, 3 Assessments with Term End FAT (Computer Based Test)

Text Book(s):

1. FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2. ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.
3. SMART, PlaceMentor, 2018, 1st Edition, Oxford University Press.
4. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.

Reference Book(s):

1. Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.

Recommended by Board of Studies			
Approved by Academic Council	No. 53	Date	13.12.2018

Course code	Course title	L	T	P	J	C
STS2201	Numerical Ability and Cognitive Intelligence	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				1.0

Course Objectives:

1. To develop the students' logical thinking skills and apply it in the real-life scenarios
2. To learn the strategies of solving quantitative ability problems
3. To enrich the verbal ability of the students

Expected Course Outcome:

1. Students will be able to demonstrate critical thinking skills, such as problem solving related to their subject matters
2. Students will be able to demonstrate competency in verbal, quantitative and reasoning aptitude
3. Students will be able to perform good written communication skills

Module:1	Logical Reasoning	10 hours

Clocks, calendars, Direction sense and Cubes

- Clocks
- Calendars
- Direction Sense
- Cubes

Practice on advanced problems

Data interpretation and Data sufficiency - Advanced

- Advanced Data Interpretation and Data Sufficiency questions of CAT level
- Multiple chart problems
- Caselet problems

Module:2	Quantitative Aptitude	19 hours

Time and work – Advanced

- Work with different efficiencies
- Pipes and cisterns: Multiple pipe problems
- Work equivalence
- Division of wages
- Advanced application problems with complexity in calculating total work

Time, Speed and Distance - Advanced

- Relative speed
- Advanced Problems based on trains
- Advanced Problems based on boats and streams
- Advanced Problems based on races

Profit and loss, Partnerships and averages - Advanced

- Partnership
- Averages
- Weighted average
- Advanced problems discussed

Number system - Advanced

Advanced application problems on Numbers involving HCF, LCM, divisibility tests, remainder and power cycles.

Module:3	Verbal Ability	13 hours

Sentence Correction - Advanced

- Subject-Verb Agreement
- Modifiers
- Parallelism
- Pronoun-Antecedent Agreement
- Verb Time Sequences
- Comparisons
- Prepositions
- Determiners

Quick introduction to 8 types of errors followed by exposure to GMAT level questions

Sentence Completion and Para-jumbles - Advanced

- Pro-active thinking
- Reactive thinking (signpost words, root words, prefix suffix, sentence structure clues)
- Fixed jumbles
- Anchored jumbles

Practice on advanced GRE/ GMAT level questions

Reading Comprehension – Advanced

Exposure to difficult foreign subject-based RCs of the level of GRE/ GMAT

Module:4	Writing skills for placements	3 hours

Essay writing

- Idea generation for topics
- Best practices
- Practice and feedback

Total Lecture hours:	45 hours

Mode of Evaluation: FAT, Assignments, 3 Assessments with Term End FAT (Computer Based Test)

Text Book(s):

1.	FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2.	ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.
3.	SMART, PlaceMentor, 2018, 1st Edition, Oxford University Press.
4.	R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.

Reference Book(s):

1. Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.

Recommended by Board of Studies			
Approved by Academic Council	No. 53	Date	13.12.2018

Course Code	Course Title	L	T	P	J	C
STS2202	Advanced Aptitude and Reasoning Skills	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				1.0

Course Objectives:

1. To develop the students' logical thinking skills and apply it in the real-life scenarios
2. To learn the strategies of solving quantitative ability problems
3. To enrich the verbal ability of the students
4. To strengthen the basic programming skills for placements

Expected Course Outcome:

1. The students will be able to interact confidently and use decision making modelseffectively
2. The students will be able to deliver impactful presentations
3. The students will be able to be proficient in solving quantitative aptitude and verbal ability questions effortlessly

Module:1	Logical Reasoning	4 hours

Logical Reasoning puzzles - Advanced

Advanced puzzles:

1. Sudoku
2. Mind-bender style word statement puzzles
3. Anagrams
4. Rebus puzzles

Logical connectives, Syllogism and Venn diagrams

1. Logical Connectives
2. Advanced Syllogisms - 4, 5, 6 and other multiple statement problems
3. Challenging Venn Diagram questions: Set theory

Module:2	Quantitative Aptitude	10 hours

Logarithms, Progressions, Geometry and Quadratic equations - Advanced

1. Logarithm
2. Arithmetic Progression
3. Geometric Progression
4. Geometry
5. Mensuration
6. Coded inequalities
7. Quadratic Equations

Concepts followed by advanced questions of CAT level

Permutation, Combination and Probability - Advanced

- Fundamental Counting Principle
- Permutation and Combination
- Computation of Permutation - Advanced problems
- Circular Permutations

- Computation of Combination - Advanced problems
- Advanced probability

Module:3	Verbal Ability	5 hours

Image interpretation

1. Image interpretation: Methods
2. Exposure to image interpretation questions through brainstorming and practice

Critical Reasoning - Advanced

1. Concepts of Critical Reasoning
2. Exposure to advanced questions of GMAT level

Module:4	Recruitment Essentials	8 hours

Mock interviews

Cracking other kinds of interviews

Skype/ Telephonic interviews
Panel interviews
Stress interviews

Guesstimation

1. Best methods to approach guesstimation questions
2. Practice with impromptu interview on guesstimation questions

Case studies/ situational interview

1. Scientific strategies to answer case study and situational interview questions
2. Best ways to present cases
3. Practice on presenting cases and answering situational interviews asked in recruitment rounds

Module:5	Problem solving and Algorithmic skills	18 hours

1. Logical methods to solve problem statements in Programming
2. Basic algorithms introduced

Total Lecture hours:	45 hours

Mode of Evaluation: FAT, Assignments, Mock interviews, 3 Assessments with Term End FAT (Computer Based Test)

Text Book(s):

1.	FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2.	ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.
3.	SMART, PlaceMentor, 2018, 1st Edition, Oxford University Press.
4.	R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.

Reference Book(s):

1. Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.

Recommended by Board of Studies			
Approved by Academic Council	No. 53	Date	13.12.2018

Course Code	Course Title	L	T	P	J	C
STS3001	Preparedness for External Opportunities	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				2.0

Course Objectives:

1. To effectively tackle the interview process, and leave a positive impression with your prospective employer by reinforcing your strength, experience and appropriateness for the job.
2. To check if candidates have the adequate writing skills that are needed in an organization.
3. To enhance the problem solving skills.

