GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore – 641 013

Curriculum and Syllabi For

B.E. COMPUTER SCIENCE AND ENGINEERING (Full Time)

2018

Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS

GOVERNMENT COLLEGE OF TECHNOLOGY

THADAGAM ROAD, COIMBATORE-641 013

VISION AND MISSION OF THE INSTITUTION

VISION

To emerge as a center of excellence and eminence by imparting futuristic technical education in keeping with global standards, making our students technologically competent and ethically strong so that they can readily contribute to the rapid advancement of society and mankind.

MISSION

- To achieve academic excellence through innovative teaching and learning practices.
- To enhance employability and entrepreneurship.
- To improve the research competence to address societal needs.
- To inculcate a culture that supports and reinforces ethical, professional behaviours for a harmonious and prosperous society.

VISION AND MISSION OF THE DEPARTMENT

VISION

To be in the frontier of Computer Science and Engineering and to produce globally competent graduates with moral values committed to build a vibrant nation.

MISSION

- To strengthen the core competence in Computer Science and Engineering through analytical learning.
- To produce successful graduates with personal and professional responsibilities and committed to lifelong learning.
- To uplift innovative research in Computer Science and Engineering to serve the needs of Industry, Government and Society.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Graduates will be in computing profession as experts in solving hardware/software engineering problems by their depth of understanding in core computing knowledge or will have completed or will be pursuing research leading to higher degrees.

PEO2: Graduates will have sufficient breadth of understanding to enable continued professional development and lifelong learning throughout their career.

PEO3: Graduates will demonstrate creativity in their engineering practices including entrepreneurial and collaborative ventures with strategic thinking, planning and execution.

PEO4: Graduates will communicate effectively, recognize and incorporate societal needs and constraints in their professional endeavors, and practice their profession with high regard to legal and ethical responsibilities.

PROGRAMME OUTCOMES

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

B.E. - COMPUTER SCIENCE AND ENGINEERING

PROGRAMME SPECIFIC OUTCOMES (PSOs)

Theoretical Computer Science: Students at the time of graduation will be able to apply fundamental knowledge of theoretical computer science and critically analyze problems to provide computer based solutions for engineering applications.

Hardware and software systems: Students at the time of graduation will be able to design cost effective hardware/software systems and components for engineering/social applications using the knowledge of hardware and/or software architecture, programming and development.

Technology: Students at the time of graduation will be able to apply appropriate technology to find solutions for complex problems.

Research Capability: Students at the time of graduation will be able to apply domain knowledge and expertise for enhancing research capability to transform innovative ideas into reality.

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013

B.E.COMPUTER SCIENCE AND ENGINEERING

CBCS 2018 REGULATIONS

FIRST SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks
		Induction Programme	MC	0	0	0

Details of the Programme:

Number of Days: 21 Days

Day0: College Admission

Day1: Orientation Programme

Day2: Registration.

Day3 to Day 23 : Induction Programme

Activities:
Physical activity,
Playground Events,
Yoga Practices,
Literary, Proficiency modules,
Team Building,
Lectures by Eminent people,
Familiarization to department,
Branch oriented information,
Motivational speakers,
Talent exposure,
Quiz completion,
Visit to local areas….etc.

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013

B.E.COMPUTER SCIENCE AND ENGINEERING

CBCS 2018 REGULATIONS

FIRST SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18SHS101	Communicative English	HS	50	50	100	2	1	0	3
2	18SBS102	Calculus	BS	50	50	100	3	1	0	4
3	18SBS103	Semiconductor Physics	BS	50	50	100	3	1	0	4
4	18SES104	Programming in C	ES	50	50	100	3	0	0	3
		PRACTICAL								
5	18SBS105	Physics Laboratory	BS	50	50	100	0	0	3	1.5
6	18SES106	Workshop Practice	ES	50	50	100	1	0	4	3
7	18SES107	Programming in C Laboratory	ES	50	50	100	0	0	3	1.5
		TOTAL		**350**	**350**	**700**	**12**	**3**	**10**	**20**

SECOND SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18SBS201	Applied Chemistry	BS	50	50	100	3	1	0	4
2	18SBS202	Differential Equations and Linear Algebra	BS	50	50	100	3	1	0	4
3	18SES203	Fundamentals of Electrical and Electronics Engineering	ES	50	50	100	3	0	0	3
		PRACTICAL								
4	18SBS204	Chemistry Laboratory	BS	50	50	100	0	0	3	1.5
5	18SES205	Fundamentals of Electrical and Electronics Engineering Laboratory	ES	50	50	100	0	0	3	1.5
6	18SES206	Engineering Graphics	ES	50	50	100	2	0	4	4
		TOTAL		**300**	**300**	**600**	**11**	**2**	**10**	**18**

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013
B.E.COMPUTER SCIENCE AND ENGINEERING
CBCS 2018 REGULATIONS

THIRD SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18SHS301	Humanities	HS	50	50	100	3	0	0	3
2	18SBS302	Probability Theory and Applied Statistics	BS	50	50	100	3	1	0	4
3	18SBS303	Discrete Structures	BS	50	50	100	3	0	0	3
4	18SES304	Engineering Mechanics	ES	50	50	100	3	1	0	4
5	18SPC305	Digital Systems	PC	50	50	100	3	0	0	3
6	18SPC306	Data Structures	PC	50	50	100	3	0	0	3
7	18SMC3Z7	Environmental Sciences and Engineering	MC	50	50	100	3	0	0	0
		PRACTICAL								
8	18SPC308	Digital Systems Laboratory	PC	50	50	100	0	0	3	1.5
9	18SPC309	Data Structures Laboratory	PC	50	50	100	0	0	3	1.5
		TOTAL		**450**	**450**	**900**	**21**	**2**	**6**	**23**

FOURTH SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18SHS401	Technology Management	HS	50	50	100	3	0	0	3
2	18SES402	Analog and Digital Communication	ES	50	50	100	3	0	0	3
3	18SPC403	Computer Architecture	PC	50	50	100	3	0	0	3
4	18SPC404	Database Management Systems	PC	50	50	100	3	0	0	3
5	18SPC405	System Programming and Operating Systems	PC	50	50	100	3	0	0	3
6	18SPC406	Theory of Computation	PC	50	50	100	3	1	0	4
7	18SMC4Z7	Constitution of India	MC	50	50	100	3	0	0	0
		PRACTICAL								
8	18SPC408	Database Management Systems Laboratory	PC	50	50	100	0	0	3	1.5
9	18SPC409	System Programming and Operating Systems Laboratory	PC	50	50	100	0	0	3	1.5
		TOTAL		**450**	**450**	**900**	**21**	**1**	**6**	**22**

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013
B.E.COMPUTER SCIENCE AND ENGINEERING
CBCS 2018 REGULATIONS

FIFTH SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18SHS501	Professional Communication Skills	HS	50	50	100	2	0	2	3
2	18SES502	Embedded Computing Systems	ES	50	50	100	3	0	0	3
3	18SPC503	Computer Networks	PC	50	50	100	3	0	0	3
4	18SPC504	Design and Analysis of Algorithms	PC	50	50	100	3	1	0	4
5	18SPE5XX	Professional Elective-I	PE	50	50	100	3	0	0	3
6	18#OE5XX	Open Elective-I	OE	50	50	100	3	0	0	3
		PRACTICAL								
7	18SPC507	Computer Networks Laboratory	PC	50	50	100	0	0	3	1.5
8	18SEE508	Embedded Computing Systems Laboratory	EEC	50	50	100	0	0	3	1.5
		TOTAL		**400**	**400**	**800**	**17**	**1**	**8**	**22**

SIXTH SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18SPC601	Digital Signal Processing and Applications	PC	50	50	100	3	1	0	4
2	18SPC602	Compiler Design	PC	50	50	100	3	0	0	3
3	18SPC603	Software Engineering Methodologies	PC	50	50	100	3	0	0	3
4	18SPE6XX	Professional Elective-II	PE	50	50	100	3	0	0	3
5	18#OE6XX	Open Elective-II	OE	50	50	100	3	0	0	3
6	18#OE6XX	Open Elective-III	OE	50	50	100	3	0	0	3
		PRACTICAL								
7	18SPC607	Compiler Design Laboratory	PC	50	50	100	0	0	3	1.5
8	18SVL608	Software Engineering Methodologies Laboratory	EEC	50	50	100	0	0	3	1.5
		TOTAL		**400**	**400**	**800**	**18**	**1**	**6**	**22**

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013
B.E.COMPUTER SCIENCE AND ENGINEERING
CBCS 2018 REGULATIONS

SEVENTH SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18SPC701	Machine Learning	PC	50	50	100	3	0	0	3
2	18SPC702	Artificial Intelligence	PC	50	50	100	3	0	0	3
3	18SPC703	Computer Graphics and Visualizations	PC	50	50	100	3	0	0	3
4	18SPE7XX	Professional Elective-III	PE	50	50	100	3	0	0	3
5	18SPE7XX	Professional Elective-IV	PE	50	50	100	3	0	0	3
6	18#OE7XX	Open Elective-IV	OE	50	50	100	3	0	0	3
		PRACTICAL								
7	18SPC707	Machine Learning Laboratory	PC	50	50	100	0	0	4	2
8	18SEE708	Mini Project	EEC	50	50	100	0	0	8	4
		TOTAL		**400**	**400**	**800**	**18**	**0**	**12**	**24**

EIGHTH SEMESTER

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18SPE8XX	Professional Elective-V	PE	50	50	100	3	0	0	3
2	18SPE8XX	Professional Elective-VI	PE	50	50	100	3	0	0	3
		PRACTICAL								
3	18SEE803	Project Work	EEC	50	50	100	0	0	16	8
		TOTAL		**150**	**150**	**300**	**6**	**0**	**16**	**14**

CURRICULAM DESIGN FOR CBCS 2018 REGULATIONS

FULL TIME B.E COMPUTER SCIENCE AND ENGINEERING (U.G)

SUMMARY

S.No	Category	Credits Per Semester								Total Credits	% of Credits	AICTE Suggested Credits.
		I	II	III	IV	V	VI	VII	VIII			
1	**HS**	3		3	3	3				**12**	**7.27**	**12**
2	**BS**	9.5	9.5	7						**26**	**15.76**	**25**
3	**ES**	7.5	8.5	4	3	3				**26**	**15.76**	**24**
4	**PC**			9	16	8.5	11.5	11		**56**	**33.94**	**48**
5	**PE**					3	3	6	6	**18**	**10.91**	**18**
6	**OE**					3	6	3		**12**	**7.27**	**18**
7	**EEC**					1.5	1.5	4	8	**15**	**9.09**	**15**
8	**MC**			0	0					**0**	**0**	**0**
Total		**20**	**18**	**23**	**22**	**22**	**22**	**24**	**14**	**165**	**100**	**160**

HS	Humanities and Social Science
BS	Basic Science
ES	Engineering Science
PC	Professional Core
PE	Professional Elective
OE	Open Elective
EEC	Employability Enhancement Courses
MC	Mandatory Course

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT (HS)

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18SHS101	Communicative English	HS	50	50	100	2	1	0	3
2	18SHS301	Humanities	HS	50	50	100	3	0	0	3
3	18SHS401	Technology Management	HS	50	50	100	3	0	0	3
4	18SHS501	Professional Communication Skills	HS	50	50	100	2	0	2	3

BASIC SCIENCES (BS)

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
		THEORY								
1	18SBS102	Calculus	BS	50	50	100	3	1	0	4
2	18SBS103	Semiconductor Physics	BS	50	50	100	3	1	0	4
3	18SBS105	Physics Laboratory	BS	50	50	100	0	0	3	1.5
4	18SBS201	Applied Chemistry	BS	50	50	100	3	1	0	4
5	18SBS202	Differential Equations and Linear Algebra	BS	50	50	100	3	1	0	4
6	18SBS204	Chemistry Laboratory	BS	50	50	100	0	0	3	1.5
7	18SBS302	Probability Theory and Applied Statistics	BS	50	50	100	3	1	0	4
8	18SBS303	Discrete Structures	BS	50	50	100	3	0	0	3

ENGINEERING SCIENCES (ES)

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18SES104	Programming in C	ES	50	50	100	3	0	0	3
2	18SES106	Workshop Practice	ES	50	50	100	1	0	4	3
3	18SES107	Programming in C Laboratory	ES	50	50	100	0	0	3	1.5
4	18SES203	Fundamentals of Electrical and Electronics Engineering	ES	50	50	100	3	0	0	3
5	18SES205	Fundamentals of Electrical and Electronics Engineering Laboratory	ES	50	50	100	0	0	3	1.5
6	18SES206	Engineering Graphics	ES	50	50	100	2	0	4	4
7	18SES304	Engineering Mechanics	ES	50	50	100	3	1	0	4
8	18SES402	Analog and Digital Communication	ES	50	50	100	3	0	0	3
9	18SES502	Embedded Computing Systems	ES	50	50	100	3	0	0	3

PROFESSIONAL CORE (PC)

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18SPC305	Digital Systems	PC	50	50	100	3	0	0	3
2	18SPC306	Data Structures	PC	50	50	100	3	0	0	3
3	18SPC308	Digital Systems Laboratory	PC	50	50	100	0	0	3	1.5
4	18SPC309	Data Structures Laboratory	PC	50	50	100	0	0	3	1.5
5	18SPC403	Computer Architecture	PC	50	50	100	3	0	0	3
6	18SPC404	Database Management Systems	PC	50	50	100	3	0	0	3
7	18SPC405	System Programming and Operating Systems	PC	50	50	100	3	0	0	3
8	18SPC406	Theory of Computation	PC	50	50	100	3	1	0	4
9	18SPC408	Database Management Systems Laboratory	PC	50	50	100	0	0	3	1.5
10	18SPC409	System Programming and Operating Systems Laboratory	PC	50	50	100	0	0	3	1.5
11	18SPC503	Computer Networks	PC	50	50	100	3	0	0	3
12	18SPC504	Design and Analysis of Algorithms	PC	50	50	100	3	1	0	4
13	18SPC507	Computer Networks Laboratory	PC	50	50	100	0	0	3	1.5
14	18SPC601	Digital Signal Processing and Applications	PC	50	50	100	3	1	0	4
15	18SPC602	Compiler Design	PC	50	50	100	3	0	0	3
16	18SPC603	Software Engineering Methodologies	PC	50	50	100	3	0	0	3
17	18SPC607	Compiler Design Laboratory	PC	50	50	100	0	0	3	1.5
18	18SPC701	Machine Learning	PC	50	50	100	3	0	0	3
19	18SPC702	Artificial Intelligence	PC	50	50	100	3	0	0	3
20	18SPC703	Computer Graphics and Visualizations	PC	50	50	100	3	0	0	3
21	18SPC707	Machine Learning Laboratory	PC	50	50	100	0	0	4	2

PROFESSIONAL ELECTIVES (PE)

S. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18SPE$01	Introduction to Web Technology	PE	50	50	100	3	0	0	3
2	18SPE$02	Simulation and Modeling	PE	50	50	100	3	0	0	3
3	18SPE$03	Digital Image Processing	PE	50	50	100	3	0	0	3
4	18SPE$04	Cryptography	PE	50	50	100	3	0	0	3
5	18SPE$05	Natural Language Processing	PE	50	50	100	3	0	0	3
6	18SPE$06	Software Defined Networks	PE	50	50	100	3	0	0	3
7	18SPE$07	Cloud Engineering	PE	50	50	100	3	0	0	3
8	18SPE$08	Computer Vision	PE	50	50	100	3	0	0	3
9	18SPE$09	High Performance Computing	PE	50	50	100	3	0	0	3
10	18SPE$10	Object Oriented Analysis and Design	PE	50	50	100	3	0	0	3
11	18SPE$11	Fundamentals of Internet of Things	PE	50	50	100	3	0	0	3
12	18SPE$12	Big Data Analytics	PE	50	50	100	3	0	0	3
13	18SPE$13	Information Security	PE	50	50	100	3	0	0	3
14	18SPE$14	Distributed Computing	PE	50	50	100	3	0	0	3
15	18SPE$15	Wireless Communication and Networks	PE	50	50	100	3	0	0	3
16	18SPE$16	Social Networks	PE	50	50	100	3	0	0	3
17	18SPE$17	Data Warehousing and Data Mining	PE	50	50	100	3	0	0	3
18	18SPE$18	Multimedia Systems	PE	50	50	100	3	0	0	3

OPEN ELECTIVES (O.E)

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	18COE$01	Climate Change and Adaptation	OE	50	50	100	3	0	0	3
2.	18COE$02	Disaster Management and Mitigation	OE	50	50	100	3	0	0	3
3.	18COE$03	Energy Efficient Buildings	OE	50	50	100	3	0	0	3
4.	18MOE$04	Nanotechnology and Surface Engineering	OE	50	50	100	3	0	0	3
5.	18MOE$05	Mechatronics	OE	50	50	100	3	0	0	3
6.	18EOE$07	Renewable Power Generation Systems	OE	50	50	100	3	0	0	3
7.	18EOE$08	Electric Vehicles	OE	50	50	100	3	0	0	3
8.	18EOE$09	Smart Grid Systems	OE	50	50	100	3	0	0	3
9.	18LOE$10	Mobile Communication	OE	50	50	100	3	0	0	3
10.	18LOE$11	Introduction to VLSI System Design	OE	50	50	100	3	0	0	3
11.	18LOE$12	Microcontroller and Applications	OE	50	50	100	3	0	0	3
12.	18POE$13	Rapid Prototyping	OE	50	50	100	3	0	0	3
13.	18POE$14	Managerial Economics	OE	50	50	100	3	0	0	3
14.	18POE$15	Hydraulics and Pneumatics	OE	50	50	100	3	0	0	3
15.	18NOE$16	Measurement and Control	OE	50	50	100	3	0	0	3
16.	18NOE$17	Industrial Automation	OE	50	50	100	3	0	0	3
17.	18NOE$18	Virtual Instrumentation	OE	50	50	100	3	0	0	3
18.	18SOE$19	Programming in Java	OE	50	50	100	3	0	0	3
19.	18SOE$20	Cyber Security	OE	50	50	100	3	0	0	3
20.	18SOE$21	Network Essentials	OE	50	50	100	3	0	0	3
21.	18IOE$22	Programming in Python	OE	50	50	100	3	0	0	3
22.	18IOE$23	Big Data Science	OE	50	50	100	3	0	0	3
23.	18IOE$24	Object Oriented Programming Using C++	OE	50	50	100	3	0	0	3
24.	18BOE$25	Computational Biology	OE	50	50	100	3	0	0	3
25.	18BOE$26	Fundamental concepts of Biology for Engineers	OE	50	50	100	3	0	0	3
26.	18BOE$27	Fundamentals of Bioengineering	OE	50	50	100	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC) – PRACTICAL COURSES AND PROJECT WORK

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18SEE508	Embedded Computing Systems Laboratory	EEC	50	50	100	0	0	3	1.5
2	18SVL608	Software Engineering Methodologies Laboratory	EEC	50	50	100	0	0	3	1.5
3	18SEE708	Mini Project	EEC	50	50	100	0	0	8	4
4	18SEE803	Project Work	EEC	50	50	100	0	0	16	8

MANDATORY COURSE (MC) (NO - CREDIT)

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18SMC3Z7	Environmental Sciences and Engineering	MC	50	50	100	3	0	0	0
2	18SMC4Z7	Constitution of India	MC	50	50	100	3	0	0	0

VALUE ADDED COURSES (ONE CREDIT)

S. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18SVA$01	Decision Science, Data Analytics & Deep Learning	VA	100	-	100	1	0	0	1

18SHS101	COMMUNICATIVE ENGLISH *(Common to All Branches)*	SEMESTER I

Category : HS

PRE-REQUISITES: NIL

L	T	P	C
2	1	0	3

COURSE OBJECTIVES:

The course is intended to

- Make learners listen to audio files and replicate in speaking contexts
- Make learners read widely and practice it in writing
- Make learners develop vocabulary and strengthen grammatical understanding

UNIT-I : LISTENING	**(6+3 Periods)**
Listening Comprehension, Pronunciation, Intonation, Stress, Pause, Rhythm, Listening to Short & Long Conversations/Monologues - Note-Taking.	
UNIT-II : SPEAKING	**(6+3 Periods)**
Self Introduction, Making Oral & Formal Presentation, Communication at Work Place, Mock Interviews, Role Play Activities, Group Discussions, Debates, Delivering Welcome Address, Proposing Vote of Thanks, Introducing the Chief Guest at a function.	
UNIT-III : READING	**(6+3 Periods)**
Reading Comprehension, Speed Reading, Interpreting Visual Materials (Signs, Post Cards Pictures, Labels Etc.), Reading for Specific Information-Reading to identify Stylistic Features (Syntax, Lexis, Sentence Structures)-Cloze Test.	
UNIT-IV : WRITING	**(6+3 Periods)**
Phrase, Clause And Sentence Structures, Punctuation, Discourse Markers, Coherence, Precision in Writing, Graph & Process Description-Definition, Writing Email-Paraphrasing, Note making, Job Application With Resume, Writing Review of a Book / Movie, Creative Writing.	
UNIT-V : GRAMMAR AND VOCABULARY	**(6+3 Periods)**
Word Formation with Prefix and Suffix, Synonyms and Antonyms, Tenses, Parts of Speech, Common Errors in English (Subject –Verb Agreement, Noun-Pronoun Agreement, Prepositions, Articles, Conditional statements, Redundancies, Clichés etc), Voices.	
Contact periods:	

Lecture: 30 Periods	**Tutorial: 15 Periods**	**Practical: 0 Periods**	**Total: 45 Periods**

TEXT BOOKS:

1. ***"Board of Editors, Using English"***, Orient Black Swan, 2015.

REFERENCE BOOKS:

1. ***"Practical English Usage"***, Michael Swan. OUP 1995.
2. ***"Cambridge BEC Vantage"*** - Practice Tests, Self-study Edition, CUP, 2002
3. ***"Exercises in Spoken English*** **Parts. I –III"**. EFLU,Hyderabad, OUP, 2014
4. ***"Indlish"***. Jyothi Sanyal, Viva Books,2006
5. ***"Communicative English"***. J.Anbazhagan Vijay, Global Publishers, Chennai. 2018

WEB REFERENCES

1. *www.cambridgeenglish.org/exams/business.../business-**preliminary**/*
2. *http://www.examenglish.com/BEC/BEC_Vantage.html*
3. *www.splendid-speaking.com/exams/**bec**_speaking.htmlhtml*

COURSE OUTCOMES:

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

CO1: Enhance their listening capacity through various accents and discourse

CO2: Communicate better at various public meeting and work place environments

CO3: Read and strengthen their interpretive and linguistic skills

CO4: Write appropriately on technical, business and general contexts.

CO5: Understand the usage of grammar and vocabulary

COURSE ARTICULATION MATRIX

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	--	--	--	M	H	L	M	--	H	H	M	H	M	H	H	--
CO2	--	--	--	H	H	L	M	M	H	H	M	L	M	H	H	--
CO3	--	--	--	H	H	L	M	M	--	H	M	H	M	H	H	--
CO4	--	--	--	H	H	L	M	M	--	H	M	L	M	H	H	--
CO5	--	--	--	L	H	L	--	--	--	H	M	H	M	H	H	--
18SHS101	--	--	--	H	H	L	M	M	L	H	M	M	M	H	H	--

L-Low, M-Moderate (Medium), H-High

18SBS102	CALCULUS *(Common to CSE & IT Branches)*	SEMESTER I

Category : BS

PRE-REQUISITES: NIL

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To be familiarize with differentiation of single variable and its applications.
- To obtain the knowledge of integration and its applications.
- To acquire knowledge of testing convergence of sequences and series.
- To acquire knowledge of differentiation for more than one variable and vector differentiation.
- To gain the knowledge of multiple integration and related applications and vector integration including theorems.

UNIT-I: Differential Calculus	**(9+3 Periods)**
Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders, Indeterminate forms and L'Hospital's rule, Maxima and minima, Evolute of a curve.	
UNIT-II: Integral Calculus	**(9+3 Periods)**
Evaluation of definite and improper integrals, Beta and Gamma functions and their properties, Applications of definite integrals to evaluate surface areas andvolume of revolution.	
UNIT-III: Sequences and series	**(9+3 Periods)**
Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions.	
UNIT-IV: Multivariable Calculus (Differentiation)	**(9+3 Periods)**
Limits, continuity and partial derivatives, total derivative Jacobians, Maxima, minima and saddle points, Method of Lagrange multipliers, Gradient, curl and divergence.	
UNIT-V: Multivariable Calculus (Integration)	**(9+3 Periods)**
Multiple integration - Double integrals, change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Triple integrals (Cartesian), Change of variables (Cartesian to spherical polar). Theorems of Green, Gauss and Stokes, Simple applications involving cubes, sphere and rectangular parallelepipeds.	
Contact periods:	

Lecture: 45 Periods	**Tutorial: 15 Periods**	**Practical: 0 Periods**	**Total: 60 Periods**

TEXT BOOKS:

1. *Sivaramakrishnadas.P, Rukmangadachari.E,* ***"Engineering Mathematics",*** *Pearson, Chennai & Delhi, 2nd Edition 2013.*
2. *Srimanta Pal and suboth.C.Bhunia,* ***"Engineering Mathematics"****, Oxford University Press, New Delhi, 2015.*

REFERENCE BOOKS:

1. *B.S.Grewal,* ***"Higher Engineering Mathematics"****, Khanna Publishers, 43rd Edition,2010.*
2. *Erwinkreyszig,* ***"Advanced Engineering Mathematics"*** *,9th Edition, John Wiley&Sons, 2006.*
3. *N.P. Bali and Manish Goyal,* ***"A text book of Engineering Mathematics"****, Laxmi Publications, Reprint, 2008.*
4. *James Stewart,* ***"Essential Calculus"****, Cengage Learning, Delhi, 2nd Edition, 2013.*
5. *Howard Anton, IRL Bivens, Stephen Davis,* ***"Calculus",*** *Wiley, New Delhi, 10th Edition,2013.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand the standard theorems and applications like maxima and minima, evolute of a curve using principles of differentiation.

CO2: Acquire fluency in integration for one variable for definite and improper integrals like beta and gamma functions and also applications of area and volumes.

CO3: Understand the convergence and divergence of sequences and series.

CO4: Understand the techniques of partial differentiation and vector differentiation.

CO5: Understand multiple integration for finding area, surface and volume and applications to Green's, Stoke's and Gauss theorems on Vector Calculus.

COURSE ARTICULATION MATRIX

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-	-
CO2	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-	-
CO3	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-	-
CO4	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-	-
CO5	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-	-
18SBS102	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-	-

L – Low, M – Moderate (Medium), H- High

18SBS103	SEMICONDUCTOR PHYSICS *(Common to CSE & IT Branches)*	SEMESTER I

Category : BS

PRE-REQUISITES: NIL

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

To enhance the fundamental knowledge in Semiconductor Physics and its applications relevant to various streams of Engineering and Technology. Upon completion of this course the students will be familiar with:

- The properties of electronic materials.
- The properties and applications of semiconductors.
- The application of magnetic and super conducting materials.
- Measurement of various parameters related to semiconductors.
- Applications and properties of engineered semiconductor materials.
- Nano materials and its properties.

UNIT-I : ELECTRONIC MATERIALS	**(9+3 Periods)**
Classical Free electron theory of metals – Postulates – Electrical and Thermal conductivity of metals –Derivation of Wiedeman – Franz law – Lorentz number – Drawbacks of Classical theory - Occupation probability – Effect of temperature – Density of energy states in metals (derivation) – Carrier concentration in metals - Calculation of Fermi energy at 0 K - Types of electronic materials: metals, semiconductors, and insulators.	
UNIT-II : SEMICONDUCTORS	**(9+3 Periods)**
Properties of semiconductors – elemental and compound semiconductors - Direct and indirect band gaps - Intrinsic and extrinsic semiconductors - Fermi level - Carrier concentration in intrinsic semiconductor - Dependence of Fermi level on temperature – Electrical conductivity – band gap determination – extrinsic semiconductors – Carrier concentration in P- type and N-type semiconductors - Dependence of Fermi level on impurity concentration and temperature for P-type and N-type semiconductors.	
UNIT-III : MAGNETIC AND SUPER CONDUCTING MATERIALS	**(9+3 Periods)**
Origin of magnetic moment - Bohr magneton - Dia, Para, and Ferro magnetic materials - Domain theory of ferromagnetism - Hysteresis - Hard and Soft magnetic materials. Superconductivity - Types of superconductors - BCS theory of superconductivity (qualitative) - properties- -Meissner effect, effect of magnetic field and heavy current- Applications of superconductors: Cryotron, Magnetic levitation.	
UNIT-IV : MEASUREMENTS	**(9+3 Periods)**
Four-point probe and van der Pauw measurements for carrier density, resistivity, and hall mobility - Hot-point probe measurement - capacitance-voltage measurements - parameter extraction from diode I-V characteristics - DLTS – Determination of band gap by UV-Vis spectroscopy - absorption/transmission.	
UNIT-V : ENGINEERED SEMICONDUCTOR MATERIALS	**(9+3 Periods)**
Density of states in 2D, 1D and 0D (qualitatively) - Practical examples of low-dimensional systems such as quantum wells, wires, and dots – Nanomaterials – Properties – Methods of synthesize – Top-down & Bottom-up Approach – Ball Milling – Chemical vapour deposition – Applications of Nanomaterials.	

Contact periods:			
Lecture: 45 Periods	**Tutorial: 15 Periods**	**Practical: 0 Periods**	**Total: 60 Periods**

TEXT BOOKS:

1. *Dr. V.Rajendran*, **"*Material Science*",** *Tata McGraw-Hill Publications, NewDelhi, (2011).*
2. *Dr.Jayakumar .S*, **"*Materials* science"** , *R.K.publishers, (2008).*

REFERENCE BOOKS:

1. *William D Callister and David G. Rithwish , **"Materials science & Engineering : An introduction"** ; 9th edition , Wiley (2013)*
2. *S. M. Sze, **"Semiconductor Devices: Physics and Technology"**, Wiley (2008).*
3. *P. Bhattacharya*, **"*Semiconductor Optoelectronic Devices*"**, *Prentice Hall of India (1997).*
4. *J.Singh*, **"*Semiconductor Optoelectronics: Physics and Technology*"**, *McGraw-Hill Inc. (1995)*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze the properties of conducting materials. [Familiarity]
CO2: List and analyze the properties of Semiconducting materials and devices. [Familiarity]
CO3: Identify, analyze the properties and applications of magnetic & super conducting materials. [Familiarity]
CO4: Interpret the various measuring instruments related to semiconductor parameters.
CO5: List the properties and applications of engineered semiconducting materials. [Familiarity& Application]

COURSE ARTICULATION MATRIX

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	M	M	M	--	--	--	--	--	--	--	--	M	L	M	M
CO2	H	H	M	L	--	--	M	--	--	--	--	--	M	--	--	--
CO3	H	H	M	M	M	M	--	--	--	--	--	--	M	--	--	--
CO4	H	H	M	L	M	--	--	--	--	--	--	--	M	--	--	--
CO5	H	H	M	M	L	L	L	--	--	--	--	--	L	--	--	--
18SBS103	H	H	M	M	M	M	M	--	--	--	--	--	M	L	M	M

L-Low, M-Moderate (Medium), H-High

18SES104	PROGRAMMING IN C *(Common to all branches except MECH & PRODN Branches)*	SEMESTER I

Category : ES

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- The Computer and Programming fundamentals
- Data types in C and Flow control statements
- Functions, Arrays, Pointers and Strings
- Bitwise Operators, Preprocessor Directives, Structures and Unions
- Structures, List Processing, Input and Output

UNIT-I : COMPUTER AND PROGRAMMING FUNDAMENTALS	**(9 Periods)**
Computer fundamentals – Evolution, classification, Anatomy of a computer: CPU, Memory, I/O – Introduction to software – Generation and classification of programming languages – Compiling – Linking and loading a program – Translator – loader – linker – develop a program – software development – Introduction to OS –Types of OS – Algorithms – Structured programming concept.	
UNIT-II : DATA TYPES AND FLOW OF CONTROL	**(9 Periods)**
An overview of C – Programming and Preparation – Program Output – Variables – Expressions, and Assignment, The use of #include, printf(), scanf() – Lexical elements, operators and the C systems – The fundamental data types – Flow of control	
UNIT-III : FUNCTIONS, ARRAYS, POINTERS AND STRINGS	**(9 Periods)**
Functions and storage classes - 1D Arrays – Pointers – Call by reference – Relationship between Arrays and Pointers – Pointer arithmetic and element size – Arrays as function argument – Dynamic memory allocation – Strings – String handing functions – Multidimensional Arrays.	
UNIT-IV : ARRAY OF POINTERS, BITWISE OPERATORS, PREPROCESSOR DIRECTIVES	**(9 Periods)**
Arrays of Pointers – Arguments to main () - Ragged Arrays – Functions as Arguments – Arrays of Pointers to Functions - Type qualifiers.-Bitwise operators and expressions – Masks – Software tools – Packing and unpacking – Enumeration types – The preprocessor directives.	
UNIT-V : STRUCTURES AND UNIONS, I/O AND FILE OPERATIONS	**(9 Periods)**
Structures and Unions – Operator precedence and associativity – Bit fields – Accessing bits and bytes - Input and Output functions – File Processing Functions – Environment variables – Use of make and touch.	
Contact periods:	

Lecture: 45 Periods	**Tutorial: 0 Periods**	**Practical: 0 Periods**	**Total: 45 Periods**

TEXT BOOKS:

1. *Pradip Dey, Manas Ghosh,* ***"Computer Fundamentals and Programming in C",*** *Second Edition, Oxford University Press, 2013.*
2. *Al Kelley, Ira Pohl, "A Book on C-Programming in C", Fourth Edition, Addison Wesley, 2001.*

REFERENCE BOOKS:

1. *Stephen G. Kochan,* ***"Programming in C-A complete introduction to the C programming language",*** *Third Edition, Sams Publication, 2004.*
2. *Yashavant P. Kanetkar,* ***"Let Us C",*** *13th edition, BPB Publications, 2013.*
3. *Brian W. Kernighan and Dennis Ritchie,* ***"The C Programming Language",*** *Second Edition, Prentice Hall Software Series, 1988.*
4. *Stephen Prata,* ***"C Primer Plus",*** *Fifth Edition, Sams Publishing, 2005.*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

CO1: Articulate the programming environment [Familiarity]
CO2: Write algorithm for solving the given problem statement [Usage]
CO3: Use right data types and flow control statements [Assessment]
CO4: Write programs using functions, arrays, pointers and strings [Usage]
CO5: Use right storage classes, preprocessor directives, bitwise operators in programs [Assessment]
CO6: Use structures, unions and files [Usage]

COURSE ARTICULATION MATRIX:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	H	H	--	M	M	M	M	L	M	H	H	M	M
CO2	H	H	M	H	H	--	--	M	M	M	L	M	H	H	M	M
CO3	H	H	M	H	H	--	--	M	M	M	L	M	H	H	M	M
CO4	H	H	M	H	H	--	--	M	M	M	L	M	H	H	M	M
CO5	H	H	M	H	H	--	--	M	M	M	L	M	H	H	M	M
CO6	H	H	M	H	H	--	--	M	M	M	L	M	H	H	M	M
18SES104	H	H	M	H	H	--	M	M	M	M	L	M	H	H	M	M

L-Low, M-Moderate(Medium), H-High

18SBS105	PHYSICS LABORATORY *(Common to All Branches)*	SEMESTER I

Category : BS

L	T	P	C
0	0	3	1.5

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

To improve the basic knowledge in Physics and its applications relevant to various streams of Engineering and Technology. Upon completion of this course the students will be familiar with:

- To have a practical knowledge about the concepts of physics and its applications in the emerging fields of engineering and technology

LABORATORY EXPERIMENTS			
1.	Spectrometer - Diffraction Grating Normal Incidence Method		
2	Air Wedge –Determination thickness of a paper		
3.	Young's Modulus – Cantilever Bending Koenig's Method		
4.	a) Laser - Particle size Determination b) Optical fiber - Determination of NA & Acceptance angle		
5.	Ammeter and Voltmeter Calibration – Low Range		
6.	Determination of Bandgap Energy of Semiconductor		
7.	Ultrasonic Interferometer - Velocity of sound & Compressibility of liquids.		
8.	Torsional pendulum –Determination of Rigidity Modulus & Moment of Inertia		
Contact periods:			
Lecture: 0 Periods	**Tutorial: 0 Periods**	**Practical: 45 Periods**	**Total: 45 Periods**

COURSE OUTCOMES:

Upon the completion of the course, the student will be able to

CO1: Determine all physical properties of any matter,

CO2: Calibrate electrical measuring instruments and thereby effectively using it for Particular Application

CO3: Understand principle of Laser diffraction and its application in particle size determination

CO4: Understand the concept of light propagation through optical fibers and determination of its parameters

CO5: Determine the Intrinsic characteristic features of electronic devices for electrical and electronic applications.

CO6: Understand the ultrasonic wave propagation in liquids and the determination of compressibility of liquids for engineering applications

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	M	L	M	M	M	--	--	--	--	--	--	M	M	L	L
CO2	H	H	L	--	--	--	--	--	--	--	--	--	M	--	--	--
CO3	M	M	M	--	--	--	--	--	--	--	--	--	L	--	--	--
CO4	H	M	M	L	M	--	--	--	--	--	--	--	M	L	--	--
CO5	H	M	M	M	M	M	--	--	--	--	--	--	M	M	L	--
CO6	H	M	M	H	M	L	--	--	--	--	--	--	M	M	--	--
18SBS105	H	M	M	M	M	M	--	--	--	--	--	--	M	M	L	L

L-Low, M-Moderate (Medium), H-High

18SES106	WORKSHOP PRACTICE *(Common to All Branches)*	SEMESTER I

Category : ES

L	T	P	C
1	0	4	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To make various basic prototypes in the carpentry trade such as Lap joint, Lap Tee joint, Dove tail joint, Mortise & Tenon joint and Cross-Lap joint.
- To make various welding joints such as Lap joint, Lap Tee joint, Edge joint, Butt joint and Corner joint.

LIST OF EXPERIMENTS			
1	Introduction to use of tools and equipments in Carpentry, Welding, Foundry and Sheet metal		
2	Safety aspects in Welding, Carpentry and Foundry		
3	Half lap Joint and Dovetail Joint in Carpentry		
4	Welding of Lap joint, Butt joint and T-joint		
5	Preparation of Sand mould for cube, conical bush, pipes and V pulley		
6	Fabrication of parts like tray, frustum of cone and square box in sheet metal		
7	Electrical wiring – simple house wiring		
8	Plumbing		
9	CNC Machines demonstration and lecture on working principle.		
10	Additive manufacturing demonstration and lecture on working principle.		
Contact Periods :			
Lecture: 15 Periods	**Tutorial: 0 Periods**	**Practical: 60 Periods**	**Total: 75 Periods**

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO 1: Safely Use tools and equipment's used in Carpentry, Welding, Foundry and Sheet metal to create basic joints.