Expected Course Outcome:

1. Enabling students acquire skills for preparing for interviews, presentations and higher education

Module:1	Interview Skills	3 hours

Types of interview

Structured and unstructured interview orientation, Closed questions and hypothetical questions, Interviewers' perspective, Questions to ask/not ask during an interview

Techniques to face remote interviews

Video interview, Recorded feedback , Phone interview preparation

Mock Interview

Tips to customize preparation for personal interview, Practice rounds

Module:2	Resume Skills	2 hours

Resume Template

Structure of a standard resume**,** Content, color, font

Use of power verbs

Introduction to Power verbs and Write up

Types of resume

Quiz on types of resume

Customizing resume

Frequent mistakes in customizing resume, Layout - Understanding different company's requirement, Digitizing career portfolio

Module:3	Presentation Skills	6 hours

Preparing presentation

10 tips to prepare PowerPoint presentation**,** Outlining the content, Passing the Elevator Test

Organizing materials

Blue sky thinking, Introduction , body and conclusion, Use of Font, Use of Color, Strategic presentation

Maintaining and preparing visual aids

Importance and types of visual aids, Animation to captivate your audience, Design of posters

Dealing with questions

Setting out the ground rules, Dealing with interruptions, Staying in control of the questions,Handling difficult questions

Module:4	Quantative Ability	14 hours

Permutation-Combinations

Counting, Grouping, Linear Arrangement, Circular Arrangements

Probability

Conditional Probability, Independent and Dependent Events

Geometry and Mensuration

Properties of Polygon, 2D & 3D Figures, Area & Volumes

Trigonometry

Heights and distances, Simple trigonometric functions

Logarithms Introduction,
Basic rules**Functions**
Introduction, Basic rules

Quadratic Equations

Understanding Quadratic Equations, Rules & probabilities of Quadratic Equations

Set Theory

Basic concepts of Venn Diagram

Module:5	Reasoning Ability	7 hours

Logical reasoning

Syllogisms, Binary logic, Sequential output tracing, Crypto arithmetic

Data Analysis and Interpretation

Data Sufficiency

Data interpretation-Advanced Interpretation tables, pie charts & bar chats

Module:6	Verbal Ability	8 hours

Comprehension and Logic

Reading comprehension Para
Jumbles
Critical Reasoning :
Premise and Conclusion, Assumption & Inference, Strengthening & Weakening an Argument

Module:7	Writing Skills	5 hours

Note making

What is note making, Different ways of note making

Report writing

What is report writing, How to write a report, Writing a report & work sheet

Product description

Designing a product, Understanding it's features, Writing a product description

Research paper

Research and its importance, Writing sample research paper

Total Lecture hours:	45 hours

Text Book(s)

1. Michael Farra, Quick Resume & Cover letter Book, 2011, 1st Edition, JIST Editors, Saint Paul.

2.	Daniel Flage, An Introduction to Critical Thinking, 2002, 1st Edition, Pearson, London.
Reference Books	
1.	FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2.	ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt. Ltd.

Mode of Evaluation: FAT, Assignments, Projects, Case studies, Role plays,3 Assessments with Term End FAT (Computer Based Test)			
Recommended by Board of Studies	**09/06/2017**		
Approved by Academic Council	**No. 45**	**Date**	**15/06/2017**

Course Code	Course Title	L	T	P	J	C
STS3004	Data Structures and Algorithms	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				1.0

Course Objectives:

1. To assess how the choice of data structures and algorithm design methods impacts the performance ofprograms.
2. To develop logics which will help them to create programs, applications in C.
3. To learn how to design a graphical user interface (GUI) with Java Swing.

Expected Course Outcome:

1. Clear knowledge about problem solving skills in DS & Algorithms concepts

Module:1	**Data Structures**	**10 hours**
Introduction to data structures, Array, Linked List, Stack, Queue, Trees.		
Module:2	**Algorithms**	**15 hours**
Introduction to Algorithms, Searching Algorithms, Sorting Algorithms, Greedy Algorithm, Divide and Conquer, Analysis of Algorithm.		
Module:3	**C Programming**	**10 hours**
Introduction to C, Execution and Structure of a C Program, Data Types and Operators, Control Statements, Looping, Arrays, Structure, Pointers, Memory Management in C, Functions		
Module:4	**C++ Programming**	**5 hours**
Introduction to C++, Need for OOP, Class & Objects, Create C++ & Java class and show the similarity Encapsulation, Access Specifiers, Relationship, Polymorphism, Exception Handling, Abstract Classes.		
Module:5	**JAVA**	**5 hours**
Introduction to Java, Data Types and Operators, Control Statements, Looping, Arrays, Need for OOP, Class & Objects, Create C++ & Java class and show the similarity Encapsulation, Access Specifiers, Relationship, Polymorphism, Exception Handling, Abstract Classes, Interfaces.		
Total Lecture hours:	**45 hours**	

Reference Books

1. Data Structures and Algorithms: https://ece.uwaterloo.ca/~dwharder/aads/Lecture_materials/: University of waterloo
2. C Programming: C Programming Absolute Beginner's Guide (3rd Edition) by Greg Perry, Dean Miller
3. Java: Thinking in Java, 4th Edition

Mode of Evaluation: FAT, Assignments, Projects, 3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies	**09/06/2017**		
Approved by Academic Council	**No. 45**	**Date**	**15/06/2017**

Course Code	Course Title	L	T	P	J	C
STS3005	Code Mithra	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				1.0

Course Objectives:

1. To develop logics which will help them to create programs, applications in C.
2. To learn how to design a graphical user interface (GUI) with Java Swing.
3. To present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively.

Expected Course Outcome:

1. Enabling students to write coding in C, C++, Java and DBMS concepts

Module:1	C Programming	15 hours

Introduction to C, Execution and Structure of a C Program, Data Types and Operators, Control Statements, Looping, Arrays, Structure, Pointers, Memory Management in C,Functions.

Module:2	C++ Programming	15 hours

Introduction to C++, Need for OOP, Class & Objects, Create C++ & Java class and show the similarity Encapsulation, Access Specifiers, Relationship, Polymorphism, Exception Handling, Abstract Classes, Interfaces.

Module:3	JAVA	10 hours

Introduction to Java, Data Types and Operators, Control Statements, Looping, Arrays, Need for OOP, Class & Objects, Create C++ & Java class and show the similarity Encapsulation, Access Specifiers, Relationship, Polymorphism, Exception Handling, Abstract Classes, Interfaces.

Module:4	Database	5 hours

Introduction to database, DDL, Data Manipulation, SELECT, Joins.

Total Lecture hours:	45 hours

Reference Books

1. Data Structures and Algorithms: https://ece.uwaterloo.ca/~dwharder/aads/Lecture_materials/
2. C Programming: C Programming Absolute Beginner's Guide (3rd Edition) by Greg Perry, Dean Miller
3. Java: Thinking in Java, 4th Edition
4. **Websites:** www.eguru.ooo

Mode of Evaluation: FAT, Assignments, Projects 3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	No.45	Date	15/06/2017

Course Code	Course Title	L	T	P	J	C
STS3006	Preparedness for External Opportunities	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				1.0

Course Objectives:

1. To enhance the problem solving skills.
2. To check if candidates have the adequate writing skills that are needed in an organization.
3. To reason, model, and draw conclusions or make decisions with mathematical, statistical, and quantitative information.

Expected Course Outcome:

1. Students will be able to solve mathematical, reasoning and verbal questionnaires

Module:1	Quantitative Ability	12 hours

Time and Work, Time Speed and Distance, Number System, Equations, Percentages, Profit and Loss, Permutation and Combination, Probability, Geometry and Mensuration, Averages, Progression, Allegations and Mixtures, Ages

Module:2	Reasoning Ability	12 hours

Data Arrangement - Linear, Circular and Cross Variable Relationship, Data Sufficiency, Data Interpretation-Advanced Interpretation Tables, Coding and Decoding, Abstract Reasoning, Input Type Diagrammatic Reasoning, Spatial Reasoning, Cubes, Clocks and Calendar

Module:3	Verbal Ability	21 hours

Vocabulary Building

Synonyms & Antonyms, One word substitutes, Word Pairs, Spellings, Idioms, Sentence completion, Analogies, Cloze Test.

Comprehension and Logic

Reading comprehension Para

Jumbles

Critical Reasoning

Premise and Conclusion, Assumption & Inference, Strengthening & Weakening an Argument.

Sentence Correction

Modifiers, parallelism, Verb time sequences, Comparison, Determiners.

Building personal lexicon

Benefits of becoming a logophile, Etymology – Root words, Prefix and suffix.

Grammar

Spot the Errors, Sentence Correction, Gap Filling Exercise.

Text Book(s)

1. FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2. ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.
3. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.

Reference Books

1. Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.

Mode of evaluation: Assignments, Projects, Case studies, FAT (Computer Based Test)			
Recommended by Board of Studies			
Approved by Academic Council	**No.49**	**Date**	**15/03/2018**

Course Code	Course Title	L	T	P	J	C
STS3007	Preparedness for Career Opportunities	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				1.0

Course Objectives:

1. To enrich the logical thinking ability for better analysis and decision making
2. To hone the competence in solving problems and reasoning skills
3. To build a good vocabulary and use it in effective communication

Expected Course Outcome:

1. Students will be able to solve mathematical, reasoning and verbal questionnaires

Module:1	Quantitative Ability	15 hours

Time and Work, Time Speed and Distance, Number System, Equations, Percentages, Profit and Loss, Permutation and Combination, Probability, Geometry and Mensuration, Averages, Progression, Allegations and Mixtures, Ages

Module:2	Reasoning Ability	12 hours

Data Arrangement - Linear, Circular and Cross Variable Relationship**,** Data Sufficiency, Data Interpretation-Advanced Interpretation Tables**,** Coding and Decoding, Abstract Reasoning, Input Type Diagrammatic Reasoning, Spatial Reasoning, Cubes, Clocks and Calendar

Module:3	Verbal Ability	18 hours

Vocabulary Building

Synonyms & Antonyms, One word substitutes, Word Pairs, Spellings, Idioms, Sentencecompletion, Analogies, Cloze Test.

Comprehension and Logic

Reading comprehension Para, Jumbles

Critical Reasoning: Premise and Conclusion, Assumption & Inference, Strengthening & Weakening an Argument.

Sentence Correction

Modifiers, parallelism, Verb time sequences, Comparison, Determiners.

Building personal lexicon

Benefits of becoming a logophile, Etymology – Root words, Prefix and suffix.

Text Book(s)

1. FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2. ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.
3. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.

Reference Books

1. Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.

Mode of evaluation: Assignments, Projects, Case studies, FAT (Computer Based Test)

Recommended by Board of Studies			
Approved by Academic Council	No.49	Date	15/03/2018

Course Code	Course Title	L	T	P	J	C
STS3101	Introduction to Programming Skills	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				1.0

Course Objectives:

1. Ability to translate vast data into abstract concepts and to understand JAVA concepts
2. To have a clear understanding of subject related concepts
3. To develop computational ability in Java programming language

Expected Course Outcome:

1. Clear Knowledge about problem solving skills in JAVA concepts
2. Students will be able to write codes in Java

Module:1	Object and Class, Data types	8 hours

Types of programming
Disadvantages of functional programming
Class & Objects
Attributes
Methods
Objects
Solving MCQs based on Objects and Classes
Solving tricky questions based on encapsulation
Solving frequently asked object-based questions

Data types
Data
Why data type
Variables
Available data types Numeric – int, float, doubleCharacter – char, string
Solving MCQs based on type casting, data typesSolving debugging based MCQs

Module:2	Basic I / O, Decision Making, Loop Control	8 hours

Printing
Getting input from user during run time
Command line arguments
Solving programming questions based on CLA
Solving MCQs questions based on CLA

Need for control statement
if..else
if..else if..else
Nested if..else
Switch case
Common mistakes with control statements (like using = instead of ==)
Solving frequently asked questions on decision making

Types of looping statements
Entry Controlled
For
While
Exit Controlled
do while
break and continue
Demo on looping
Common mistakes with looping statements (like using; at the end of the loop)
Solving pattern programming problems, series problems
Solving predict the output questions

Module:3	String, Date, Array	10 hours

String handling, data handling
Solving problems based on arrays like searching, sorting, rearranging, iteration)
Multi-dimensional arrays
Solving pattern problems using 2D arrays
Real time application based on 2D arrays