CO 2: Prepare sand mold for various basic pattern shapes.

CO 3: Fabricate parts like tray, frustum of cone and square box in sheet metal.

CO 4: Carry out minor works/repair related to electrical wiring and plumbing.

CO 5: Demonstrate the working of CNC machines and additive manufacturing.

COURSE ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	--	L	--	L	--	--	--	L	--	--	--	--	L	--	--
CO2	H	--	L	--	L	--	--	--	L	--	--	--	--	L	--	--
CO3	H	--	L	--	L	--	--	--	L	--	--	--	--	L	--	--
CO4	H	--	L	--	M	--	--	--	L	--	--	--	--	L	--	--
CO5	H	--	L	--	H	--	--	--	L	--	--	--	--	L	--	--
18SES106	H	--	L	--	M	--	--	--	L	--	--	--	--	L	--	--

L-Low, M-Moderate (Medium), H-High

18SES107	PROGRAMMING IN C LABORATORY *(Common to all branches except MECH & PRODN Branches)*	SEMESTER I

Category : ES

PRE-REQUISITES: NIL

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Data types in C and Flow control statements
- Functions, Arrays, Pointers And Strings
- Dynamic memory allocation and command line arguments
- Bitwise Operators, Preprocessor Directives, Structures and Unions
- Structures, List Processing, Input and Output

PRACTICALS **EXERCISES ILLUSTRATING THE FOLLOWING CONCEPTS:**	
1	Operators , Expressions and IO formatting
2	Decision Making and Looping
3	Arrays and Strings
4	Functions and Recursion
5	Pointers
6	Dynamic Memory Allocation
7	Structures
8	Unions
9	Files
10	Command line arguments
11	Mini Project

Contact periods:			
Lecture: 0 Periods	**Tutorial: 0 Periods**	**Practical: 45 Periods**	**Total: 45 Periods**

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

CO1: Use appropriate data types and flow control statements [Usage]
CO2: Write programs using functions, arrays, pointers and strings [Usage]
CO3: Write programs using dynamic memory allocation [Usage]
CO4: Implement programs using right storage classes, preprocessor directives, bitwise operators [Usage]
CO5: Work with command line arguments, structures, unions and files [Usage]
CO6: Develop applications using C [Usage]

COURSE ARTICULATION MATRIX:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	H	H	--	--	M	M	M	L	M	H	H	H	M
CO2	H	H	M	H	H	--	--	M	M	M	L	M	H	H	H	M
CO3	H	H	M	H	H	--	--	M	M	M	L	M	H	H	H	M
CO4	H	H	M	H	H	--	--	M	M	M	L	M	H	H	H	M
CO5	H	H	M	H	H	--	--	M	M	M	H	H	H	H	H	M
CO6	H	H	M	H	H	--	--	M	M	M	M	M	H	H	H	M
18SES107	H	H	M	H	H	--	--	M	M	M	M	M	H	H	H	M

L-Low, M-Moderate (Medium), H-High

18SBS201	APPLIED CHEMISTRY *(Common to EEE, ECE, EIE, CSE & IT Branches)*	SEMESTER II

Category : BS

PRE-REQUISITES: NIL

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- The course is aimed at inculcating knowledge of applied chemistry topics which would be useful for students to understand Chemistry relevant to circuitry Engineering subjects.

UNIT-I : ELECTROCHEMICAL CELLS	**(9+3 Periods)**
Galvanic cells – redox reactions- electrodes - metal and metal ion, hydrogen electrode and calomel electrode – electrode potentials – standard oxidation and reduction potentials - Nernst equation and problems - EMF series and significance – Application of EMF measurements - pH measurement using glass electrode and fluoride measurement by ISE.	
UNIT-II : BATTERIES	**(9+3 Periods)**
Batteries - components, characteristics - voltage, current, current capacity, power density, energy density, cycle life, shelf life and self-discharge. Types of batteries- Primary - Zn/MnO_2 , Zn/HgO, Zn/Ag_2O, $Li/SOCl_2$ - construction, function and performance comparison – Secondary- Pb/ acid, Ni/Cd, and Lithium ion battery- construction, function and performance comparison.	
UNIT-III : CORROSION	**(9+3 Periods)**
Corrosion- Spontaneity - Chemical corrosion- mechanism, nature of oxides – PilliingBedworth rule- electrochemical corrosion- mechanism-Galvanic series and importance – Prevention methods - design of materials, cathodic protection techniques(sacrificial anode and impressed current cathode), Inhibitors - Protective coatings-Inorganic coating- electroplating – surface preparation and plating method applied to Cr and Ni and galvanizing – Organic coating- paints - constituents and functions.	
UNIT-IV : SPECTROSCOPIC TECHNIQUES AND APPLICATIONS	**(9+3 Periods)**
Beer Lambert's law -UV visible spectroscopy and IR spectroscopy – principles – instrumentation (block diagram only)- Flame photometry- principle – instrumentation (block diagram only)- estimation of sodium by flame photometry- Atomic absorption spectroscopy – principles – instrumentation(block diagram only) – estimation of nickel by atomic absorption spectroscopy.	
UNIT-V : SILICON WAFER TECHNOLOGY	**(9+3 Periods)**
Silicon for IC chips - single crystal – preparation by Czechralsky and float zone processes- wafer preparation, P-N junction formation – Ion implantation , Diffusion and epitaxial growth techniques - Insulator layer by oxidation- Printing of circuits by photolithography – masking and electron beam methods- etching by chemical and electrochemical methods.	

Contact periods:			
Lecture: 45 Periods	**Tutorial: 15 Periods**	**Practical: 0 Periods**	**Total: 60 Periods**

TEXT BOOKS:

1. *Jain. P.C. and Monica Jain*, ***"Engineering Chemistry",*** *Dhanpat Rai Publications Pvt. Ltd, New Delhi, 16th Edition, 2017.*
2. *Vairam. S, Subha Ramesh*, ***"Engineering Chemistry"***, *Wiley India, 2015.*

REFERENCE BOOKS:

1. *Dara. S.S, Umarae*, **"*Text book of Engineering Chemistry",*** *S. Chand Publications, 2013.*
2. *M.S.Tyagi,* ***"Introduction to semiconductor materials and devices",*** *Wiley India, 2012.*
3. *Y R Sharma ,* ***"Elementary Organic Spectroscopy",*** *S. Chand Publications, 2013.*
4. *B.R. Puri, L.R. Sharma & M. S. Pathania*, **"*Principles of Physical Chemistry*",** *S. Nagin Chand and Co., 2017*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand the principles of electrochemical principles such as EMF measurements, electrode potentials and apply them in experimental techniques useful for electrochemical instrumentation.

CO2: Know the knowledge about different types of batteries with the functions which find use in their society including engineering fields.

CO3: Be familiar with corrosion of the instruments and equipment they use in their field and also to learn the mechanisms and the preventive measures by various techniques.

CO4: Know about the different types of spectroscopic techniques and applications.

CO5: Gain the knowledge about the silicon chips and their fabrication methods and to apply in preparation of in electrical and electronic instruments.

COURSE ARTICULATION MATRIX

PO/CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	M	M	--	--	L	--	--	--	--	--	--	--	--	--	--	--
CO2	L	M	L	--	--	--	--	--	---	--	--	--	--	--	--	--
CO3	--	L	L	--	--	--	--	--	L	--	--	--	--	--	L	--
CO4	--	L	--	L	L	--	--	--	--	--	--	--	--	--	--	--
CO5	L	H	--	--	M	--	--	--	--	--	--	L	--	--	M	L
18SBS201	L	M	L	L	L	--	--	--	--	--	--	L	--	--	L	L

L-Low, M-Moderate (Medium), H-High

18SBS202	DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA *(Common to CSE & IT Branches)*	SEMESTER II

Category: BS

L	T	P	C
3	1	0	4

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To know about matrix theory used to find inversion and to solve linear system.
- To be familiar with the methods to solve different types of first order differential equations.
- To gain methods to solve second order differential equations with constant and variable coefficients.
- To gain the concepts of vector spaces and linear transformations.
- To obtain the knowledge of eigenvalues and diagonalisation of a matrix.

UNIT-I: Matrices	**(9+3 Periods)**
Matrices, Linear systems of equations, linear Independence, rank of a matrix, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.	
UNIT-II: First order ordinary differential equations	**(9+3 Periods)**
Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.	
UNIT-III: Ordinary differential equations of higher order	**(9+3 Periods)**
Second order linear differential equations with constant and variable coefficients: Cauchy-Euler equation, Cauchy-Legendre equation. Method of variation of parameters, Power series solutions of Bessel and Legendre equations.	
UNIT-IV :Vector spaces I	**(9+3 Periods)**
Vector Space, linear dependence of vectors, basis, dimension, Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank-nullity theorem, composition of linear maps, Matrix associated with a linear map.	
UNIT-V : Vector spaces II	**(9+3 Periods)**
Eigenvalues, eigenvectors, symmetric, skew-symmetric and orthogonal Matrices, Eigen bases, Diagonalization, Inner product spaces, Gram-Schmidt orthogonalization.	
Contact periods:	

Lecture: 45 Periods	**Tutorial: 15 Periods**	**Practical: 0 Periods**	**Total: 60 Periods**

TEXT BOOKS:

1. *B.S.Grewal,* ***"Higher Engineering Mathematics"****, Khanna Publishers, 43rd Edition,2015.*
2. *Howard Anton, Chris Rorres,* ***"Elements of Linear Algebra with Applications"****,Wiley, New Delhi, 2nd Edition,2015*

REFERENCE BOOKS:

1. *E. A. Coddington,* ***" An Introduction to Ordinary Differential Equations"****, Prentice Hall India, 1995.*
2. *G.F. Simmons and S.G. Krantz,* ***"Differential Equations"****, Tata McGraw Hill, 2007.*
3. *Srimanta Pal and suboth.C.Bhunia,* ***"Engineering Mathematics"****, Oxford university publications, New Delhi, 2015.*

4. *Gilbert Strang,* ***"Linear Algebra and its Applications"****, Cengage Learning, Delhi, 4th Edition, 2006..*
5. *D.Poole,* ***"Linear Algebra: A Modern Introduction"****,2nd Edition,Brooks/Cole,2005.*
6. *V. Krishnamurthy, V.P. Mainra and J.L. Arora,* ***"An introduction to Linear Algebra"****, Affiliated East–West press, Reprint 2005.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Solve the linear system of equations by rank of a matrix and matrix inversion.
CO2: Acquire fluency in solving different types of first order differential equations.
CO3: Understand the general solutions to higher order differential equations and power series solutions to second order differential equations leading to Bessel and Legendre functions.
CO4: Understand the concepts of vector spaces and linear transformation orientation with matrices.
CO5: Solve to find eigenvalues of a matrix and understand the process of diagonalization by similarity and orthogonal transformation including Inner product spaces.

COURSE ARTICULATION MATRIX

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-	-
CO2	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-	-
CO3	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-	-
CO4	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-	-
CO5	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-	-
18SBS202	H	L	L	-	-	-	-	-	-	-	-	M	L	-	-	-

L – Low, M – Moderate (Medium), H- High

18SES203	FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING *(Common to CSE & IT Branches)*	SEMESTER II

Category : ES

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To understand and analyze basic electric circuits
- To Study the working principles of Electrical Machines and Transformers
- To study the working of basic electronics system
- To understand the functioning of power electronic circuits and it applications.

UNIT-I : DC CIRCUITS	**(9 Periods)**
Electrical Circuit Elements – Voltage and Current Sources– Source transformation techniques – Ohms law, Kirchhoff's laws –Analysis of simple circuits with DC excitation – Superposition, Thevenin and Norton's theorem. Star and Delta transformation.	
UNIT-II : AC CIRCUITS	**(9 Periods)**
Representation of Sinusoidal waveforms, peak, rms and average value. Real power, reactive power, apparent power and power factor. Analysis of single phase AC circuits consisting of R,L, C, RL, RC, RLC combinations (Series and Parallel) – Resonance in series Circuits (Study of phenomenon). Three phase circuits – relation between voltage and current in star and delta connections – Three phase balanced circuits.	
UNIT-III : ELECTRICAL MACHINES AND TRANSFORMERS	**(9 Periods)**
Working and construction of Single phase transformer – EMF equation – Equivalent circuit - Regulation and Efficiency. Construction and Principle of operation of: Three phase induction motor and Singlephase induction motor – Synchronous generators - Regulation and efficiency – Construction and Operation of DC generator and DC motor – Load test on DC motor and Swinburne's test – DC generator emf equation – Applications of all machines.	
UNIT-IV: BASIC ELECTRONIC SYSTEMS	**(9 Periods)**
Semiconductor materials – Operation and characteristics of BJT, JFET, MOSFET, UJT and SCR. Amplifier circuits – Operational Amplifiers and its characteristics – Inverting – Non Inverting – Summing – Differential amplifiers. Linear IC applications: Voltage regulators– 555 Timer and Phase locked loops.	
UNIT-V : ENERGY, POWER ELECTRONICS AND MEASUREMENTS	**(9 Periods)**
Three phase Converter and Inverter Circuit Operation – UPS – SMPS – Batteries and Types – Design of battery for backup – Measuring Instruments: Digital voltmeter – Digital Storage Oscilloscope – Energy Consumption Calculation – Power factor improvement – Harmonics and its mitigation methods.	
Contact periods:	

Lecture: 45 Periods	**Tutorial: 0 Periods**	**Practical: 0 Periods**	**Total: 45 Periods**

TEXT BOOKS:

1. *D.P.Kothari, I.J.Nagrath,,* ***"Basic Electrical Engineering"****, Tata McGraw Hill, 2010.*
2. *P. S. Bimbhra,* ***"Electrical Machinery****", Khanna Publishers, 2011.*
3. *M. H. Rashid,* ***"Power electronics: circuits, devices, and applications",*** *Pearson Education India, 2009.*
4. *R.S.Sedha,* ***"A Textbook of Applied Electronics"****, S.Chand and Company Limited, 2016*

REFERENCE BOOKS:

1. *Nagsarkar T K and Sukhija M S,* ***"Basic Electrical Engineering"****, Oxford Press (2005).*
2. *I.J. Nagrath and D. P. Kothari,* ***"Electric Machines",*** *McGraw Hill Education, 2010.*
3. *E.Hughes,* ***" Electrical and Electronics Technology"****, Pearson, 2010.*
4. *Mahmood Nahvi and Joseph A. Edminister,* ***"Electric Circuits"****, Schaum Outline Series, McGraw Hill, Sixth edition (2014).*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Verify Ohm's law, Kirchoff's laws and theorems for simple electrical circuits.
CO2: Solve problems on AC circuits and analyze three phase AC circuits.
CO3: Understand the performance of AC, DC machines and transformers.
CO4: Studying of analog electronic devices and Operational Amplifier applications.
CO5: Understanding of power electronic circuits and their application

COURSE ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	--	--	--		--	--	--	--	L	--	M	L	--
CO2	H	M	L	--	--	--		--	--	--	--	L	--	M	L	--
CO3	H	M	--	H		--		--	--	--	--	L	--	L	--	L
CO4	H	M	H	H	L	--	L	--	--	--	--	L	--	H	--	--
CO5	H	M	H	--	L	--	L	--	--	--	--	L	--	M	--	L
18SES203	H	M	M	L	L	--	L	--	--	--	--	L	--	M	L	L

L-Low, M-Moderate (Medium), H-High

18SBS204	CHEMISTRY LABORATORY *(Common to All Branches)*	SEMESTER II

Category : BS

L	T	P	C
0	0	3	1.5

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To inculcate practical applications of chemistry to students and make him apply in the fields of engineering and technology

LIST OF EXPERIMENTS			
1.	Estimation of hardness by EDTA method.		
2	Estimation of chloride by Argentometric method.		
3.	Conductometric titration of mixture of strong acid and weak acid using strong base.		
4.	Potentiometric titration of ferrous iron by dichromate.		
5.	Determination of Saponification value of an oil.		
6.	Estimation of Iron by Spectrophotometry.		
7.	Estimation of HCl by pH titration.		
8.	Determination of the rate constant of reaction.		
9.	Estimation of Dissolved Oxygen.		
Contact periods:			
Lecture: 0 Periods	**Tutorial: 0 Periods**	**Practical: 45 Periods**	**Total: 45 Periods**

REFERENCE BOOKS:

1. *A.O. Thomas, **"Practical Chemistry"**, Scientific Book Centre, Cannanore, 2003.*
2. *Vogel's **"Text book of Quantitative Analysis"**, Jeffery G H, Basset J. Menthom J, Denney R.C., 6th Edition, EBS, 2009.*

COURSE OUTCOMES:

Upon the completion of the course, the student will be able to

CO1: Understand the nature of hardness using EDTA Complex
CO2 Iron present in water can be estimated and chloride level, pollution level using dissolved oxygen content.
CO3: Apply the EMF and conductometric measurements in quantitative analysis of Substances.
CO4: pH of the liquid sample will be analysed and hence strength of the sample can be estimated using pH Meter

COURSE ARTICULATION MATRIX:

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L	L	L	M	--	L	--	--	--	--	--	L	--	--	--	--
CO2	L	H	--	L	--	L	--	--	--	--	--	--	L	--	--	--
CO3	M	L	L	M	--	--	--	--	--	--	--	--	---	--	L	--
CO4	L	M	--	L	--	--	--	--	--	--	--	L	--	--	--	--
18SBS204	L	L	L	L	--	L	--	--	--	--	--	L	L	--	L	--

L-Low, M-Moderate (Medium), H-High

18SES205	FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY *(Common to CSE & IT Branches)*	SEMESTER II

Category : ES

L	T	P	C
0	0	3	1.5

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To familiarize with basic electrical wiring and measurements
- To provide basic laboratory experience on electronic circuits, DC machines, AC machines and Transformer
- To demonstrate internal view of machines and other advanced measurement devices

LIST OF EXPERIMENTS			
1.	Introductions to measuring instruments – voltmeter, ammeter, wattmeter, multimeter and Digital Storage Oscilloscope.		
2	Resonance in RLC circuits, verification of laws in electrical circuits.		
3.	Measurement of phase difference between voltage and current.		
4.	Voltage Current relations in three phase circuit and three phase power measurement.		
5.	Op Amp and its applications in simple circuits.		
6.	Demonstration of cut out section of machines.		
7.	No load test on single phase transformer and equivalent test.		
8.	Load Test on single phase transformer.		
9.	Swinburne's Test, Speed Control and Load test on DC motor.		
10.	Direction change and load test on three phase induction motor.		
11.	Alternator load test and regulation test.		
12.	Demonstration of Power Quality Analyzer, AC and DC drives.		
Contact periods:			
Lecture: 0 Periods	**Tutorial: 0 Periods**	**Practical: 45 Periods**	**Total: 45 Periods**

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Making electrical connections by wires of appropriate wires [Usage]

CO2: Acquire exposure to common electrical components and measuring instruments [Familiarity]

CO3: Verify Simple laws using electrical circuits [Usage]

CO4: Do experiment to understand the characteristics of transformers and Electrical machines [Usage]

CO5: Understand the working of Low Tension Switch gear components, AC and DC drives. [Assessment]

COURSE ARTICULATION MATRIX:

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	M	H	--	--	--	--	--	H	H	--	--	--	H	--	--
CO2	H	H	H	H	M	--	--	--	--	--	--	--	--	M	H	--
CO3	H	H	H	H	M	--	--	--	--	--	--	--	--	H	H	--
CO4	H	H	H	H	--	--	--	--	--	--	--	--	--	--	M	H
CO5	H	H	H	H	--	--	L	L	--	H	H	--	--	--	--	H
18SES205	H	H	H	M	L	--	L	L	L	L	L	--	--	L	L	L

L-Low, M-Moderate (Medium), H-High

18SES206	ENGINEERING GRAPHICS *(Common to All Branches)*	SEMESTER II

Category : ES

L	T	P	C
2	0	4	4

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- Geometrical constructions
- Orthographic projections.
- Performing section of solids and development of the same.
- Pictorial view of solids
- Familiarization of CAD packages.

UNIT-I : GEOMETRICAL CONSTRUCTIONS	**(6+12 Periods)**
Dimensioning-Lettering-Types of Lines-Scaling conventions-Dividing a given straight line in to any number of equal parts- Bisecting a given angle- Drawing a regular polygon given one side-Special methods of constructing a pentagon and hexagon.	
UNIT-II : ORTHOGRAPHIC PROJECTIONS	**(6+12 Periods)**
Introduction to Orthographic Projection-Projection of points-Projection of straight lines with traces -Conversion of pictorial views to orthographic views-Projection of solids.	
UNIT-III : SECTION OF SOLIDS AND DEVELOPMENT	**(6+12 Periods)**
Section of solids- Development of surfaces	
UNIT-IV : PICTORIAL VIEWS	**(6+12 Periods)**
Isometric projections - Conversion of orthographic views to pictorial views (simple objects).	
UNIT-V : COMPUTER AIDED DRAFTING	**(6+12 Periods)**
Introduction to computer aided drafting package to make 2-D Drawings. OBJECT CONSTRUCTION – page layout – Layers and Line type – Creating, Editing and selecting the Geometric Objects MECHANICS – Viewing, Annotating, Hatching and Dimensioning the drawing – Creating Blocks and Attributes, DRAFTING – Create 2D drawing. A number of chosen problems will be solved to illustrate the concepts clearly. (Demonstration purpose only, not be included in examinations)	
Contact periods:	

Lecture: 30 Periods	**Tutorial: 0 Periods**	**Practical: 60 Periods**	**Total: 90 Periods**

TEXT BOOKS:

1. *K.Venugopal, **"Engineering Graphics"**, New Age International (P) Limited, 2015.*
2. *K.L.Narayana and P.Kannaiah, **"Text book on Engineering Drawing,"** 2nd Edition, SciTech Publications (India) Pvt. Ltd, Chennai, 2009.*

REFERENCE BOOKS:

1. *Dhananjay.A.Jolhe, **"Engineering Drawing"**, Tata McGraw Hill Publishing Co., 2007.*
2. *K.V.Nataraajan, **"A text book of Engineering Graphics"**, Dhanalakashmi Publishers, Chennai, 2006.*
3. *M.B.Shah and B.C. Rana, **"Engineering Drawing"**, Pearson Education, 2005.*
4. *Luzadder and Duff, **"Fundamentals of Engineering Drawing"**, Prentice Hall of India Pvt Ltd, XIth Edition, 2001.*
5. *Alan Kalameja, **"AutoCAD 2008: A tutor for Engineering Graphics",** Auto Desk Press 2007*
6. *CAD Software manuals of latest version.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Construct basic geometric shapes and dimension the drawing as per standards.

CO2: Project points, lines and solids in various positions, and convert 2D projections to pictorial projections.

CO3: Generate sectional views of solids and construct development drawings.

CO4: Generate and interrupt pictorial views.

CO5: Use AutoCAD to create simple Engineering Drawings.

COURSE ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	--	--	L	--	M	L	--	--	M	M	L	--	--	L	--	--
CO2	--	--	L	--	M	L	--	--	M	M	L	--	--	L	--	--
CO3	--	--	L	--	H	L	--	--	M	M	L	--	--	L	--	--
CO4	--	--	L	--	H	L	--	--	M	M	L	--	--	L	--	--
CO5	--	--	L	--	H	L	--	--	M	M	L	--	--	L	--	--
18SES206	--	--	L	--	H	L	--	--	M	M	L	--	--	L	--	--

L-Low, M-Moderate (Medium), H-High

18SHS301	HUMANITIES	SEMESTER III

PRE-REQUISITES: NIL **Category: HS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Essential complementary between 'values' and 'skills' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- The development of a Holistic perspective among students towards life, profession and happiness based on a correct understanding of the Human reality and the rest of existence, which forms the basis of Value based living in a natural way.
- The plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually satisfying human behavior and mutually enriching interaction with nature.
- Engineering Ethics and Human Values.
- Social responsibility of an Engineer.
- Ethical dilemma while discharging duties in Professional life.

UNIT – I : INTRODUCTION TO VALUE EDUCATION	**(9 Periods)**
Introduction-Need, Basic Guidance, Content and process for Value Education- Basic human Aspirations- Prosperity and happiness – Methods to fulfill human aspirations – Understanding and living in harmony at various levels.	
UNIT – II : HARMONY IN THE HUMAN BEING	**(9 Periods)**
Coexistence - Happiness and convenience – Appraisal of Physical needs – Mental and Physical health – Human relationship – Mutual Trust and Respect.	
UNIT – III : ETHICS	**(9 Periods)**
Morals, Values and Ethics – Integrity – Work Ethics – Service Learning – Civic Virtue – Caring – Sharing – Honesty – Courage – Empathy – Self Confidence – Ethical Human Conduct – Basis for humanistic Education, Constitution and universal order – Competence in Professional ethics – Strategy for transition from the present state to Universal human order.	
UNIT – IV : ENGINEERING ETHICS AND ENGINEERING AS SOCIAL EXPERIMENTATION	**(9 Periods)**
Senses of Engineering Ethics – variety of moral issues – types of inquiry – moral dilemmas – moral autonomy – Kohlberg's Theory – Gilligen's Theory – Consensus and contraversy – Models of Professional roles – theories about right actions – Self interest – customs and religion – uses of ethical theories – Valuing time – cooperation – commitment. Engineering as experimentation – engineers as responsible experimenters – codes of ethics – a balanced outlook on law – the challenger case study – engineers as managers – consulting engineers – Moral leadership.	
UNIT – V : SAFETY, RESPONSIBILITIES, RIGHTS AND GLOBAL ISSUES	**(9 Periods)**
Safety and risk – assessment of safety and risk – risk benefits analysis and reducing risk – the three mile island and chernobyl case studies – Environmental ethics – computer ethics – weapons development – Multinational corporations – engineers as expert witnesses and advisors.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *R.R.Gaur, R. Singal, G.P. Bangaria,* ***"Foundation Course in Human Values and Professional Ethics",****2009, Excel Book Private Ltd., New Delhi.*
2. *Mike Martin and Roland Schinzinger,* ***"Ethics in Engineering",*** *McGraw Hill, New York, 1996.*
3. *M. Govindarajan, S.Natarajan and V.S. Senthil kumar,* ***"Engineering Ethics (including human values)",*** *Eastern Economy Edition, Printice Hall of India Ltd., 2004.*

REFERENCE BOOKS:

1. *S. K. Chakraborty and Dabangshu Chakraborty,* ***"Human Values and Ethics: Achieving Holistic Excellence",*** *ICFAI University Press, 2006.*
2. *N.Tripathy,* ***"Human Values",*** *New Age International publishers, 2003.*
3. *M. Govindarajan, S. Natarajan and V.S. Senthil Kumar,* ***"Engineering Ethics"****(including human values), Eastern Economy Edition, Prentice Hall of India Ltd., 2004.*
4. *E.G. Seebauer and Rober.L. Berry,* ***"Fundamentals of Ethics for Scientists and Engineers",*** *Oxford University Press,2000.*
5. *Charles D.Fleddermann,* ***"Engineeering in Ethics",*** *Pearson Education,2004.*
6. *Edmund G Seebauer ND Robert L.Berry,* ***"Fundamentals of Ethics for Scientists and Engineers",*** *2001, Oxford University Press.*
7. *Charles E. Harris, Michael S.Protchard and Michael J. Rabins,* ***"Engineering Ethics – Concepts and Cases",*** *Thomson Learning, 2000.*
8. *John R. Boatright,* ***"Ethics and Conduct of Business",*** *Pearson Education, 2003.*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to,

CO1: Start exploring themselves, get comfortable to each other and to the teacher and start finding the need and relevance for the course . **[Familiarity]**

CO2: See that their practice in living is not in harmony with their natural acceptance most of and able to refer to their natural acceptance to remote this disharmony.**[Familiarity]**

CO3: Aware of their activities like understanding, desire, thought and selection and start finding their focus of attention at different moments. **[Familiarity]**

CO4: Able to see that respect is right evaluation and only right evaluation leads to fulfillment in relationship. **[Familiarity]**

CO5: Understand and appreciate Human values, exhibit self confidence and develop good Character. **[Familiarity]**

CO6: Understand and practise code of ethics. **[Familiarity]**

CO7: Assess safety and risk and capable of doing risk benefit analysis. **[Familiarity]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1						H	H	H	M				L			
CO2						H	H	H	M				L			
CO3						H	H	H	M				L			
CO4						H	H	H	M				L			
CO5						H	H	H	M				L			
CO6						H	H	H	M				L			
CO7						H	H	H	M				L			
18SHS301						H	H	H	M				L			

L - Low, M - Moderate (Medium), H – High

18SBS302	PROBABILITY THEORY AND APPLIED STATISTICS *(Common to CSE & IT)*	SEMESTER III

PRE-REQUISITES: NIL

Category: BS

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To gain the knowledge of basic probability concepts.
- To understand the statistical distributions both discrete and continuous cases.
- To be familiar with statistical averages regarding one or more random variables.
- To acquire knowledge of Random process and Markov chains.
- To acquire knowledge of queueing models with finite/infinite capacity in single/multi servers.

UNIT I: PROBABILITY AND RANDOM VARIABLES	**(9+3 Periods)**
Sample spaces – Events - Probability Axioms – Conditional Probability – Independent Events – Baye's Theorem. Random Variables**:** Distribution Functions – Expectation – Moments - Moment Generating Functions.	
UNIT II: PROBABILITY DISTRIBUTIONS	**(9+3 Periods)**
Binomial, Poisson, Geometric, Uniform, Exponential, Normal, Gamma, Weibull (Mean, Variance and Simple problems). Functions of random variables.	
UNIT III: TWO DIMENSIONAL RANDOM VARIABLES	**(9+3 Periods)**
Joint distributions – Marginal Distributions – Conditional distributions – Covariance – Correlation and Regression – Transformation of random variables – Central Limit Theorem.	
UNIT IV: RANDOM PROCESSES	**(9+3 Periods)**
Definition and Examples - first and Second order, Strict sense stationary, Wide sense stationary and ergodic processes- Markov processes – Poisson processes - Birth and Death processes - Markov chains - Transition probabilities - Limiting distributions.	
UNIT V: QUEUEING THEORY	**(9+3 Periods)**
Markovian models-M/M/1 and M/M/C, finite and infinite capacity, M/G/1 queue (steady state solutions only) Pollazack Khintchine formula-Special cases.	

Contact periods:
Lecture: 45 Periods **Tutorial:15 Periods** **Practical: 0 Periods** **Total: 60 Periods**

TEXT BOOKS:

1. *Veerarajan T.,* ***"Probability and Random Processes"*** *(with Queueing Theory and Queueing Networks), Fourth Edition, McGraw Hill Education (India)Pvt Ltd., New Delhi, 2016.*

REFERENCE BOOKS:

1. *Gupta S.C and Kapoor V.K.,* ***"Fundamentals of Mathematical Statistics",*** *Sultan Chand & Sons, New Delhi, 2015.*
2. *Gupta S.P,* ***"Statistical Methods",*** *Sultan Chand & Sons, New Delhi, 2015.*
3. *Trivedi K.S,* ***"Probability and Statistics with Reliability, Queuing and Computer Science Applications",*** *Prentice Hall of India, New Delhi.*
4. *Hwei Hsu,* ***"Schaum's outline series of Theory and Problems of Probability and Random Process",*** *Tata McGraw Hill Publishing Co., New Delhi, 2015.*
5. *Kandasamy, Thilagavathy and Gunavathy,* ***"Probability and Random Process",*** *S.Chand & Co, Ramnagar, New Delhi, Reprint 2013.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand probability axioms and calculate expected values through moment generating functions.**[Familiarity]**

CO2: Identify various probability distributions of discrete and continuous random variables. [**Familiarity]**

CO3: Understand the concept of two dimensional random variables**[Familiarity]**

CO4: Understand the first and second order stationary process and Markovian processes. **[Familiarity]**

CO5: Utilize queuing models in engineering problems. **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	M	H	M	M	H	M	M	L	M	M	H	M	H	M
CO2	H	H	M	H	M	M	M	M	M	L	M	M	H	M	H	M
CO3	H	H	M	M	M	M	M	M	M	L	M	M	M	M	M	M
CO4	H	H	H	H	H	L	H	M	H	M	M	H	H	M	H	H
CO5	H	H	H	H	H	L	H	M	H	M	M	H	H	M	H	H
18SBS302	H	H	M	H	M	M	H	M	M	L	M	M	H	M	H	M

L - Low, M - Moderate (Medium), H - High

18SBS303	DISCRETE STRUCTURES	SEMESTER III

PRE-REQUISITES: NIL

Category: BS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Syntax and semantics of sets, propositional and predicate logic
- Operations on discrete structures such as functions and relations
- Idea of a group, a ring, an integral domain and aware of examples of these structures in mathematics.
- Application of graph theory
- Graph mining

UNIT – I : SETS AND PROPOSITIONS	**(9 Periods)**
Sets: Introduction – Combinations of Sets – Finite and Infinite Sets – Mathematical Induction – Principle of Inclusion and Exclusion – Multisets. Propositions: Logical Connectives – Conditional and Biconditionals –Well Formed Formulas-Tautologies –Logical Equivalences – Theory of inference for Statement calculus – Predicate Calculus	
UNIT – II : RELATION AND FUNCTIONS	**(9 Periods)**
Relations: Introduction-A Relational Model for Data Bases-Properties of binary relations-Closure of relations-Warshall's Algorithm-Equivalence relations and Partitions- Partial ordering relations and Lattices-Chains and antichains- A Job scheduling problem- Compatible relation Functions: Composition of functions-Invertible Functions-Recursive Functions-Hashing-Pigeonhole Principle	
UNIT – III : GROUPS AND RINGS	**(9 Periods)**
Introduction-Groups-Subgroups-Generators and evaluation of powers-Cosets and Lagrange's Theorem-Permutation groups and Burnside's Theorem-Codes and group codes-Isomorphisms and Automorphisims-Homomorphisims and Normal subgroups-Rings, Integral domains and fields-ring homomorphisims-polynomial rings and cyclic codes	
UNIT – IV : GRAPH THEORY	**(9 Periods)**
Introduction-Basic Terminology-Multigraphs and Weighted graphs-Digraphs and Relations-Representation of graphs-operations on graphs-Paths and Circuits-Graph traversals-shortest paths in weighted graphs-Euclidian paths and circuits-Hamiltonian Paths and Circuits-The Traveling Salesperson Problem-Planar Graphs-Graph Coloring –Case Study.	
UNIT – V : GRAPH MINING	**(9 Periods)**
Patterns in static graph –Patterns in Evolving graph – Patterns in weighted graph – structure of specific graph : world wide web – random graph models – generators for Internet topology – Case study .	

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. *C.L. Liu,D.P. Mohapatra* ***"Elements of Discrete Mathematics: A Computer Oriented Approach"****, Third Edition Tata McGraw Hill, (SIE), 2008.*
2. *William Kocay, Donald L. Kreher* ***"Graphs, Algorithms, and Optimization",*** *Second Edition, CRC Press, 2017.*
3. *Deepayan Chakrabarti, Christos Faloutsos* ***"Graph Mining: Laws, Tools, and Case Studies"*** *Margon & Claypool publishers 2012.*

REFERENCE BOOKS:

1. *Krishnaiyan Thulasiraman, Subramanian Arumugam, Andreas Brandstädt, Takao Nishizeki,* ***"Handbook of Graph Theory, Combinatorial Optimization, and Algorithms",*** *CRC press,2016*
2. *Donald binder,Martin Erickson* ***,*** *"****A Student's Guide To The Study, Practice, and Tools of Modern Mathematics",*** *CRC Press,2011.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Verify the correctness of an argument using propositional and predicate logic. **[Assessment]**

CO2: Perform operations on discrete structures such as sets, functions and relations. **[Usage]**

CO3: Use the concepts of advanced algebra such as groups and rings in applied contexts **[Usage]**

CO4: Use graph as a powerful modelling tool to solve practical problems in various fields. **[Usage].**

CO5: Use graph mining as a powerful pattern tool to derive valuable information **[Usage**].

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	H								H	H	H		H
CO2	M	M	H	M								L	H	H		H
CO3	M	M	M	M								L	H	H		H
CO4	H	H	H	H	H							H	H	H	L	H
CO5	H	H	H	H	H							H	H	H	L	H
18SBS303	H	H	H	H	H							H	H	H	L	H

L - Low, M - Moderate (Medium), H – High

18SES304	**ENGINEERING MECHANICS** *(Common to Mech., EEE, Prodn., EIE, & CSE branches)*	**SEMESTER III**

PRE-REQUISITES: NIL

Category: ES

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- To understand the force systems, geometrical properties and frictions in real life applications.
- To understand the dynamics behaviour of particles and impulse momentum principle.

UNIT – I : INTRODUCTION TO MECHANICS AND FORCE CONCEPTS	**(9+3 Periods)**
Principles and Concepts – Laws of Mechanics – system of forces – resultant of a force system – resolution and composition of forces – Lami's theorem – moment of a force – physical significance of moment-Varignon's theorem – resolution of a force into force and couple – forces in space – addition of concurrent forces in space – equilibrium of a particle in space.	
UNIT – II : FRICTION	**(9+3 Periods)**
Frictional resistance – classification of friction- laws of friction – coefficient of friction-angle of friction – angle of repose — cone of friction – free body diagram-advantages-equilibrium of a body on a rough inclined plane – non-concurrent force system - ladder friction – rope friction – wedge friction.	
UNIT – III : GEOMETRICAL PROPERTIES OF SECTION	**(9+3 Periods)**
Centroids – Determination by integration – centroid of an area – simple figures - composite sections – bodies with cut parts - moment of inertia – theorems of moment of inertia – moment of inertia of composite sections – principal moment of inertia of plane areas - radius of gyration.	
UNIT – IV : BASICS OF DYNAMICS	**(9+3 Periods)**
Kinematics and kinetics – displacements, velocity and acceleration - Equations of motion – Rectilinear motion of a particle with uniform velocity, uniform acceleration, varying acceleration – motion curves – motion under gravity – relative motion – curvilinear motion of particles – projectiles – angle of projection – range – time of flight and maximum height. Newton's second law of motion – linear momentum – D'Alembert's principle, Dynamics equilibrium — work energy equation of particles– law of conservation of energy – principle of work and energy	
UNIT – V : IMPULSE MOMENTUM AND IMPACT OF ELASTIC BODIES	**(9+3 Periods)**
Principle of impulse and momentum – Equations of momentum – Laws of conservation of momentum. Impact – Time of compression, restitution, collision – Co-efficient of restitution – types of impact – collision of elastic bodies by direct central impact and oblique impact – collision of small body with a massive body – Kinetic energy of a particle.	