Module:4	Inheritance, Aggregation & Associations	12 hours

Need - Is A – Inheritance
Types of inheritance supported - Diagrammatic representation - Demo on inheritance
Has A – Aggregation - Diagrammatic representation - Demo on aggregation
Uses A - Association - Diagrammatic representation - Demo on association
Assignment on relationships - Solving MCQs based on relationships between classes

Module:5	Modifiers, Interface & Abstract classes (Javaspecific), Packages	7 hours

Types of access specifiers
Demo on access specifiers
Assignment on access modifiers
Instance Members
Solving MCQs based on modifiers
Abstract Classes : Need - Abstract Classes - Abstract Methods
Interfaces
Assignment on abstract classes and interface
Need for packages - Access specifiers & packages- Import classes from other packages

Total Lecture hours:	45 hours

Reference Books

1.	Java The Complete Reference, 2014, 9th Edition by By Herbert Schildt, McGraw-Hill Education Pvt Ltd
2.	Introduction to Programming with Java: A Problem-Solving Approach by John Dean

Mode of Evaluation: FAT, Assignments, 3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies			
Approved by Academic Council	**No. 53**	**Date**	**13.12.2018**

Course Code	Course Title	L	T	P	J	C
STS3104	Enhancing Programming Ability	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				1.0

Course Objectives:

1. Ability to translate vast data into abstract concepts and to understand JAVA concepts
2. To have a clear understanding of subject related concepts
3. To develop computational ability in Java programming language

Expected Course Outcome:

1. Clear Knowledge about problem solving skills in JAVA concepts
2. Students will be able to write codes in Java

Module:1	Collections	12 hours

ArrayList, LinkedList, List Interface, HashSet, Map Interface, HashMap, SetProgramming questions based on collections
Real world problems based on data structure

Module:2	Threads, Exceptions, LinkedList, Arrays	6 hours

Need of threads - Creating threads – Wait – Sleep - Thread execution
Need for exception handlingtry, catch, throw, throws
Creating own exception (Java, Python)Handling own exceptions
Solving programming questions based on linked list and arrays

Module:3	Stack and Queue, Trees	7 hours

Solving programming questions based on stacks and queuesHow to implement a stack using queue?
How to implement a queue using stack?
Solving programming questions based on trees, binary trees, binary search trees

Module:4	JDBC Connectivity, JDBC Data	10 hours

JDBC Overview - Database Setup - Install the MySQL Database
Create New Database User in MySQL Workbench
Selecting data from tables -Inserting Data into the Database - Updating Data in the Database
Deleting Data from the DatabaseCreating Prepared Statements

Module:5	Networking with Java	10 hours

Working with URLs - Sending HTTP Requests - Processing JSON data using JavaProcessing XML data using Java

Total Lecture hours:	45 hours

Reference Books

1. Java The Complete Reference, 2014, 9th Edition by By Herbert Schildt, McGraw-Hill Education Pvt Ltd
2. Introduction to Programming with Java: A Problem-Solving Approach by John Dean

Mode of Evaluation: FAT, Assignments, 3 Assessments with Term End FAT (Computer Base Test)

Recommended by Board of Studies			
Approved by Academic Council	No. 53	Date	13.12.2018

Course Code	Course title	L	T	P	J	C
STS3105	Computational Thinking	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				1.0

Course Objectives:

1. Ability to translate vast data into abstract concepts and to understand JAVA concepts
2. To have a clear understanding of subject related concepts
3. To develop computational ability in Java programming language

Expected Course Outcome:

1. Clear Knowledge about problem solving skills in JAVA concepts
2. Students will be able to write codes in Java

Module:1	Date, Array	10 hours

Data handling
Solving problems based on arrays like searching, sorting, rearranging, iteration)Multi-dimensional arrays
Solving pattern problems using 2D arrays - Real time application based on 2D arrays

Module:2	Inheritance, Aggregation & Associations	15 hours

Need - Is A – Inheritance
Types of inheritance supported Diagrammatic representation Demo on inheritance
Has A – Aggregation Diagrammatic representationDemo on aggregation
Uses A - Association Diagrammatic representationDemo on association Assignment on relationships
Solving MCQs based on relationships between classes

Module:3	Modifiers, Interface & Abstract classes (Java specific)	10 hours

Types of access specifiers Demo on access specifiers Assignment on access modifiers Instance Members
Solving MCQs based on modifiers -Abstract Classes – Need -Abstract Classes - Abstract Methods
Interfaces - Assignment on abstract classes and interface

Module:4	Packages	5 hours

Need for packages - Access specifiers & packages Import classes from other packages

Module:5	Exceptions	5 hours

Need for exception handling try, catch, throw, throws
Creating own exception (Java, Python)Handling own exceptions

Total Lecture hours:	45 hours

Reference Books

1. Java The Complete Reference, 2014, 9th Edition by By Herbert Schildt, McGraw-Hill Education Pvt Ltd
2. Introduction to Programming with Java: A Problem-Solving Approach by John Dean

Mode of Evaluation: FAT, Assignments, 3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies			
Approved by Academic Council	No. 53	Date	13.12.2018

Course Code	Course Title	L	T	P	J	C
STS3201	Programming Skills for Employment	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				1.0

Course Objectives:

1. Ability to translate vast data into abstract concepts and to understand JAVA concepts
2. To have a clear understanding of subject related concepts
3. To develop computational ability in Java programming language

Expected Course Outcome:

1. Clear Knowledge about problem solving skills in JAVA concepts
2. Students will be able to write codes in Java

Module:1	Object and Class, Data types, Basic I / O	8 hours

Types of programming - Disadvantages of functional programming
Class & Objects - AttributesMethods Objects
Solving MCQs based on Objects and Classes
Solving tricky questions based on encapsulation
Solving frequently asked object based questions

Data types – Data - Why data typeVariables - Available data types Numeric – int, float, double
Character – char, string - Solving MCQs based on type casting, data types
Solving debugging based MCQs

Printing
Getting input from user during run time
Command line arguments
Solving programming questions based on CLA
Solving MCQs questions based on CLA

Module:2	Decision Making, Loop Control, String, Date,Array	10 hours

Need for control statement
if..else
if..else if..else
Nested if..else
Switch case
Common mistakes with control statements (like using = instead of ==)
Solving frequently asked questions on decision making
Types of looping statementsEntry Controlled - For – While
Exit Controlled - do while - break and continue
Demo on looping
Common mistakes with looping statements (like using ; at the end of the loop)
Solving pattern programming problems, series problems
Solving predict the output questions