Contact Periods:
Lecture: 45 Periods **Tutorial: 15 Periods** **Practical: 0 Periods** **Total: 60 Periods**

TEXT BOOKS:

1. *S.S. Bhavikatti and K.G. Rajasekarappa* ***"Engineering Mechanics"*** *New Age International (P) Ltd. 1999.*
2. *S.C. Natesan* ***"Engineering Mechanics"*** *Umesh Publications, 5-B north market, Naisarak, Delhi , 2002.*
3. *Domkundwar V.M and Anand V. Domkundwar****, "Engineering Mechanics (Statics and Dynamics)",*** *Dhanpat Rai and Co. Ltd, 1 st Edition, 2006.*

REFERENCE BOOKS:

1. *F.B. Beer and E.R. Johnson,* ***"Vector Mechanics for Engineers"****, Tata Mc.Graw Hill Pvt. Ltd, 10th Edition,2013.*
2. *S. Timoshenko and Young,* ***"Engineering Mechanics",*** *Mc.Graw Hill, 4th Edition, 1995.*
3. *Irving Shames and Krishna Mohana Rao,* ***"Engineering Mechanics"****, Prentice Hall of India Ltd, Delhi, 2006.*
4. *R.C. Hibbeller,* ***"Engineering Mechanics"****, Prentice Hall of India Ltd,13th Edition,2013.*
5. *Vela Murali,* ***"Engineering Mechanics",*** *Oxford university Press,1st Edition,2010.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Know the concept of mechanics and system of forces. **[Familiarity]**
CO2: Calculate the frictional properties at different bodies. **[Familiarity]**
CO3: Identify the locations of centre of gravity and moment of inertia for different sections. **[Familiarity]**
CO4: Understand the basics of dynamics of particles. **[Familiarity]**
CO5: Know the impulse and momentum principle and impact of elastic bodies. **[Familiarity]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	M	L	L						L			M	L		
CO2	H	M	L	L									M			
CO3	L	H	M	L									M			
CO4	M	M	L	L						L			M	L		
CO5	L	L	M	H	L								M			
18SES304	M	M	M	M	L					L			M	L		

L - Low, M - Moderate (Medium), H - High

18SPC305	DIGITAL SYSTEMS	SEMESTER III

PRE-REQUISITES: NIL

Category: PC

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Basic aspects and designing of digital systems.
- Synthesis of combinational circuits.
- Synchronous and asynchronous sequential circuits.

UNIT – I : INTRODUCTION TO NUMBER SYSTEMS AND CODES	**(9 Periods)**
Binary Number Systems-Signed Binary Numbers-Binary Arithmetic-1's and 2's Complement-Octal And Hexadecimal Number Systems- Binary codes -Introduction To Boolean Algebra and logic gates-Minimization Of Boolean Function Using Karnaugh Map(Upto Four Variables)-SOP-POS-Quine Mclusky Methods.	
UNIT – II : COMBINATIONAL LOGIC CIRCUITS	**(9 Periods)**
Introduction to combinational logic- Design procedure - Code Conversion-Binary Code to Gray Code And Gray to Binary-BCD to Excess-3 and Excess 3 to BCD Code- Implementation Of Multiplexer/Demultiplexer -Decoders-Encoders - Priority Encoders- Implementation of Combinational Logic Circuits using Multiplexer/Demultiplexer, Encoder/Decoder -Design of Integer Arithmetic Circuits Using Combinational Logic: Integer Adder - Ripple Carry Adder And Carry Lookahead Adder-Integer Subtraction Using Adders-Design of Combinational Circuits Using Programmable Logic Devices(PLDS):Programmable Read Only Memories(PROM)-Programmable Logic Arrays(PLA)-Programmable Array Logic(PAL) Devices.	
UNIT – III : SEQUENTIAL CIRCUITS	**(9 Periods)**
Latches:RS Latch And JK Latch-Flipflops-RS,JK,T And D Flipflops-Master-Slave Flipflops-Edge Triggered Flipflops-Analysis And Design of Synchronous Sequential Circuits: Introduction To Sequential Circuits - Characteristics Table-Characteristic Equations And Excitation Table	
UNIT – IV : MODULAR SEQUENTIAL LOGIC CIRCUITS	**(9 Periods)**
Registers-Register with parallel load -Overview of Shift Register - Counters- Ripple counter - Synchronous/Asynchronous counters-Up-Down counters, Ring counter-Johnson Counters	
UNIT – V : ALGORITHMS STATE MACHINES AND MEMORIES	**(9 Periods)**
RTL Notations - ASM Charts-Notations- VHDL :Introduction to HDL-VHDL-Library-Introduction to memories - Read,Write Cycles - Random Access Memory- TTL RAM Cell - ROMs-EPROM - MOS Static RAM Cell-Dynamic RAM Cell-Refreshing Memory Cycle.	

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. *M. Morris Mano, Michael D. Ciletti **"Digital Design"** 5th edition,Pearson Education, 2013*
2. *A P Malvino,D P Leach And Gountansala **"Digital Principles and Applications"** 7th Edition, Tata Mc Graw Hill, 2010*

REFERENCE BOOKS:

1. *Stephen Brown,Zvonko Vranesic,* ***"Fundamentals Of Digital Logic Design With VHDL",*** *3rd Edition, Tata Mc Graw Hill, 2008.*
2. *Mark K Bach,* ***"Complete Digital Design",*** *Tata Mc Graw Hill, 2003.*
3. Wakerly Pearson **"Digital Design:Principles And Practices",** 4th Edition, Pearson Education, 2008

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply knowledge of number systems and codes in problem solving related to code conversion and number system.**[Usage]**

CO2: Apply the concepts of combinational logic devices in digital circuits design**.[Usage]**

CO3: Apply the concepts of sequential logic devices in digital circuits design**.[Usage]**

CO4: Explain fundamentals of different types of memories**.[Familiarity]**

CO5: Design of digital circuits using VHDL. **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	M	H	M	M	M					M		M		M	
CO2	M	M	H	M	M	M					M		M		M	
CO3	M	M	H	M	M	M					M		M		M	
CO4	M	M	M	M		M		M					M		M	
CO5	M	M	M	M	M						M		M		M	
18SPC305	M	M	H	M	M	M		M			M		M		M	

L - Low, M - Moderate (Medium), H - High

18SPC306	DATA STRUCTURES	SEMESTER III

PRE-REQUISITES : **Category: PC**

1. 18SES104- Programming in C

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Analyzing the time complexity of an algorithm.
- List, Stack, Queue, Tree Abstract Data Types.
- Graph Representation and Graph Traversals.
- Shortest Path Algorithm and Minimum Spanning Tree Algorithms.
- Various internal and external sorting Techniques.

UNIT – I : INTRODUCTION AND ABSTRCT DATATYPES	**(9 Periods)**
Algorithm Analysis: Calculation of Running Time – Abstract Data Type- List ADT: Array implementation of List, Linked Lists, Doubly Linked List, Circularly Linked Lists.	
UNIT – II : STACK AND QUEUE ADT	**(9 Periods)**
Stack ADT: Stack Model, Implementation of stacks, Applications: Balancing Symbols, Postfix expression evaluation, Infix to postfix conversion, Function Calls – Queue ADT: Queue Model, Implementation of Queues, Applications.	
UNIT – III : TREE ADT	**(9 Periods)**
Preliminaries – Implementation of Trees – Tree Traversals – Binary Tree : Implementation , Expression Tree – Search Tree ADT – AVL Trees , Rotation for Height Balancing - BTrees – Red Black Trees.	
UNIT – IV : GRAPH ALGORITHMS	**(9 Periods)**
Definitions – Representation of Graphs – Traversal- Topological sort – Shortest Path Algorithms : Dijkstra's Algorithm – Network Flow Problem – Minimum Spanning Tree : Prim's and Kruskal's algorithm.	
UNIT – V : SORTING	**(9 Periods)**
Insertion Sort – Shell Sort – Heap Sort – Merge Sort – Quick Sort – Bucket Sort – External Sorting: Simple Algorithm, Multi way merge, Poly Phase Merge	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Mark Allen Weiss,* ***"Data Structures and Algorithm Analysis in C"*** *Second Edition, Pearson Education Limited, 2002.*

REFERENCE BOOKS:

1. *Thomas H. Cormen , Charles E. Leiseron, Ronald L.Rivest, Clifford Stein,* ***"Introduction to Algorithms",*** *Third Edition, PHI learning Pvt. Ltd., 2011.*
2. *Sartaj Sahni,* ***"Data Structures, Algorithms and applications in C++",*** *Second Edition, Universities Press, 2005.*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to,

CO1: Analyze the time complexity of various algorithms **[Analyze]**

CO2: Define and use list, stack and queue Abstract Data Types **[Usage]**

CO3: Define and Use Tree ADT**[Usage]**

CO4: Explain Tree and Graph Traversals **[Familiarity]**

CO5: Explain Height balanced Trees**[Familiarity]**

CO6: Use shortest Path Algorithm and minimum spanning Tree algorithms **[Usage]**

CO7: Use suitable sorting Technique **[Analyze]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	H	H		L	L			L	L	H	H	H	H
CO2	H	H	H	H	M					L		L	H	M	H	
CO3	H		H	M									M	M	M	
CO4	H	H	H	H							M	L	H	M	M	M
CO5	H	H	H	H			M			L	M	L	H	M	M	M
CO6	H	H	H	H	M						H	L	H	H	M	L
CO7	H	H	H	H	M					L	H	L	H	H	M	L
18SPC306	H	H	H	H	M		L	L		L	M	L	H	M	M	M

L - Low, M - Moderate (Medium), H - High

18SMC3Z7	ENVIRONMENTAL SCIENCES AND ENGINEERING *(Common to All branches)*	SEMESTER III

PRE-REQUISITES: NIL

Category: MC

L	T	P	C
3	0	0	0

COURSE OBJECTIVES:

- The course is aimed at creating awareness among students and also to inseminate the critical ideas of preserving environment.

UNIT I: ENVIRONMENTAL RESOURCES	**(9 Periods)**
Natural resources-Forest – benefits, over exploitation, deforestation & consequences – Water- unique features, hydrological cycle & over exploitation – Food -effect of modern agriculture, fertilizers, pesticides, eutrophication & biomagnifications- Energy resources - renewable & non-renewable resources - wind, solar and tidal-harnessing methods.	
UNIT II: ECO SYSTEM AND BIODIVERSITY	**(9 Periods)**
Ecology - ecosystem, physical and chemical components of ecosystem, biological components of ecosystem, forest ecosystem, desert ecosystem and pond ecosystem, Energy flow in ecosystem, nitrogen cycle and carbon dioxide cycle, food pyramid, Ecological succession, Biodiversity - types, values of biodiversity, hot spots of biodiversity, endangered and endemic species, conservation of biodiversity – in situ – ex situ conservation.	
UNIT III: ENVIRONMENTAL POLLUTION	**(9 Periods)**
Air pollution, classification of air pollutants – sources, effects and control of gaseous pollutants SO_2, NO_2, H_2S, CO, CO_2 and particulates, control methods - cyclone separator and electrostatic precipitator, water pollution - classification of water pollutants, organic and inorganic pollutants, sources, effects and control of water pollutants, soil pollution- sources, effects and control, noise pollution - decibel scale , sources, effects and control.	
UNIT IV: ENVIRONMENTAL THREATS	**(9 Periods)**
Acid rain, greenhouse effect, global warming and ozone depletion, disaster management - flood, drought, earthquake and tsunami, Threats to biodiversity-destruction of habitat, habit fragmentation- hunting, over exploitation and man-wildlife conflicts, The IUCN red list categories, status of threatened species.	
UNIT V: SOCIAL ISSUES AND ENVIRONMENT	**(9 Periods)**
Sustainable development- sustainable technologies, need for energy and water conservation, rain water harvesting, water shed management, waste land reclamation, Pollution control Act, Wild life protection act, Forest conservation act, population growth- exponential and logistic growth, variation in population among nations, population policy, women and child welfare programs, role of information technology in human and health, HIV/AIDS - effects and preventive measures.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Sharma J.P., **"Environmental Studies",** 3rd Edition, University Science Press, New Delhi 2009.*
2. *Anubha Kaushik and C.P.Kaushik, **"Environmental Science and Engineering",** 3rd Edition, New age International Publishers, New Delhi, 2008.*

REFERENCE BOOKS:

1. *R.K.Trivedi,* ***"Hand book of Environmental laws, Rules, Guidelines, Compliances and Standards",*** *Vol.I&II, Environ Media, 2006.*
2. *G.TylerMiller, JR,* ***"Environmental Science",*** *Tenth Edition, Thomson BROOKS / COLE Publishing, 2004.*
3. *Gilbert M.Masters,* ***"Introduction to Environmental Engineering and Science",*** *2nd Edition, Pearson Education, 2004.*

COURSE OUTCOMES:

Upon the completion of the course, Students will be able to

CO1: To know about the various environmental resources, the effective utility and problems accompanied in over exploitation.

CO2: To acquire knowledge about the interaction of biosphere with environment and conservation methods of bio diversity.

CO3: To be aware of the sources of various types of pollution, their ill effects and preventive methods.

CO4: To understand the environmental threats, Acid rain, Green house effect and Ozone depletion and natural disasters.

CO5: To create an idea about sustainable development and social issues.

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L	H	L	M	M	M	M	M	M	L	L	L	L	M
CO2	M	L	L	L	L	L	L	L	L	L	L	L	M	L	L
CO3	L	L	H	L	L	L	M	M	L	M	L	L	L	L	L
CO4	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L
CO5	M	L	H	L	L	L	H	H	L	M	L	L	M	L	M
18SMC3Z7	M	L	H	L	L	L	M	M	L	M	L	L	L	L	L

L - Low, M - Moderate (Medium), H - High

18SPC308	DIGITAL SYSTEMS LABORATORY	SEMESTER III

PRE-REQUISITES: NIL **Category: PC**

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Usage of Logic gates.
- Simplification of Boolean functions to the minimum number of literals.
- Design of Multiplexer and Demultiplexer.
- Design of Flip flops and Shift registers.
- Design of synchronous and asynchronous counter.

LIST OF EXPERIMENTS

1. Verification of Truth Tables of logic gates.
2. Implementation of given Boolean Function using logic gates in both SOP and POS form.
3. Design and verify the implementation of Half /Full Adder.
4. Design and verify the implementation of Half /Full subtractor.
5. Simulation of Half /Full Adder, Half /Full subtractor using VHDL.
6. Verification of State Tables of RS, J-K, T and D Flip-Flops using NAND and NOR Gates.
7. Implementation of combinational logic circuits using Multiplexer/Demultiplexer
8. Implementation of combinational logic circuits using Encoder / Decoder.
9. Design and implementation of Shift registers.
10. Implementation of Sequence generators.
11. Simulation of Synchronous and Asynchronous Counter using VHDL.

Contact Periods:
Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Verify the truth table of logic gates **[Usage]**
CO2: Analyze and design combinational systems using standard gates and minimization methods such as Karnaugh maps **[Assessment]**
CO3: Analyze and design combinational systems composed of standard combinational modules, such as multiplexers /encoders and De- multiplexers /decoders **[Assessment]**
CO4: Design and implement different types of sequential logic circuits using Flip Flops **[Assessment]**
CO5: Design and implement different types of Counters, registers and sequence generators. **[Assessment]**
CO6: Analyze and design circuits with needed components for simple application using logic gates **[Assessment]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	M	H				H	H		H	H	H	L	L
CO2	H	H	H	H	H				H	H		H	H	H	L	L
CO3	H	H	H	H	H				H	H		H	H	H	L	L
CO4	H	H	H	H	H				H	H		H	H	H	L	L
CO5	H	H	H	H	H				H	H		H	H	H	L	L
CO6	H	H	H	H	H				H	H		H	H	H	L	L
18SPC308	H	H	H	H	H				H	H		H	H	H	L	L

L - Low, M - Moderate (Medium), H - High

18SPC309	DATA STRUCTURES LABORATORY	SEMESTER III

PRE-REQUISITES:
1.18SES107-Programming in C Laboratory

Category: PC

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Implementation of linear and non linear data structures.
- Implementation and analysis of sorting and searching techniques.
- Real Time Application Development.

LIST OF EXPERIMENTS

1. Stack Operations in array and Linked List Implementation
2. Queue operations in array and Linked List Implementation
3. Application of stacks: Recursion, Infix to postfix conversion
4. Application of Queue: Simulation of FCFS and Round Robin Scheduling
5. Linked list: Circularly linked list, doubly linked list.
6. Application of Linked List: Polynomial Manipulations
7. Trees: Operations on binary tree and binary search tree.
8. Implementation of height balanced trees
9. Implementation of Tree and Graph Traversal Algorithms
10. Implementation of Minimum Spanning Algorithms
11. Implementation of hashing techniques.
12. Implementation of sorting techniques.

Contact Periods:
Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**

COURSE OUTCOMES:

Upon completion of this course, the students will be able to,

CO1: Implement queue and stack data structures using arrays and Linked Lists **[Usage]**
CO2: Implement Tree Data structure and perform tree traversals. **[Usage]**
CO3: Implement Graph Data structure and traverse the same. **[Usage]**
CO4: Implement various sorting and searching Techniques. [**Usage]**
CO5: Implement hashing technique[**Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	M	H	M				M	M		H	H	H	M	M
CO2	H	H	M	H	L				M	M		H	H	H	M	M
CO3	H	H	M	H	L				M	M	M	H	H	H		M
CO4	H	H	M	H	M				M	M	M	H	H	H	M	M
CO5	H	H	H	H	M				M	M	M	H	H	H	M	M
18SPC309	H	H	M	H	M				M	M	M	H	H	H	M	M

L - Low, M - Moderate (Medium), H - High

18SHS401	**TECHNOLOGY MANAGEMENT** *(Common to EEE, EIE, CSE, IT & IBT branches)*	**SEMESTER IV**

PRE-REQUISITES: NIL

Category: HS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Intricacies of technology selection.
- The role of technology in today's business.

UNIT – I : INTRODUCTION	**(9 Periods)**
Evolution, Growth of Technology, Role and Significance of Technology Management, Forms of Technology – Process, Product Technology, Impact of Technology on Society and Business, Technology and Competition.	
UNIT – II : TECHNOLOGY FORECASTING	**(9 Periods)**
Technology forecasting, characteristics, principles, process, forecasting methods and techniques.	
UNIT – III : ACQUISITION OF NEW TECHNOLOGY	**(9 Periods)**
Alternative for acquiring new Technology, Reasons to obtain new technology, Management of acquired technology, Measures of scale and mechanisms for acquiring technologies. Technology Transfer- Models, Modes of transfer, Dimensions of Technology transfer, Features of Technology Package- Routes of Technology Transfer.	
UNIT – IV : HUMAN ASPECTS OF TECHNOLOGY MANAGEMENT	**(9 Periods)**
Integration of people and Technology, Factors Considered in Technology Management – Organizational, Psychological, Organisational structure and Technology - Technological change and Industrial relations.	
UNIT – V : SOCIAL ASPECTS OF TECHNOLOGY MANAGEMENT	**(9 Periods)**
Technology Assessment and Environmental Impact Analysis (EIA)-EIA-Process, Scope, Issues in report preparation, Elements of environmental problem, Case study on social impact of technology.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Sanjiva Shankar Dubey.,* ***"Technology and Innovation Management",*** *PHI Learning Private Ltd., 2017.*

REFERENCE BOOKS:

1. *Gerard H. Gaynor,* ***"Hand Book Technology of Management",*** *McGraw Hill professional, 2009.*
2. *Khalil, T,* ***"Management of Technology: The Key to competitiveness and wealth creation"*** *Tata McGraw Hill, Delhi, 2013.*
3. *Ralph Katz,* ***"The Human Side of Managing Technological Innovation: A Collection of Readings",*** *2nd Edition Oxford University Press, 2003.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to,

CO1: Learn to manage ideas and knowledge in a technology-based organization. [**Familiarize]**
CO2: Equipped with skills needed to implement technology polices and strategies. [**Familiarize]**
CO3: Formulate technology polices and strategies for businesses. **[Understand]**
CO4: Appropriately choose the new technologies. **[Analyse]**
CO5: Future technological requirements. [**Familiarize]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M				M	H		M								M
CO2	M							M	H	M	M				M	M
CO3	M							H			M				M	M
CO4	M								M						M	M
CO5								M			H				M	
18SHS401					M	H		M	H	H	M	H			M	

L - Low, M - Moderate (Medium), H - High

18SES402	ANALOG AND DIGITAL COMMUNICATION	SEMESTER: IV

PRE-REQUISITES: NIL **Category: ES**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Basic analog modulation techniques.
- Fundamental knowledge required to explore wireless communication systems.
- Spread spectrum techniques and multiple access techniques for wireless communication.
- Working principles of microwave and optical communication system.
- Digital transmission techniques.

UNIT – I : FUNDAMENTALS OFANALOG COMMUNICATION	(9 Periods)
Principles of amplitude modulation-AM envelope - frequency spectrum – bandwidth - modulation index - percent modulation - Voltage and power distribution - AM detector – peak detector - Angle modulation - FM and PM waveforms - phase deviation and modulation index - frequency deviation and percent modulation - Frequency analysis of angle modulated waves - Bandwidth requirements for Angle modulated waves - FM detector – slope detector.	
UNIT – II : DIGITAL COMMUNICATION	**(9 Periods)**
Introduction- Shannon limit for information capacity- ASK transmitter, receiver and bandwidth- FSK transmitter, receiver and bandwidth- BPSK transmitter, receiver and bandwidth- QPSK transmitter, receiver and bandwidth- Quadrature Amplitude modulation – transmitter, receiver and bandwidth efficiency- carrier recovery – squaring loop- Costas loop- DPSK – transmitter and receiver.	
UNIT – III : DIGITAL TRANSMISSION	**(9 Periods)**
Sampling theorem- reconstruction of message from its samples- Pulse modulation- PCM – PCM sampling, quantization- signal to quantization noise rate-companding – analog and digital – percentage error- delta modulation-transmitter and receiver- adaptive delta modulation- differential pulse code modulation-transmitter and receiver- pulse transmission – Intersymbol interference- ISI-Nyquist criteria for distortionless transmission.	
UNIT – IV : SPREAD SPECTRUM AND MULTIPLE ACCESS TECHNIQUES	**(9 Periods)**
Pseudo-noise sequence -Direct Sequence spread spectrum with coherent binary PSK- Frequency-hop spread spectrum – slow and fast hopping. multiple access techniques: FDMA- TDMA- CDMA - SDMA- wireless communication-frequency reuse and cell splitting- TDMA and CDMA in wireless communication systems- source coding of speech for wireless communications	
UNIT – V : MICROWAVE AND OPTICAL COMMUNICATION	**(9 Periods)**
UHF and microwave antennas –parabolic and conical horn antenna- frequency modulated microwave radio system – transmitter, receiver and repeater- Line of sight path characteristics. Optical fiber Communication System: Light propagation in fiber- Optical fiber classification-Losses in optical fibers- Sources and Detectors.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Wayne Tomasi* ***"Electronic Communication Systems: Fundamentals Through Advanced",*** *Fifth edition, Pearson Education, 2004.*
2. *Simon Haykin* ***"Communication Systems"*** *Third edition, John Wiley & Sons, 2004.*

REFERENCE BOOKS:

1. *B.P.Lathi,* ***"Modern Analog and Digital Communication systems"****, Fourth Edition, Oxford University Press, 2009.*
2. *T G Kennedy, B Davis and S R M Prasanna* ***"Electronic communication systems"*** *, Fifth Edition, Tata Mc-Graw Hill Education Pvt Limited, 2011.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Explain the principles of Amplitude modulation, Frequency modulation and Phase modulation **[Familiarity]**

CO2: Describe the operation of transmitter and receiver system for digital communication. **[Familiarity]**

CO3: Apply the concept of pulse code modulation for telecommunication networks**. [Usage]**

CO4: Describe the concept of spread spectrum modulation to obtain secure communication. **[Familiarity]**

CO5: Differentiate multiple access techniques like FDMA, TDMA, CDMA and SDMA. **[Familiarity]**

CO6: Explain the working principles of microwave antennas. **[Familiarity]**

CO7: Explain the optical fiber communication system. **[Familiarity]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	M	H	M	M	M					M		M		M	
CO2	M	M	H	M	M	M					M		M		M	
CO3	M	M	H	M	M	M					M		M		M	
CO4	M	M	M	M		M		M					M		M	
CO5	M	M	M	M	M						M		M		M	
CO6	M	M	M								M		M		M	
CO7	M	M	M								M		M		M	
18SES402	M	M	H	M	M	M		M			M		M		M	

L - Low, M - Moderate (Medium), H - High

18SPC403	COMPUTER ARCHITECTURE	SEMESTER IV

PRE-REQUISITES: NIL **Category: PC**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Memory addressing modes used by the instructions and to expose the major differentials of RISC and CISC architectural characteristics with performance evaluation of CPU.
- Basics of number representation of signed integers and to perform operations like addition and subtraction of signed integers represented multiplication and floating point addition.
- Organization of a computer system including the CPU data path and control
- Concept of pipelining and the various hazards that arise in a pipeline and the typical solutions to the hazards.
- Concept of memory Technologies and Parallelism and Memory Hierarchies.
- Concepts of Multicore and Shared Memory Multiprocessors

UNIT – I : INTRODUCTION	**(9 Periods)**
Introduction – Eight Great Ideas in Computer Architecture –Technologies for Building Processors and Memory - performance -CPU performance and its factors – evaluating performance - The Power Wall -Uniprocessors to Multiprocessors - classes of computing- high-level language to language of hardware – operation of computer hardware – operands of the computer hardware –instructions – Special-purpose instructions - Addressing modes - Supporting procedures in computer hardware - Parallelism and Instructions: Synchronization.	
UNIT – II : ARITHMETIC FOR COMPUTERS	**(9 Periods)**
Signed number representation, fixed and floating point representations, character representation. Computer arithmetic - integer addition and subtraction - multiplication - shift-and-add, Booth multiplier, carry save multiplier, etc. Division - non-restoring and restoring techniques, floating point arithmetic - Parallelism and Computer Arithmetic: Subword Parallelism.	
UNIT – III : PROCESSOR AND PIPELINING	**(9 Periods)**
Single -Cycle Datapath and Control - Multi-cycle Datapath and Control-Micro-programming and Hardwired Control Units- Introduction to Pipelining; Pipelined Datapath and Control - Pipeline Hazards: Structural, Data Hazards: Forwarding versus Stalling–Control – Exceptions- Parallelism via Instructions.	
UNIT – IV : MEMORY SYSTEMS AND I/O INTERFACING	**(9 Periods)**
Introduction - Memory Technologies - The Basics of Caches - Measuring and Improving Cache Performance - Dependable Memory Hierarchy - Virtual Machines - Virtual Memory - A Common Framework for Memory Hierarchy - Parallelism and Memory Hierarchies: Cache Coherence - Redundant Arrays of Inexpensive Disks.	
UNIT – V : PARALLEL PROCESSORS FROM CLIENT TO CLOUD	**(9 Periods)**
Introduction - Difficulty of Creating Parallel Processing Programs - SISD, MIMD, SIMD, SPMD, and Vector - Hardware Multithreading - Multicore and Shared Memory Multiprocessors - Graphics Processing Units - Clusters, Warehouse Scale Computers, and Message-Passing Multiprocessors - Multiprocessor Network Topologies - Cluster Networking - Multiprocessor Benchmarks and Performance Models.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *David. A. Patterson, John L. Hennessy* ***"Computer Organization and Design: The Hardware/Software Interface",*** *Fifth Edition, Morgan-Kaufmann Publishers Inc. 2014.*

REFERENCE BOOKS:

1. *Carl Hamachar, ZvoncoVranesic and SafwatZaky,* ***"Computer Organization",*** *5th edition, McGraw Hill, 2011.*
2. *John P.Hayes,* ***"Computer Architecture and Organization"*** *Third Edition, Mc-Graw Hill International, 1998.*
3. *William Stallings,* ***"Computer Organization and Architecture: Designing for Performance",*** *10th Edition, Pearson Education, 2016.*
4. *Morris Mano. M,* ***"Computer system Architecture",*** *3rd edition, PHI publication, 2008.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Describe and analyze the main functional units of a computer and its performance evaluation. [**Usage**]
CO2: Explain the Computer Arithmetic .To demonstrate the performance impact of sub word parallelism. [**Familiarity**]
CO3: Identify different pipelining hazards and their inference.**[Assessment]**
CO4: Explain the Single –Cycle, Multi-cycle Data path and Control and Micro-programming and Hard-wired Control Units. [**Familiarity**]
CO5: Exploit the advantages of computer memory having virtual memory and cache. [**Usage**]
CO6: Explain the Multicore and Shared Memory Multiprocessors.[**Familiarity]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	H	H		H				H	M	H	H	M	L
CO2	H	H	H	H	H		H				H	M	H	H	M	L
CO3	H	H	H	H	H		H				H	M	H	H	M	L
CO4	H	H	H	H	H		H				H	M	H	H	M	L
CO5	H	H	H	H	H		H				H	M	H	H	M	L
CO6	H	H	H	H	H		H				H	M	H	H	M	L
18SPC403	H	H	H	H	H		H				H	M	H	H	M	L

L - Low, M - Moderate (Medium), H – High

18SPC404	DATABASE MANAGEMENT SYSTEMS	SEMESTER IV

PRE-REQUISITES: NIL **Category: PC**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Database system and its architecture
- Data models and data modeling
- Database theory and normalization
- Query Processing and Transaction Processing
- NoSQL Databases
- Enhanced data models such as spatial, temporal, multimedia and active databases.

UNIT – I : DATABASE SYSTEM CONCEPTS AND DATA MODELS	**(9 Periods)**
Data base approach : Characteristics, Advantages, Applications – Data Models - Three Schema Architecture- Data base System Environment- Data Modeling with ER model- Enhanced ER Model.	
UNIT – II : RELATIONAL DATA MODEL AND SQL	**(9 Periods)**
Relational Algebra-Relational Model: Concepts, Constraints, Schemas – Basic SQL: Data Definition, Data types, Constraint Specification, Data retrieval Queries, Triggers, Views and Schema Modification- ER and EER to Relational mapping	
UNIT – III : DATABASE DESIGN AND QUERY PROCESSING	**(9 Periods)**
Design Guidelines – Functional Dependencies – Normal Forms based on Primary Keys – Second and Third Normal Forms – BCNF – Multi valued Dependencies and Fourth Normal Form – Join Dependency and Fifth Normal Form. Strategies for Query Processing – Query Optimization	
UNIT – IV : TRANSACTION PROCESSING, CONCURRENCY CONTROL AND RECOVERY	**(9 Periods)**
Transaction: Desirable Properties, Schedules based on recoverability and Serializability, Transaction support in SQL. Concurrency Control: Locking Technique, Time stamp based ordering, Multi version concurrency control, Validation and Snapshot isolation concurrency control. Recovery Techniques: Concepts, NO-UNDO/ REDO Recovery based on deferred update, Recovery based on immediate update, Shadow paging, ARIES algorithm, Recovery in multi database systems	
UNIT – V : NOSQL DATABASES AND ENHANCED DATA MODELS	**(9 Periods)**
Introduction to NOSQL Systems: CAP Theorem, Document based systems and MongoDB, NOSQL Key-value stores, Column based and NOSQL Graph Databases- Enhanced Data models: Active Database, Temporal Database, Spatial, multimedia and Deductive Databases.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Ramez Elmasri, Shamkant B. Navathe* ***"Fundamentals of Database Systems"*** *Seventh Edition, Pearson Education Limited, 2015.*

REFERENCE BOOKS:

1. *Abraham Silberschatz , Henry F. Korth and S. Sudarshan,* ***"Database System Concepts",*** *Sixth Edition, McGraw-Hill, 2012.*
2. *Raghu Ramakrishnan and Gehrke,* ***"Database Management Systems",*** *Third Edition, McGraw Hill, 2003*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Explain the various data models **[Familiarity]**

CO2: Design a good relational data base system **[Usage]**

CO3: Explain query processing and optimization techniques **[Familiarity]**

CO4: Write Transaction processing applications considering concurrency control and recovery issues **[Usage]**

CO5: Explain Active Database, Temporal Database, Spatial, multimedia and Deductive Databases **[Familiarity]**

CO6: Use NOSQL Databases **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	M	M					L	L	L	H	M	M	
CO2	H	H	H	H	M	M	M	M	M	L	H	M	H	H	H	M
CO3	H	H	H	H	H		M	M	M				H	H	H	H
CO4	H	H	H	H	H	M		H	H	M	H	H	H	H	H	H
CO5	H	H	H	H	H	H				L	L	L	H	H	H	
CO6	H	H	H	H	H	H				L	L	L	H	H	H	
18SPC404	H	H	H	H	M	M	M	M	M	L	H	H	H	H	H	L

L - Low, M - Moderate (Medium), H - High

18SPC405	SYSTEM PROGRAMMING AND OPERATING SYSTEMS	SEMESTER IV

PRE-REQUISITES: NIL **Category: PC**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Pass structure of assembler.
- Basics concepts of linker and loader.
- Process management and process synchronization
- Different approaches to memory management such as paging and segmentation
- Issues related to file system interface and implementation, disk management
- Protection and security mechanisms.

UNIT – I : INTRODUCTION TO SYSTEM SOFTWARE	**(9 Periods)**
Introduction to system software – Overview of language processors – Assemblers – Elements of Assembly language programming – pass structure of assemblers –Design of two pass assembler – Algorithm for single pass Assembler	
UNIT – II : MACROS,LINKERS AND LOADERS	**(9 Periods)**
Macro and Macro preprocessors – Introduction – Macro definition and call –Macro expansion – advanced Macro facilities –Design of Macro Preprocessor. Linkers and Loaders – Introduction – relocation and linking concept –design of Linker –self relocating programs –Loaders.	
UNIT – III : PROCESS MANAGEMENT AND PROCESS SYNCHRONIZATION	**(9 Periods)**
Operating System – User view –System view - Process management: Process concepts – operation on processes - scheduling – Inter process communication. Threads: Multithread models – Implicit threading - Threading issues. CPU Scheduling: Basic concepts-Scheduling criteria-Scheduling algorithms-Multiple- Processor scheduling- Process synchronization: The critical- section problem. Peterson's Solution, synchronization Hardware, semaphores, classical problems of synchronization, monitors. Deadlock: System model-Deadlock characterization- prevention-avoidance and detection-Recovery from deadlock.	
UNIT – IV : MEMORY MANAGEMENT	**(9 Periods)**
Memory Management Requirements – Memory partitioning – paging– Segmentation –security issues - Paged segmentation-Virtual memory concepts-Demand paging, Performance of demand paging-Page replacement algorithms-Thrashing-Cache memory organization-Locality of reference.	
UNIT – V : STORAGE MANAGEMENT	**(9 Periods)**
Disk Structure-Disk Attachment - Disk scheduling- Disk Management-Swap Space Management – RAID Structure. File System- File concept- Access methods- Directory and Disk Structure- File system Mounting-File sharing- File system implementation issues-File system protection and security.	

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *D.M.Dhamdhere **"System Programming"**, Tata McGraw Hill Education Private Limited, 2011.*
2. *A.Silberschatz & Peter Baer Galvin and Greg Gagne **"Operating System concepts"** 9th edition, John Wiley and sons Inc., 2012.*

REFERENCE BOOKS:

1. *Andrew S. Tanenbaum, Albert S. Woodhull: **"Operating Systems, Design and Implementation",** 3rd Edition, Prentice Hall, 2011.*
2. *Gary Nutt: **"Operating Systems",** 3rd Edition, Pearson Education, 2009.*
3. *D M Dhamdhere, **"Operating Systems: A Concept-based Approach"**, 2nd Edition, Tata McGraw-Hill Education, 2009.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Explain the pass structure of Assemblers **[Familiarity]**
CO2: Explain the working principle of Macros, Linkers and Loaders **[Familiarity]**
CO3: Explore inter process communication using shared memory and Message Passing **[Usage]**
CO4: Solve problems using CPU Scheduling algorithms like FCFS,SJF and RR **[Usage]**
CO5: Use locks, semaphores, monitors for synchronization in multithreaded programs **[Usage]**
CO6: Identify and handle Resource allocation, deadlock prevention, avoidance and detection techniques in multiprogramming environment **[Usage]**
CO7: Use different kinds of memory management techniques like paging and segmentation **[Usage]**
CO8: Use disk management and disk scheduling algorithms for better utilization of external memory **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	M	M	M	M							M	H	H	M	H
CO2	H	L	M	L	M							M	H	H	M	M
CO3	M	H	H	L	M							H	H	M	M	M
CO4	M	H	H	L	M							H	H	M	M	M
CO5	H	H	H	H	L							H	H	H	M	M
CO6	H	M	H	M	L							H	M	M	M	M
CO7	H	M	H	M	L							H	M	M	M	M
CO8	H	M	M	M	M							H	H	M	H	H
18SPC405	H	M	H	M	M							H	H	M	M	M

L - Low, M - Moderate (Medium), H - High

18SPC406	THEORY OF COMPUTATION	SEMESTER: IV

PRE-REQUISITES: NIL

Category: PC

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Regular languages and Finite Automata
- Context Free Languages and Push Down Automata
- Turing Machines
- Recursively and Recursively Enumerable Languages
- Undecidable problems.

UNIT – I : REGULAR LANGUAGES	**(9+3 Periods)**
Regular Languages and Regular Expressions - Memory Required to Recognize a Language -Finite Automata - Distinguishing One String from Another - Unions, Intersections, and Complements. Nondeterministic Finite Automata - Nondeterministic Finite Automata with ∧-transitions -Kleene's Theorem. Criterion for Regularity- Minimal Finite Automata-Pumping Lemma for Regular Languages	
UNIT – II : CONTEXT FREE LANGUAGES	**(9+3 Periods)**
Context-Free Grammar (CFG) – Derivation Trees – Ambiguity in Grammars and Languages – Equivalence of Parse Trees and Derivation – Simplification of Context-free Grammar – Chomsky Normal Form – Greibach Normal Form - Definition of the Pushdown Automata – Languages of a Pushdown Automata – Equivalence of Pushdown Automata and CFG– Pumping Lemma for CFL – Closure Properties - Deterministic Pushdown Automata	
UNIT – III : TURING MACHINES	**(9+3 Periods)**
Turing Machines – Language of a Turing Machine – Turing Machine as a Computing Device - Techniques for TM – Modifications of Turing Machines – Two-way Infinite Tape, Equivalence of One Way Infinite Tape and Two-way Infinite Tape Turing Machines – Multi Tape Turing Machines, Non-deterministic Turing machine.	
UNIT – IV : RECURSIVE AND RECURSIVELY ENUMERABLE LANGUAGES	**(9+3 Periods)**
Recursively Enumerable and Recursive-Enumerating a Language –More General Grammars- Context – Sensitive Languages and the Chomsky hierarchy- Not all Languages and Recursively Enumerable.	
UNIT – V : UNDECIDABILITY	**(9+3 Periods)**
A Language that is not Recursively Enumerable (RE) – An Undecidable Problem that is RE – Undecidable Problems about Turing Machine – Rice Theorem for Recursive and Recursively Enumerable Languages – Post's Correspondence Problem (PCP) – Modified Post Correspondence Problem	

Contact Periods:
Lecture: 45 Periods **Tutorial: 15 Periods** **Practical: 0 Periods** **Total: 60 Periods**

TEXT BOOKS:

1. *John C. Martin* ***"Introduction to languages and the theory of computation"****, Third edition, Mc Graw Hil, 2015.*

REFERENCE BOOKS:

1. *John E Hopcroft, Rajeev Motwani, Jeffrey D Ullman,* ***"Introduction to Automata Theory, Languages and Computation"****, Third Edition, Pearson, 2013.*
2. *Michael Sipser,* ***"Introduction to Theory of Computation"****, Third Edition, Cengage learning, 2013.*
3. *Adam Brooks Webber,* ***"Formal languages: a practical introduction"****, Jim Leisy, 2008.*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to,

CO1: Write Regular Expression/Context free grammar for the given language **[Usage**]

CO2: Construct Automata for the given language**. [Usage]**

CO3: Design Turing machines for the given problem **[Usage]**

CO4: Identify recursive and recursively enumerable language**. [Usage]**

CO5: Find whether the given problem is decidable or not**. [Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	H	H	L	L	H	M	L		M	H	M	L	H
CO2	H	H	H	H	H	L	L	H	M	L		M	H	M	L	H
CO3	H	H	H	H	H	L	L	H	M	L		M	H	M	L	H
CO4	H	H	H	H	H	L	L	H	M	L		M	H	M	L	H
CO5	H	H	H	H	H	L	L	H	M	L		M	H	M	L	H
18SPC406	H	H	H	H	H	L	L	H	M	L		M	H	M	L	H

L-Low, M-Moderate(Medium), H-High

18SMC4Z7	CONSTITUTION OF INDIA *(Common to All branches)*	SEMESTER: IV

PRE-REQUISITES: NIL

Category: MC

L	T	P	C
3	0	0	0

COURSE OBJECTIVES:

- To know about Indian constitution.
- To know about central and state government functionalities in India.
- To know about Indian society.

UNIT – I : INTRODUCTION	**(9 Periods)**
Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Role of the Election Commission.	
UNIT – II : STRUCTURE AND FUNCTION OF CENTRAL AND STATE GOVERNMENT	**(9 Periods)**
Union Government – Structures of the Union Government and Functions – President – Vice President– Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review. State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.	
UNIT – III : CONSTITUTION FUNCTIONS OF INDIA AND INDIAN SOCIETY	**(9 Periods)**
Indian Federal System – Central – State Relations – President's Rule – Constitutional Amendments – Constitutional Functionaries - Assessment of working of the Parliamentary System in India. Society : Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India; Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.	
UNIT – IV : POLICIES AND ACTS - GENERAL	**(9 Periods)**
Insurance and Bonding – Laws Governing Sale, Purchase and use of Urban and Rural Land – Land Revenue Codes – Tax Laws – Income Tax, Sales Tax , Excise and Custom duties and their Influence on Construction Cost – Legal Requirements for Planning – Property Law– Agency Law – Local Government Laws for Approval.	
UNIT – V : POLICIES AND ACTS ON INFRASTRUCTURE DEVELOPMENT	**(9 Periods)**
A Historical Review of the Government Policies on Infrastructure – Current Public Policies on Transportations – Power and telecom Sector – Plans for Infrastructure Development – Legal framework for Regulating Private Participation in Roads and Highways – Ports and Airport and Telecom	

Contact Periods:
Lecture: 45Periods **Tutorial: 00** **Practical: 00** **Total :45 Periods**

TEXT BOOKS:

1. *Durga Das Basu,* ***"Introduction to the Constitution of India ",*** *Prentice Hall of India, New Delhi,2018*
2. *R.C.Agarwal* ***"Indian Political System"****, S.Chand and Company, New Delhi,2004.*
3. *Maciver and Page,* ***"Society: An Introduction Analysis",*** *Mac Milan India Ltd., New Delhi,2007*
4. *K.L.Sharma,* ***"Social Stratification in India: Issues and Themes",*** *Jawaharlal Nehru University, New Delhi,2006*

REFERENCE BOOKS:

1. *M.Laxmikanth,* ***"Indian Polity",*** *Mcgraw Hill Education (India)Private limited,2016*
2. *Sharma, Brij Kishore,* ***"Introduction to the Constitution of India",*** *Prentice Hall of India, New Delhi,2018*

COURSE OUTCOMES:

On completion of the course, the students will able to

CO1: Understand and abide the rules of the Indian constitution.
CO2: Understand the functions of Central government.
CO3: Understand the function of state government.
CO4: Understand the various constitutional functions.
CO5: Understand the different culture among the people of India.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1						M	M					M			L	
CO2						L						M		L		
CO3						L						M				
CO4						L						L		L		
CO5						L	L					L		L	L	
18SMC4Z7						L	L					M		L	L	

L-Low, M-Moderate (Medium), H-High

18SPC408	DATABASE MANAGEMENT SYSTEMS LABORATORY	SEMESTER: IV

PRE-REQUISITES: NIL **Category: PC**

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- DDL, DML, DCL and TCL commands.
- Operations in Relational Algebra
- Concepts of Views
- Concepts of Stored procedures, functions, Cursors and triggers
- Front end design

LIST OF EXPERIMENTS

Experiments should be implemented in MySQL/NoSQL

1. DDL and DML commands.
2. Form Design and report generation using PHP/Java/Django
3. Views & Subqueries.
4. Relational Algebra Operations
5. Stored Procedures and Cursors.
6. Stored Functions.
7. Triggers.
8. DCL and TCL commands.
9. Mini Project

Contact Periods:
Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**

COURSE OUTCOMES:

Upon completion of this course, the students will be able to,

CO1: Manipulate a database using DDL, DML, DCL and TCL commands. **[Usage]**

CO2: Implement a database schema for any real world problem. **[Usage]**

CO3: Impose integrity constraints on a database. **[Usage]**

CO4: Apply PL/SQL constructs to practice Stored Procedures, Functions, Cursors, Packages and Triggers. **[Usage]**

CO5: Perform transaction processing without conflicts.**[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	M	M						L	L	H	M	M	
CO2	H	H	H	H	M		M	M			H	L	H	H	H	M
CO3	H	H	H	H	H		M	M			M	L	H	H	H	H
CO4	H	H	H	H	H	L		H			H	L	H	H	H	H
CO5	H	M	H	H	H						L	L	H	H	H	
18SPC408	H	H	H	H	M	L	M	M			M	L	H	H	H	L

L - Low, M - Moderate (Medium), H - High

18SPC409	SYSTEM PROGRAMMING AND OPERATING SYSTEMS LABORATORY	SEMESTER: IV

Category: PC

PRE-REQUISITES: NIL

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Designing Assembler and macro processors
- Simulating linkers and loaders.
- Process scheduling and Inter process communication.
- Process synchronization using mutex and semaphore.
- Deadlock prevention and avoidance.
- Paging and disk scheduling.
- Storage allocation techniques

LIST OF EXPERIMENTS

Experiments should be implemented in C/C++/Java

SYSTEM PROGRAMMING

1. Design of single pass assembler
2. Design of two pass assembler
3. Simulation of static and dynamic linker
4. Implementation of relocation loader
5. Design of MASM macro processor

OPERATING SYSTEMS

1. Implementation of process scheduling
2. Illustrated of inter process communication strategies
3. Implementation of mutual exclusion by semaphores
4. Deadlock prevention & avoidance algorithms
5. Virtual memory: paging and segmentation
6. Implementation of page replacement algorithms
7. Implementation of disk scheduling algorithms
8. Implementation of file structures

Contact Periods:
Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**

COURSE OUTCOMES:

Upon completion of this course, the students will be able to,

CO1: Design single and two pass assemblers. **[Usage]**
CO2: Implement the static and dynamic linker **[Usage]**
CO3: Design simple loader and MASM macro pre-processor. **[Usage]**
CO4: Identify and use suitable process scheduling algorithm **[Usage]**
CO5: Solve producer-consumer and reader-write problem using semaphore. **[Usage]**
CO6: Handle deadlocks.**[Usage]**
CO7: Design Virtual memory system **[Usage]**
CO8: Design file system for the given application **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	M	H	M				M	M		L	M	H	M	M
CO2	H	H	H	H	M				M	M		L	M	H	M	M
CO3	H	H	M	H	M				M	M		L	M	H	M	M
CO4	H	H	M	H	M				M	M		L	M	H	M	M
CO5	H	H	L	H	M				M	M		L	M	H	M	M
CO6	H	H	L	H	M				M	M		L	M	H	M	M
CO7	H	H	L	H	M				M	M		L	M	H	M	M
CO8	H	H	L	H	M				M	M		L	M	H	M	M
18SPC409	H	H	M	H	M				M	M		L	M	H	M	M

L - Low, M - Moderate (Medium), H - High

18SHS501	PROFESSIONAL COMMUNICATION SKILLS	SEMESTER V

PRE-REQUISITES: NIL **Category: HS**

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

* listening and speaking skills in both formal and informal contexts
* Correct reading and pronunciation of English words
* Steps for writing good resume and general articles.
* Correct usage of vocabulary
* Correct usage of grammar

UNIT– I : LISTENING	**(6 Periods)**
Listening to persuade/dissuade people, Complaints and transfer of information. Speaking –Role play activities on a formal/corporate context, Delivering Welcome Address - Listening to express regrets/sympathy/condolences, Listening and Note-taking. Listening to describe manner and frequency, Listening to expressions of assumptions/inference.	
UNIT – II : READING	**(6 Periods)**
Reading to infer lexical and contextual meaning - Reading a short story or an article from newspaper - Reading passages with time limit - Reading the job advertisements and the profile of the company concerned - Note making and Intensive reading.	
UNIT – III : WRITING	**(6 Periods)**
Writing - Effective use of SMS on Whatsapp/ Hike/ Messenger, Writing Emails on a business context, Technical style. Writing a review of a book/movie/music concert/sports event, Graph Description. Writing Notice, Agenda and Minutes of meetings - Elements of Writing Technical articles	
UNIT – IV : VOCABULARY	**(6 Periods)**
Homonyms and Homophones -Noun/Adjective/Adverbial phrases - Cause and effect expressions. Same word used as different parts of speech – Idioms - Nominal Compounds	
UNIT – V : GRAMMAR	**(6 Periods)**
Use of relative / reflexive pronouns - Discourse Markers - Noun/Adjective/Adverbial phrases - Cause and effect expressions - Numerical expressions - Conditional clauses - Direct and indirect speech - Time Statements and Contracted Time Statements.	

LIST OF EXPERIMENTS (30 Periods)

1. Listening to American accent
2. Listening to British accent
3. Practising pronunciation
4. Practising stress and intonation
5. Watching & doing Presentation and GD
6. Watching and doing Debate and Mock Interviews
7. Writing resume
8. Writing articles in English

Contact Periods:

Lecture: 30 Periods Tutorial: 0 Periods Practical: 30 Periods Total: 60 Periods

TEXT BOOKS:

1. *Sadanand, Kamlesh & Punitha, Susheela,* ***"Spoken English: A Foundation Course (Part 2)"****, Orient Blackswan, Hyderabad. 2014.*
2. *Raman, Meenakshi & Sangeetha Sharma,* ***"Technical Communication: Principles and Practice",*** *Oxford University Press, New Delhi. 2011.*

REFERENCE BOOKS:

1. *Herbert, A.J, "****Structure of Technical English****", The English Language Society, London. 1971.*
2. *Rajendrapal & Korlahalli. J.S,* ***"Essentials of Business Communication",*** *Sultan Chand & Sons, 2002*
3. *Vijay, Anbazhagan.J, & Jaishree.N,* ***"Technical English-II",*** *Global Publishers, Chennai, 2016.*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to,

CO1: Listen to and understand spoken English [Familiarity]
CO2: Use correct pronunciation and speak English with proper stress and intonation. [Usage]
CO3: Do presentation, GD, Debate & Mock interview confidently. [Usage]
CO4: Write good resume and articles in English. [Usage]
CO5: Read books in English with confidence. [Familiarity]
CO6: Develop body language and soft skills. [Usage]

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1						H			H	H	H	H	M	H	H	H
CO2						H			H	H	H	H	M	H	H	H
CO3						H			L	L	L	H	M	H	H	H
CO4						H	H	H	H	M	L	H	L	H	H	H
CO5						H			H	H	M	H	M	H	H	H
CO6						H			L	L	L	H	M	H	H	H
18SHS501						H	M	M	H	M	M	H	M	H	H	H

L - Low, M - Moderate (Medium), H - High

18SES502	EMBEDDED COMPUTING SYSTEMS	SEMESTER V

PRE-REQUISITES: NIL **Category: PC**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Basic hardware and software components and their selection for embedded computing systems.
- Hardware software co-design and firmware design approaches.
- Basics of RTOS.
- Interfacing and development of LPC2148 Microcontroller application.

UNIT – I : INTRODUCTION TO EMBEDDED SYSTEMS AND ARM PROCESSOR	**(9 Periods)**
Introduction to Embedded System: Characteristics of Embedded System – Application Areas – Real Time Examples of Embedded System – ES Hardware Design – Design and Development of Embedded Software –Real time ES. ARM Processor: Family – Application of ARM Processor – Compiler –Emulation and Debugging – Difference between RISC & CISC.	
UNIT – II : EMBEDDED NETWORKING AND INTERRUPTS SERVICES MECHANISM	**(9 Periods)**
Embedded Networking: Introduction, I/O Devices – Ports &Buses. Bus communication Protocols – RS232 Standard –RS422 – RS485 – CAN Bus – Serial Peripheral Interface (SPI) – Inter Integrated Circuit (I^2C) – Interrupt Sources, Programmed –I/O busy-wait approach without Interrupt Service Mechanism – ISR concept – Multiple interrupt – context switching – Introduction to Devices Drivers.	
UNIT – III : RTOS BASED EMBEDDED SYSTEM DESIGN	**(9 Periods)**
Introduction to Basic concept of RTOS – Task, Process & Threads, Interrupt routines in RTOs , Multiprocessing & Multitasking, Preemptive & Non- Preemptive scheduling, Task communication – Shared Memory, Message Passing, Interprocess communication – Comparison of commercial RTOs Features – RTOS lite, Full RTOS, Vxworks, µc/os –II, RT Linux.	
UNIT – IV : PROGRAM DESIGN AND ANALYSIS	**(9 Periods)**
Component for Embedded Programs, Model's of Programs, Assembly, linking & loading , Basic Compilation Techniques, Program Optimization, Program Level Performance Analysis, Software Performance Optimization, Program-Level energy & Power Analysis , Analysis & Optimization of Program Size, Program Validation & testing.	
UNIT – V : INTRODUCTION TO LPC2148 MICROCONTROLLER, SYSTEM CONTROL AND GPIO	**(9 Periods)**
The LPC 2148: ARM7 Microcontroller – Features of LPC 2148 – Block diagram of LPC 2148 – Pin diagram of LPC 2148 – Architectural Overview – On-chip Flash Program Memory – On-chip Static RAM. System Control: Crystal Oscillator – PLL – Rest & Wake – Up timer – Brownout Detector – External interrupt input – Memory Mapping control – Power Control. GPIO: General purpose parallel I/O: Features – 8 bit LED's & Switches – Relay & Buzzer.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods
TEXT BOOKS:

1. *Wayne Wolf,* ***"Computers as Components, Principles of Embedded Computing Systems Design"*** *2nd Edition, Elsevier, 2008.*
2. *Shibu K V,* ***"Introduction to Embedded Systems"****, Tata McGraw Hill, 2009.*

REFERENCE BOOKS:

1. *James K. Peckol,* ***"Embedded Systems, A contemporary Design Tool",*** *Wiley India, 2008.*
2. *Tammy Neorgaard,* ***"Embedded Systems Architecture"****, Elsevier, 2005.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply the microcontroller cores (ARM, RISC, CISC, and SOC) for the Embedded systems**. [Usage]**
CO2: Explain the design components of embedded systems **[Familiarity]**
CO3: Develop programs using embedded programming **[Usage]**
CO4: Apply RTOS concepts of task and time management, memory management for embedded systems. **[Usage]**
CO5: Develop Embedded applications using embedded systems development environment. **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	M	H	M	M	M			L		M	L	L	H	H	H
CO2	M	M	H	M	M	M	M	M	H	H	M	H	L	H	H	H
CO3	M	M	H	M	M	M	L	M	M	M	M	H	M	H	H	H
CO4	M	M	M	M		M	M	M	M	M		M	M	H	H	H
CO5	M	M	M	M	M		H	H	H	M	M	H	L	H	H	H
18SES502	M	M	M	M	M	M	M	M	H	M	M	H	M	H	H	H

L - Low, M - Moderate (Medium), H - High

18SPC503	COMPUTER NETWORKS	SEMESTER V

PRE-REQUISITES: NIL

Category: PC

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- The division of network functionality into layers.
- The functions and protocols of each layer of TCP/IP protocol suite.
- The flow of information from one node to another node in the network.
- The components required to build different types of network.
- The concepts of network addressing

UNIT – I : INTRODUCTION TO LAYER ARCHITECTURE AND PHYSICAL LAYER	**(9 Periods)**
The Network edge and core – Delay, loss and throughput in packet switched networks - Layered Architecture – ISO/OSI Model – Internet Architecture (TCP/IP) - Transmission – Impairments – Bandwidth Limitations – Modulation – Frequency Spectrum – Multiplexing – Encoding Techniques – Transmission Media - Copper – Fiber – Optical – Radio	
UNIT – II : DATA LINK LAYER	**(9 Periods)**
Link Layer – Framing – Addressing – Error Detection/Correction – Multiple Access Protocols – Address Resolution Protocol (ARP) – Ethernet Basics – CSMA/CD – Frame Format – Switching – Types (datagram, virtual) – Hubs, Bridges, Switches – Virtual LAN (VLAN) – Wireless LAN (802.11) – WAN Technologies	
UNIT – III : NETWORK LAYER	**(9 Periods)**
Virtual Circuit and datagram networks – Routers - Internet Protocol – Routing algorithms – Routing in the Internet – Broadcast and Multicast routing	
UNIT – IV : TRANSPORT LAYER	**(9 Periods)**
Introduction to Transport layer services – Multiplexing and demultiplexing – Principles of reliable data transfer - User Datagram Protocol (UDP)– Connection Oriented Transport - Transmission Control Protocol (TCP) - Flow Control – Congestion Control	
UNIT – V : APPLICATION LAYER	**(9 Periods)**
Network Security - Principles of Network applications - Application Layer Protocols – Web and HTTP – FTP – Telnet – Email – DNS – Peer to peer applications	

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. *Andrew S. Tanenbaum,* ***"Computer networks"****, 5th edition ,Pearson Education, 2013.*
2. *Larry L. Peterson, Bruce S. Davie* ***"Computer Networks: A Systems Approach"*** *Fifth Edition, Morgan Kaufmann Publishers Inc., 2011*

REFERENCE BOOKS:

1. *William Stallings,* ***"Data and Computer Communications",*** *Tenth Edition, Pearson Education, 2013.*
2. *Behrouz A. Forouzan and Firouz Mosharraf,* ***"Computer Networks a Top Down Approach",*** *Tata McGraw-Hill, 2011.*
3. *James F. Kurose, Keith W. Ross* ***"Computer Networking, A Top-Down Approach Featuring the Internet"*** *Sixth Edition, Pearson Education, 2012*
4. *Douglas E. Comer,* ***"Internetworking with TCP/IP (Volume I) Principles, Protocols and Architecture"****, Sixth Edition, Pearson Education, 2013.*

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

CO1: Explain data communication systems and its components **[Familiarity]**

CO2: Identify the different types of network topologies and protocols **[Familiarity]**

CO3: Enumerate the layers of the OSI model and TCP/IP and Explain the functions of each layer **[Familiarity]**

CO4: Identify the design issues of physical, data link, network, transport and application layers **[Familiarity]**

CO5: Describe basic protocols of Computer Networks and how they can be used to assist in network design and implementation. **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	M	M	M	L	M	L	H	L	M		L	H	H	M	H
CO2	H	M	M	M	L	M	L	H	L	M		L	H	H	M	H
CO3	H	M	M	M	L	M	L	H	L	M		L	H	H	M	H
CO4	H	M	M	M	L	M	L	H	L	M		L	H	H	M	H
CO5	H	M	M	M	L	M	L	H	L	M		L	H	H	M	H
18SPC503	H	H	H	H	M	M	L	H	L	M		M	H	H	M	H

L-Low, M-Moderate(Medium), H-High

18SPC504	DESIGN AND ANALYSIS OF ALGORITHMS	SEMESTER V

Category: PC

PRE-REQUISITES:

1. 18SPC306 Data Structures

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Different approaches for algorithm analysis.
- Decrease and Conquer technique.
- Greedy approach, Divide and Conquer and Dynamic Programming technique.
- Backtracking and Branch and Bound technique.
- Approximation and Randomized algorithms.

UNIT – I : INTRODUCTION TO ALGORITHM ANALYSIS	(9+3 Periods)
Fundamentals of Algorithmic Problem Solving - Important Problem Types - Fundamentals of the Analysis of Algorithm Efficiency - Asymptotic Notations and Basic Efficiency Classes - Mathematical Analysis of Nonrecursive Algorithms - Mathematical Analysis of Recursive Algorithms - Amortized Analysis - Empirical Analysis of Algorithms - Algorithm Visualization	
UNIT – II : DECREASE AND CONQUER TECHNIQUE	**(9+3 Periods)**
Decrease by constant: Insertion sort - Topological algorithm. Decrease-by-a-Constant-Factor: Binary Search - Fake-Coin Problem - Russian Peasant Multiplication - Josephus Problem. Variable-Size-Decrease - Computing a Median and the Selection Problem - Interpolation Search - Searching and Insertion in a Binary Search Tree - The Game of Nim.	
UNIT – III : ALGORITHM DESIGN TECHNIQUES -I	**(9+3 Periods)**
Greedy Approach : Prim's algorithm- Kruskal's Algorithm- Dijkstra's Algorithm - Huffman Trees and codes .Divide and Conquer : Merge Sort – Quick sort - Matrix Multiplication of Large Integers - Strassen's Matrix Multiplication .Dynamic Programming : Matrix Chain Multiplication – Knapsack problem and Memory Function – optimal binary search tree - Warshall's and Floyd's Algorithms – Longest common Subsequence	
UNIT – IV : ALGORITHM DESIGN TECHNIQUES -II	**(9+3 Periods)**
Backtracking: n-Queen problem – Hamilton Circuit Problem – Subset sum problem - CNF –SAT .Branch and Bound: Assignment problem – Knapsack problem - Travelling Salesman Problem.	
UNIT – V : NP COMPLETENESS	**(9+3 Periods)**
Introduction to NP Class – NP Completeness and Reducibility - Approximation Algorithm for NP Hard Problems: TSP - Knapsack problem – Randomization and Linear Programming.	

Contact Periods:
Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods

TEXT BOOKS:

1. *Anany Levitin "**Introduction to the Design and Analysis of Algorithms**" Third Edition, Pearson Education, 2012*
2. *Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein "**Introduction to Algorithms**" Third Edition, MIT Press/McGraw-Hill, 2009.*

REFERENCE BOOKS:

1. *Michael T Goodrich and Roberto Tamassia,* ***"Algorithm Design: Foundations, Analysis, and Internet Examples",*** *Second Edition, Wiley, 2006.*
2. *Mark de Berg, Mark van Kreveld, Mark Overmars and Otfried Shwarzkopf (Cheong),* ***"Computational Geometry: Algorithms and Applications",*** *Third edition, Springer-Verlag, 2008.*
3. *Skiena S. Steven* ***"The algorithm design manual",*** *Second edition, Springer 2008.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze the time complexity of given problem. **[Assessment]**
CO2: Explain and apply Decrease and Conquer algorithm. **[Usage]**
CO3: Derive and solve recurrences describing the performance of divide-and-conquer algorithms. **[Usage]**
CO4: Identify and apply Greedy approach and Dynamic Programming technique. **[Usage]**
CO5: Analyze algorithm deploying Backtracking and Branch and Bound technique.**[Assessment]**
CO6: Describe Approximation and randomized algorithm. **[Familiarity]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	H	H							H	H	H	H	H
CO2	H	H	H	H	H							H	H	H	M	H
CO3	H	H	H	H	H							H	H	H	M	H
CO4	H	H	H	H	H							H	H	H	M	H
CO5	H	H	H	H	H							H	H	H	M	H
CO6	L	L	H	M	H							M	M	M	M	H
18SPC504	H	H	H	H	H							H	H	H	M	H

L - Low, M - Moderate (Medium), H - High

18SPC507	COMPUTER NETWORKS LABORATORY	SEMESTER V

PRE-REQUISITES: NIL **Category: PC**

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Implementation of various network protocols
- Client-server communication using socket programming
- TRACEROUTE, PING commands and RPC
- Configuration of routers and switches
- Network simulation tools

LIST OF EXPERIMENTS

Experiments should be implemented in Java/NS2/NS3/Wireshark

1. Implementation of Stop and Wait Protocol and Sliding Window Protocol.
2. Implement Socket Programming and Client – Server model
3. Write a code to simulate ARP /RARP protocols.
4. Write a code to simulate PING and TRACEROUTE commands
5. Create a socket for HTTP for web page upload and download.
6. Write a program to implement RPC (Remote Procedure Call)
7. Devise IP address plan for a mid-size Org network using ideas of subnetting and VLSM.
8. Implement the plan on a simulated network and assign addresses using a DHCP server
9. Study and configure functionalities of a router and switches (or by simulation)
10. Packet sniffing using WIRESHARK application
11. Perform the following

- LEACH protocol simulation.
- Performance comparison of MAC protocols.
- LAN simulation.
- Measuring network performance.
- Simulating a MANET.

Contact Periods:

Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**

COURSE OUTCOMES:

Upon completion of this course, the students will be able to,

CO1: Implement various network protocols **[Usage]**
CO2: Create client-server communication using socket programming **[Usage]**
CO3: Simulate TRACEROUTE, PING, RPC **[Usage]**
CO4: Configure routers and switches **[Usage]**
CO5: Use network simulation tools **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	H	H	L	L	M	L	L	L	M	H	M	L	H
CO2	H	H	H	H	H	L	L	M	L	L	L	M	H	M	L	H
CO3	H	H	M	H	H	L	L	M	L	L	L	H	H	M	L	H
CO4	H	H	H	H	H	L	L	M	L	L	L	M	H	M	L	H
CO5	H	M	M	M	L	L	L	H	L	L	L	L	H	M	L	H
18SPC507	H	H	H	H	H	L	L	M	L	L	L	M	H	M	L	H

L-Low, M- Moderate(Medium), H-High

18SEE508	EMBEDDED COMPUTING SYSTEMS LABORATORY	SEMESTER V

PRE-REQUISITES : **Category: EEC**

1.18SPC308 - Digital Systems Laboratory

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Implementation of Assembly programs on ARM based Processor
- Configuration of GPIO port pins
- Usage of Timer and Interrupt handler
- Concept of Interfacing with other devices.

LIST OF EXPERIMENTS

1. Study of ARM based Processor
2. Simple Assembly Program for
    a. Addition | Subtraction | Multiplication | Division
    b. Operating Modes, System Calls and Interrupts
    c. Loops, Branches, Operators.
3. Write an Assembly programs to configure and control General Purpose Input/output (GPIO) port pins.
4. Write an Assembly programs to read digital values from external peripherals and execute them with the Target board.
5. Program to perform reading and writing from a file
6. Program to demonstrate Time delay program using built in Timer / Counter feature on IDE environment
7. Program to demonstrate a simple interrupt handler and setting up a timer.
8. Program to Interface 8 Bit LED and Switch Interface
9. Program to implement Buzzer Interface on IDE environment
10. Program to display a message in a 2 line x 16 Characters LCD display and verify the result in debug terminal.
11. Mini project

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

Upon completion of this course, the students will be able to,

CO1: Write simple Assembly program in an ARM based Processor**[Usage]**

CO2: Write Assembly program for configuring GPIO port pin ,Timer and Interrupts **[Assessment]**

CO3: Demonstrate the Usage of Files **[Usage]**

CO4: Write programs that interact with other devices like LED, Switch and LCD **[Assessment]**

CO5: Develop simple Embedded applications**[Assessment]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	L	H	M	M							M	H	H	H	H
CO2	M	L	H	M	M							M	H	H	H	H
CO3	L	L	L	L	M							M	L	L	L	M
CO4	L	L	L	L	M	L						M	L	H		M
CO5	H	L	H	M	M	L	L	L	L	L	L	M	H	H	H	H
18SEE508	H	L	H	M	M	L	L	L	L	L	L	M	H	H	H	H

L-Low, M- Moderate (Medium), H-High

18SPC601	DIGITAL SIGNAL PROCESSING AND APPLICATIONS	SEMESTER VI

PRE-REQUISITES : **Category: PC**

1. 18SES402 – Analog and Digital Communication

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Describing the fundamentals of signals and systems.
- Solving the problems using DFT and FFT.
- Describing methods to learn the IIR filters
- Describing methods to learn the FIR filters
- Acquiring knowledge on signal conversion and errors in real time applications of DSP

UNIT – I : SIGNALS AND SYSTEMS	**(9+3 Periods)**
Basic Elements of Digital Signal Processing – Concept of Frequency in Continuous Time and Discrete Time Signals – Sampling Theorem – Discrete Time Signals – Discrete Time Systems – Analysis of Linear Time Invariant Systems – Z Transform – Convolution and Correlation	
UNIT – II : FAST FOURIER TRANSFORMS	**(9+3 Periods)**
Introduction to DFT – Efficient Computation of DFT – Properties of DFT – FFT Algorithms – Radix-2 and Radix-4 FFT Algorithms – Decimation in Time – Decimation in Frequency– Use of FFT Algorithms in Linear Filtering and Correlation.	
UNIT – III : IIR FILTER DESIGN	**(9+3 Periods)**
Structure of IIR – System Design of Discrete Time IIR filter From Continuous Time Filter – IIR Filter Design by Impulse Invariance – Bilinear Transformation – Approximation Derivatives – Design of IIR Filter in the Frequency Domain.	
UNIT – IV : FIR FILTER DESIGN	**(9+3 Periods)**
Symmetric and Anti-symmetric FIR Filters – Linear Phase Filter – Windowing Technique – Rectangular– Kaiser Windows– Frequency Sampling Techniques – Structure for FIR Systems.	
UNIT – V : FINITE WORD LENGTH EFFECTS	**(9+3 Periods)**
Quantization Noise – Derivation for Quantization Noise Power – Fixed Point and Binary Floating Point Number Representation – Comparison – Over Flow Error – Truncation Error – Co-Efficient Quantization Error – Limit Cycle Oscillation – Signal Scaling – Analytical Model of Sample and Hold Operations – Application of DSP – Model of Speech Wave Form – Vocoder.	

Contact Periods:
Lecture: 45 Periods **Tutorial: 15 Periods** **Practical: 0 Periods** **Total: 60 Periods**

TEXT BOOKS:

1. *John G Proakis and Dimtris G Manolakis* ***"Digital Signal Processing Principles – Algorithms and Application"*** *Fourth Edition, PHI/Pearson Education, 2007*
2. *Alan V Oppenheim, Ronald W Schafer and John R Buck* ***"Discrete Time Signal Processing"****, PHI/Pearson Education, 2000*

REFERENCE BOOKS:

1. *SanjitK.Mitra,* ***"Digital Signal Processing A Computer - Based Approach",*** *Second Edition, Tata McGraw-Hill, 2001.*
2. *JohnyR.Johnson,* ***"Introduction to Digital Signal Processing",*** *Prentice Hall of India/Pearson Education, 2002.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Compute convolution of continuous and discrete time signals and use Z Transform to analyse discrete time systems. **[Usage]**

CO2: Analyse computational complexity of Fast Fourier transform and apply FFT for linear filtering and correlation **[Usage]**

CO3: Transform differential equations into direct form structures for IIR filters**. [Usage]**

CO4: Design FIR filters using windowing, rectangular, Kaiser and frequency sampling techniques**. [Usage]**

CO5: Compare overflow, truncation and Co-efficient errors**. [Assessment]**

CO6: Describe the application of DSP in designing of vocoder. [**Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	M	H	M	M				M	L	M	L	L	M	H	H
CO2	H	H	H	M	M				M	L	M	M	H	M	M	M
CO3	H	H	M	H	M					L	M	M	H	M	M	H
CO4	H	M	H	M	M			M	M	H	M	M	H	H	M	M
CO5	H	M	H	M	M				M	M	M	M	M	L	M	M
CO6	H	M	H	M	M	L	L	H	H	M	M	M	H	H	H	H
18SPC601	H	M	H	M	M	L	L	M	M	M	M	M	M	M	M	H

L - Low, M - Moderate (Medium), H - High

18SPC602	COMPILER DESIGN	SEMESTER VI

PRE-REQUISITES:
1. 18SPC406 – Theory of Computation

Category: PC

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

Upon completion of this course, the students will be familiar with:

- Lexical Analysis
- Syntax Analysis
- Intermediate code generation
- Runtime environment and code generation
- Code optimization

UNIT – I : LEXICAL ANALYSIS	**(9 Periods)**
Translators-Compilation and Interpretation-Language processors -The Phases of Compiler-Errors Encountered in Different Phases-The Grouping of Phases-Compiler Construction Tools - Programming Language basics. Need and Role of Lexical Analyzer-Lexical Errors-Expressing Tokens by Regular Expressions-Converting Regular Expression to DFA- Minimization of DFA.	
UNIT – II : SYNTAX ANALYSIS	**(9 Periods)**
Need and Role of the Parser-Context Free Grammars -Top Down Parsing -General Strategies-Recursive Descent Parser Predictive Parser-LL(1) Parser-Shift Reduce Parser-LR Parser-LR (0)Item-Construction of SLR Parsing Table -Introduction to LALR Parser - Error Handling and Recovery in Syntax Analyzer-YACC-Design of a syntax Analyzer for a Sample Language.	
UNIT – III : INTERMEDIATE CODE GENERATION	**(9 Periods)**
Syntax Directed Definitions, Evaluation Orders for Syntax Directed Definitions, Syntax Directed Translation Schemes, Intermediate Languages: Syntax Tree, Three Address Code, Postfix Code, Declarations, Translation of Expressions, Type Checking, Back Patching.	
UNIT – IV : RUNTIME AND OBJECT CODE GENERATION	**(9 Periods)**
Storage Organization, Stack Allocation Space, Access to Non-local Data on the Stack, Heap Management - Issues in Code Generation - Design of Code Generator - Register Allocation and Assignment – Instruction Selection by Tree Rewriting – Optimal Code Generation for Expressions – Dynamic Programming Code Generation.	
UNIT – V : CODE OPTIMIZATION	**(9 Periods)**
Basic Blocks and Flow Graphs – Optimization of Basic Blocks – Principal Sources of Optimizations – Data Flow Analysis – Constant Propagation – Partial Redundancy Elimination – Peephole Optimizations.	

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. *Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman* ***"Principles, Techniques and Tools"*** *Second Edition, Pearson Education, 2009.*

REFERENCE BOOKS:

1. *Randy Allen, Ken Kennedy,* ***"Optimizing Compilers for Modern Architectures: A Dependence-based Approach"****, Morgan Kaufmann Publishers, 2002*
2. *Steven S. Muchnick,* ***"Advanced Compiler Design and Implementation"****, Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2003*
3. *Keith D Cooper and Linda Torczon,* ***"Engineering a Compiler",*** *Morgan Kaufmann Publishers Elsevier Science, 2004*
4. *V. Raghavan,* ***"Principles of Compiler Design"****, Tata McGraw Hill Education Publishers, 2010*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to,

CO1: Construct lexical analyzer **[Usage]**

CO2: Design top down and bottom up parsers **[Usage]**

CO3: Generate intermediate codes **[Usage]**

CO4: Simulate run time environment **[Usage]**

CO5: Generate Machine codes **[Usage]**

CO6: Apply right code optimization techniques **[Assessment]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	H	H	M	L	H	M	M	L	M	H	H	M	H
CO2	H	H	H	H	H	M	L	H	M	M	L	M	H	H	M	H
CO3	H	H	H	H	H	M	L	H	M	M	L	M	H	H	M	H
CO4	H	H	H	H	H	M	L	H	M	M	L	M	H	H	M	H
CO5	H	H	H	H	H	M	L	H	M	M	L	M	H	H	M	H
CO6	H	H	M	H	H	M	L	H	M	M	L	H	H	H	M	H
18SPC602	H	H	H	H	H	M	L	H	M	M	L	H	H	H	M	H

L-Low, M-Moderate(Medium), H-High

18SPC603	SOFTWARE ENGINEERING METHODOLOGIES	SEMESTER VI

PRE-REQUISITES: NIL **Category: PC**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Software Process models
- Software Requirement Analysis and design
- Aspects related to Software Quality
- Software Estimation techniques and Testing Methodology
- SCRUM Development Process

UNIT – I : SOFTWARE PROCESS MODEL	**(9 Periods)**
Principle of Software engineering – Software myths - Prescriptive process model: Waterfall Model - Incremental Process Models - Evolutionary Process Models - Concurrent Models–Unified process – Agile Development: Agility Principles - Extreme Programming - Other Agile Process Model.	
UNIT – II : SOFTWARE REQUIREMENT MODELING	**(9 Periods)**
Requirement Engineering – Eliciting Requirement - Quality Function Deployment - Building Requirement model - Negotiating Requirement - Validating Requirement - Requirement Analysis - Scenario Based Modeling - Data Modeling - Class Based Modeling - Flow Oriented Modeling - Case Study	
UNIT – III : SOFTWARE DESIGN AND ESTIMATION	**(9 Periods)**
Design Process - Design Concepts – Design model - architectural design - component level design – User interface design .Software Project Estimation – Decomposition techniques- Empirical Estimation model – specialized estimation technique for Agile Development - project scheduling - risk management	
UNIT – IV : SOFTWARE QUALITY AND TESTING	**(9 Periods)**
Software Quality – Review Techniques – Software Quality Assurance – Strategic approach to software testing – Testing Strategies for Conventional software- Object- Oriented software – Validation testing –system testing –Art of Debugging – Testing Conventional Application – Testing Object- Oriented Application - Case study Tarantula : Software testing tool for Agile Development	
UNIT – V : INTRODUCTION TO SCRUM DEVELOPMENT PROCESS	**(9 Periods)**
Basics of Scrum – Running a Scrum project – Steps for transition to scrum – Metrics for scrum –Case Study	

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Roger Pressman.S,* ***"Software Engineering: A Practitioner's Approach",*** *Eighth Edition, McGraw Hill, 2010.*
2. *Ian Sommerville,* ***"Software Engineering"****, Nineth Edition, Pearson Education Asia, 2011.*
3. *Mark C. Layton* ***, "Scrum For Dummies"*** *John Wiley & Sons Inc,2015.*

REFERENCE BOOKS:

1. *Shari Lawrence Pfleeger, Joanne M. Atlee,* ***"Software Engineering: Theory and Practice",*** *Fourth Edition, Pearson Education, 2011.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Describe different models of the software development process, their drawbacks and when they are applicable **[Familiarity]**

CO2: Design requirement model for a software project **[Assessment]**

CO3: Perform architectural design, component level design and UI design for a software project. **[Assessment]**

CO4: Apply effort and schedule estimation models .**[Assessment]**

CO5: Apply testing strategies to verify and validate a software application. **[Usage]**

CO6: Develop Software using SCRUM development process**.[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	M								M	L	H		H
CO2	H	H	H	H	H				H	H	H	H	H	H	L	H
CO3	H	H	H	H	H				H	H	H	H	H	H	L	H
CO4	L	L	M	L	H				H	H	H	L	L	H		
CO5	H	H	H	M								M	L	H		H
CO6	H	H	H	H	H				H	H	H	H	H	H	L	H
18SPC603	H	H	H	M								M	L	H		H

L - Low, M - Moderate (Medium), H - High

18SPC607	COMPILER DESIGN LABORATORY	SEMESTER VI

PRE-REQUISITES: NIL **Category: PC**

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Compiler writing tools.
- Implement the different Phases of compiler
- Control flow and data flow analysis
- Storage allocation strategies
- Simple optimization techniques

LIST OF EXPERIMENTS

EXERCISES ILLUSTRATING THE FOLLOWING CONCEPTS:

1. Implementation of Symbol Table
2. Develop a lexical analyzer to recognize a few patterns in C. (Ex. identifiers, constants, comments, operators etc.)
3. Implementation of Lexical Analyzer using Lex Tool
   a. Tokenizer with LEX for declarations in C language.
   b. Tokenizer with LEX for assignment statement.
4. Generate YACC specification for a few syntactic categories.
   a) Program to recognize a valid arithmetic expression that uses operators +, - , * and /.
   b) Program to recognize a valid variable which starts with a letter followed by any number of letters or digits.
   c) Implementation of Calculator using LEX and YACC
5. Convert the BNF rules into Yacc form and write code to generate Abstract Syntax Tree.
6. Implement type checking
7. Implement control flow analysis and Data flow Analysis
8. Implement any one storage allocation strategies (Heap,Stack,Static)
9. Construction of DAG
10. Implement the back end of the compiler which takes the three address code and produces the 8086 assembly language instructions that can be assembled and run using a 8086 assembler. The target assembly instructions can be simple move, add, sub, jump. Also simple addressing modes are used.
11. Implementation of Simple Code Optimization Techniques (Constant Folding., etc.)