String handling, date handling
Solving problems based on arrays like searching, sorting, rearranging, iteration)
Multi-dimensional arrays
Solving pattern problems using 2D arraysReal time application based on 2D arrays

Module:3	Inheritance, Aggregation & Associations	10 hours

Need
Is A – Inheritance - Types of inheritance supported
Diagrammatic representation - Demo on inheritance
Has A – Aggregation - Diagrammatic representation - Demo on aggregation
Uses A - Association - Diagrammatic representation - Demo on association
Assignment on relationships
Solving MCQs based on relationships between classes

Module:4	Modifiers, Interface & Abstract classes (Javaspecific), Packages	7 hours

Types of access specifiers
Demo on access specifiers
Assignment on access modifiers
Instance Members
Solving MCQs based on modifiers
Abstract Classes – Need - Abstract Classes
Abstract Methods
Interfaces
Assignment on abstract classes and interface
Need for packages
Access specifiers & packages Import classes from other packages

Module:5	Collections	10 hours

ArrayList, LinkedList, List Interface, HashSet, Map Interface, HashMap, Set Programming questions based on collections
Real world problems based on data structure

Total Lecture hours:	45 hours

Reference Books

1. Java The Complete Reference, 2014, 9th Edition by By Herbert Schildt, McGraw-Hill Education Pvt Ltd
2. Introduction to Programming with Java: A Problem-Solving Approach by John Dean

Mode of Evaluation: FAT, Assignments, 3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies			
Approved by Academic Council	No. 53	Date	13.12.2018

Course Code	Course Title	L	T	P	J	C
STS3204	JAVA Programming and Software Engineering Fundaments	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				1.0

Course Objectives:

1. Ability to translate vast data into abstract concepts and to understand JAVA concepts
2. To have a clear understanding of subject related concepts
3. To develop computational ability in Java programming language

Expected Course Outcome:

1. Clear Knowledge about problem solving skills in JAVA concepts
2. Students will be able to write codes in Java

Module:1	Threads, Exceptions, LinkedList, Arrays,Stack and Queue	8 hours

Need of threads - Creating threads – Wait – Sleep - Thread execution
Need for exception handling try, catch, throw, throws
Creating own exception (Java, Python)-Handling own exceptions
Solving programming questions based on linked list and arrays
Solving programming questions based on stacks and queues
How to implement a stack using queue? - How to implement a queue using stack?

Module:2	Trees, JDBC Connectivity	7 hours

Solving programming questions based on trees, binary trees, binary search trees
JDBC Overview - Database Setup - Install the MySQL Database
Create New Database User in MySQL Workbench

Module:3	JDBC Data	6 hours

Selecting data from tables - Inserting Data into the Database - Updating Data in the Database - Deleting Data from the Database - Creating Prepared Statements

Module:4	Networking with Java	12 hours

Working with URLs - Sending HTTP Requests - Processing JSON data using Java - Processing XML data using Java

Module:5	Advanced programming	12 hours

File Operations - CSV Operations - Encoder & Decoders - Encryption & Decryption – Hashes Loggers

Total Lecture hours:	45 hours

Reference Books

1. Java The Complete Reference, 2014, 9th Edition by By Herbert Schildt, McGraw-Hill Education Pvt Ltd
2. Introduction to Programming with Java: A Problem-Solving Approach by John Dean

Mode of Evaluation: FAT, Assignments, 3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies			
Approved by Academic Council	No. 53	Date	13.12.2018

Course Code	Course Title	L	T	P	J	C
STS3205	Advanced JAVA Programming	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				1.0

Course Objectives:

1. Ability to translate vast data into abstract concepts and to understand JAVA concepts
2. To have a clear understanding of subject related concepts
3. To develop computational ability in Java programming language

Expected Course Outcome:

1. Clear Knowledge about problem solving skills in JAVA concepts
2. Students will be able to write codes in Java

Module:1	Associations, Modifiers	9 hours

Uses A - Association - Diagrammatic representation - Demo on association
Assignment on relationships
Solving MCQs based on relationships between classes
Types of access specifiers - Demo on access specifiers - Assignment on access modifiers
Instance Members - Solving MCQs based on modifiers

Module:2	Interface & Abstract classes (Java specific),Packages	10 hours

Abstract Classes – Need - Abstract Classes - Abstract Methods – Interfaces - Assignment on abstract classes and interface
Need for packages- Access specifiers & packages - Import classes from other packages

Module:3	Exceptions	7 hours

Need for exception handling - try, catch, throw, throws
Creating own exception (Java, Python) - Handling own exceptions

Module:4	Collections	15 hours

ArrayList, LinkedList, List Interface, HashSet, Map Interface, HashMap, Set
Programming questions based on collections
Real world problems based on data structure

Module:5	LinkedList, Arrays	4 hours

Solving programming questions based on linked list and arrays

Total Lecture hours:	45 hours

Reference Books

1. Java The Complete Reference, 2014, 9th Edition by By Herbert Schildt, McGraw-Hill Education Pvt Ltd
2. Introduction to Programming with Java: A Problem-Solving Approach by John Dean

Mode of Evaluation: FAT, Assignments, 3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies			
Approved by Academic Council	No. 53	Date	13.12.2018

Course Code	Course Title	L	T	P	J	C
STS3301	JAVA for Beginners	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				1.0

Course Objectives:

1. Ability to translate vast data into abstract concepts and to understand JAVA concepts
2. To have a clear understanding of subject related concepts
3. To develop computational ability in Java programming language

Expected Course Outcome:

1. Clear Knowledge about problem solving skills in JAVA concepts
2. Students will be able to write codes in Java

Module:1	Introduction to Programming	10 hours

Introduction to Flow Charts - Pseudo code - Program Development Steps & Algorithms - Computer Operations & Data Types Comparison Operators - Single Selection - Dual Selection - Three or More Choices - Nested Ifs - Boolean Operators - Loops

Module:2	Object and Class	10 hours

Types of programming - Disadvantages of functional programming - Class & Objects - Attributes - Methods – Objects - Solving MCQs based on Objects and Classes Solving tricky questions based on encapsulation - Solving frequently asked object based questions