Contact Periods:

Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**

COURSE OUTCOMES:

Upon completion of this course, the students will be able to,

CO1: Implement the different Phases of compiler using tools **[Usage]**

CO2: Analyze the control flow and data flow of a typical program **[Usage]**

CO3: Illustrate storage allocation strategies **[Usage]**

CO4: Optimize a given program **[Usage]**

CO5: Generate an assembly language program equivalent to a source language program **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	H	H	L	M	M	M	M		M	H	H	M	H
CO2	H	H	H	H	H	L	M	M	M	M		M	H	H	M	H
CO3	H	H	H	H	H	L	M	M	M	M		M	H	H	M	H
CO4	H	H	H	H	H	L	M	M	M	M		M	H	H	M	H
CO5	H	H	H	H	H	L	M	M	M	M		M	H	H	M	H
18SPC607	H	H	H	H	H	L	M	M	M	M		M	H	H	M	H

L-Low, M-Moderate(Medium), H-High

18SVL608	SOFTWARE ENGINEERING METHODOLOGIES LABORATORY	SEMESTER VI

PRE-REQUISITES: NIL

Category: EEC

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- SRS preparation
- UML diagrams and Software Project Cost Estimation.
- Testing strategies
- Designing and developing webpage using Restful Web Services

LIST OF EXPERIMENTS:

SOFTWARE ENGINEERING:

1. Prepare SRS for an Application
2. Design UML diagrams for an application
3. Perform software Project Estimation
4. Perform software testing (Blackbox and Whitebox)
5. Mini project.

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Design an SRS for given application **[Assessment]**
CO2: Apply UML and Dataflow diagram to model an system **[Usage]**
CO3: Estimate the cost for a application using LOC based estimation, FP based estimation and COCOMO model **[Assessment]**
CO4: Demonstrate the use of Time line charts **[Usage]**
CO5: Apply black box testing to test the functionalities of the application **[Usage]**
CO6: Apply white box testing to test the structure of the system **[Usage]**
CO7: Develop mini project using software engineering concepts **[Assessment]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	H	H	M	H				H	H	H	H	H	H	H
CO2	H	H	H	H	H				H	H	H	H	H	H	H
CO3	H	H	H	H	H				H	H	H	H	H	H	H
CO4	H	H	H	H	H				H	H	H	H	H	H	H
CO5	H	H	H	H	H				H	H	H	H	H	H	H
CO6	H	H	H	H	H				H	H	H	H	H	H	H
CO7	H	H	H	H	H				H	H	H	H	H	H	H
18SVL608	H	H	H	H	H				H	H	H	H	H	H	H

L - Low, M - Moderate (Medium), H - High

18SPC701	MACHINE LEARNING	SEMESTER:VII

PRE-REQUISITES: NIL **Category: PC**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Basic underlying concepts, Characterise for machine learning algorithms.
- Neural networks, support vector machine and few machine learning tools.
- Bayesian techniques and Inference and learning algorithms for the hidden Markov Model.
- Instant based learning and clustering.
- Ensemble methods and reinforcement learning algorithms.

UNIT – I : INTRODUCTION, CONCEPT LEARNING	**(9 Periods)**
Introduction- Well-Posed learning problems, Designing a learning system, perspectives and Issues in machine learning. Types of machine learning – Concept Learning – version spaces and candidate elimination algorithm – inductive bias –machine learning tools-R, Scikit Learn	
UNIT – II : SUPERVISED LEARNING	**(9 Periods)**
Linear Regression – Classification – Support Vector Machines – Neural Network Representation – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Decision tree Learning – issues in decision tree learning- K- Nearest Neighbor Learning – Locally Weighted Regression – Radial Basis Functions.	
UNIT – III : UNSUPERVISED LEARNING	**(9 Periods)**
Clustering- Mixture Densities- K-means clustering- Hierarchical Clustering-Distributional clustering - Association Rules - The Curse of dimensionality- Dimensionality reduction. -Principal Component Analysis.	
UNIT – IV : BAYESIAN AND PROBABILISTIC GRAPHICAL MODELS	**(9 Periods)**
Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier– Bayesian Belief Network – EM Algorithm – Graphical models - Directed and undirected graphical model - Conditional Independence properties-Hidden Markov Models.	
UNIT – V : ENSEMBLE METHODS AND REINFORCED LEARNING	**(9 Periods)**
Ensemble Methods- basic concepts - popular learning algorithms - Evaluation and Comparison-Bagging - Boosting-Combination Methods - Averaging, Voting– Reinforcement Learning – introduction – Learning Task – Q-Learning – Temporal Difference Learning.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Tom Mitchell,* ***"Machine Learning"*** *McGraw-Hill, 2013.*
2. *Ethem Alpaydin,* ***"Introduction to Machine Learning"****, MIT Press, Third Edition, 2014.*

REFERENCE BOOKS:

1. *Zhi Hua Zhon,* ***"Ensemble Methods: Foundation and Algorithms",*** *CRC Press, 2012.*
2. *Kevin P. Murphy,* ***"Machine Learning: A Probabilistic Perspective",*** *MIT Press, 2012.*
3. *Trevor Hastie, Robert Tibshirani, Jerome Friedman,* ***"The Elements of Statistical Learning"****, Springer, Second Edition, 2011.*
4. *Richard Sutton and Andrew Barto,* ***"Reinforcement Learning: An introduction"****. MIT Press,2017.*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Explain and discuss the basic concepts, the fundamental issues and challenges of machine learning algorithms and the Decision tree learning. **[Familiarity].**

CO2: Apply effectively neural networks and support Vector Machines for appropriate applications. **[Usage].**

CO3: Design and implement some basic machine learning algorithms using Machine learning tools**. [Usage].**

CO4: Apply Bayesian techniques and Hidden Markov Models.**[Usage].**

CO5: Discuss the basic concepts Instant based learning and Clustering**. [Familiarity].**

CO6: Explain and discuss the basic concepts and architecture of reinforcement learning algorithms and Ensembles Methods. **[Familiarity].**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	H	H	L		M	M			M	H	M	H	L
CO2	H	H	H	H	H	L		M	M			M	H	M	H	L
CO3	H	H	H	H	H	L		M	M			M	H	M	H	L
CO4	H	H	H	H	H	L		M	M			M	H	M	H	L
CO5	H	H	H	H	H	L		M	M			M	H	M	H	L
CO6	H	H	H	H	H	L		M	M			M	H	M	H	L
18SPC 701	H	H	H	H	H	L		M	M			M	H	M	H	L

L - Low, M - Moderate (Medium), H - High

18SPC702	ARTIFICIAL INTELLIGENCE	SEMESTER: VII

PRE-REQUISITES: NIL **Category: PC**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Fundamental concepts of Artificial Intelligence.
- Algorithms to solve real world problems.
- Methods to represent knowledge and understand real world problems.
- Construction of plans and making decisions in the presence of uncertainty.
- Learning techniques and Natural Language Processing.

UNIT – I : INTRODUCTION	**(9 Periods)**
Introduction to Artificial Intelligence – AI Applications – Turing test and Rational Test Approaches – Problem Solving – AI problems - Production Systems – Control Strategies – Reasoning – Forward and Backward Reasoning. AI Agents – Types – Structure – Behavior and Environment.	
UNIT – II : SEARCHING TECHNIQUES AND GAME PLAYING	**(9 Periods)**
Breadth first Search – Depth first Search – Heuristics Search – Iterative Deepening – Hill Climbing –Simulated annealing - Best first search, A* algorithm, AO* algorithm, Minmax & game trees, refining minmax, Alpha – Beta pruning, Means End analysis and constraint satisfaction	
UNIT – III : KNOWLEDGE REPRESENTATION	**(9 Periods)**
First order predicate calculus, Resolution, Unification, Natural deduction system, Refutation, Logic programming, PROLOG, Semantic networks, Frame system, Value inheritance, Conceptual dependency, Ontologies	
UNIT – IV : PLANNING AND UNCERTAINTY	**(9 Periods)**
Representation for planning, Symbolic-Centralized vs. Reactive-Distributed, Partial order planning algorithm. Uncertainty – Types - degree of belief and truth, Probability constructs - prior probability, conditional probability, probability axioms, probability distributions, and joint probability distributions, Bayes' rule, Dempster-Shafer theory	
UNIT – V : LEARNING AND NATURAL LANGUAGE PROCESSING	**(9 Periods)**
Learning from Observations – Inductive Learning – Learning Decision Trees. Natural Language Processing - Parsing Techniques, components of communication – Formal Vs Natural Languages in the context of grammar - Parsing – Semantics - Recursive and Augmented Transition Nets.	

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. *Russell and Norvig, **"Artificial Intelligence, A Modern Approach"**, 3rd edition, Pearson Prentice Hall,2010.*
2. *Elaine Rich,Kevin Knight,Shivashankar B. Nair, **"Artificial Intelligence"**, 3rd edition, Tata McGraw Hill, 2009.*

REFERENCE BOOKS:

1. *Dan W. Patterson,* ***"Introduction to Artificial Intelligence and Expert Systems"****, Prentice Hall of India, 2009.*
2. *Akerkar,* ***"Introduction to Artificial Intelligence"****, Prentice-Hall of India, 2011*
3. *Deepak Khemani,* ***"A First Course in Artificial Intelligence",*** *Tata Mc Graw Hill Education 2013*
4. *William F. Clocksin, Christopher S. Mellish,* ***"Programming in Prolog"****, 5th Edition Springer-Verlag, 2008.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Explain applications of Artificial Intelligent and structure of AI Agents **[Familiarity]**
CO2: Use Search Algorithms to solve real world AI problems **[Usage]**
CO3: Use PROLOG to express relations and rrepresent knowledge using Semantic Nets **[Usage]**
CO4: Reason facts by constructing plans and understand uncertainty by effective decision making **[Usage]**
CO5: Understand Natural Language Processing techniques. **[Familiarity]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	H	H	H	L				H	H	H	H	M	M	M	M
CO2	H	H	H	H	L				H	H	H	H	M	M	M	M
CO3	L	L	L	L	M				L	L	L	H	M	M	M	M
CO4	L	H	M	M	M				H	M	L	H	L	L	L	L
CO5	H	H	H	M	L				H	H	M	H	M	M	M	M
18SPC702	H	H	H	M	M				H	M	L	H	M	M	M	M

L - Low, M - Moderate (Medium), H - High

18SPC703	COMPUTER GRAPHICS AND VISUALIZATIONS	SEMESTER: VII

PRE-REQUISITES: NIL **Category: PC**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Computer graphics hardware , software and algorithms which includes line, circle and ellipse drawing.
- Geometric transformations on graphics objects.
- Classical two and three dimensional viewing
- Representation of Curves and surfaces.
- Color models, Visualization Principles and algorithms.

UNIT – I : INTRODUCTION	**(9 Periods)**
Computer Graphics hardware–software–Introduction to OpenGL–Basic OpenGL programming–graphics Output primitives–Attributes of graphics primitives–Implementation algorithms for graphics primitives and attributes-Line-Circle and Ellipse drawing algorithms.	
UNIT – II : 2D GEOMETRIC TRASFORMATIONS & VIEWING	**(9 Periods)**
Basic 2D Geometric Transformations – Matrix Representations – Composite Transformations – Reflection and Shearing Transformations- 2D Viewing-The Viewing pipeline – Normalization and Viewport Transformations – Two Dimensional Viewing Functions- Clipping Operations –Point Clipping –Cohen-Sutherland Line Clipping – Liang - Barsky Line Clipping – Sutherland - Hodgman Polygon Clipping.	
UNIT – III : 3D GEOMETRIC TRASFORMATIONS	**(9 Periods)**
3D Transformations-Translation–Rotation–Scaling–Reflection and Shear- Composite transformations – Transformations between 3D coordinate systems-Affine Transformations - 3D clipping algorithms – Clipping in Three-Dimensional Homogeneous Coordinates- Three- Dimensional Region Codes- Three Dimensional Point and Line clipping - Three-Dimensional Polygon Clipping.	
UNIT – IV : 3D OBJECT VIEWING & REPRESENTATIONS	**(9 Periods)**
3D viewing pipeline-viewing coordinate parameters- Transformation from World to Viewing coordinates – Projection Transformations-Viewport Transformation and 3D screen coordinates-Parallel Projection-Perspective Projection – Curved surfaces – Quadric surfaces–Interpolation and Approximation Splines - Bezier Spline curves.	
UNIT – V : COLOR MODELS AND VISUALIZATION	**(9 Periods)**
Color Models – Standard Primaries and the Chromaticity Diagrams –The RGB Color Model – YIQ and related Color Models – CMY and CMYK Color Models – HSV and HLS Color Models–Visualization: Visualization Principles-Color in Graphics and Visualization-Scientific Visualization algorithms. OPENGL:Orthographic projection, viewing box, world coordinates-the OpenGL window and screen coordinates-OpenGL Geometric primitives-special visualization techniques: blending, fog, antialiasing points, lines, multisampling polygons.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Donald Hearn and Pauline Baker**, "Computer Graphics with OpenGL"** fourth edition, Pearson Education, 2014.*
2. *T. Theoharis, Georgios Papaioannou, Nikolaos Platis, **"Graphics and Visualization: Principles & Algorithms"**, CRC Press,2008.*
3. *Sumanta Guha**, "Computer Graphics Through OpenGL®: From Theory to Experiments"** 3rd Edition, CRC Press, 2018**.***

REFERENCE BOOKS:

1. *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",** Third Edition, AddisonWesley Professional, 2013.*
2. *F. S. Hill Jr. and S. M. Kelley, **"Computer Graphics using OpenGL"**, third edition, Prentice Hall, 2007.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Implement the drawing algorithms such as line, circle and ellipse. **[Usage]**
CO2: Perform transformations (rotation, scaling, translation, shearing) on 2D and 3D geometric objects. **[Usage]**
CO3: Apply line and polygon clipping algorithms on 2D and 3D objects **[Usage]**
CO4: Explain various 3D projections and current models for surfaces. **[Familiarity]**
CO5: Apply color and transformation techniques for various applications of computer graphics in the development of computer games, information visualization, and business applications. **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	M	H	L	M	M		M	M	H		M	H	L	H	M
CO2	H	L	M	M	M				M	H		M	H	L	M	M
CO3	H	L	M	M	M				M	H		H	H	M	M	H
CO4	H	L	M	M	M				M	H		M	H	L	M	M
CO5	H	M	H	L	M	M	M	M	H	H	M	M	H	L	H	M
18SPC703	H	L	M	M	M	M	M	M	M	H	M	M	H	L	M	M

L - Low, M - Moderate (Medium), H - High

18SPC707	MACHINE LEARNING LABORATORY	SEMESTER VII

PRE-REQUISITES: NIL **Category: PC**

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Basic knowledge of Machine learning tools.
- Basic concepts of learning algorithm.
- Decision Tree and Support Vector Machines.
- Back-propagation algorithm and Naive Bayes Algorithm.
- Instant based learning algorithm and Clustering
- Hidden Markov Models.

LIST OF EXPERIMENTS

EXERCISES ILLUSTRATING THE FOLLOWING CONCEPTS:

1. Study of machine learning tool R.
2. Study of machine learning tool Scikit Learn.
3. Implement the CANDIDATE – ELIMINATION algorithm. Show how it is used to learn from training examples and hypothesize new instances in Version Space.
4. Implement the FIND–S algorithm. Show how it can be used to classify new instances of target concepts. Run the experiments to deduce instances and hypothesis consistently.
5. Implement the ID3 algorithm for learning Boolean–valued functions for classifying the training examples by searching through the space of a Decision Tree.
6. Design and implement the Back-propagation algorithm by applying it to a learning task involving an application like FACE RECOGNITION.
7. Design and implement Naive Bayes Algorithm for learning and classifying TEXTDOCUMENTS.
8. Design and implement K-nearest Neighbor learning algorithm.
9. Design and implement Support Vector Machines.
10. Design and implement the Hidden Markov Models.
11. Design and implement the Clustering algorithm.

Contact Periods:

Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 60 Periods** **Total: 60 Periods**

COURSE OUTCOMES:

Upon completion of this course, the students will be able to,

CO1: Use appropriate Machine Learning tools **[Usage]**
CO2: Implement the CANDIDATE – ELIMINATION algorithm **[Usage]**
CO3: Implement the FIND–S algorithm **[Usage]**
CO4: Implement the ID3 algorithm.**[Usage]**
CO5: Design and implement the Back-propagation algorithm **[Usage]**
CO6: Design and implement Naïve Bayes Algorithm **[Usage]**
CO7: Design and implement K-nearest Neighbor learning algorithm. **[Usage]**
CO8: Design and implement Support Vector Machines. **[Usage]**
CO9. Design and implement the Hidden Markov Models. **[Usage]**
CO10. Design and implement the Clustering algorithm. **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	M	H	L	M	H	H	H	H	M	H	M	H	L
CO2	H	H	H	M	H	L	M	H	H	H	H	M	H	M	H	L
CO3	H	H	H	M	H	L	M	H	H	H	H	M	H	M	H	L
CO4	H	H	H	M	H	L	M	H	H	H	H	M	H	M	H	L
CO5	H	H	H	M	H	L	M	H	H	H	H	M	H	M	H	L
CO6	H	H	H	M	H	L	M	H	H	H	H	M	H	M	H	L
CO7	H	H	H	M	H	L	M	H	H	H	H	M	H	M	H	L
CO8	H	H	H	M	H	L	M	H	H	H	H	M	H	M	H	L
CO9	H	H	H	M	H	L	M	H	H	H	H	M	H	M	H	L
CO10	H	H	H	M	H	L	M	H	H	H	H	M	H	M	H	L
18SPC 707	H	H	H	M	H	L	M	H	H	H	H	M	H	M	H	L

L - Low, M - Moderate (Medium), H - High

18SEE708	MINI PROJECT	SEMESTER VII

PRE-REQUISITES: NIL

Category: EEC

L	T	P	C
0	0	8	4

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Knowledge of the mathematical, computational and natural sciences to develop applications for the benefit of society.
- Design, implement and document a project.

Contact Periods:

Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 120 Periods** **Total: 120 Periods**

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

CO1: Identify problem by considering societal / industrial demands **[Assessment]**
CO2: Use programming languages, design and simulation tools for implementation **[Usage]**
CO3: Function in a team at any role. **[Usage]**
CO4: Develop and deliver a good quality formal presentation. **[Usage]**
CO5: Write clear, concise, and accurate technical document**. [Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	H	H	H	H	H			H	H	H	H	H	H
CO2	H	H	H	H	H							H	H	H	H	H
CO3	H	H							H			H				H
CO4	H	H								H	H	H				H
CO5	H	H								H	H	H				H
18SEE708	H	H	M	M	M	L	L	L	M	M	M	H	M	M	M	H

L - Low, M - Moderate (Medium), H - High

18SEE803	PROJECT WORK	SEMESTER: VIII

PRE-REQUISITES: NIL **Category: EEC**

L	T	P	C
0	0	16	8

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Applying mathematical, computational and natural sciences knowledge gained by study, experience and practice with judgment to develop effective use of matter, energy and information to the benefit of mankind.
- Planning, executing and documenting a project.
- To construct logical and physical models to demonstrate the skills at assimilating, synthesizing and critically appraising all materials relevant to the project.

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 240 Periods Total: 240 Periods

COURSE OUTCOMES:

Upon completion of this course the students will be able to:
CO1: Identify problem by considering societal / industrial demands. **[Assessment]**
CO2: Perform exhaustive literature survey on identified problem. **[Assessment]**
CO3: Build feasible mathematical / logical model. **[Assessment]**
CO4: Use design / simulation tools like MATLAB, NS2, NS3, WEKA, etc.**[Usage]**
CO5: Function in a team at any role. **[Usage]**
CO6: Develop and deliver a good quality formal presentation. **[Usage]**
CO7: Write clear, concise, and accurate technical document. **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	H	H	H					H	H	H	H	H	H
CO2	H	H	H	H							H	H	H	H		H
CO3	H	H	H	H	H							H	H	H		H
CO4					H		H	H	H					H		H
CO5							H			H						
CO6										H						
CO7										H						
18SEE803	H	H	H	H	H	L	M	M	M	H	M	H	H	H	M	H

L - Low, M - Moderate (Medium), H - High

18SPE$01	INTRODUCTION TO WEB TECHNOLOGY

PRE-REQUISITES: NIL **Category: PE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

* Hyper Text Markup Language
* Cascading Style Sheets
* Client side scripting with Java script
* XML and Ajax enabled Internet application design
* Server side Development

UNIT – I : INTRODUCTION TO HTML AND CSS	**(9 Periods)**
Introduction to computers and Internet – HTML: Basic HTML Elements, Input and page structure Elements- Cascading Style Sheet: Inline and embedded Styles, Positioning elements, Backgrounds, Element Dimensions, Box Model and Text Flow, Media Types and queries, Shadows, Gradients, Animations, Transitions and Transformations, Web Font, Multi column Layout.	
UNIT – II : CLIENT SIDE SCRIPTING	**(9 Periods)**
Java script: Programming Basics- Introduction to Scripting, Control Statement, Functions, Arrays, Objects: Math, String, Date, Boolean, document Objects, Document Object Model, Event Handling.	
UNIT – III : XML and AJAX ENABLED RICH INTERNET APPLICATIONS	**(9 Periods)**
XML: Basics, Structuring Data, XML Name spaces, DTDs-Schema Documents, Extensible style sheet Language and XSL Transformation, DOM – Web application Development: Traditional Vs Ajax web application Development, RIA with Ajax, XML Http Request Object, Using XML and DOM, Application creation.	
UNIT – IV : SERVER SIDE DEVELOPMENT	**(9 Periods)**
Web Servers: HTTP Transactions, Multi tier Application Architecture, Accessing Web Servers, Apache, MySQL and PHP Installation, IIS Express and Web Matrix-Database: MySQL- PHP: Data Types, Operators, Arrays, String Processing, Form Processing and Business Logic, Reading from a Database, Cookies, Dynamic Content	
UNIT – V : SERVER-SIDE DEVELOPMENT WITH JSF AND JAVA	**(9 Periods)**
Java Server Faces: Application Development, Model View Controller Architecture, JSF Components, Validation, Session Tracking, Accessing Databases in Web Apps, Web Services: SOAP, REST, JSON, Publishing and Consuming SOAP based web services, REST based XML Web services, REST Based JSON Web Service.	

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. *Paul Deitel, Harvey Deitel, Abbey Deitel* ***"Internet and World Wide Web- How to Program"*** *Fifth Edition, Pearson,2012.*

REFERENCE BOOKS:

1. *Achyut Godbole, Atul Kahate,* ***"Web Technologies:TCP/IP to Internet Application Architectures"****, Tata McGraw-Hill Education, 2002.*
2. *Nicholas C. Zakas,* ***"Professional Javascript for Web Developers",*** *Third Edition, Wrox Press,2011.*
3. *Jon Duckett,* ***"Beginning Web Programming with HTML, XHTML and CSS"****, Wrox Press, 2004.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Design a web page with HTML elements and CSS. **[Usage]**
CO2: Write client side scripts using Javascript. **[Usage]**
CO3: Structure Data using XML. **[Usage]**
CO4: Create and access the web servers. **[Usage]**
CO5: Develop applications using JSF and Java **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	H	M			M		L	L	H	H	H	H	H
CO2	H	H	H	H	H			M		L	L	H	H	H	H	H
CO3	H	H	H	H	H			M		L	L	H	H	H	H	H
CO4	H	H	H	H	H			M		L	L	H	H	H	H	H
CO5	H	H	H	H	H			M		L	L	H	H	H	H	H
18SPE$01	H	H	H	H	H			M		L	L	H	H	H	H	H

L - Low, M - Moderate (Medium), H – High

18SPE$02	SIMULATION AND MODELING

PRE-REQUISITES: NIL

Category: PE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

* Role of modeling and simulation
* Simulation models
* Human interaction
* Verification and validation of simulation
* Uses and Future of Simulation

UNIT – I : INTRODUCTION TO MODELING AND SIMULATION	**(9 Periods)**
Modeling and Simulation: Models, History, Application areas, Advantages and disadvantages – Role of modeling and simulation: Using simulations to solve problems, uncertainty and its effects, Gaining insight, Simulation's lifetime.	
UNIT – II : SIMULATION MODELS	**(9 Periods)**
Discrete Event Simulation – Continuous Simulation – Queue Modeling and Simulation: Analytical solution, Queueing modeling, Sequential Simulation, SimPack queueing implementation, Parallel Simulation.	
UNIT – III : HUMAN INTERACTION, VERIFICATION AND VALIDATION	**(9 Periods)**
Simulation and data dependency – visual representation – performing verification and validation, Verification and validation examples.	
UNIT – IV : USES AND FUTURE OF SIMULATION	**(9 Periods)**
Facts of simulation, Experimentation aspects of simulation, Experience aspects of simulation, Examples of uses of simulation, Ethics in the use of simulation, Excuses to avoid using the simulation – convergent simulation –serious games – Human computer interfaces – Computing technology.	
UNIT – V : CASE STUDY	**(9 Periods)**
Transportation modeling and simulation – Business modeling and simulation – Medical modeling and simulation – Social science modeling and simulation – Communication systems modeling and simulation.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *John A Sokolowski, Catherine M Banks* ***"Principles of Modeling and Simulation, A Multidisciplinary approach"*** *Wiley 2009*

REFERENCE BOOKS:

1. *John A Sokolowski, Cathereine M Banks,* ***"Modeling and Simulation fundamentals: Theoretical underpinnings and practical domains"****, Wiley 2010.*
2. *Bernard P. Zeigler, Herbert Praehofer, Tag Gon Kim****,"Theory of Modeling and Simulation****", Second Edition, Integrating discrete event and continuous complex dynamic systems, Academic Press 2000.*
3. *Hans-Joachim Bungartz, Stefan Zimmer, Martin Buchholz, Dirk Pflüger* ***"Modeling and Simulation: An Application-Oriented Introduction"****, Springer 2014.*
4. *K. C. Raveendranathan,* ***"Communication Systems Modelling and Simulation, using MATLAB and Simulink"****, University Press 20*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Model and Solve problems using simulation **[Usage]**

CO2: Apply discrete event and continuous simulation models **[Usage]**

CO3: Use right queueing models to represent the problem **[Assessment]**

CO4: Perform verification and validation of simulation models **[Usage]**

CO5: Summarize the simulation facts, Ethics and Excuses **[Familiarity]**

CO6: Simulate the models such as Transportation models, Business models, Medical models, Social science models, Communication systems models. **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	H	H	L	L	M	L	L	L	M	H	M	L	H
CO2	H	H	H	H	H	L	L	M	L	L	L	M	H	M	L	H
CO3	H	H	M	H	H	L	L	M	L	L	L	H	H	M	L	H
CO4	H	H	H	H	H	L	L	M	L	L	L	M	H	M	L	H
CO5	H	M	M	M	L	L	L	H	L	L	L	L	H	M	L	H
CO6	H	H	H	H	H	L	L	M	L	L	L	M	H	M	L	H
18SPE$02	H	H	H	H	H	L	L	M	L	L	L	M	H	M	L	H

L-Low, M-Moderate(Medium), H-High

18SPE$03	DIGITAL IMAGE PROCESSING

PRE-REQUISITES: NIL

Category : PE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Fundamentals of digital image processing.
- Image enhancement techniques in Spatial and Frequency domain.
- Concepts of degradation function and restoration techniques.
- Image segmentation and representation techniques.
- Image compression and recognition methods

UNIT – I : DIGITAL IMAGE FUNDAMENTALS	**(9 Periods)**
Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels – Color image fundamentals – RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms – DFT, DCT.	
UNIT – II : IMAGE ENHANCEMENT	**(9 Periods)**
Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.	
UNIT – III : IMAGE RESTORATION	**(9 Periods)**
Image Restoration – degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering.	
UNIT – IV : IMAGE SEGMENTATION	**(9 Periods)**
Edge detection, Edge linking via Hough transform – Thresholding – Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.	
UNIT – V : IMAGE COMPRESSION AND RECOGNITION	**(9 Periods)**
Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture – Patterns and Pattern classes – Recognition based on matching.	

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. *Rafael C. Gonzalez, Richard E. Woods,* ***"Digital Image Processing Pearson"****, Education, Third Edition, 2009.*

REFERENCE BOOKS:

1. *Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,* ***"Digital Image Processing using MATLAB"****, Pearson Education, Inc., 2011.*
2. *Milan Sonka, Vaclav Hlavac and Roger Boyle,* ***"Image Processing, Analysis and Machine Vision"****, Fourth Edition, Cengage Learning, 2014.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Process digital images using fundamental steps of image processing and simple arithmetic, logical and geometric operations and apply image transforms like DFT, DCT.**[Usage]**

CO2: Operate on images by using the techniques of smoothing, sharpening and enhancement.**[Usage]**

CO3: Identify the degradation model and restore the image using spatial filtering. **[Usage]**

CO4: Perform edge detection and segmentation **[Assessment]**

CO5: Apply lossy and lossless image compression techniques for digital images and classify or recognize an object using shape and texture measures **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	M	M	L							M	H	M	M	M
CO2	H	H	M	M	L							M	H	M	M	M
CO3	H	H	M	M	L							M	H	M	M	M
CO4	H	H	L	M	L							M	H	M	M	M
CO5	H	H	L	M	L							M	H	M	M	M
18SPE$03	H	H	L	M	L							M	H	M	M	M

L - Low, M - Moderate (Medium), H - High

18SPE$04	CRYPTOGRAPHY

PRE-REQUISITES: NIL **Category: PE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Symmetric Encryption techniques
- Asymmetric Encryption techniques
- Principle of digital signatures, Hash functions and MAC.
- Fundamental Principles of Key Management
- Applications of Cryptography.

UNIT – I : INTRODUCTION TO CRYPTOGRAPHY	**(9 Periods)**
Overview of Cryptology -Goals of Cryptography–Classification of Cryptosystem-Practically Useful Cryptosystem-Basic Algebra-Group-ring –field-Symmetric Cryptography – Cryptanalysis – historical ciphers –Stream ciphers – Encryption and decryption with stream ciphers –Unbreakable stream cipher – Shift register based Stream cipher. Block Cipher – Ciphertext Stealing (ECB and CBC modes)- Data Encryption Standard (DES)–Internal Structure–Algorithm–Security–Advanced Encryption Standard (AES)-Internal Structure–Algorithm–Triple DES–Lightweight Cipher PRESENT – Block Ciphers – Mode of Operation-Design Considerations –Increasing Security of Block Cipher.	
UNIT – II : PUBLIC KEY CRYPTOGRAPHY	**(9 Periods)**
Symmetric vs. Asymmetric Cryptography- Practical Aspects of Public-Key Cryptography – Essential Number Theory for Public-Key Algorithms -Cardinality of Primes- Congruences-Solving Linear Congruence in Z_n -Chinese Remainder Theorem (CRT)-Euclidean Algorithm - Extended Euclidean Algorithm-Euler's Phi Function- Pollard's p – 1 Method -Pollard's Rho Method -Quadratic Sieve - Number Field Sieve - Primality Testing-Quadratic Congruence-Exponentiation and Logarithm-Discrete Logarithm Problem-Fermat's Little Theorem and Euler's Theorem - The RSA Cryptosystem --Rabin Cryptosystem-ElGamal Cryptosystem-Public-Key Cryptosystems Based on the Discrete Logarithm Problem- Elliptic Curve Cryptosystems.	
UNIT – III : AUTHENTICATION TECHNIQUES	**(9 Periods)**
Digital Signatures - Principles of Digital Signatures - The RSA Signature Scheme - The Elgamal Digital Signature Scheme - The Digital Signature Algorithm (DSA)- The Elliptic Curve Digital Signature Algorithm (ECDSA) . Hash Functions - Security Requirements of Hash Functions - Dedicated Hash Functions: The MD4 Family - Hash Functions from Block Ciphers -MD5- The Secure Hash Algorithm SHA-1 - Message Authentication Codes (MACs) - MACs from Hash Functions: HMAC - MACs from Block Ciphers: CBC-MAC - Galois Counter Message Authentication Code (GMAC). Probability and Perfect Secrecy - Basic Concept of Probability -Birthday Paradox -Perfect Secrecy -Vernam One-Time Pad -Random Number Generation -Pseudo-random Number Generator-Complexity Theory.	
UNIT – IV : KEY MANAGEMENT	**(9 Periods)**
Key Establishment - Using Symmetric-Key Techniques - Using Asymmetric Techniques - Unique key per transaction schemes - Quantum key establishment- Key Storage - Key backup, archival and recovery.	

UNIT – V : APPLICATIONS	(9 Periods)
Cryptography on the Internet - Cryptography for wireless local area networks - Cryptography for mobile telecommunications - Cryptography for secure payment card transactions - Cryptography for video broadcasting - Cryptography for identity cards - Cryptography for home users.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Bart Preneel and Christ of Paar "**Understanding Cryptography A Textbook for Students and Practitioners**" Springer-Verlag Berlin Heidelberg, 2010*
2. *Keith M. Martin "**Everyday Cryptography -Fundamental Principles and Applications**" OXFORD University Press, 2nd edition, 2017.*
3. *Sahadeo Padhye , Rajeev A. Sahu, Vishal Saraswat " **Introduction to Cryptography**" ,CRC Press,2018*

REFERENCE BOOKS:

1. *William Stallings, **"Cryptography & Network Security",** Pearson Education, 6th Edition 2014.*
2. *Jonathan Katz, Yehuda Lindell, **" Introduction to Modern Cryptography",** Second Edition, CRC Press, 2014.*
3. *Niels Ferguson, Bruce Schneier, Tadayoshi, **"Cryptography Engineering: Design Principles and Practical Applications"**, Wiley Publishing, 2011.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Describe and implement some of the prominent Symmetric encryption techniques in stream and block cipher. **[Usage]**
CO2: Apply suitable encryption techniques for confidentiality related security issues in networks. **[Usage]**
CO3: Use suitable authentication methods for integrity related security issues. **[Usage]**
CO4: Explain the important Key management approaches in both private and public key encryption. **[Familiarity]**
CO5: Explain the protocols behind the application of cryptography in everyday life. **[Familiarity]**

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	M	L	M	L	H				H	H	M	H	H
CO2	H	H	H	M	L	M	L	H				H	H	M	H	H
CO3	H	H	H	M	L	M	L	H				H	H	M	H	H
CO4	H	H	H	M	L	M	L	H				H	H	M	H	H
CO5	H	H	H	M	L	M	H	H			L	H	H	M	H	H
18SPE$04	H	H	H	M	L	M	L	H			L	H	H	M	H	H

L - Low, M - Moderate (Medium), H - High

18SPE$05	NATURAL LANGUAGE PROCESSING

PRE-REQUISITES: NIL

Category : PE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- To learn the fundamentals of natural language processing
- To understand the use of CFG and PCFG in NLP
- To understand the role of semantics of sentences and pragmatics
- To apply the NLP techniques to IR applications

UNIT – I : INTRODUCTION	**(9 Periods)**
Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance	
UNIT- II : WORD LEVEL ANALYSIS	**(9 Periods)**
Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.	
UNIT – III : SYNTACTIC ANALYSIS	**(9 Periods)**
Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures.	
UNIT – IV : SEMANTICS AND PRAGMATICS	**(9 Periods)**
Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.	
UNIT – V : DISCOURSE ANALYSIS AND LEXICAL RESOURCES	**(9 Periods)**
Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Daniel Jurafsky, James H. Martin,* ***"Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech"****, Pearson Publication, 2014.*
2. *Steven Bird, Ewan Klein and Edward Loper,* ***"Natural Language Processing with Python"****, First Edition, OReilly Media, 2009*

REFERENCE BOOKS:

1. *Breck Baldwin,* ***"Language Processing with Java and LingPipe Cookbook",*** *Atlantic Publisher, 2015.*
2. *Richard M Reese,* ***"Natural Language Processing with Java"****, OReilly Media, 2015.*
3. *Nitin Indurkhya and Fred J. Damerau,* ***"Handbook of Natural Language Processing",*** *Second Edition, Chapman and Hall/CRC Press, 2010.*
4. *Tanveer Siddiqui, U.S. Tiwary,* ***"Natural Language Processing and Information Retrieval"****, Oxford University Press, 2008.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: To tag a given text with basic Language features. **[Familiarity]**

CO2: To design an innovative application using NLP components. **[Familiarity]**

CO3: To implement a rule based system to tackle morphology/syntax of a language. **[Familiarity]**

CO4: To design a tag set to be used for statistical processing for real-time applications. **[Familiarity]**

CO5: To compare and contrast the use of different statistical approaches for different types of NLP applications. **[Familiarity]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	M	L	L	L	L							M		L	L
CO2	M	M	H	H	M	L						M	M	H	M	M
CO3	M	M	H	H	M	L						M	M	H	M	M
CO4	M	M	H	H	M	L						M	M	H	M	M
CO5	M	H	M	H	M	L						M	M	H	M	M
18SPE$05	M	M	H	H	M	L						M	M	H	M	M

L - Low, M - Moderate (Medium), H - High

18SPE$06	SOFTWARE DEFINED NETWORKS

PRE-REQUISITES: NIL **Category : PE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

* Advance and emerging networking technologies.
* Software defined networking and how it is changing the way communications networks are managed, maintained, and secured.
* The concepts of virtualization and virtual machines.