Module:3	Data types, Basic I / O	10 hours

Data types – Data - Why data type – Variables - Available data types Numeric – int, float, double Character – char, string - Solving MCQs based on type casting, data types - Solving debugging based MCQs – Printing - Getting input from user during run time - Command line arguments - Solving programming questions based on CLASolving MCQs questions based on CLA

Module:4	Decision Making, Loop Control	10 hours

Need for control statement - if..else - if..else if..else - Nested if..else - Switch case - Common mistakes with control statements (like using = instead of ==) - Solving frequently asked questions on decision making - Types of looping statements - Entry Controlled – For – While - Exit Controlled - do while - break and continue - Demo on looping - Common mistakes with looping statements (like using ; at the end of the loop) - Solving pattern programming problems, series problems - Solving predict the output questions

Module:5	String	5 hours

String handling

Total Lecture hours:	45 hours

Reference Books

1. Java The Complete Reference, 2014, 9th Edition by By Herbert Schildt, McGraw – Hill Education Pvt Ltd
2. Introduction to Programming with Java: A Problem-Solving Approach by John Dean

Mode of Evaluation: FAT, Assignments, 3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies			
Approved by Academic Council	No. 53	Date	13.12.2018

Course Code	Course Title	L	T	P	J	C
STS3401	Foundation to Programming Skills	3	0	0	0	1
Pre-requisite	NIL	Syllabus version				1.0

Course Objectives:

1. Ability to translate vast data into abstract concepts and to understand JAVA concepts
2. To have a clear understanding of subject related concepts
3. To develop computational ability in Java programming language

Expected Course Outcome:

1. Clear Knowledge about problem solving skills in JAVA concepts
2. Students will be able to write codes in Java

Module:1	Object and Class	8 hours

Types of programming - Disadvantages of functional programming - Class & Objects - Attributes Methods – Objects - Solving MCQs based on Objects and Classes - Solving tricky questions based on encapsulation - Solving frequently asked object based questions

Module:2	Data types, Basic I / O	8 hours

Data types – Data - Why data type Variables - Available data types - Numeric – int, float, double Character – char, string - Solving MCQs based on type casting, data types - Solving debugging based MCQs – Printing - Getting input from user during run time - Command line arguments - Solving programming questions based on CLA - Solving MCQs questions based on CLA

Module:3	Decision Making, Loop Control	9 hours

Need for control statement - if..else - if..else if..else - Nested if..else - Switch case - Common mistakes with control statements (like using = instead of ==) - Solving frequently asked questions on decision making - Types of looping statements - Entry Controlled – For – While - Exit Controlled - do while - break and continue - Demo on looping - Common mistakes with looping statements (like using ; at the end of the loop) - Solving pattern programming problems, series problems - Solving predict the output questions

Module:4	String, Date, Array	10 hours

String handling, date handling - Solving problems based on arrays like searching, sorting, rearranging, iteration) Multi-dimensional arrays - Solving pattern problems using 2D arrays Real time application based on 2D arrays

Module:5	Inheritance, Aggregation	10 hours

Need - Is A – Inheritance

Types of inheritance supported - Diagrammatic representation - Demo on inheritance

Has A – Aggregation - Diagrammatic representation - Demo on aggregation

Solving MCQs based on relationships between classes

Total Lecture hours:	45 hours

Reference Books

1. Java The Complete Reference, 2014, 9th Edition by By Herbert Schildt, McGraw-Hill Education Pvt Ltd
2. Introduction to Programming with Java: A Problem-Solving Approach by John Dean

Mode of Evaluation: FAT, Assignments, 3 Assessments with Term End FAT (Computer Based Test)			
Recommended by Board of Studies			
Approved by Academic Council	No. 53	Date	13.12.2018

Course Code	Course Title	L	T	P	J	C
STS5002	Preparing for Industry	3	0	0	0	1
Pre-requisite		Syllabus version			2.0	

Course Objectives:

1. To develop the students' logical thinking skills
2. To learn the strategies of solving quantitative ability problems
3. To enrich the verbal ability of the students
4. To enhance critical thinking and innovative skills

Expected Course Outcome:

1. Enabling students to simplify, evaluate, analyze and use functions and expressions to simulate real situations to be industry ready.

Module:1	**Interview skills – Types of interview and Techniques to face remote interviews andMock Interview**	**3 hours**

Structured and unstructured interview orientation, Closed questions and hypothetical questions, Interviewers' perspective, Questions to ask/not ask during an interview, Video interview, Recorded feedback, Phone interview preparation, Tips to customize preparation for personal interview, Practice rounds

Module:2	**Resume skills – Resume Template and Use ofpower verbs and Types of resume and Customizing resume**	**2 hours**

Structure of a standard resume, Content, color, font, Introduction to Power verbs and Write up, Quiz on types of resume, Frequent mistakes in customizing resume, Layout – Understanding different company's requirement, Digitizing career portfolio

Module:3	**Emotional Intelligence - L1 – TransactionalAnalysis and Brain storming and Psychometric Analysis and Rebus Puzzles/Problem Solving**	**12 hours**

Introduction, Contracting, ego states, Life positions, Individual Brainstorming, Group Brainstorming, Stepladder Technique, Brain writing, Crawford's Slip writing approach, Reverse brainstorming, Star bursting, Charlette procedure, Round robin brainstorming, Skill Test, Personality Test, More than one answer, Unique ways

Module:4	**Quantitative Ability-L3 – Permutation- Combinations and Probability and Geometry and mensuration and Trigonometry and Logarithms and Functions and QuadraticEquations and Set Theory**	**14 hours**

Counting, Grouping, Linear Arrangement, Circular Arrangements, Conditional Probability, Independent and Dependent Events, Properties of Polygon, 2D & 3D Figures, Area & Volumes, Heights and distances, Simple trigonometric functions, Introduction to logarithms, Basic rules of logarithms, Introduction to functions, Basic rules of functions, Understanding Quadratic Equations, Rules & probabilities of Quadratic Equations, Basic concepts of Venn Diagram

Module:5	**Reasoning ability-L3 – Logical reasoning andData Analysis and Interpretation**	**7 hours**

Syllogisms, Binary logic, Sequential output tracing, Crypto arithmetic, Data Sufficiency, Data interpretation-Advanced, Interpretation tables, pie charts & bar chats