UNIT – I : SDN: BACKGROUND AND MOTIVATION	**(9 Periods)**
Evolving Network Requirements - The history of SDN -The SDN Approach - SDN architecture and its fundamental abstractions - SDN- and NFV-Related Standards -Why SDN? - How SDN Works? Open Flow Concept and Implementation - OpenFlow Limitations. Mininet: A simulation environment for SDN.	
UNIT – II : SDN DATA PLANE AND CONTROL PLANE	**(9 Periods)**
SDN Data Plane and OpenFlow : SDN Data Plane -OpenFlow Logical Network Device -OpenFlow Protocol SDN Control Plane: SDN Control Plane Architecture - ITU-T Model - OpenDaylight - REST - Cooperation and Coordination Among Controllers. Programming SDNs - Frenetic, Procera.	
UNIT – III : SDN APPLICATION PLANE	**(9 Periods)**
SDN Application Plane Architecture - Network Services Abstraction Layer-Traffic Engineering - Measurement and Monitoring - Security - Data Center Networking - Mobility and Wireless - Information-Centric Networking.	
UNIT – IV : NETWORK FUNCTIONS VIRTUALIZATION	**(9 Periods)**
Concepts and Architecture - Background and Motivation for NFV -Virtual Machines -NFV Concepts - NFV Benefits and Requirements - NFV Reference Architecture - NFV Functionality : NFV Infrastructure - Virtualized Network Functions -SDN and NFV- Network Virtualization: OpenFlow VLAN Support - Network Virtualization - OpenDaylight's Virtual Tenant Network- Software Defined Infrastructure.	
UNIT – V : QUALITY OF SERVICE AND SECURITY	**(9 Periods)**
Quality of Service : QoS Architectural Framework - Integrated Services Architecture (ISA) - Differentiated Services - Service Level Agreements - IP Performance Metrics - OpenFlow QoS Support. **Quality of Experience:** Definition of QoE- QoE Strategies in Practice-Factors Influencing QoE Measurements of QoE -Application of QoE **SECURITY:** Security Requirements - SDN Security -NFV Security - Applying Programming Techniques to Networks, Security Applications.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *William Stallings* ***"Foundations of Modern Networking : SDN, NFV, QoE, IoT, and Cloud"*** *1st edition, Pearson Education, Inc. 2016.*

REFERENCE BOOKS:

1. *Paul Goransson and Chuck Black,* ***"Software Defined Networks: A Comprehensive Approach"****, edition, Morgan Kaufmann Publishers, Inc., 2014.*
2. *Thomas D. Nadeau; Ken Gray,* ***"SDN: Software Defined Networks"****, O'Reilly Media, Inc. 2013.*
3. *Vivek Tiwari,* ***"SDN and OpenFlow for beginners with hands on labs"****, Amazon Digital Services, Inc. 2013.*
4. *Kreutz et al.:* ***"Software-Defined Networking: A Comprehensive Survey"****, Proceedings of the IEEE, Vol. 103, No. 1, January 2015.*

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

CO1: Differentiate between traditional networks and software defined networks. **[Familiarity]**
CO2: Explain and discuss the basic concepts and architecture of SDN. **[Familiarity]**
CO3: Compare the performance of various open flow versions. Analyse and apply implementation of SDN through Open Flow Switches **[Assessment]**
CO4: Identify various SDN applications and environments that benefits from its use. **[Usage]**
CO5: Explain and discuss the basic concepts and architecture of Network Functions Virtualization. **[Familiarity]**
CO6: Evaluate the security issues and Quality of Service related to SDN. **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	H	H			L				M	H	M	H	L
CO2	H	H	H	H	H			L				M	H	M	H	L
CO3	H	H	H	H	H			L				M	H	M	H	L
CO4	H	H	H	H	H			L				M	H	M	H	L
CO5	H	H	H	H	H			L				M	H	M	H	L
CO6	H	H	H	H	H			L				M	H	M	H	L
18SPE$06	H	H	H	H	H			L				M	H	M	H	L

L - Low, M - Moderate (Medium), H - High

18SPE$07	CLOUD ENGINEERING

PRE-REQUISITES: NIL

Category: PE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

* Cloud Architecture
* Cloud Services
* Web Based Cloud Computing
* Cloud Security

UNIT – I : INTRODUCTION	**(9 Periods)**
Introduction – Cloud types – Characteristics - Assessing the Value Proposition -Cloud Computing Stack - Connecting to the Cloud -Infrastructure as a Service (IaaS) -Platform as a Service (PaaS) - Software as a Service (SaaS) -Identity as a Service (IDaaS)- Compliance as a Service (CaaS).	
UNIT – II : VIRTUALIZATION	**(9 Periods)**
Basics of virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – tools and Mechanisms – Virtualization of CPU, Memory, I/O Devices – Virtual clusters and resource management – Virtualization for data –center Automation.	
UNIT – III : CLOUD INFRASTRUCTURE	**(9 Periods)**
Architectural Design of Compute and Storage clouds – Layered Cloud Architecture Development – Design Challenges – Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources.	
UNIT – IV : CLOUD APPLICATION PROGRAMMING AND THE ANEKA PLATFORM	**(9 Periods)**
Aneka - Framework overview - anatomy of the Aneka container - Cloud programming and management - Programming applications with threads - Multithreading with Aneka – Task computing - Task-based application models - Aneka task-based programming - Data-Intensive Computing - Aneka MapReduce programming.	
UNIT – V : SECURITY IN THE CLOUD	**(9 Periods)**
Security Overview – Cloud Security Challenges and Risks – Software-as-a-Service security –Security Governance – Risk Management – Security Monitoring – Security Architecture Design –Data Security – Application Security – Virtual Machine Security- Identity Management and Access Control – Autonomic Security.	

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. *Sosinsky, Barrie.* ***"Cloud computing bible"****, Vol. 762. John Wiley & Sons, 2010.*
2. *Kai Hwang, Geoffrey C. Fox, Jack, J. Dongarra* ***"Distributed and Cloud Computing from Parallel Processing to the Internet of Things",*** *Elsevier 2012.*
3. *Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi* ***"Mastering Cloud Computing Foundations and Applications Programming",*** *2013.*

4. *John W. Rittinghouse, James F. Ransome,* ***"Cloud Computing Implementation, Management, and Security",*** *CRC Press, 2010.*
5. *Tim Mather, Subra Kumaraswamy, Shahed Latif,* ***"Cloud Security & Privacy"*** *O'ReillyMedia, September 2009.*

REFERENCE BOOKS:

1. *Haley Beard,* ***"Cloud Computing Best Practices for Managing and Measuring Processes for on demand Computing, Applications and Data Centers in the Cloud with SLAS".*** *Emereo Pvt Limited, July 2008.*
2. *John Ritting house & James Ransome,* ***"Cloud Computing, Implementation, Management and Strategy"****, CRC Press, 2010.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Explain the cloud architecture and cloud storage **[Familiarity]**
CO2: Create Cloud computing applications **[Usage]**
CO3: Use Cloud services **[Usage]**
CO4: Explain web based cloud services and tools **[Familiarity]**
CO5: Explain the necessity and approaches for cloud security.**[Familiarity]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	M				M				H	H	M	H	H
CO2	H	H	H	M				M				H	H	M	H	H
CO3	H	H	H	M				M				H	H	M	H	H
CO4	H	H	H	M				M				H	H	M	H	H
CO5	H	H	H	M				M				H	H	M	H	H
18SPE$07	H	H	H	M				M				H	H	M	H	H

L - Low, M - Moderate (Medium), H - High

18SPE$08	COMPUTER VISION

PRE-REQUISITES: NIL

Category: PE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Fundamentals of image models.
- Filters, Features, Texture and Edge detection.
- Geometry of multiple views.
- Segmentation, Fitting and Tracking methods.
- Relationship between object features, image features and camera models.

UNIT – I : IMAGE FORMATION AND IMAGE MODELS	**(9 Periods)**
Radiometry: Light in Space - Light at Surfaces - Radiosity - Directional Hemispheric -Reflectance - Lambertian Surfaces and Albedo - Specular Surfaces - Sources, Shadows and Shading: Radiometric Properties of Light Sources - Qualitative Radiometry - Local Shading Models - Global Shading Models. Colour: Human Colour Perception - Representing Colour - Geometric Image Features: Elements - Contour Geometry -Analytical Image Features: Elements - Geometric Camera Parameters - Calibration.	
UNIT – II : EARLY VISION-ONE IMAGE	**(9 Periods)**
Linear Filters: Linear Filters and Convolution - Shift invariant linear systems - Spatial Frequency and Fourier Transforms – Sampling- Edge Detection: Estimating Derivatives with Finite Differences - Noise - Edges and Gradient-based Edge Detectors. Filters and Features: Filters as Templates - Filters and Primate Early Vision - Normalised Correlation and Finding Patterns - Corners and Orientation Representations - Advanced Smoothing Strategies and Non-linear Filters. Texture: Representing Texture - Analysis Using Oriented Pyramids - Application: Synthesizing Textures for Rendering - Shape from Texture.	
UNIT – III : EARLY VISION-MULTIPLE IMAGES	**(9 Periods)**
The Geometry of Multiple Views -Two Views - Three Views - More Views. Stereopsis: Reconstruction - Binocular Fusion - Trinocular Stereo - Multiple-Baseline Stereo - Affine Structure from Motion: Elements - Affine Structure from Two Images and Multiple Images - Affine to Euclidean Images - Affine Motion Segmentation. Projective Structure From Motion: Elements - Projective Scene Reconstruction from Two Views - Motion Estimation from Two or Three Views - Motion Estimation from Multiple Views - From Projective to Euclidean Structure and Motion.	
UNIT – IV : MID-LEVEL VISION	**(9 Periods)**
Segmentation Using Clustering Methods - Human vision: Grouping and Gestalt -Applications: Shot Boundary Detection, Background Subtraction and Skin Finding - Image Segmentation by Clustering - Segmentation by Graph-Theoretic Clustering . Fitting :The Hough Transform -Fitting Lines - Fitting Curves - Fitting to the Outlines of Surfaces .Tracking: Tracking as an Abstract Inference -Linear Dynamic Models and the Kalman Filter - Non-Linear Dynamic Models -Particle Filtering - Data Association	
UNIT – V : HIGH-LEVEL VISION	**(9 Periods)**
Correspondence and Pose Consistency - Pose Consistency for Perspective Cameras - Affine and Projective Camera Models - Linear Combinations of Models - Obtaining Hypotheses by Pose Clustering - Obtaining Hypotheses Using Invariants - Finding Templates Using Classifiers - Building Classifiers From Class Histograms - Finding Skin Pixels Using A Classifier - Feature Selection - Recognition By Relations Between Templates - Finding Objects by Voting on Relations between Templates - Relational Reasoning using Probabilistic Models and Search - Using Classifiers to Prune Search	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *David Forsyth and Jean Ponce* ***"Computer vision: a modern approach"*** *2nd edition, Pearson India Education Services Pvt. Ltd, 2012.*

REFERENCE BOOKS:

1. *Richard Szeliski,* ***"Computer Vision- Algorithms and Applications"****, Springer Science & Business Media, 2011.*
2. *Simon J.D. Prince,* ***"Computer Vision - Models, Learning and Inference"****, Cambridge University Press, 2012.*
3. *Linda G. Shapiro, George C. Stockman,* ***"Computer Vision"****, Prentice Hall, 2001*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply fundamentals concepts of camera model and calibration to image formation and image model **[Usage]**

CO2: Apply Filters, Features, Texture and Edge detection techniques to enhance an image**[Usage]**

CO3: Recover 3D structure and Motion of objects using two views and multiple views of an object. **[Usage]**

CO4: Identify objects or other relevant information in digital images using segmentation, clustering and tracking methods. **[Assessment]**

CO5: Find the relationship between the position of image features, and the position and orientation of an object. **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	M	M	L							M	H	M	M	M
CO2	H	H	M	M	L							M	H	M	M	M
CO3	H	H	M	M	L							M	H	M	M	M
CO4	H	H	L	M	L							M	H	M	M	M
CO5	H	H	L	M	L							M	H	M	M	M
18SPE$08	H	H	M	M	L							M	H	M	M	M

L - Low, M - Moderate (Medium), H - High

18SPE$09	HIGH PERFORMANCE COMPUTING

PRE-REQUISITES: NIL

Category : PE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- To Study various computing technology architecture.
- To know Emerging trends in computing technology.
- To know the advantage of parallel programming

UNIT – I : MODERN PROCESSORS	**(9 Periods)**
Stored-program computer architecture-General-purpose cache-based microprocessor architecture-Memory hierarchies – multicore processors - Multithreaded processors - Vector processors	
UNIT – II : OPTIMIZATION TECHNIQUES	**(9 Periods)**
Scalar profiling -The role of compilers- Data Access Optimization: Balance analysis and light speed estimates- Storage order Case study: The Jacobi algorithm, Dense matrix transpose - Algorithm classification and access optimizations	
UNIT – III : PARALLEL COMPUTERS	**(9 Periods)**
Taxonomy of parallel computing paradigms - Shared-memory computers - Distributed-memory computers- Hierarchical (hybrid) systems- Networks	
UNIT – IV : SHARED-MEMORY PARALLEL PROGRAMMING	**(9 Periods)**
Introduction to OpenMP- Case study: OpenMP-parallel Jacobi algorithm -Advanced OpenMP: Wavefront parallelization- Profiling OpenMP programs - Performance pitfalls	
UNIT – V : DISTRIBUTED-MEMORY PARALLEL PROGRAMMING WITH MPI	**(9 Periods)**
Introduction to Message passing - MPI performance tools - Communication parameters - Synchronization, serialization, contention - Reducing communication overhead - Understanding intra node point-to-point communication	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Hager, Georg, and Gerhard Wellein.* ***"Introduction to high performance computing for scientists and engineers",*** *CRC Press, 2010.*

REFERENCE BOOKS:

1. *Ravikumar, C. P.* ***"High-Performance Cluster Computing. Volume 1: Architecutes and Systems. Volume 2: Programming and Applications",*** *Scalable Computing: Practice and Experience 2.4 (1999).*
2. *Wadleigh, Kevin R., and Isom L. Crawford.* ***"Software optimization for high-performance computing",*** *Prentice Hall Professional, 2000.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand the various architectures in computing technology.
CO2: Understand the need of optimization
CO3: Differentiate various types of parallel computers
CO4: Write parallel programs using OpenMP
CO5: Write parallel programs using MPI

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	L	H	L	L							H	H	H	M	H
CO2	M	H	H	H	L							H	H	H	M	H
CO3	H	H	H	M	H							H	H	H	M	H
CO4	H	H	H	M	L							H	H	H	M	H
CO5	M	H	H	H	L							H	H	H	M	H
18SPE$09	H	H	H	M	L							H	H	H	M	H

L - Low, M - Moderate (Medium), H - High

18SPE$10	OBJECT ORIENTED ANALYSIS AND DESIGN

PRE-REQUISITES: NIL **Category : PE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Basic terminology and OO concepts.
- Object Oriented Methodologies & UML Diagrams.
- Process of object-oriented analysis for software development
- Design axioms and corollaries, design patterns and UML object constraint language.
- Testing techniques for object oriented software

UNIT – I : INTRODUCTION	**(9 Periods)**
An overview – Object basics – Object state and properties – Behavior – Methods – Messages – Information hiding – Class hierarchy – Relationships – Associations – Aggregations – Identity – Dynamic binding – Persistence – Meta classes – Object oriented system development life cycle.	
UNIT – II : METHODOLOGY AND UML	**(9 Periods)**
Introduction – Rumbugh- Booch- Jacobson methods – Patterns – Frameworks – Unified approach – Unified modeling language – Static and Dynamic models – UML diagrams – Class diagram – Use case diagrams – Dynamic modeling – Model organization – Extensibility.	
UNIT – III : OBJECT ORIENTED ANALYSIS	**(9 Periods)**
Identifying Use case – Business object analysis – Use case driven object oriented analysis – Use case model – Documentation – Classification – Identifying object, relationships, attributes, methods – Super sub class – A part of relationships Identifying attributes and methods – Object responsibility.	
UNIT – IV : OBJECT ORIENTED DESIGN	**(9 Periods)**
Design process – Axioms – Corollaries – Designing classes – Class visibility – Refining attributes – Methods and protocols – Object storage and object interoperability Databases – Object relational systems – Designing interface objects – Macro and Micro level processes – Purpose of a view layer interface.	
UNIT – V : SOFTWARE QUALITY ASSURANCE	**(9 Periods)**
Quality Assurance test–testing Strategies-Black box testing-White box testing-Top-Down Testing-Bottom-up Testing-Impact of Object Orientation on Testing- Test cases– test plan – usability testing – User satisfaction – testing-Case Study: Developing Usability test plans and test cases for Developing Usability test plans and test cases -Inventory Control System-ATM System-Mobile Applications.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Ali Bahrami **"Object Oriented System Development"** Tata McGraw Hill International Edition, 2008.*

REFERENCE BOOKS:

1. *Craig Larman, "**Applying UML and Patterns",** 2nd Edition, Pearson Education, 2012*
2. *Stephan R. Schach, **"Object Oriented and Classical Software Engineering**", McGraw-Hill,2007.*
3. *Mike O'Docherty **"Object-Oriented Analysis & design – understanding system development with UML 2.0",** 2nd Edition, John Wiley & Sons, 2005.*
4. *Booch, Jacobson, Rumbagh, **"The UML user Guide"**, 2nd Edition, Pearson Education, 2005.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Describe how modeling supports the OOSD process **[Familiarity]**
CO2: Identify and describe the essential elements in a UML Use Case diagram **[Usage]**
CO3: Apply appropriate object oriented methodologies for solving the problem with the help of various case studies **[Usage]**
CO4: Analyze problem scenario and model the system using UML diagrams **[Usage]**
CO5: Identify actors, attributes, classes/ Objects, their properties and associations by analyzing the given scenario and develop Usecase **[Familiarity]**
CO6: Identify and Use the appropriate patterns in solving problems **[Familiarity]**
CO7: Analyze the given case study, identify the appropriate testing strategies and Create the test plan and test cases **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	H	H	M	M							M	L	M	M	H
CO2	M	H	H	M	M						M	M	L	M	M	H
CO3	M	H	H	H	M							M	H	M	H	H
CO4	M	H	H	H	M						M	M	H	M	H	H
CO5	M	M	H	L	L							L	M	M	L	M
CO6	M	M	H	L	L							L	M	M	L	M
CO7	M	H	H	M	M	L	L	L	L	L	M	H	M	M	M	M
18SPE$10	M	H	H	H	M	L	L	L	L	L	M	M	M	M	M	M

L - Low, M - Moderate (Medium), H - High

18SPE$11	FUNDAMENTALS OF INTERNET OF THINGS

PRE-REQUISITES: NIL

Category: PE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

* Applications and enabling technologies of IoT
* Need for Standardization of IoT and related protocols
* Interoperability issues in IoT ecosystem
* Fundamentals of Web of Things [WoT]
* Security issues concerning IoT

UNIT – I : INTRODUCTION	**(9 Periods)**
IoT history and Vision – Physical and Logical Design of IoT- Functional Blocks – Web 3.0 View of IoT– Ubiquitous IoT Applications – Four Pillars of IoT – DNA of IoT - Communication models – Enabling Technologies – IoT Levels – Domain Specific IoT - IoT Vs M2M, SDN. IoT Applications – Smart environment, smart energy, smart agriculture and smart health..	
UNIT – II : PROTOCOLS AND STANDARDISATION	**(9 Periods)**
Protocol Standardization for IoT – Efforts – Machine to Machine and Wireless Sensor Networks Protocols – SCADA and RFID Protocols. Defining a common architecture, iCore functional architecture, Machine to Machine Service Level standardization – OGC Sensor Web for IoT – IEEE and IETF –ITU -T.	
UNIT – III : INTEROPERABILITY	**(9 Periods)**
Physical Vs Virtual World – Types of Interoperability - Data Interoperability - Semantic Interoperability - Organizational Interoperability - Eternal Interoperability - Research Roadmap for IoT Testing Methodologies - Semantics as an Interoperability Enabler.	
UNIT – IV : WoT Vs IoT AND APPLICATION DEVELOPMENT	**(9 Periods)**
Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence. Application Development - MQTT, REST/HTTP, CoAP, MySQL.	
UNIT – V : SECURITY AND FUTURE RESEARCH	**(9 Periods)**
Issues related to Governance - Security, Privacy and Trust in IoT –Platforms for Smart Cities - Big data in IoT, platforms for Big data in IoT - Cloud computing – Issues of incorporating cloud in IoT - Fog computing. Case study – Smarter Classrooms.	

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. *Ovidiv Vermesan, Peter Friess "**Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems**" River publications, 2013.*
2. *Adrian McEwen & Hakim Cassimally "**Designing the Internet of Things**" Wiley, 2014.*

REFERENCE BOOKS:

1. *Dieter Uckelmann,* ***"Architecting the Internet of Things",*** *Springer 2011.*
2. *Honbo Zhou,* ***"The Internet of Things in the Cloud: A Middleware Perspective",*** *CRC Press, 2012.*
3. *Olivier Hersent, Omar Elloumi and David Boswarthick,* ***"The Internet of Things: Applications to the Smart Grid and Building Automation",*** *Wiley, 2012.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Explain functional building blocks of IoT and its applications. **[Familiarity]**
CO2: Compare IoT with M2M and SDN. **[Usage]**
CO3: Explore IoT and its related protocols for heterogeneous communication. **[Familiarity]**
CO4: Define a common Architecture for IoT. **[Usage]**
CO5: Compare Data, Semantic, Organizational and Eternal Interoperability to resolve heterogeneity issues. **[Assessment]**
CO6: Identify middleware for WoT and WoT portals. **[Usage]**
CO7: Develop applications using MQTT, REST/HTTP, CoAP, MySQL **[Assessment]**
CO8: Define security principles for IoT and explain futuristic IoT Vision. **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	M	H	M	L	M	M	M				M	H	H	M	L
CO2	H	M	H	M	M	M	M	M				M	H	H	M	L
CO3	H	M	H	M	M	L	L	L				M	H	H	M	L
CO4	H	M	M	M	L	M	M	M				H	H	H	H	H
CO5	H	M	L	L	M	M	M	M				M	L	L	L	L
CO6	H	L	M	L	H	L	L	L				H	H	L	H	H
CO7	H	M	M	M	M	M	M	M	M	M		M	M	M	M	M
CO8	H	M	M	M	M	M	M	M				M	M	M	M	M
18SPE$11	H	M	L	L	M	M	M	M	M	M	L	M	H	H	M	M

L - Low, M - Moderate (Medium), H - High

18SPE$12	BIG DATA ANALYTICS

PRE-REQUISITES: **Category: PE**

1. 18SPC404 - Database Management Systems

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

* Evolution of Big Data and its characteristics
* Domain specific analysis of Big data
* Mining larger data streams
* Concepts related to Link analysis and handle large and frequent data sets
* Frameworks for Big Data and its applications.

UNIT – I : INTRODUCTION	**(9 Periods)**
Introduction to Big Data – Platforms for Big Data – Traits - Challenges - Web Data – Analytic Scalability - Modern Data Analytic Tools - Big data sources – Acquisition – Big Data Security, Compliance, auditing and protection - Evolution of Big data – Best Practices for Big data Analytics - Data Appliance and Integration tools	
UNIT – II : BIG DATA ANALYSIS	**(9 Periods)**
Evolution of analytic scalability – Convergence – parallel processing systems - Cloud computing – grid computing – Map Reduce Framework - Hadoop – Hive – Sharding –Spark.– enterprise analytic sand box – analytic data sets - Analysis approaches – Statistical significance - Multivariate analysis, Bayesian modeling, Analysis of time series: linear systems analysis, nonlinear dynamics – Rule induction.	
UNIT – III : MINING DATA STREAMS	**(9 Periods)**
The stream data model – Sampling data streams – counting distinct elements in a stream – Estimating moments. Finding similar items – Applications of nearest neighbor search – shingling of documents - similarity preservation – locality sensitive hashing- distance measures – methods for high degree similarity.	
UNIT – IV : LINK ANALYSIS	**(9 Periods)**
Link analysis – Page rank – Efficient computation of a page rank – topic sensitive page rank – link spam –Frequent datasets – the market basket model – A-Priori algorithm – handling larger datasets in main memory –limited pass algorithm – counting frequent items in a stream	
UNIT – V : BIG DATA FRAMEWORKS AND APPLICATIONS	**(9 Periods)**
NoSQL Databases - S3 - Hadoop Distributed file systems – Hbase – Impala –Big data for ECommerce – Big data for blogs – Case Study - Analyzing big data with twitter - Futuristic vision and applications of Big Data.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total:45 Periods

TEXT BOOKS:

1. *Frank J Ohlhorst,* ***"Big Data Analytics: Turning Big Data into Big Money",*** *Wiley and SAS Business Series, 2012.*
2. *Anand Rajaraman and Jeffrey David Ullman,* ***"Mining of Massive Datasets",*** *Cambridge University Press, 2012.*

REFERENCE BOOKS:

1. *Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "**Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data"**, McGrawHill Publishing, 2012*
2. *Michael Berthold, David J. Hand, "**Intelligent Data Analysis"**, Springer, 2007.*
3. *Glenn J. Myatt, **"Making Sense of Data**", John Wiley & Sons, 2007*
4. *Paul Zikopoulos, Dirk deRoos, Krishnan Parasuraman, Thomas Deutsch , James Giles, David Corrigan, **"Harness the Power of Big data – The big data platform",** McGraw Hill, 2012.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Explain platforms, traits and best practices of Big Data. **[Familiarity]**

CO2: Use statistical techniques to analyze Big Data and identify sample and mine larger data streams. **[Usage]**

CO3: Apply nearest neighbor search to calculate degree similarity between data**. [Assessment]**

CO4: Compare frameworks for Big Data and list their performance. **[Usage]**

CO5: Explain futuristic vision and applications of Big Data. **[Familiarity]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	H	H	H	H				H	H	H	H	M	H	H	H
CO2	H	H	H	H	H				H	H	H	H	M	H	H	H
CO3	M	H	L	L	H				L	L	L	H	M	H	H	H
CO4	M	H	M	M	H				H	M	L	H	L	H	H	H
CO5	H	H	H	M	H				H	H	M	H	M	H	H	H
18SPE$12	H	H	H	M	H				H	M	M	H	M	H	H	H

L - Low, M - Moderate (Medium), H – High

18SPE$13	INFORMATION SECURITY

PRE-REQUISITES: NIL **Category: PE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Threats, attacks and issues in a security model.
- Cryptography to secure data.
- Firewalls, wireless security and intrusions.
- Security of operating systems, servers and mobile devices.
- Ensuring availability of data.

UNIT – I : INTRODUCTION	**(9 Periods)**
The History of Information Security - CNSS Security Model -Components of an Information System - Security Professionals and the Organization – the need for security – threats – attacks – Secure software development – Legal, Ethical, and Professional Issues in Information Security- Risk Analysis.	
UNIT – II : DATA SECURITY	**(9 Periods)**
Securing Unstructured Data – Overview of Information Rights Management – Encryption – Symmetric key cryptography – Public key cryptography – Public key Infrastructure - Modern Storage Security – Database security.	
UNIT – III : NETWORK SECURITY	**(9 Periods)**
Secure Network Design - Network Device Security – Firewalls – Virtual Private Network – Wireless Network Security - Intrusion Detection and Prevention Systems - Voice Over IP (Voip) And PBX Security.	
UNIT – IV : COMPUTER SECURITY	**(9 Periods)**
Operating System Security Models – Unix Security – Windows Security – Securing E-mail, Web servers, DNS servers, Proxy Servers – Protecting Virtual Storage and Networks - Securing Mobile Devices.	
UNIT – V : SECURITY OPERATIONS AND PHYSICAL SECURITY	**(9 Periods)**
Security Operations Management - Disaster Recovery - Business Continuity – Backups - High Availability - Incident Response - Forensic Analysis. Physical security: Physical Vulnerability Assessment - Choosing Site Location for Security - Locks and Entry Controls - Physical Intrusion Detection.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total:45 Periods

TEXT BOOKS:

1. *Mark Rhodes-Ousley **"Information Security The Complete Reference"** 2nd edition, McGraw Hill Professional, 2013.*

REFERENCE BOOKS:

1. *Michael E. Whitman, Herbert J. Mattord,* ***"Principles of Information Security"****, 4th edition, Cengage Learning, 2011.*
2. *Jason Andress, Steven Winterfeld,* ***"The Basics of Information Security – Understanding the Fundamentals of Infosec in Theory and Practice"****, 2nd edition, Syngress, 2014.*
3. *Michael Whitman, Herbert Mattord,* ***"Management of Information Security"****, 3rd edition, Nelson Education, 2013*
4. *Richard E.Smith,* ***"Elementary Information Security"****, 2nd edition, Jones & Bartlett Publishers, 2015.*

.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to,

CO1: Identify threats and attacks to the information within systems. **[Familiarity]**

CO2: Secure information stored in servers, storage networks and databases using cryptography. **[Usage]**

CO3: Secure the network using proper design, firewalls and intrusion detection and prevention systems. **[Usage]**

CO4: Apply proper access control mechanism to protect operating system, e-mail, servers and mobile devices. **[Usage]**

CO5: Apply appropriate disaster recovery plan and backup to ensure high availability of data. **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	L	L		H		M				M	H	H	L	L
CO2	H	H	L	M		H		M				M	H	H	M	L
CO3	H	H	L	H		H		M				M	H	H	M	L
CO4	H	H	L	H		H		M				M	H	H	M	L
CO5	H	H	L	H		H		M				M	H	H	M	L
18SPE$13	H	H	L	H		H		M				M	H	H	M	L

L-Low,M-Moderate(Medium), H-High

18SPE$14	DISTRIBUTED COMPUTING

PRE-REQUISITES: NIL **Category: PE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Need and Characteristics of a Distributed system
- Inter-process Communication and Remote Method Invocation
- Distributed file systems and Services
- Concepts of local Vs global clocks and distributed mutual exclusion
- Concepts related to Transactions and Concurrency control in a distributed Environment

UNIT – I : INTRODUCTION	**(9 Periods)**
Need for Distributed systems - Characteristics of Distributed Systems – System Models – Physical, Architectural and Fundamental Models – Inter Process Communication – External Data representation, Marshalling, Network Virtualization, Overlay Networks – Client/ Server Communication.	
UNIT – II : INDIRECT COMMUNICATION	**(9 Periods)**
Protocols for Request – Reply, Remote Procedure Call, Remote Method Invocation, Case Study – Java RMI. Group Communication – Publish/ Subscribe Systems – Message Queues – shared Memory Approaches. Operating System Support – Processes and Threads – Communication and Invocation – Virtualization at the operating system level	
UNIT – III : DISTRIBUTED FILE SYSTEMS	**(9 Periods)**
Distributed Objects – CORBA - From Objects to Components. File Service Architecture – Sun Network File system and the Andrew File system – Name Services and Domain Name Services – Directory Services – Case Study: Global Name Services and X.500 Directory Services.	
UNIT – IV : TIME AND GLOBAL STATES	**(9)**
Clocks, events and Process States – Synchronizing Physical clock's- Logical Time and Logical Clocks – Global states – Debugging in the distributed System. Coordination and Agreement – distributed Mutual Exclusion – Elections – Coordination and agreement in group communication – Consensus and related problems.	
UNIT – V : DISTRIBUTED DATA MANAGEMENT	**(9 Periods)**
Introduction to Transactions – Nested Transaction – Locks – Optimistic Concurrency control – Timestamp Ordering. Distributed Transactions- Flat and Nested Distributed Transactions – Atomic commit Protocols – Concurrency Control – Distributed Deadlocks – Transaction Recovery- Fault Tolerant Services – Case study – Gossip Architecture – Transactions with Replicated Data.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *George Coulouris, Jean Dollimore, Tim Kindberg,* ***"Distributed Systems: Concepts and Design", 5th Edition,*** *Pearson Education, 2012.*
2. *Andrew S. Tanenbaum and Maarten van Steen,* ***"Distributed Systems: Principles and Paradigms",*** *2nd Edition, Prentice Hall, 2007.*

REFERENCE BOOKS:

1. *Mukesh Singhal, "**Advanced Concepts in Operating Systems**", Mc Graw Hill Series in Computer Science, 2001*
2. *Ajay D. Kshemkalyani and Mukesh Singhal, "**Distributed Computing: Principles, Algorithms and Systems**", Cambridge University Press, 2008.*
3. *M. L. Liu, "**Distributed Computing: Principles and Applications**", Addison-Wesley, 2004*
4. *James H.Anerson, Giuseppe Prencipe, Roger Wattenhofer, **"Principles of Disrtibuted Systems",** Springer, 2005.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Explain architectural models of a Distributed System **[Familiarity]**
CO2: Use Remote Method Invocation to implement Request /Reply communication. **[Usage]**
CO3: Explain network file system, Name Services and directory Services. **[Familiarity]**
CO4: Use global clocks to order events in a distributed System. **[Usage]**
CO5: Handle distributed Transactions and use Atomic Commit protocols to achieve Concurrency Control. **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	H	H	H	H				H	H	H	H	M	H	H	H
CO2	H	H	H	H	H				H	H	H	H	M	H	H	H
CO3	L	L	L	L	H				L	L	L	H	M	H	H	H
CO4	L	H	M	M	H				H	M	L	H	L	H	H	H
CO5	H	H	H	M	H				H	H	M	H	M	H	H	H
18SPE$14	H	H	M	M	H		M	M	H	M	M	H	M	H	H	H

L - Low, M - Moderate (Medium), H - High

18SPE$15	WIRELESS COMMUNICATION AND NETWORKS

PRE-REQUISITES: NIL **Category : PE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Wireless communication technologies and wireless systems
- Wireless Application Protocol and Wireless Local Area Networks
- 4G Technologies and Mesh Networks
- Ad Hoc and Wireless Sensor Networks
- Mobile IP and Security issues of Wireless Systems

UNIT – I : INTRODUCTION	**(9 Periods)**
Wireless Communication Technologies: Frequency Spectrum, Wireless Communication Primer, Spread Spectrum, Global System for Mobile and General Packet Radio Service, Code-Division Multiple Access, GSM Versus CDMA, 3G Cellular Systems, 2G Mobile Wireless Services, 802.11 Wireless LANs, Bluetooth, Ultra-Wideband, Radio-Frequency Identification, Wireless Metropolitan Area Networks, Satellite, Wireless Sensor Networks, Standardization in the Wireless World - Overview of Wireless Systems.	
UNIT – II : WAP AND WIRELESS LANS	**(9 Periods)**
Wireless Application Protocol: WAP and the World Wide Web (WWW), The WAP Programming Model, WAP Architecture, Traditional WAP Networking Environment, WAP Advantages and Disadvantages, Applications of WAP, imode, imode Versus WAP - Wireless Local Area Networks.	
UNIT – III : NEW WIRELESS TECHNOLOGIES	**(9 Periods)**
New Wireless Technologies: 4G Vision, Features and Challenges, Applications, 4G Technologies - Mesh Networks: Optimal Routing and Scheduling.	
UNIT – IV : AD HOC AND WIRELESS SENSOR NETWORKS	**(9 Periods)**
Ad Hoc and Wireless Sensor Networks: Communication and sensing Coverage, Localization, Function Computation, Scheduling - Sensor Network Platforms and Tools: Sensor Node Hardware, Sensor Network Programming Challenges, Node-Level Software Platforms, Node-Level Simulators, Programming Beyond Individual Nodes: State-Centric Programming.	
UNIT – V : MOBILE IP AND SECURITY ISSUES	**(9 Periods)**
Mobile IP: Requirements of Mobile IP, Extending the Protocols, Reverse Tunneling, Security Concerns - Mobile IPv6 - Security and Survivability of Wireless Systems.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Pei Zheng, Feng Zhao, David Tipper, Jinmei Tatuya "**Wireless Networking Complete**" Elsevier, 2010 .*

REFERENCE BOOKS:

1. *Asoke K Talukder, Roopa Yavagal,* ***"Mobile Computing – Technology, Application and Service Creation"****, McGraw Hill, 2007.*
2. *Leonhard Korowajczuk,* ***"LTE, WiMAX and WLAN Network Design, Optimization and Performance Analysis",*** *Wiley-Blackwell, 2011.*
3. *Erik Dahlman, Stefan Parkvall, Johan Skold****, "4G: LTE/LTE-Advanced for Mobile Broadband"****, Second Edition, Academic Press Inc., 2013.*
4. *Maritn Sauter,* ***"From GSM to LTE: An Introduction to Mobile Networks and Mobile Broadband"****, John Wiley and Sons, 2011.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to
CO1: Summarize Wireless communication technologies and wireless systems **[Familiarity]**
CO2: Explain Wireless Application Protocol and Wireless Local Area Networks **[Familiarity]**
CO3: Describe 4G Technologies and Mesh Networks **[Familiarity]**
CO4: Explain Ad Hoc and Wireless Sensor Networks **[Familiarity]**
CO5: Describe Mobile IP and Security issues of Wireless Systems **[Familiarity]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	M	M	M	L	M	M	H	L	H		L	H	H	M	H
CO2	H	M	M	M	L	M	M	H	L	H		L	H	H	M	H
CO3	H	M	M	M	L	M	M	H	L	H		L	H	H	M	H
CO4	H	M	M	M	L	M	M	H	L	H		L	H	H	M	H
CO5	H	M	M	M	L	M	M	H	L	H		L	H	H	M	H
18SPE$15	H	M	M	M	L	M	M	H	L	H		L	H	H	M	H

L - Low, M - Moderate (Medium), H – High

18SPE$16	SOCIAL NETWORKS

PRE-REQUISITES: NIL **Category : PE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- The basic concepts of social graphs and network datasets
- Behavior and relationships between nodes in social networks.
- Page ranking and Link analysis in social graphs.
- Interactions between an individual and the population.
- Fine grained dynamics of search processes and epidemics

UNIT – I : INTRODUCTION	**(9 Periods)**
Introduction – Fundamentals of Graphs – Strong and Weak Ties - Triadic Closure - The Strength of Weak Ties- Tie Strength and Network Structure in Large-Scale Data- Tie Strength, Social Media, and Passive Engagement- Closure, Structural Holes, and Social Capital- Betweenness Measures and Graph Partitioning. Network Datasets – Types and formats- Dataset repositories - Handling network Datasets using python.	
UNIT – II : SOCIAL NETWORK RELATIONSHIPS	**(9 Periods)**
Networks in Their Surrounding Contexts- Homophily- Selection and Social Influence- Affiliation- Tracking Link Formation in On-Line Data- A Spatial Model of Segregation. Positive and Negative Relationships- Structural Balance- Characterizing the Structure of Balanced Networks- Applications of Structural Balance- A Weaker Form of Structural Balance.	
UNIT – III : LINK ANALYSIS	**(9 Periods)**
Link Analysis and Web Search- The Problem of Ranking- Link Analysis using Hubs and Authorities- PageRank- Applying Link Analysis in Modern Web Search- Applications beyond the Web- Spectral Analysis, Random Walks, and Web Search.	
UNIT – IV : NETWORK DYNAMICS: POPULATION MODELS	**(9 Periods)**
Information Cascades- Following the Crowd- Bayes' Rule - Sequential Decision-Making and Cascades. Network Effects- The Economy with and without Network Effects- Stability Vs Instability - Tipping Points- Mixing Individual Effects with Population-Level Effects- Negative Externalities and The El Farol Bar Problem. Power Laws and Rich-Get-Richer Phenomena.	
UNIT – V : NETWORK DYNAMICS: STRUCTURAL MODELS	**(9 Periods)**
Cascading Behavior in Networks- Diffusion in Networks- Cascades and Clusters- Diffusion, Thresholds, and the Role of Weak Ties- Knowledge, Thresholds, and Collective Action. The Small-World Phenomenon- Six Degrees of Separation- Structure and Randomness. Epidemics- Branching Processes- The SIR and SIS Epidemic Model.	