Module:6	**Verbal Ability-L3 – Comprehension andLogic**	**7 hours**
Reading comprehension, Para Jumbles, Critical Reasoning (a) Premise and Conclusion, (b) Assumption & Inference, (c) Strengthening & Weakening an Argument		
Total Lecture hours:		**45 hours**

Reference Books

1.	Michael Farra and JIST Editors(2011) Quick Resume & Cover Letter Book: Write and Use an Effective Resume in Just One Day. Saint Paul, Minnesota. Jist Works
2.	Daniel Flage Ph.D(2003) The Art of Questioning: An Introduction to Critical Thinking.London. Pearson
3.	David Allen(2002) Getting Things done : The Art of Stress -Free productivity. New YorkCity. Penguin Books.
4.	FACE(2016) Aptipedia Aptitude Encyclopedia.Delhi. Wiley publications
5.	ETHNUS(2013) Aptimithra. Bangalore. McGraw-Hill Education Pvt. Ltd.

Websites:

1.	www.chalkstreet.com
2.	www.skillsyouneed.com
3.	www.mindtools.com
4.	www.thebalance.com
5.	www.eguru.ooo

Mode of Evaluation: FAT, Assignments, Projects, Case studies, Role plays,3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies	**09/06/2017**		
Approved by Academic Council	**No. 45**	**Date**	**15/06/2017**

BRIDGE COURSES

(2018 - 2019)

B.Tech. Computer Science and Engg. with Specialization in Bioinformatics

Course Code	Course Title	L	T	P	J	C
BIT1001	INTRODUCTION TO LIFE SCIENCES	4	0	0	0	4
Pre-requisite	NIL	Syllabus version				1.2

Course Objectives:

1. Compare living beings and lives processes.
2. Illustrate biota, biosphere, biodiversity and biological evolution.
3. Create interests in life sciences.

Expected Course Outcome:

1. Understand the science of life.
2. Determine the adaptations of biota and their functions in the nature.
3. Develop ideas, facts and theories relevant to biodiversity.
4. Choose new sources of renewable energy.
5. Analyze the contemporary issues of nature and role of biospheres.
6. Construct advanced biotechnologies for the sustainable utilizations and conservation.

Module:1	DIVERSITY IN THE LIVING WORLD	8 hours

Origin of life, Characteristics of Life, Linnaean and Whittaker' classification, Plant Kingdom-Classification, Structure, types and modifications of root, stem and leaf. Animal Kingdom-Classification and taxonomical aids.

Module:2	CELL STRUCTURE AND FUNCTIONS	8 hours

Structures of prokaryotic and Eukaryotic cells, levels of organization, cellular organelles and functions, nuclear components. Major cell types, concepts of cell theory, Cell Cycle and Cell Division.

Module:3	CHEMISTRY OF LIFE	8 hours

Bio-macromolecules, central Dogma of Molecular Biology, nucleic acids, proteins, carbohydrates, lipids, fats, Vitamins and Minerals; cellular metabolism.

Module:4	MICROORGANISMS, ECOLOGYANDEVOLUTION	8 hours

Microbial World, Classification. structure and types of bacteria, virus, micro algae and fungi, Microbial Growth, beneficial and harmful microorganisms. Ecology, Niches, Food chainand Food Web, Migration; Pollution. Theories of Evolution. Lamarckism, Darwinism, Speciation.

Module:5	PLANT PHYSIOLOGY	6 hours

Plant cell growth and differentiation, germination, photosynthesis, respiration, transpiration, transport of food, nutrients and water, Phyto-hormones, concept of totipotency.

Module:6	ANIMAL/HUMAN PHYSIOLOGY	6 hours

Circulatory System, Excretory System, Immune system, Nervous system, Digestive system. Sensory organs.

Module:7	**GENETICS**	**8 hours**
Mendelian Genetics, Laws of Inheritance, Mono, di hybrid crosses, polygenic inheritance, Multiple alleles, Linkage and Crossing Over, Eugenics		
Module:8	**BIOTECHNOLOGY**	**8 hours**
History of important discoveries in biotechnology.rDNA technology, Gene cloning and applications- Dolly, Polly, ANDi, Bt Cotton, Applications in Health care and Agriculture; Ethical Issues.		
Total Lecture hours:		**60 hours**

Text Book(s)

1.	Campbell, N.A. Reece,J.B., and Simon, E.J. 2015. Essential Biology with Physiology (6th Edition). Campbell Biology Websites Series.

Mode of Evaluation : CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	**03-08-2017**		
Approved by Academic Council	**No. 46**	**Date**	**24-08-2017**

Course Code	Course Title	L	T	P	J	C
ENG1002	Effective English	0	0	4	0	2
Pre-requisite	Not cleared English Proficiency Test (EPT)	Syllabus version				
		v.2.0				

Course Objectives:

1. To enable students develop basic proficiency in Language Skills
2. To help students overcome communication barriers
3. To facilitate students communicate effectively in academic and social contexts

Expected Course Outcome:

1. Speak fluently in academic and social contexts
2. Listen for global and specific comprehension to improve study skills like note taking, summarizing, etc
3. Read and comprehend technical and general texts
4. Write grammatically correct creative and descriptive sentences and paragraphs inspecific contexts
5. Enact on social contexts with a message, and communicate clearly and effectively in formal and informal contexts

Module:1	Speaking	**4 hours**
Introduce yourself using Temperament Sorter		
Module:2	Listening	**4 hours**
Listen to songs – Gap-fill Exercise		
Module:3	Reading	**2 hours**
Loud Reading with focus on pronunciation		
Module:4	Writing	**2 hours**
Make sentences using jumbled words		
Module:5	Listening	**4 hours**
Listen to Motivational Speeches – Note taking		
Module:6	Speaking	**4 hours**
Situational Dialogues		
Module:7	Reading	**2 hours**
Reading for vocabulary development		
Module:8	Writing	**2 hours**
Descriptive Writing – Process		
Compare & Contrast – Product description		
Module:9	Listening	**4 hours**
Minimal Pairs- Difficult Sounds for Indian Speakers		
Module:10	Speaking	**4 hours**
Just a Minute		
Module:11	Reading	**2 hours**
Global Comprehension		

Module:12	Writing	**2 hours**
Travelogue Writing - 25+ FAQs (Wh-questions) on a place they have visited – Pair work		
Module:13	Listening	**4 hours**
Listen to a Documentary/Talk show and summarize		
Module:14	Speaking	**4 hours**
Discuss facts and opinions using question tags		
Module:15	Speaking**:**	**4 hours**
Role Play with a Message		
Module:16	Writing	**2 hours**
Formal Letter Writing focusing on Content		
Module:17	Vocabulary	**2 hours**
Correct spelling errors		
Module:18	Speaking	**4 hours**
Asking for and giving Directions/Instructions		
Module:19	Reading	**2 hours**
Factual Comprehension		
Module:20	Writing	**2 hours**
Story writing using prompts/pictures		
Total Practical hours:		**60 hours**

Text Books

1.	Lewis Lansford and Peter Astley. Oxford English for Careers: Engineering 1: Student'sBook. 2013. USA: Oxford University Press.
2.	Jaimie Scanlon. Q: Skills for Success 1 Listening & Speaking. 2015. [Second Revised Edition]. Oxford: Oxford University Press.

Reference Books

1.	Sanjay Kumar and Puspalata. Communication Skills. 2015. [Second Edition] Print. New Delhi: Oxford University Press.
2.	John Seely. Oxford Guide to Effective Writing and Speaking. 2013. [Third Edition].New Delhi: Oxford University Press.
3.	Meenakshi Raman. Communication Skills. 2011. [Second Edition]. New Delhi: Oxford University Press.
4.	Terry O'Brien. Effective Speaking Skills. 2011. New Delhi: Rupa Publishers.
5.	BarunMitra. Effective Technical Communication: A Guide for Scientists and Engineers. 2015. New Delhi: Oxford University Press.

Mode of Evaluation: Online Quizzes, Presentation, Role play, Group Discussions,Assignments, Mini project.

List of Challenging Experiments (Indicative)

1.	Speaking: Introduce yourself using Temperament Sorter	8 hours
2.	Reading: Loud Reading with focus on pronunciation	4 hours
3.	Writing: Descriptive Writing – Process Compare & Contrast – Product description	6 hours
4.	Speaking: Just a Minute / Activities through VIT Community Radio	6 hours

5.	Writing: Travelogue Writing - 25+ FAQs (Wh-questions) on a placethey have visited – Pair work	10 hours
6.	Speaking: Discuss facts and opinions using question tags	6 hours
7.	Writing: Formal Letter Writing focusing on Content	6 hours
8.	Vocabulary: Correct spelling errors	4 hours
9.	Speaking: Asking for and giving Directions/Instructions	6 hours
10.	Writing: Story writing using prompts/pictures	4 hours
	Total Laboratory Hours	**60 hours**

Mode of evaluation: Online Quizzes, Presentation, Role play, Group Discussions, Assignments, Mini project.

Recommended by Board of Studies			
Approved by Academic Council	**No. 42**	**Date**	**25-08-2016**

Course Code	Course Title	L	T	P	J	C
MAT1001	FUNDAMENTALS OF MATHEMATICS	3	2	0	0	4
Pre-requisite	NIL	Syllabus version				1.1

Course Objectives:

1. This fundamental course on Basic Mathematics provides requisite and relevant background necessaryto understand the other important engineering mathematics courses.
2. Further this course is a prerequisite for the non- mathematics students to learn further topics of Engineering Mathematics.

Expected Course Outcome:

At the end of this course the students are expected to

1. Solve a system of linear equations by matrix
2. Apply the techniques of differentiation to find maxima and minima, and techniques ofintegration to evaluate areas and volumes of revolution
3. Understand the concept of ordinary differential equations, and first and second order linear differential equations
4. Have a clear understanding of analytic geometry and vector
5. Apply concepts of mathematical logic and elementary probability to real life problems

Module:1	Matrices	5 hours

Matrices - types of matrices - operations on matrices-determinants - adjoint matrix -inverse of a matrix -solution of a system of linear equations by inversion method–elementary transformations –rank of a matrix - consistency and inconsistency of system of equations

Module:2	Differential Calculus	6 hours

Differentiation of functions of single variable – differentiation techniques physical interpretations - differentiation of implicit function – higher order derivatives – Taylor's series - maxima and minima for functions of a single variable

Module:3	Integral Calculus	6 hours

Partial fractions - Integration- integration techniques- integration by parts definite integrals – properties- evaluation of area and volume by integration

Module:4	Linear Ordinary Differential Equations	6 hours

Differential equations-definition and examples- formation of differential equation- solving differential equations of first order-solving second order homogenous differential equations with constant coefficients.

Module:5	Analytic geometry	5 hours

Analytic geometry of three dimensions-direction cosines and direction ratios-plane, straight line and sphere

Module:6	Vector Algebra	7 hours

Vectors–operations on vectors-angle between two vectors-projection of one vector on another vector– equations of plane, straight line and sphere in vector forms-shortest distance between two skew lines- equation of a tangent plane to a sphere.

Module:7	**Logic and Probability**	**8 hours**
Mathematical logic – propositions – truth table – connectives– tautology – contradiction. Permutations and combinations – probability – classical approach – addition law- conditional probability - multiplicative law- Baye's theorem and applications.		
Module:8	**Contemporary Issues**	**2 hours**
Total Lecture hours:		**45 hours**
Tutorial	• A minimum of 10 problems to be worked out by students in every Tutorial Class. • Another 5 problems per Tutorial Class to begiven as home work. Mode: Individual Exercises, Team Exercises, OnlineQuizzes, Online Discussion Forums	**30 hours**

Text Book(s)

1.	K. A. Stroud and Dexter J. Booth, Engineering Mathematics, 2013, 7th Edition, Palgrave Macmillan.

Reference Books

1.	B. S. Grewal, Elementary Engineering Mathematics, 2015, 43rd edition, Khanna Publications.
2.	Seymour Lipschutz and Marc Lipson, Discrete Mathematics, 2010, 3rd Edition, Tata McGraw - Hill.
3.	Seymour Lipschutz and John Schiller, Introduction to Probability and Statistics, 2011, 2nd Edition, Tata McGraw -Hill.

Mode of Evaluation: Digital Assignments(Solutions by using soft skill), Quiz, Continuous Assessments, Final Assessment Test

Recommended by Board of Studies	**21-08-2017**		
Approved by Academic Council	**No. 47**	**Date**	**5-10-2017**