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total:45 Periods

TEXT BOOKS:

1. *David Easley and Jon Kleinberg,"* ***Networks, Crowds and Markets"****, Cambridge University Press, 2010.*
2. *Matthew O.Jackson ,* ***"Social and Economic Networks"****,Princeton University Press,2010.*

REFERENCE BOOKS:

1. *Charu C. Aggarwal,* ***"Social Network Data Analytics"****, Springer 2011*
2. *David Easley and Jon Kleinberg. Networks, Crowds, and Markets:* ***Reasoning About a Highly Connected World****, Cambridge University Press, 2010*
3. *Borko Furht,* ***"Handbook of Social Network Technologies and Applications"****, Springer 2010.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Identify social network structures and properties **[Familiarity]**
CO2 : Discriminate selection and social influence to estimate homophily in social network communities. **[Usage]**
CO3 : Use page ranking and link analysis algorithms for efficient web search. **[Usage]**
CO4 : Explore interactions among individuals and the population **[Familiarity]**
CO5 : Use Small World Phenomenon to identify six degrees of separation **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	H	H		M					M	H	M	H	H
CO2	H	H	H	H	H		M					M	H	M	H	H
CO3	H	H	H	H	H		M					M	H	M	H	H
CO4	H	H	H	H	H		M					M	H	M	H	H
CO5	H	H	H	H	H		M					M	H	M	H	H
18SPE$16	H	H	H	H	H		M					M	H	M	H	H

L - Low, M - Moderate (Medium), H - High

18SPE$17	DATA WAREHOUSING AND DATA MINING

PRE-REQUISITES: NIL **Category : PE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course the students will be familiar with:

- Building data warehouse using data model, warehouse architecture and OLAP server.
- Association mining techniques used for the development of efficient data mining system.
- Classification and prediction methods.
- Clustering the data using clustering techniques.
- Applications of data mining.

UNIT – I : INTRODUCTION TO DATA WAREHOUSE	**(9 Periods)**
Introduction- a multi dimensional data model – Data cube technology-Data warehouse architecture-Types of OLAP servers-Data warehouse implementation-Data warehousing to data mining.	
UNIT – II : INTRODUCTION TO DATA MINING	**(9 Periods)**
Data mining – functionalities - Major issues - Data cleaning - Data integration and Transformation - Data reduction - Discretization and concept hierarchy generation-Efficient and scalable frequent item set mining methods-Mining various kinds of association rules-Association mining to correlation analysis-Constraint based association mining.	
UNIT – III : CLASSIFICATION AND PREDICTION	**(9 Periods)**
Introduction – Issues – Classification by decision tree induction - Bayesian classification- Rule based classification-Classification by back propagation- Other classification methods- Prediction-Accuracy and error measures- Evaluating the accuracy.	
UNIT – IV : CLUSTER ANALYSIS	**(9 Periods)**
Cluster analysis – Types of data – Partitioning methods – Hierarchical methods – Density based methods-Grid based methods – Model based Clustering methods – Clustering High dimensional data – Constraint based cluster analysis – outlier analysis.	
UNIT – V : DATA MINING APPLICATIONS	**(9 Periods)**
Data mining for financial analysis-Retail industry-Telecommunication industry-Biological data analysis- Other scientific applications-Intrusion detection.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Jiewei Han, MichelineKamber,* ***"Data mining concepts and techniques"****, Morgan Kaufmann Pub, Third Edition, 2011.*

REFERENCE BOOKS:

1. *William H. Inmon,* ***"Building the data ware house"****, Wiley DreamtechPvt Ltd., Fourth Edition, 2005.*
2. *Ian H.Witten, Eibe Frank, "****Data Mining: Practical M/c Learning tools and techniques with Javaimplementation"****, Morgan Kaufmann Pub, Third Edition, 2011.*
3. *K.P.Soman,ShyamDiwakar,V.Ajay,* ***" Insight into Data Mining, theory and practice"****, PHI Pvt Ltd, 2006.*
4. *Ronen Feldman, James Sangee,* ***"The Text Mining Handbook: Advanced Approaches in analyzing unstructured data"****, Cambridge University Press, 2007.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Develop financial data warehouse using Stars, snowflake, fact constellations schema and OLAP concepts. **[Assessment]**

CO2: Transform data to normalized form and solve problems using association mining. **[Assessment]**

CO3: Apply classification techniques like decision tree induction, Bayesian classification, Rule based classification and back propagation to classify an unlabeled data. **[Usage]**

CO4: Apply model based clustering method and remove the irrelevant data using outlier analysis. **[Usage]**

CO5: Analyze data mining for transaction analysis, biological data analysis, social network analysis. **[Familiarity]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	H	H	H	H				H	H	H	H	M	H	H	M
CO2	H	H	H	H	H				H	H	H	H	M	H	H	M
CO3	M	H	L	L	H				L	L	L	H	M	H	H	M
CO4	M	H	M	M	H				H	M	L	H	L	H	H	L
CO5	H	H	H	M	H				H	H	M	H	M	H	H	M
18SPE$17	H	H	M	H	H				H	M	M	H	M	H	H	M

L - Low, M - Moderate (Medium), H - High

18SPE$18	MULTIMEDIA SYSTEMS

PRE-REQUISITES: NIL **Category : PE**

COURSE OBJECTIVES:

L	T	P	C
3	0	0	3

Upon completion of this course, the students will be familiar with:

- Fundamentals of Multimedia Technologies.
- Various file formats for Text, image and graphics.
- Fundamentals of media components such as audio, video.
- Multimedia communication across the networks.
- Multimedia Applications

UNIT – I : INTRODUCTION OF MULTIMEDIA	**(9 Periods)**
Multimedia an overview – Digital representation – Visual Display Systems – Multimedia Input and output Technologies.	
UNIT – II : TEXT, IMAGE AND GRAPHICS	**(9 Periods)**
Text: Introduction- Types of Text – Unicode Standard – Font – Insertion of Text – Text compression – File Formats. Image: Image types – Seeing color – Color Models – Basic Steps for image processing – Scanner –Digital Camera – Interface standards – Specifications of digital images – Color Management Systems – Image processing Software - File Formats – Image output on monitor – Image output on printer, Graphics .	
UNIT – III : AUDIO, VIDEO AND ANIMATION	**(9 Periods)**
Audio: Introduction – Acoustics – Nature of sound waves – Characteristics of Sound – Elements of Audio Systems Microphone – Amplifier – Loud Speaker – Audio Mixer – Digital Audio – Synthesizer – MIDI – Audio Transmission – Audio recording Devices – File Formats, Video, animation .	
UNIT – IV : MULTIMEDIA COMMUNICATION AND DOCUMENTS	**(9 Periods)**
Basics of Computer and Networks-Layers-Protocols and Services-LAN,WAN,MAN-Application System-Transport subsystem- Quality of Service and Resource Management - Multimedia Documents – Multimedia Application Development.	
UNIT – V : MULTIMEDIA APPLICATION	**(9 Periods)**
Media Preparation- Media Editing- Media Integration- Media Transmission- Media Usage- Case Study: i-LAND	

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Ranjan Parekh, "**Principles of Multimedia"**, The McGraw - Hills Company, Twelfth Reprint 2013.*
2. *Ze-Nian Li, Mark S. Drew, Jiangchuan Liu , **"Fundamentals of Multimedia"**, Springer International Publishing,2nd Edition,2014.*
3. *Ralf Steinmetz and Klara Nahrstedt , **"Multimedia Applications"**, Springer International Publishing,1 nd Edition,2008.*

REFERENCE BOOKS:

1. *Ralf Steinmetz and Klara Nahrstedt**, "Multimedia: Computing Communications & Applications"**, Pearson Education, 2012.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Design a basic Multimedia system using Multimedia Input and output Technologies **[Usage]**
CO2: Apply various file formats for audio, video and text media. **[Usage]**
CO3: Design a Multimedia system using audio and video .**[Usage]**
CO4: Explain the types of Multimedia communication and documents.**[Familiarity]**
CO5: Design and develop the multimedia applications[**Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	M	M	L							M	H	M	M	M
CO2	H	H	M	M	L							M	H	M	M	M
CO3	H	H	M	M	L							M	H	M	M	M
CO4	H	H	L	M	L							M	H	M	M	M
CO5	H	H	L	M	L							M	H	M	M	M
18SPE$18	H	H	M	M	L							M	H	M	M	M

L - Low, M - Moderate (Medium), H – High

18COE$01	CLIMATE CHANGE AND ADAPTATION *(Common to All Branches)*

Category : OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- Able get knowledge about Climate system and its changes and causes
- Able to learn about impacts, adaptation and mitigation of climate change
- Able to learn about clean technology and clean energy

UNIT – I : EARTH'S CLIMATE SYSTEM	**(9 Periods)**
Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification - Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies - Cloud Formation and Monsoon Rains – Storms and Hurricanes - The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation – The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.	
UNIT – II : OBSERVED CHANGES AND ITS CAUSES	**(9 Periods)**
Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modeling.	
UNIT – III : IMPACTS OF CLIMATE CHANGE	**(9 Periods)**
Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions – Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.	
UNIT – IV : CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES	**(9 Periods)**
Adaptation Strategy/Options in various sectors – Water – Agriculture –- Infrastructure and Settlement including coastal zones – Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS) - Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.	
UNIT – V : CLEAN TECHNOLOGY AND ENERGY	**(9 Periods)**
Clean Development Mechanism – Carbon Trading - examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding.	

Contact periods:
Lecture: 45 **Tutorial: 0** **Practical: 0** **Total : 45 periods**

TEXT BOOKS:

1 *Jan C. van Dam,* ***"Impacts of Climate Change and Climate Variability on Hydrological Regimes"****, Cambridge University Press, 2009.*
2 *Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds.,* ***"Climate Change and Water"****. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 2008.*
3 *Dash Sushil Kumar,* ***"Climate Change – An Indian Perspective"****, Cambridge University Press India Pvt. Ltd, 2007.*
4 *IPCC Report Technical paper VI – Climate change and Water, 2008.*

REFERENCE BOOKS:

1 *IPCC fourth assessment report - The AR4 synthesis report, 2007*
2 *IPCC fourth assessment report –Working Group I Report, " The physical Science Basis",2007*
3 *IPCC fourth assessment report - Working Group II Report,* ***"Impacts, Adaptation and Vulnerability"****, 2007*
4 *Climate change 2014: Impacts, Adaptation and Vulnerability, IPCC*
5 *Climate change 2013: The Physical Science basis, IPCC.*
6 *www.environment.gov.au/climate-change/adaptation.*
7 *www.environment.org/explore-topics/climate-change/what.we.do/climate-adaptation.*

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Understand the climatic system and the factors influencing the climatic changes
CO2: Assess the uncertainty and impact of climatic changes
CO3: Understand the impacts of climate change in various sectors.
CO4: Develop strategies for adaptation and mitigation of climatic changes
CO5: Identify clean technologies for sustainable growth

COURSE ARTICULATION MATRIX:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1			M			L	L					L	L	L	L	L
CO2	L					L	L					L	M	M	M	L
CO3						L	L					L		H	H	
CO4	M	M	L	M		L	M					L	L	M	M	M
CO5	L	M	M	M		L	H					L	L	M	L	M
18COE $01	L	M	M	M		L	M					L	L	M	M	M

L-Low, M-Moderate (Medium), H-High

18COE$02	DISASTER MANAGEMENT AND MITIGATION *(Common to All Branches)*

Category : OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To give knowledge about basics of Disaster Management.
- To impart knowledge about Hazards and Vulnerability.
- To give knowledge about mitigation and preparedness.
- To teach about Response and Recovery.
- To impart knowledge about the participants involved in the disaster management activity.

UNIT - I : INTRODUCTION	**(9 Periods)**
Disaster throughout history, History of disaster management, Capacity by demand, UN International strategy for disaster reduction, the Hyogo framework for action, Post 2015 framework, Disaster trends.	
UNIT – II : HAZARDS AND RISK VULNERABILITY	**(9 Periods)**
Hazard Identification and Hazard Profiling, hazard analysis, Types of hazards- Natural and technological Components of Risk- likelihood and Consequence, Trends and Computation of likelihood and Consequence. Risk Evaluation – purpose, Risk Acceptibility, Alternatives, Personnel. Political/ social, Economic. vulnerability-Physical Profile, Social Profile, Environmental Profile, Economic Profile. Factors Influncing Vulnerability, risk Perception.	
UNIT - III : MITIGATION AND PREPAREDNESS	**(9 Periods)**
Mitigation - types of mitigation ,Ostacles in mitigation, Assement and selection of Mitigation options, Emergency response capacity as , Incorporating Mitigation into development and relief projects. Prepareness- Government Preparedness, Public Preparedness, Media as a public educator. Obstacles to public education and preparedness.	
UNIT – IV : RESPONSE AND RECOVERY	**(9 Periods)**
Response the Emergency- Pre disaster, post disaster, Provision of water, food and shelter, volunteer management , command , control and coordination. Recovery- short term and long term recovery components of recovery- planning, coordination, information, money and supplies, allocation of relief funds, personnel. Types of recovery- Government, Infrastructure, Debris removal disposal and processing, environment, housing, economic and livelihood, individual, family and social recovery-special considerations in recovery.	
UNIT – V : PARTICIPANTS	**(9 Periods)**
Governmental Disaster management agencies- Fire, law, emergency management, Emergency medical service, Millitary and other resources. Structures- local, regional, national. Bilateral assistance and its types. Types of national agencies involved in international disaster management. Political implications of bilateral assistance. Non GovernmentalOrganaisations – operations, NGO/ Millitary coordination, standard of conduct. The role of Private sector and academia. Multilateral organaisations - UN agencies and progammes, Regional &Inernationalorganaisations. International Financial Institutions- the world bank, IMF, ADB, IADB. Special considerations.	

Contact periods:
Lecture: 45 Tutorial: 0 Practical: 0 Total : 45 Periods

TEXT BOOKS:

1. *Damon P. Coppola,* ***"Introduction to International Disaster management"****, Elsevier publication, 2015*

REFERENCE BOOKS:

1. Brassard, Caroline, Giles, David W., Howitt, Arnold M., ***"Natural Disaster Management in the Asia-Pacific"****, Policy and Governance.*
2. ***"Disaster Management",*** *Global Challenges and Local Solutions, Universities Press, 2009.*
3. Jack Pinkowski, ***"Disaster Management Handbook"****, CRC Press , January 22, 2008.*
4. Disaster Management Guidelines, GOI-UNDP Disaster Risk Reduction Programme (2009-2012).

COURSE OUTCOME:

CO1: Able to get knowledge about basics of Disaster management.
CO2: Able to impact knowledge about Hazards and vulnerability
CO3: Able to know about Mitigation and preparedness.
CO4: Able to attain knowledge about response and recovery.
CO5: Able to learn about the participants involved in the disaster management activity.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS01	PS02	PS03	PS04
CO1		L			L	L		L								L
CO2	L	H		M	L	M						L	L			L
CO3	L	L			H	M						L	L			L
CO4	L	M		L	L	M	M									L
CO5		M		L	L	M										L
18COE $02	L	M		L	L	M	M					L	L			L

L-Low, M-Moderate (Medium), H-High

18COE$03	ENERGY EFFICIENT BUILDINGS *(Common to All Branches)*

Category : OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To understand the Concepts of Sustainable Environment, basics of energy analysis, simulation and management.
- To understand the concept of managing air quality.
- To understand the Green building concepts.

UNIT – I : INTRODUCTION	**(9 Periods)**
Life cycle impacts of materials and products – sustainable design concepts – strategies of design for the environment -the sun-earth relationship and the energy balance on the earth's surface, climate, wind – solar radiation and solar temperature – sun shading and solar radiation on surfaces – energy impact on the shape and orientation of buildings – thermal properties of building materials.	
UNIT – II : ENERGY EFFICIENT TECHNIQUES	**(9 Periods)**
Passive Cooling And Day Lighting – Active Solar And Photovoltaic- Building Energy Analysis Methods- Building Energy Simulation- Building Energy Efficiency Standards- Lighting System Design- Lighting Economics and Aesthetics- Impacts of Lighting Efficiency – Energy Audit and Energy Targeting- Technological Options For Energy Management.	
UNIT – III : INDOOR ENVIRONMENTAL QUALITY MANAGEMENT	**(9 Periods)**
Psychrometry- Comfort Conditions- Thermal Comfort- Ventilation And Air Quality Air Conditioning Requirement- Visual Perception- Illumination Requirement- Auditory Requirement- Energy Management Options- Air Conditioning Systems- Energy Conservation In Pumps- Fans And Blowers-Refrigerating Machines- Heat Rejection Equipment- Energy Efficient Motors- Insulation.	
UNIT – IV : GREEN BUILDING CONCEPTS	**(9 Periods)**
Green Building Concept- Green Building Rating Tools- Leeds And IGBC Codes. – Material Selection Embodied Energy- Operating Energy- Façade Systems- Ventilation Systems- Transportation- Water Treatment Systems- Water Efficiency- Building Economics.	
UNIT – V : GREEN BUILDING DESIGN CASE STUDY	**(9 Periods)**
Students To Work Through A Controlled Process of Analysis And Design To Produce Drawings and Models Of Their Own Personal Green Building Project. Topics Include Building Form, Orientation and Site Considerations; Conservation Measures; Energy Modeling; Heating System And Fuel Choices; Renewable Energy Systems; Material Choices; and Construction Budget- Students Will Research Green Construction and Design in A Particular -Construction Context and Report Their Results to the Class.	

Contact periods:
Lecture: 45 Tutorial: 00 Practical: 00 Total : 45 Periods

TEXT BOOKS:

1 *Kibert, C.* ***"Sustainable Construction: Green Building Design and Delivery"****, John Wiley & Sons, 4th Edition, 2016.*
2 *Edward G Pita,* ***"An Energy Approach- Air-Conditioning Principles and Systems"****, Pearson Education, 2003.*
3 *Satyajit Ghosh, Abhinav Dhaka,* ***"Green structures: Energy efficient buildings"****, 2015.*

REFERENCE BOOKS:

1 *Colin Porteous,* ***"The New Eco-Architecture"****, Spon Press, 2002.*
2 *Ganesan T P,* ***"Energy Conservation in Buildings"****, ISTE Professional Center, Chennai, 1999.*
3 *NPTEL* ***"Energy Efficiency and Simulation"****, Prof.E.Rajsekar., IIT Roorkee.*
4 *Energy Conservation Building Codes: www.bee-india.nic.in*
5 *Lever More G J,* ***"Building Energy Management Systems"****, E And FN Spon, London, 2000.*
6 *NPTEL* ***"Energy efficiency acoustics and day lighting in building"****, Prof.B.Bhattacharjee., IIT Delhi.*

COURSE OUTCOMES:

On completion of the course, the students will be able to
CO1: Understand the Concepts of Sustainable Environment.
CO2: Understand the basics of energy analysis, simulation and management.
CO3: Understand the concept of managing air quality.
CO4: Understand the Green building concepts.
CO5: Create drawings and models of their own personal green building project

COURSE ARTICULATION MATRIX:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	L	M	L			M	M	L	L	L		L	L	M	L	L
CO2			L	L		L	L					L		L		
CO3		L				L	M	L				L		L		
CO4	L	M					H					M		M		
CO5	M	M	H	L			H	L	M		M	M		H	L	M
18COE $03	L	M	H	L		M	H	L	L	L	M	M	L	H	L	M

L-Low, M-Moderate (Medium), H-High

18MOE$04	NANOTECHNOLOGY AND SURFACE ENGINEERING *(Common to All Branches)*

Category : OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To Understand and analyze the concepts of Quantum confinement, Dimensional structures and Properties of Nanosystems
- To be familiar with various methods of synthesis of Nanomaterials
- To analyze and understand the mechanical and electrical properties of Nanomaterial and its applications

UNIT – I: PROPERTIES OF NANOMATERIALS	**(9 Periods)**
Size effect and properties of nanoparticles - particle size - particle shape - particle density - melting point, surface tension, wettability - specific surface area and pore size – Properties of Individual nanoparticles. Quantum confinement in 3D, 2D, 1D and zero dimensional structures -Size effect and properties of nanostructures- Top down and Bottom up approach.	
UNIT – II : SYNTHESIS OF NANOMATERIALS	**(9 Periods)**
Sol-Gel Process - Self-assembly – Electrodeposition - Spray Pyrolysis - Flame Pyrolysis – Metal nano-crystals by Reduction – Solvo-thermal Synthesis - Chemical Vapor Deposition (CVD) – Metal Orgonic Chemical Vapor Deposition (MOCVD).Ball Milling - Inert Gas Condensation Technique (IGCT) – Thermal evaporation – Pulsed Laser Deposition (PLD) – DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE) – Melt Spinning process – Applications	
UNIT – III : MECHANICAL AND ELECTRICAL PROPERTIES	**(9 Periods)**
Nanoscale Mechanics - Introduction – Mechanical properties – The Elasticity of Nanomaterials – Elasticity of Bulk Nanomaterials –Plastic Deformation of Nanomaterials – Crystals and Crystal Plasticity – From Crystal Plasticity to Polycrystal Plasticity. Introduction - Energy Storage Basics - Electrical Energy Storage Devices and Impact of Nanomaterials - Electrochemical Properties of Nanoscale Materials - Aerogels and Structure-Directed Mesoporous and Macroporous Solids - Nanoparticles - Nanotubes, Nanowires, and Nanorolls	
UNIT – IV : FUNDAMENTALS OF SURFACE ENGINEERING	**(9 Periods)**
Surface engineering - classification, definition, scope and general principles, Conventional surface engineering - Surface engineering by material removal: Cleaning, pickling, etching, grinding, polishing, buffing / puffing, Surface engineering by material addition - From liquid bath, hot dipping, Electro-deposition / plating.	
UNIT – V : SURFACE MODIFICATION	**(9 Periods)**
Surface modification of steel and ferrous components - Pack carburizing, Aluminizing, calorizing, diffusional coatings (principle and scope of application), Surface modification using liquid/molten bath: Cyaniding, liquid carburizing (diffusion from liquid state), Surface modification using gaseous medium: Nitriding, Carbo-nitriding (diffusion from gaseous state).	

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

*1. Kelsall Robert W, Ian Hamley and Mark Geoghegan, —**"Nanoscale Science and Technology"**, Wiley Eastern, 2004.*

*2. N John Dinardo, **"Nanoscale Charecterisation of Surfaces & Interfaces**", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000*

*3. ASM Metals Hand Book –Vol. 5, **"Surface Engineering"**, 1996*

REFERENCE BOOKS:

1. *G. Timp. Editor, **"Nanotechnology"** AIP press, Springer-Verlag, New York, 1999*
2. *Hari Singh Nalwa, Editor, **"Nanostructured materials and Nanotechnology''**, Concise Edition, Academic Press, USA (2002).*
3. *GuozhongGao,**"Nanostructures & Nanomaterials: Synthesis, Properties & Applications**", Imperial College Press (2004).*
4. *K.G. Budinski, **"Surface Engineering for Wear Resistances",** Prentice Hall, Englewood Cliffs, 1988.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze the particle size, particle shape, particle density, Size effect and properties of Nanostructures.

CO2: Acquire knowledge in various methods of synthesis of Nanomaterials.

CO3: Analyze the Elasticity of Nanomaterials, Electrical Energy Storage Devices and Aerogels.

CO4: Apply various Nanomaterials to the LED, Transistor Applications.

CO5: Apply various surface engineering techniques

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	L	L	M	L	M	M	M	L	M	M	M	M	M
CO2	H	H	M	H	H	L	L	M	M	M	L	H	M	H	M
CO3	H	H	L	H	M	M	L	L	M	M	M	M	M	H	M
CO4	L	H	M	H	M	M	L	L	M	M	M	M	M	H	M
CO5	M	M	L	M	M	L	M	M	M	L	M	M	M	H	M
18MOE$04	H	H	L	M	H	M	H	H	M	H	M	M	M	M	M

L-Low, M-Moderate (Medium), H-High

18MOE$05	**MECHATRONICS** *(Common to All Branches)*

Category : OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To study the mechatronics system and understanding the concepts of integration and design of mechatronics system.

UNIT – I : SYSTEM MODELS	**(9 Periods)**
Introduction - Definition of Mechanical Systems, Philosophy and approach. Systems and Design - Mechatronic approach, Integrated Product Design - Modeling- Analysis and Simulation, Man-Machine Interface.	
UNIT – II : SENSORS AND TRANSDUCERS	**(9 Periods)**
Sensors and transducers - classification, Development in Transducer technology, Optoelectronics - Shaft encoders, CD Sensors, Vision System.	
UNIT – III : DRIVES AND ACTUATORS	**(9 Periods)**
Drives and Actuators - Hydraulic and Pneumatic drives - Electrical Actuators - servo motor and Stepper motor, Drive circuits, open and closed loop control - Embedded Systems - Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems.	
UNIT – IV : SMART MATERIALS	**(9 Periods)**
Smart materials - Shape Memory Alloy, Piezoelectric and Magnetostrictive Actuators - Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation.	
UNIT – V : MICROMECHATRONIC SYSTEMS	**(9 Periods)**
Micromechatronic systems - Microsensors, Microactuators - Micro-fabrication techniques - LIGA Process- Lithography, etching, Micro-joining. Application examples - Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology.	

Contact Periods:
Lecture: 45Periods Tutorial: 0Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

*1. W.Bolton, **"Mechatronics"**, Longman,2nd Edition,1999*

REFERENCE BOOKS:

*1. Michael B. Histand and David G.Alciatore, **"Introduction to Mechatronics and Measurement Systems"**, Tata McGraw Hill, 2nd Edition,2003*

*2. D.A.Bradley, D.Dawson, N.C.Buru and A.J.Loader**, "Mechatronics"** Chapman and Hall,1993*

*3. Dan S Necsulescu, **"Mechatronics"**, Pearson Education Asia,2005*

*4. Devdas Shetty, Richard A. Kolk, **"Mechatronics System Design"**, Thomson, PWS publishing, 2007.*

*5. Smaili.A and Mrad.F, **"Mechatronics: Integrated Technologies for Intelligent Machines", Oxford university** press, 2008*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Identify the key elements of mechatronics system and models.

CO2: Select appropriate sensors and transducers for industrial application.

CO 3: Integrate mechanical, electrical, electronics, control systems in the mechatronics system design

CO 4. Select the proper smart material for mechatronics system.

CO 5: Apply the principles of mechatronics in industrial needs.

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	H	H	M	L	H	L	L	H	L	M	L	M	H	L
CO2	H	H	H	L	L	H	L	L	M	L	M	L	M	H	L
CO3	H	H	H	L	L	H	L	L	M	L	M	L	M	H	L
CO4	H	H	H	M	H	H	L	L	M	M	L	L	H	H	L
CO5	H	H	H	M	L	H	L	L	H	M	M	M	H	H	L
18MOE$05	H	H	H	H	L	H	L	L	M	L	M	L	M	H	L

L-Low, M-Moderate (Medium), H-High

18EOE$07	RENEWABLE POWER GENERATION SYSTEMS *(Common to All Branches)*

Category: OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

* To elucidate the technologies used for generation and utilization of power from renewable energy resources.

UNIT-I : SOLAR ENERGY	**(9 Periods)**
Solar radiation, solar spectra-latitude and longitude, Declination angle, solar window, cosine law, seasonal variations, hour angle, calculation of angle of incidence, angstroms equation and constants, Photo voltaic: p-n junctions. Solar cells, PV systems, Standalone, Grid connected solar power - Types of solar thermal collectors – Flat and concentrating collectors, solar thermal applications -water heaters, dryers, stills, refrigeration, air-conditioning, solar pond, central receiver power generation.	
UNIT-II : WIND ENERGY	**(9 Periods)**
Wind energy - Basic principle of wind energy conversion system, wind data and energy estimation, site selection, components of wind energy conversion systems, design consideration of horizontal axis wind mill- merits and limitations- application.	
UNIT-III : BIOMASS ENERGY	**(9 Periods)**
Biomass, sources of biomass, thermo-chemical and bio-chemical conversion of biomass - Pyrolysis, gasification, combustion and fermentation. Gasifiers – Up draft, downdraft and fluidized bed gasifier. Digesters - Fixed and floating digester biogas plants, economics of biomass power generation.	
UNIT-IV : OCEAN AND GEOTHERMAL ENERGY	**(9 Periods)**
Ocean energy resources - Principles of ocean thermal energy conversion systems - ocean thermal power plants - Principles of ocean wave energy conversion and tidal energy conversion - Difference between tidal and wave power generation, Economics of OTEC. Definition and classification of Geothermal resources, Utilization for electricity generation and direct heating, Wellhead power generating units. Overview of micro and mini hydel power generation	
UNIT-V : RENEWABLE ENERGY POLICIES	**(9 Periods)**
Renewable energy policies - Feed-in tariffs, portfolio standards, policy targets, tax incentives, and biofuels mandates. International policies for climate change and energy security. Economic analysis and comparisons, Life cycle analysis, financial analysis, cost of conserved energy, and externalities. Cost assessment of supply technologies versus energy - Efficiency.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Rao. S. and Dr. Pamlekar B.B "**Energy Technology**" Khanna Publishers, Second Ed. 2016*
2. *Rai , G.D., "**Non-Conventional sources of Energy**", Khanna Publishers , V Ed.,2016*

REFERENCE BOOKS:

1. *Khan. B.H, "Non-Conventional Energy Resources", The McGraw Hills, Second edition, 2016.*
2. *Bansal NK, Kleeman and Meliss, M* ***"Renewable Energy Sources and Conversion Techniques"****, Tata McGraw Hill, 1996*
3. *Roland Wengenmayr, Thomas Buhrke," Renewable energy: Sustainable energy concepts for the future", Wiley-VCH, 1st edition, 2008.*

COURSE OUTCOMES:

CO1: Understand the concept of various Non-Conventional energy resources
CO2: Familiarize the principles of operation of renewable energy technologies
CO3: Realize the need for utilizing the energy from clean and Sustainable energy resources.
CO4: Interpret advantages and disadvantages of different renewable sources of energy
CO5: Comprehend the environmental aspects and the correlation between different operational parameters
CO6: Evaluate the options and estimate the energy generation through renewable sources

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M	M	M	-	M	H	-	-	-	-	-	H	M	M
CO2	H	H	M	L	M	M	M	L	-	-	-	-	H	H	H
CO3	H	M	M	M	M	M	M	-	-	-	-	-	M	H	H
CO4	M	H	M	L	M	H	M	-	-	-	-	-	H	H	H
CO5	M	H	L	H	M	M	M	-	-	-	L	-	M	H	M
CO6	H	M	M	L	M	M	M	-	L	-	L	-	M	H	M
18EOE $07	H	H	M	M	-	M	M	L	L	-	L	-	H	H	H

L - Low, M - Moderate (Medium), H – High

18EOE$08	**ELECTRIC VEHICLES** *(Common to All Branches)*

Category : OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

* To understand the technology of Electric and Hybrid Electric Vehicles and their business perspective

UNIT-I : INTRODUCTION	**(9 Periods)**
Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance. Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.	
UNIT-II : ELECTRIC TRAINS	**(9 Periods)**
Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, Switch Reluctance Motor drives- drive system efficiency.	
UNIT-III : ANALYSIS OF ENERGY STORAGE	**(9 Periods)**
Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems.	
UNIT-IV : ENERGY MANAGEMENT STRATEGIES	**(9 Periods)**
Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.	
UNIT-V : BUSINESS PERSPECTIVE OF ELECTRIC VEHICLE	**(9 Periods)**
Design of a Hybrid Electric Vehicle (HEV) - Design of a Battery Electric Vehicle (BEV) Hybrid Electric Heavy Duty Vehicles, Fuel Cell Heavy Duty Vehicles. Business: E-mobility business, electrification challenges, Connected mobility and Autonomous mobility- case study: E-mobility Indian Roadmap Perspective. Policy: EVs in infrastructure system, integration of EVs in smart grid, social dimensions of EVs.	

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. *Mehrdad Ehsani, Yimin Gao, Sebatien Gay and Ali Emadi, "**Modern Electric, Hybrid Electric and Fuel cell vehicles: Fundamentals, Theory and Design**", CRC press, 2004.*
2. *C. Mi, M. A. Masrur and D. W. Gao, "**Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives**", John Wiley & Sons, 2011.*
3. *S. Onori, L. Serrao and G. Rizzoni, "**Hybrid Electric Vehicles: Energy Management Strategies**", Springer, 2015.*

REFERENCE BOOKS:

1. *James Larminie and John Loury, "**Electric Vehicle Technology – Explained**", John Wiley & Sons Ltd, 2003.*
2. *Sandeep Dhameja, "**Electric Vehicle Battery Systems**", Butterworth – Heinemann, 2002.*
3. *Ronald K Jurgen, "**Electric and Hybrid – Electric Vehicles**", SAE, 2002.*
4. *Ron Hodkinson and John Fenton, "**Light Weight Electric/ Hybrid Vehicle Design**", Butterworth – Heinemann, 2001.*
5. *T. Denton, **"Electric and Hybrid Vehicles"**, Routledge, 2016.*

COURSE OUTCOMES:

CO1: Understand the basics of electric vehicle components and configuration.
CO2: Analyze suitable drive scheme for developing an electric vehicle.
CO3: Able to opt a proper energy management system.
CO4: Analyze the performance of practical HEV and EV.
CO5: Understand the infrastructure for Electric Vehicles and business potential.

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	M	M	M	-	M	M	-	-	-	-	L	M	M	-
CO2	-	M	M	M	-	M	M	-	-	-	-	L	M	M	-
CO3	-	M	M	M	-	M	M	-	-	-	-	L	M	M	-
CO4	-	M	M	M	-	M	M	-	-	-	-	L	M	M	-
CO5	-	M	M	M	-	M	M	-	-	-	-	L	M	M	-
18EOE $08	-	M	M	M	-	M	M	-	-	-	-	L	M	M	-

L - Low, M - Moderate (Medium), H – High

18EOE$09	**SMART GRID SYSTEMS** *(Common to All Branches)*

Category : OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

***** To comprehend the underlying techniques applied to Smart Grid

UNIT-I : BASICS OF POWER SYSTEMS	**(9 Periods)**
Basics of Power Systems: Load and Generation - Power Flow Analysis- Economic Dispatch and Unit Commitment Problems. Smart Grid: Definition – Applications- Government and Industry-Standardization	
UNIT-II : SMART GRID COMMUNICATIONS	**(9 Periods)**
Two-way Digital Communications Paradigm - Network Architectures - IP-based Systems - Power Line Communications - Advanced Metering Infrastructure	
UNIT-III : WIDE AREA MEASUREMENT	**(9 Periods)**
Sensor Networks - Phasor Measurement Units- Communications Infrastructure- Fault Detection and Self-Healing Systems -Applications and Challenges	
UNIT-IV : SECURITY AND PRIVACY	**(9 Periods)**
Cyber Security Challenges in Smart Grid - Load Altering Attacks- False Data Injection Attacks-Defense Mechanisms - Privacy Challenges- Cyber Security Standards	
UNIT-V : ECONOMICS AND MARKET OPERATIONS	**(9 Periods)**
Introduction, Reasons for restructuring / deregulation of power industry, Understanding the restructuring process - Entities involved. The market place mechanisms-Energy and Reserve Markets- Market Power - Generation Firms- Locational Marginal Prices= Financial Transmission Rights	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage "**Smart Grid Technologies and applications"** John Wiley Publishers Ltd., 2012.*
2. *P. Venkatesh, B.V. Manikandan, S. Charles Raja, A. Srinivasan "**Electrical Power Systems-Analysis, Security and Deregulation**" PHI Learning Private Limited, New Delhi, 2012.*

REFERENCE BOOKS:

1. *Lars T. Berger, Krzysztof Iniewski "**Smart Grid applications, Communications and Security**" John Wiley Publishers Ltd., 2012.*
2. *Yang Xiao, **"Communication and Networking in Smart Grids",** CRC Press Taylor and Francis Group, 2012.*
3. *Caitlin G. Elsworth, **"The Smart Grid and Electric Power Transmission"**, Nova Science Publishers Inc, August 2010.*

COURSE OUTCOMES:

CO1: Demonstrate the various aspects of the smart grid, including Technologies, Components, Architectures and applications
CO2: Creating a framework to operate the grid more effectively.
CO3: Evaluate the existing grid with respect to smart grid
CO4: Upgrade the existing grid to smart grid environment

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	L	L	M	H	L	M	M	M	H	M	H	M
CO2	L	L	M	M	M	M	M	L	M	M	M	M	M	M	H
CO3	-	-	-	M	M	M	M	M	M	M	M	H	M	M	M
CO4	L	-	-	M	M	M	H	-	M	M	M	H	M	H	H
18EOE $09	L	L	M	M	M	M	H	L	M	M	M	H	M	H	H

L - Low, M - Moderate (Medium), H - High

18LOE$10	**MOBILE COMMUNICATION** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the concept of Mobile radio propagation, cellular system design
- To understand mobile technologies like GSM and CDMA.
- To know the mobile communication evolution of 2G, 3G and 3 GPP in detail.
- To have overview of immerging technologies application.

UNIT I WIRELESS COMMUNICATION	**(9 Periods)**
Cellular systems- Frequency Management and Channel Assignment- types of handoff and their characteristics, dropped call rates & their evaluation -MAC – SDMA – FDMA – TDMA – CDMA – Cellular Wireless Networks.	
UNIT II WIRELESS NETWORKS	**(9 Periods)**
Wireless LAN – IEEE 802.11 Standards – Architecture – Services – Mobile Ad hoc Networks- WiFi and WiMAX - Wireless Local Loop.	
UNIT III MOBILE COMMUNICATION SYSTEMS	**(9 Periods)**
GSM-architecture-Location tracking and call setup- Mobility management- Handover-Security-GSM SMS – International roaming for GSM- call recording functions-subscriber and service data mgt – Mobile Number portability -VoIP service for Mobile Networks – GPRS – Architecture-GPRS procedures-attach and detach procedures-PDP context procedure-combined RA/LA update procedures-Billing.	
UNIT IV MOBILE NETWORK AND TRANSPORT LAYERS	**(9 Periods)**
Mobile IP – Dynamic Host Configuration Protocol-Mobile Ad Hoc Routing Protocols– Multicast routing-TCP over Wireless Networks – Indirect TCP – Snooping TCP – Mobile TCP – Fast Retransmit / Fast Recovery – Transmission/Timeout Freezing-Selective Retransmission – Transaction Oriented TCP- TCP over 2.5 / 3G wireless Networks.	
UNIT V APPLICATION LAYER	**(9 Periods)**
WAP Model- Mobile Location based services -WAP Gateway –WAP protocols – WAP user agent profile- caching model-wireless bearers for WAP - WML – WMLScripts - WTA - iMode - SyncML.	

Contact periods:

Lecture: 45 Periods **Tutorial:0 Periods** **Practical:0 Periods** **Total:45 Periods**

TEXT BOOKS:

*1. John Schiller, "**Mobile Communications**", Second Edition, Pearson Education, 2003.*

*2. William Stallings, "**Wireless Communications and Networks**", Pearson Education,2002.*

REFERENCES BOOKS:

*1. Kaveh Pahlavan, Prasanth Krishnamoorthy, "**Principles of Wireless Networks**", First Edition, Pearson Education, 2003.*

*2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, "**Principles of Mobile Computing**", Springer, 2003.*

*3. C.K.Toh, "**AdHoc Mobile Wireless Networks**", First Edition, Pearson Education, 2002.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand GSM, CDMA concepts and architecture, frame structure, system capacity, services provided.

CO2: Study of evolution of mobile communication generations 2G, 2.5G, 3G with their characteristics and limitations.

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	M	-	-	-	-	-	-	-	-	L	M	L	-
CO2	M	M	M	-	-	-	-	-	-	-	-	L	M	L	-
18LOE $10	M	M	M	-	-	-	-	-	-	-	-	L	M	L	-

L - Low, M - Moderate (Medium), H - High

18LOE$11	INTRODUCTION TO VLSI SYSTEM DESIGN *(Common to All Branches)*

Category: OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce various aspects of CMOS logic design in combinational and sequential circuit to design CMOS VLSI system components

UNIT I: CMOS LOGIC DESIGN	**(9 Periods)**
Inverter- CMOS Logic Gates: Compound Gates – Pass Transistors and Transmission Gates – Tristated – Multiplexers –CMOS Fabrication and Layout: Fabrication Process – Layout Design rule – Gate Layouts – Stick Diagrams – Design Partitioning	
UNIT II: MOS TRANSISTOR THEORY	**(9 Periods)**
Introduction – Long Channel I-V Characteristics – C-V Characteristics – Non-ideal I-V Effects – DC Transfer Characteristics – CMOS Technologies – Sources of Power Dissipation - Dynamic Power – Static Power.	
UNIT III: COMBINATIONAL CIRCUIT DESIGN	**(9 Periods)**
Circuit Families: Static CMOS – Ratioed Circuits – Cascode Voltage Switch Logic – Dynamic Circuits – Pass Transistor Circuits. Silicon-on-Insulator Circuit Design – Subthreshold Cirucit Design	
UNIT IV: SEQUENTIAL CIRCUIT DESIGN	**(9 Periods)**
Sequential static circuits – Circuit design of latched and flip-flops – Sequencing dynamic circuits – Synchronizers – Wave pipelining - VLSI clocking: CMOS clocking styles - Pipelined systems - Clock generation and distribution.	
UNIT V: DESIGN OF VLSI SYSTEMS	**(9 Periods)**
System Specifications – Structural Gate Level Modeling – Switch Level Modeling – Behavioral and RTL Modeling - Addition/subtraction – Comparators –counters —Multiplexers - Binary Decoders – Comparators – Priority Encoders – Latches - Flip-Flops and Registers – SRAM – DRAM – ROM.	

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. *N. Weste and David Money Harris, "**CMOS VLSI Design**", Fourth Edition, Pearson Education,2011.*
2. *Uyemura, John P, "**Introduction to VLSI Circuits and Systems**", Wiley & Sons, 8th Reprint 2009*

REFERENCE BOOKS:

1. *Jan M. Rabaey, "**Digital Integrated Circuits: A Design Perspective**", PHI, Second Edition, 2012.*
2. *R. Jacob Baker, "**CMOS: Circuit Design, Layout, and Simulation**", Wiley-IEEE, Revised Second Edition, 2008.*
3. *Pucknell, "**Basic VLSI Design**", Prentice Hall, 2006.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Realize the CMOS logic design

CO2: Acquire knowledge on combinational and sequential circuit design of CMOS logic

CO3: Use VLSI clocking styles and realize CMOS VLSI system components

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	M	-	-	-	-	-	-	-	-	L	H	L	L
CO2	M	M	M	-	-	-	-	-	-	-	-	L	M	L	L
CO3	M	M	M	-	-	-	-	-	-	-	-	L	H	L	L
18LOE $11	M	M	M	-	-	-	-	-	-	-	-	L	H	L	L

L - Low, M - Moderate (Medium), H - High

18LOE$12	MICROCONTROLLER AND APPLICATIONS *(Common to All Branches)*

Category: OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Describe the architecture of 8051 microcontroller.
- Develop assembly program for 8051.
- Apply the instruction set of 8051 to get effective programs.
- Design system in block level using microcontroller, memory devices, buses and other peripheral devices.
- Solve real life problem using microcontroller based systems.

UNIT I: MICROCONTROLLER	**(9 Periods)**
Microcontroller Features – On chip oscillator, List of Special Function Registers (SFRs), On chip program memory, on chip data memory, I/O Ports, Watch Dog Timer, Architecture of 8051, Instruction set - Addressing modes.	
UNIT II: ASSEMBLY LANGUAGE PROGRAMMING	**(9 Periods)**
8051 Assembly Language Programming, Branch Instruction Programming -I/O Port Programming – Arithmetic and Logic Instruction Programming-code conversion programming	
UNIT III: PROGRAMMING IN C AND INTERFACING-I	**(9 Periods)**
Timers & Counters programming - Serial Port Programming - Interrupts Programming .8255 Interfacing and Programming- External Memory Interfacing - LCD interfacing, LED Interfacing	
UNIT IV: INTERFACING-II	**(9 Periods)**
Keyboard Interfacing - ADC, DAC interfacing –Temperature Transducer-Pressure and Displacement Transducer-Light Sensor - Optocoupler - Relays.	
UNIT V: APPLICATIONS OF MICROCONTROLLERS	**(9 Periods)**
Stepper Motor interface-Temperature Monitoring and Control System-Speed Control of a DC Motor - Digital Thermometer-Digital Frequency Meter.	

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1.Mohammad Ali Mazidi, Janice Gillispie Mazidi ***"The 8051 Microcontroller and Embedded Systems (Using assembly and C)"*** *Pearson education/ Prentice Hall of India Pvt. Ltd., 2007.*

2. Ajit Pal, *"Microcontrollers : Principles and Applications"****, Prentice-Hall of India Pvt.Ltd; 1 edition (August 2011).***

REFERENCE BOOKS:

1. *Krishna Kanth,* ***"Microprocessor and Microcontroller Archotecture,Programming and System Design using 8085, 8086, 8051"****, Prentice Hall of India, 2011.*
2. *Kenneth J.Ayala,* ***"The 8051 Microcontroller"*** *3rd edition,Thompson Delmar Learning,2007, New Delhi.*
3. *Jacob Fraden,* ***"Handbook of Modern Sensors: Physics, Design and Applications"****, 3rd ed, Springer, 2010.*
4. *Michael J. Pont,* ***"Embedded C"*** *Pearson Education India, 1st edition (*2007*);*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Describe the architectures of controller

CO2: Develop Assembly program applying Digital logic and mathematics using 8051 instruction set

CO3: Design microcontroller based system within realistic constraint like user specification, availability of components etc

CO4: Interface real world sensors

CO5: Solve real life problem and construct a complete system as a solution

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	M	-	-	-	-	-	-	-	-	L	H	L	L
CO2	M	M	M	-	-	-	-	-	-	-	-	L	M	L	L
CO3	M	M	M	-	-	-	-	-	-	-	-	L	H	L	L
CO4	M	M	M	-	-	-	-	-	-	-	-	L	H	L	L
CO5	M	M	M	-	-	-	-	-	-	-	-	L	M	L	L
18LOE $12	M	M	M	-	-	-	-	-	-	-	-	L	H	L	L

L - Low, M - Moderate (Medium), H - High

18POE$13	**RAPID PROTOTYPING** *(Common to All Branches)*

Category: OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To educate students with fundamental and advanced knowledge in the field of Rapid Prototyping technology and the associated Aerospace, Architecture, Art, Medical and Industrial applications.

UNIT- I	**INTRODUCTION**	**(9 Periods)**
Need - Development of RP systems – Applications in Product Development - Virtual Prototyping- Rapid Tooling – Rapid Manufacturing - Classification of RP processes – Benefits - Applications		
UNIT- II	**REVERSE ENGINEERING AND CAD MODELING**	**(9 Periods)**
Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wireframe, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for RP- Case studies.		
UNIT- III	**LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS**	**(9 Periods)**
Classification – Liquid based systems - Stereo lithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and application. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.		
UNIT- IV	**POWDER BASED RAPID PROTOTYPING SYSTEMS**	**(9 Periods)**
Selective Laser Sintering (SLS): Principle, process, indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications – case Studies, Selective Laser Melting and Electron Beam Melting		
UNIT- V	**OTHER RAPID PROTOTYPING SYSTEMS**	**(9 Periods)**
Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, Demerits, Applications and case studies. Shape Deposition Manufacturing (SDM), Ballastic Particle Manufacturing (BPM), Bio Additive Manufacturing.		

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Chua Chee Kai and Leong Kah Fai* ***"Rapid Prototyping: Principles and Applications in Manufacturing",*** *John Wiley AND Sons, 1997*
2. *Paul F. Jacobs* ***"Stereo-lithography and other RP & M Technologies",*** *from Rapid Prototyping to Rapid Tooling, SME/ASME,1996*

REFERENCE BOOKS:

1. *Gibson, I., Rosen, D.W. and Stucker, B* ***"Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing",*** *Springer, 2010.*
2. *Chua, C.K., Leong K.F. and Lim C.S* ***"Rapid prototyping: Principles and applications",*** *second edition, World Scientific Publishers, 2010.*
3. *Gebhardt, A* ***"Rapid prototyping",*** *Hanser Gardener Publications, 2003.*
4. *Liou, L.W. and Liou, F.W* ***"Rapid Prototyping and Engineering applications: A tool box for prototype development",*** *CRC Press, 2011.*
5. *Hilton, P.D. and Jacobs, P.F* ***"Rapid Tooling: Technologies and Industrial Applications",*** *CRC press, 2005*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Appreciate the importance of computers and modern tools in manufacturing to reduce cost and matching the societal needs.

CO2: Create and analyze 2D and 3D models using CAD modeling software and integrating with manufacturing systems.

CO3: Understand the variety of Additive Manufacturing (AM) technologies apply to their potential to support design and manufacturing, case studies relevant to mass customized manufacturing.

CO4: Apply knowledge on latest techniques of manufacturing in their field of career

CO5: To monitor and control shop floor with the aid of computers

COURSE ARTICULATION MATRIX

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			L				M						L	L	
CO2			M											M	L
CO3			L										M	L	
CO4			M		H	M	L						M	H	L
CO5		M				L					M		L	H	
18POE$13		M	M		M	L	L				L		M	M	L

L- Low, M – Moderate (Medium), H – High

18POE$14	**MANAGERIAL ECONOMICS** *(Common to All Branches)*

Category: OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To introduce the fundamental economic principles necessary for production managers.

UNIT- I	FUNDAMENTALS OF MANAGERIAL ECONOMICS	(9 Periods)
Goals and Constraints - The Nature and Importance of Profits - Understanding Incentives - Economic rationality, Scarcity and opportunity cost -Marginal and Incremental Analysis.		
UNIT- II	**DEMAND ANALYSIS**	**(9 Periods)**
Demand and Supply -Market Equilibrium - Price Elasticity of Demand - Price Elasticity, Total Revenue, and Marginal Revenue - Factors Affecting Price Elasticity - Cross Price Elasticity - Income Elasticity of Demand - Other Elasticities, Elasticities for Nonlinear Demand Functions - Elasticity of Supply.		
UNIT- III	**DEMAND THEORIES**	**(9 Periods)**
Choice and Utility Theory - Law of Diminishing marginal utility - Consumer Equilibrium - Consumer Surplus - Price effect, Substitution Effect and Income Effect.		
UNIT- IV	**THEORY OF PRODUCTION AND COST**	**(9 Periods)**
The Production Function - Profit-Maximizing Input Usage - Isoquants and Isocosts - Cost Minimization and Optimal Input Substitution - The Cost Function - Breakeven analysis, Contribution analysis - Long-run Costs and Economies of Scale - Multiple Cost Functions and Economies of Scope - Learning curve.		
UNIT- V	**THEORY OF MARKET AND PRICING**	**(9 Periods)**
The Nature of Industry - Perfect Competition – Monopoly - Monopolistic Competition – Oligopoly - Product pricing.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Thomas and Maurice* ***"Managerial Economics: Concept and Applications",*** *McGraw-Hill, 2005*
2. *Maheshwari.Y* ***"Managerial Economics",*** *Prentice Hall of India, 2012*

REFERENCE BOOKS:

1. *D.N. Dwivedi,* ***"Managerial Economics",*** *Vikas Publishing house, 2015*
2. *Christopher R Thomas, S Charles Maurice,* ***"Managerial economics",*** *Mcgraw Hill, 2014*

COURSE OUTCOMES:

On completion of this course, students will be able to
CO1: Explain fundamentals of managerial economics.
CO2: Discuss the dynamics of market forces.
CO3: Explain about various theories of demand.
CO4: Discuss about the cost concepts related to production.
CO5: Describe about the theory of market and pricing method.

COURSE ARTICULATION MATRIX

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	L							L	M	M	L			L
CO2	L	L	L							M	M	L			L
CO3	L									L	M	L			L
CO4	L									L	L	L			L
CO5	L	M	M	L						L	M	L			L
18POE$14	L	L	L	L						L	M	L			L

L- Low, M – Moderate (Medium), H - High

18POE$15	HYDRAULICS AND PNEUMATICS *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To make the students to design the hydraulic and pneumatic circuits for different applications.

UNIT- I	**BASIC PRINCIPLES**	**(9 Periods)**
Hydraulic Principles; Hydraulic Fluids; Hydraulic pumps – Classification, Characteristics, Pump Selection; Hydraulic actuators; Hydraulic valves – Pressure, Flow, Direction Controls, Applications, Symbols.		
UNIT- II	**HYDRAULIC CIRCUITS**	**(9 Periods)**
Hydraulic circuits – Reciprocating, Quick Return, Sequencing, Synchronizing, Regenerative circuit, Double pump hydraulic system; Safety Circuits.		
UNIT- III	**POWER GADGETS IN HYDRAULICS**	**(9 Periods)**
Accumulators – Classification, Circuits; Pressure Intensifier and Circuit; Mechanical-hydraulic servo system; Selection of components. Installation and Maintenance of Hydraulic power pack; Troubleshooting of fluid power circuits.		
UNIT- IV	**PNEUMATIC SYSTEMS**	**(9 Periods)**
Pneumatic Fundamentals; Control Elements; Logic Circuits; Position sensing, Pressure sensing; Electrical controls: Various switches; Electro Pneumatic and Electro Hydraulic Circuits.		
UNIT- V	**DESIGN AND SELECTION OF PNEUMATIC CIRCUITS**	**(9 Periods)**
Design of Pneumatic circuits – Classic, Cascade, Step counter; PLC and Microprocessors – Uses; Selection criteria for Pneumatic components; Installation and Maintenance of Pneumatic power pack; Fault finding; Case studies.		

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Anthony Esposito,* ***"Fluid Power with Applications",*** *Pearson Education India, 7th edition, 2013.*
2. *Andrew Parr,* ***"Hydraulics and Pneumatics:A Technician's and Engineer's Guide",*** *Butterworth-Heinemann, 3rd edition, 2011.*

REFERENCE BOOKS:

1. *DudleyA Pease and John J Pippenger* ***"Basic Fluid Power",*** *Prentice Hall PTR, 2nd edition 1987.*
2. *John J Pippenger and Tyler G Hicks* ***"Industrial Hydraulics",*** *McGraw Hill,2nd edition, 1970.*
3. *J. Michael, Pinches and HohnG.Ashby* ***"Power Hydraulics",*** *Prentice Hall, 1989.*

COURSE OUTCOMES:

On completion of this course, students will be able to
CO1: Describe the principle of fluid power
CO2: Describe the components of hydraulics
CO3: Design the hydraulic circuits for automation
CO4: Describe the components of pneumatics
CO5: Design the pneumatic circuits for automation

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	H										M			
CO2	M											M			
CO3	M	H										M			
CO4	M											M			
CO5	M											M			
18POE$15	M	H										M			

L- Low, M – Moderate (Medium), H - High

18NOE$16	**MEASUREMENT AND CONTROL** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVE

- To learn about the working of different analog and digital instruments.

UNIT I – INTRODUCTION TO MEASUREMENTS	**(9 Periods)**
Significance of measurements – Methods of measurements – Classification of Instruments – Functions of Instruments and Measurement System – Elements of measurement system – Errors in measurement — Calibration of instruments: Methods & analysis – Introduction to Transducer & types.	
UNIT II – STRAIN AND DISPLACEMENT MEASUREMENT	**(9 Periods)**
Factors affecting strain measurements – Types of strain gauges – theory of operation – strain gauge materials – strain gauge circuits and applications of strain gauges. Resistive potentiometer (Linear, circular and helical) – L.V.D.T., R.V.D.T. and their characteristics – variable inductance and capacitance transducers – Piezo electrical transducers – Hall Effect devices and Proximity sensors.	
UNIT III – PRESSURE AND TEMPERATURE MEASUREMENT	**(9 Periods)**
Mechanical devices like Diaphragm, Bellows, and Bourdon tube for pressure measurement – Variable inductance and capacitance transducers – Piezo electric transducers – L.V.D.T. for measurement of pressure. Resistance type temperature sensors – RTD & Thermistor – Thermocouples & Thermopiles, Laws of thermocouple – Radiation methods of temperature measurement.	
UNIT IV – FLOW AND LEVEL MEASUREMENT	**(9 Periods)**
Differential pressure meters like Orifice plate, Venturi tube, flow nozzle, Pitot tube, Rotameter, Turbine flow meter, Electromagnetic flow meter and Ultrasonic flow meter. Resistive, inductive and capacitive techniques for level measurement – Ultrasonic methods – Air purge system (Bubbler method).	
UNIT V – AUTOMATIC CONTROL SYSTEM	**(9 Periods)**
Elements of control systems – concept of open loop and closed loop systems – Controllers – Brief idea of proportional, derivative and integral – Pneumatic Controller – Hydraulic Controller.	

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS

1. *A.K. Sawhney, Puneet Sawhney* ***"A Course in Electronic and Electrical Measurements and Instrumentation"*** *S.K.Kataria & Sons, Delhi, 2014.*
2. *E. D. Doeblin,* ***"Measurement Systems: Application and Design",*** *McGraw – Hill Publication, 6th Edition 2017.*

REFERENCE BOOKS

1. *S. K. Singh,* ***"Industrial Instrumentation & Control"****, 3rd Edition, McGraw Hill, 2016.*
2. *A.K. Sawhney, Puneet Sawhney* ***"A Course in mechanical measurements and Instrumentation & Control"****, Dhanapat Rai & Co, 2012.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO 1: Explain the construction and working of instruments used for various measurements.
CO 2: Describe the methods of measurement, classification of transducers and to analyze error.
CO 3: Elaborate the basic concept of control system.
CO 4: Analyze the characteristics of various measuring instruments
CO 5: Suggest suitable instruments for a particular application

COURSE ARTICULATION MATRIX:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	H	M	H	M	H	M	L	H	M	H	H	H	M	H
CO2	H	M	M	M	H	H	H	M	H	L	H	H	H	H	M
CO3	H	H	M	H	M	H	M	L	H	M	H	H	H	H	H
CO4	H	H	M	H	M	H	M	L	H	M	H	H	H	M	H
CO5	H	H	M	H	M	H	M	L	H	M	H	H	H	M	M
18NOE$16	H	H	M	H	M	H	M	L	H	M	H	H	M	H	M

L-Low, M-Moderate(medium), H-High

18NOE$17	**INDUSTRIAL AUTOMATION** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVE

- To elaborate the basic concept of automation and the components required for automation.

UNIT I – INTRODUCTION TO AUTOMATION	**(9 Periods)**
Automation overview – requirement of automation systems – architecture of industrial automation system – power supplies and isolators –relays – switches –transducers – sensors –seal-in circuits – industrial bus systems : modbus and profibus.	
UNIT II – AUTOMATION COMPONENTS	**(9 Periods)**
Sensors for temperature – pressure – force – displacement - speed – flow- level – humidity and pH measurement. Actuators – process control valves – power electronic drives DIAC- TRIAC – power MOSFET – IGBT. Introduction to DC and AC servo drives for motion control	
UNIT III – PROGRAMMABLE LOGIC CONTROLLERS	**(9 Periods)**
PLC Hardware – PLC programming – ladder diagram – sequential flow chart – PLC communication and networking – PLC selection – PLC installation – Advantages – Application of PLC to process control industries and Robotics.	
UNIT IV – DISTRIBUTED CONTROL SYSTEM (DCS)	**(9 Periods)**
Overview of DCS – DCS hardware – DCS software configuration – DCS communication – DCS supervisory computer tasks – DCS integration with PLC and Computers	
UNIT V – SCADA	**(9 Periods)**
Introduction - Supervisory Control and Data Acquisition Systems (SCADA) – SCADA HMI Essentials – SCADA Components – SCADA Configuration and Software – HMI hardware and software.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *John.W. Webb Ronald A Reis,* ***"Programmable Logic Controllers - Principles and Applications",*** *Prentice Hall Inc., 5th Edition, 2003.*
2. *M. P. Lukcas,* ***"Distributed Control Systems",*** *Van Nostrand Reinhold Co., 1986.*

REFERENCE BOOKS :

1. *Bela G Liptak,* ***"Process software and digital networks – Volume 3",*** *4th Edition, CRC press, 2012.*
2. *Romily Bowden,* ***"HART application guide and the OSI communication foundation",*** *1999*
3. *Frank D. Petruzella,* ***"Programmable Logic Controllers",*** *5th Edition, McGraw Hill, 2016.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO 1: Elaborate the basic architecture of automation systems

CO 2 : Describe the various sensors and actuators involved in industrial automation

CO 3: Construct ladder logic diagram using PLC basic functions, timer and counter functions for simple applications

CO 4: Illustrate the functionary components and supervisory control of DCS with relevant diagrams

CO 5: Describe the basics of SCADA technology

COURSE ARTICULATION MATRIX:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L
CO2	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L
CO3	H	H	M	M	L	L	M	H	L	M	L	L	H	L	L
CO4	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L
CO5	H	H	M	M	M	L	L	H	L	M	L	L	H	L	L
18NOE$17	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L

L-Low, M-Moderate(medium), H-High

18NOE$18	**VIRTUAL INSTRUMENTATION** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVE

- To confer applications of virtual instrumentation in various fields.

UNIT I – INTRODUCTION	**(9 Periods)**
Virtual Instrumentation and LabVIEW - Evolution of LabVIEW - Difference between LabView and conventional languages - Sequencing and data flow - Graphical programming.	
UNIT II – LabVIEW ENVIRONMENT	**(9 Periods)**
Front panel - Block diagram - Icon and Connector - Control Palette - Function Palette-Tools Palette - Creating, editing, wiring, debugging and saving VIs - sub-VIs - creating sub-VIs - simple examples-Looping: For loop, while loop-Shift registers - case and sequence; structures, formula nodes.	
UNIT III – PROGRAMMING TECHNIQUES	**(9 Periods)**
Arrays - clusters, charts and graphs, - local and global variables - property node, string and file I/O.	
UNIT IV – DATA ACQUISITION AND INSTRUMENT CONTROL	**(9 Periods)**
DAQ – Components - Buffers: Buffered and non buffered I/O - Triggering - Analog I/O-Digital I/O - Counters and timers-Instrument control: VISA, GPIB, VXI and PXI	
UNIT V – ADVANCED Lab VIEW AND APPLICATIONS	**(9 Periods)**
Connectivity in LabVIEW: an introduction - IVI - Labwindows/CVI. Applications of Lab VIEW: process control, physical, biomedical, Image acquisition and processing.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS

1. *Sanjay Gupta and Joseph John,* ***"Virtual Instrumentation using LabVIEW"*** *Tata McGraw-Hill, Second edition 2010*
2. *Gary Johnson, Richard Jennings* ***"Lab VIEW graphical programming",*** *Tata McGraw Hill, 2011.*

REFERENCE BOOKS

1. *Lisa K Wells and Jeffrey Travels,* ***"LabVIEW for everyone",*** *Prentice Hall, 3rd Edition 2009.*
2. *S. Gupta, J.P. Gupta,* ***"PC interfacing for data acquisition and process control",*** *2nd Ed., Instrument Society of America, 2011*
3. *Jovitha Jerome,* ***"Virtual Instrumentation Using LabVIEW"*** *PHI Learning Pvt. Ltd 1st Edition, 2010*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO 1 Recognize the importance and applications of virtual instrumentation.

CO 2 Develop ability for programming in LabVIEW using various data structures, program structures, plotting the graphs and charts for system monitoring, processing and controlling.

CO 3 Realize the basics of interfacing and programming using related hardware.

CO 4 condition the acquired signal from the transducer to standard data formats

CO 5 Develop real time applications using LabVIEW

COURSE ARTICULATION MATRIX:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	H	M	M	L	L	L	H	L	M	M	M	H	M	M
CO2		H	H	H	L	L	L	H	L	M	M	M	H	M	M
CO3		H	M	M	L	L	M	H	L	M	M	M	H	M	M
CO4		H	H	H	L	L	L	H	L	M	M	M	H	M	M
CO5		H	M	M	M	L	L	H	L	M	M	M	H	M	M
18NOE$18	M	H	M	M	L	L	L	H	L	M	M	M	H	M	M

L-Low, M-Moderate(medium), H-High

18SOE$19	**PROGRAMMING IN JAVA** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course the students will be familiar with:

- Basic programming constructs in java to develop simple object oriented programs.
- Exception handling, multi-threading and I/O programming
- Development of GUI applications
- Manipulation of images.
- Network Programming

UNIT – I : FUNDAMENTALS OF JAVA PROGRAMMING	**(9 Periods)**
History and Evolution of Java- Overview of java– Operators- Control Structures– Methods- Classes and Objects– Inheritance- Packages and Interfaces- Exception Handling.	
UNIT – II : THREADS , I/O AND STRING HANDLING	**(9 Periods)**
Multi threaded Programming– Enumeration- Auto boxing– Annotations- String Handling-Input/Output: Exploring java.io.	
UNIT – III : APPLETS AND EVENT HANDLING	**(9 Periods)**
Applet class- Event Handling. Introducing the AWT: working with windows- graphics and text- Using AWT controls- Layout Manager - menus.	
UNIT – IV : IMAGING AND DATABASE CONNECTIVITY	**(9 Periods)**
Imaging: Creating- loading and displaying- Image observer- Double buffering- Media tracker- Image producer– consumer– filters– animation- Java Database Connectivity.	
UNIT – V : NETWORKING	**(9 Periods)**
Networking – Remote Method Invocation – Java Beans –Java servlets	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Herbert Schildt,* ***"Java, The Complete Reference*** *", Tata McGrawHill, Eighth Edition, 2011.*

REFERENCE BOOKS:

1. *Deitel .H.M and Deitel.P.J,* ***"Java: How to Program",*** *Pearson Education Asia, Eighth Edition 2010.*
2. *Lay.S&Horstmann Gary Cornell,* ***"Core Java Vol I",*** *Seventh Edition, The Sun Microsystems & press Java Series, 2005.*
3. *Lay.S&Horstmann Gary Cornell,* ***"Core Java Vol II",*** *Eighth Edition, The Sun Microsystems & press Java Series, 2008.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Write simple java programs using fundamental concepts of java like control structures, inheritance, packages, interfaces and exception handling. [**Usage]**

CO2: Write java program using multithreading and string handling. [**Usage]**

CO3: Develop GUI based applications using Applets. [**Usage]**

CO4: Write java programs to display and manipulation of graphical images. [**Usage]**

CO5: Establish database connectivity.[**Familiarity]**

CO6: Develop client server programs using RMI and servlets. [**Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	M	H		H	M	M				H	M	M	H	H	H
CO2	M	M	H		H	M	M				H	M	M	H	H	H
CO3	M	M	H		H	M	M				H	M	M	H	H	H
CO4	M	M	H		H	M	M				H	M	M	H	H	H
CO5	M	M	H		H	M	M				H	M	M	H	H	H
CO6	M	M	H		H	M	M				H	M	M	H	H	H
18SOE$19	M	M	H		H	M	M				H	M	M	H	H	H

L - Low, M - Moderate (Medium), H - High

18SOE$20	**CYBER SECURITY** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Cybercrime and cyber offenses
- Cybercrime using mobile devices.
- Tools and methods used in cybercrime.
- Legal perspectives of cybercrime.
- Fundamentals of computer forensics.

UNIT – I : INTRODUCTION TO CYBERCRIME AND CYBEROFFENSES	**(9 Periods)**
Cybercrime and Information Security - Classifications of Cybercrimes - The Legal Perspectives - Cybercrime and the Indian ITA 2000 - A Global Perspective on Cybercrimes - Plan of Attacks - Social Engineering – Cyberstalking - Cybercafe and Cybercrimes – Botnets - Attack Vector.	
UNIT – II : CYBERCRIME: MOBILE AND WIRELESS DEVICES	**(9 Periods)**
Proliferation of Mobile and Wireless Devices - Trends in Mobility - Credit Card Frauds in Mobile and Wireless Computing Era – Security challenges posed by mobile devices – registry setting for mobile devices – authentication service security – attacks on mobile/cell phones – Organizational measures for handling mobiles.	
UNIT – III : TOOLS AND METHODS USED IN CYBERCRIME	**(9 Periods)**
Proxy Servers and Anonymizers – Phishing - Password Cracking – Keyloggers – Spywares -Virus and Worms - Trojan Horses and Backdoors – Steganography - DoS and DDoS Attacks - SQL Injection - Attacks on Wireless Networks.	
UNIT – IV : CYBERCRIMES AND CYBERSECURITY: THE LEGAL PERSPECTIVES	**(9 Periods)**
Cyberlaws- The Indian Context - The Indian IT Act - Challenges to Indian Law and Cybercrime Scenario in India - Consequences of Not Addressing the Weakness in Information Technology Act - Digital Signatures and the Indian IT Act - Amendments to the Indian IT Act - Cybercrime and Punishment.	
UNIT – V : UNDERSTANDING COMPUTER FORENSICS	**(9 Periods)**
Digital Forensics - Forensics Analysis of E-Mail - Network Forensics - Forensics and Steganography - Forensics and Social Networking Sites - Challenges in Computer Forensics - Data Privacy Issues – Forensics Auditing – Antiforensics.	

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Nina Godbole and Sunit Belapur,* ***"Cyber Security Understanding Cyber Crimes, Compute Forensics and Legal Perspectives"****, Wiley India Publications, April, 2011.*

REFERENCE BOOKS:

1. *Robert Jones,* ***"Internet Forensics: Using Digital Evidence to Solve Computer Crime",*** *O"Reilly Media, October, 2005.*
2. *Chad Steel, "****Windows Forensics: The field guide for conducting corporate computer investigations****", Wiley India Publications, December, 2006.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Explain the fundamental concepts of cybercrime and cyberoffenses. **[Familiarity]**
CO2: Describe the cybercrimes occurred in mobile and wireless devices. **[Familiarity]**
CO3: Elaborate the methods used in cybercrime. **[Familiarity]**
CO4: Explain the laws for cybercrime and its respective punishments. **[Familiarity]**
CO5: Explain the forensics Analysis of E-Mail, Network and Social Networking Sites **[Familiarity]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	M	M	M	L	H	L	M				H	H	L	M	M
CO2	M	M	M	M	M	H	M	M				M	H	H	M	M
CO3	H	L	L	L	L	H	H	L				H	H	H	L	L
CO4	H	M	M	M	M	H	H	H				M	H	H	L	L
CO5	H	M	M	M	M	L	H	L				H	H	H	M	M
18SOE$20	H	M	M	M	M	H	H	M				H	H	H	M	M

L - Low, M - Moderate (Medium), H - High

18SOE$21	**NETWORK ESSENTIALS** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Basic taxonomy and terminology of the computer networking
- Wireless networking
- Addressing and Routing
- Routing protocols
- Troubleshooting and security issues.

UNIT – I : INTRODUCTION	**(9 Periods)**
Introduction to Computer Networks - Goals and advantages of Computer Networks - Network Topologies – Basic networking devices – Protocols – the need for a layered architecture - The OSI Model and the TCP/IP reference model – the Ethernet LAN – Home Networking – Assembling an office LAN – Testing and Troubleshooting a LAN – Physical layer cabling: Twisted pair and Fiber optics.	
UNIT – II : WIRELESS NETWORKING	**(9 Periods)**
Importance of Wireless Networking – IEEE 802.11 Wireless LANs – Bluetooth- WIMAX – RFIDs – Securing the Wireless LANs – Configuring a Point to Multipoint Wireless LAN – Interconnecting network LANs – Switch, Bridges and Routers. Interconnecting LANs with the router, Configuring the network interface-Auto negotiation.	
UNIT – III : ADDRESSING AND ROUTING FUNDAMENTALS	**(9 Periods)**
IPv4 and IPv6 addressing – Subnet masks – CIDR blocks – configuration of a router – Console port connection - user EXEC mode – Privileged EXEC mode - Configuration of a switch – Static VLAN configuration - Spanning Tree protocol – Network Management – Power over Ethernet.	
UNIT – IV : ROUTING PROTOCOLS	**(9 Periods)**
Static Vs Dynamic Routing Protocols – Distance vector Routing – Link State Routing – Hybrid Routing – Configuring RIP - Network Services – DHCP, DNS - Analyzing Internet Traffic.	
UNIT – V : TROUBLESHOOTING AND NETWORK SECURITY	**(9 Periods)**
Analyzing Computer Networks – FTP data packets – Analyzing Campus Network data traffic – Troubleshooting the router and switch interface, Troubleshooting fiber optics – Intrusion – DOS – Security software and hardware.	

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. *Jeffrey S.Beasley Piyasat Nilkaew* ***"Network Essentials"*** *3rd Edition, Pearson, 2012*
2. *Larry L. Peterson and Bruce S. Davie* ***"Computer Networks, A Systems Approach"*** *5th edition, Morgan Kaufmann Publishers Inc, 2011.*

REFERENCE BOOKS:

1. *Behrouz A.Ferouzan,* ***"Data Communications and Networking"****, 5th edition, Tata McGraw-Hill, 2012.*
2. *Andrew S. Tanenbaum,* ***"Computer networks"****, PHI, 5th edition 2011.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Identify topologies and types of Computer Networks and enumerate the layers of the OSI model and TCP/IP and Explain the functions of each layer **[Familiarity]**

CO2: Explain the significance of wireless networks and configure a Wireless LAN **[Assessment]**

CO3: Describe basic routing algorithms and network services. **[Familiarity]**

CO4: Troubleshoot the router and switch interface **[Usage]**

CO5: Analyze Campus Network data traffic **[Usage]**

COURSE ARTICULATION MATRIX:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	M	H	H	H	L	L	H	H	H	H	H	M	H	H	M
CO2	L	L	L	L	H	L	L	H	L	L	L	H	M	H	H	M
CO3	L	H	M	M	H	L	L	H	H	M	L	H	L	H	H	L
CO4	H	H	H	M	H	L	L	H	H	H	M	H	M	H	H	M
CO5	H	H	H	M	H	L	L	H	H	M	L	H	M	H	H	M
18SOE$21	M	H	H	M	H	L	L	H	H	L	M	H	M	H	H	M

L - Low, M - Moderate (Medium), H - High

18IOE$22	**PROGRAMMING IN PYTHON** *(Common to all Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Data types and variables declaration.
- Control statements, Functions and the use of basic programming.
- List, dictionary and operations used in python.
- File and Exception handling.
- Object oriented programming and GUI development.

UNIT – I : INTRODUCTION	**(9 Periods)**
Introduction to Python - Setting up Python in OS – Python IDLE(write- edit- run- and save programs) – Strings - Numbers – Variables – simple I/O - Getting user input– Using String method– Converting values.	
UNIT – II : CONTROL STATEMENTS AND FUNCTIONS	**(9 Periods)**
Control statements – Random number generator- Branching and loops – Range functions- Functions –User defined functions- passing parameters- return function- working with global variables and constants.	
UNIT – III : LISTS AND DICTIONARIES	**(9 Periods)**
Lists – create- index- slice a list- Add and delete elements from a list- Append- Sort and reverse a list- nested sequences- Dictionaries – Create- add- delete from a Dictionary- Operations associated with pairs of data.	
UNIT – IV : FILES AND EXCEPTIONS	**(9 Periods)**
Files – Read from text files- Write to text files- Read and write more complex data- Exceptions – Intercept and handle errors during program's execution.	
UNIT – V : OBJECT ORIENTED PROGRAMMING AND GUI	**(9 Periods)**
Object oriented programming – Create objects of different classes in the same program- objects communication- complex object creation- derive new classes- existing class extension- override method- GUI – GUI toolkit- create and fill frames- create buttons- text entries and text boxes- create check buttons and radio buttons - case study – create a web page using GUI functionality.	

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. *Y. Daniel Liang,* ***"Introduction to Programming Using Python",*** *Pearson, 2013.*
2. *David I.Schneider,* ***"Introduction to programming using python",*** *person, 2015.*

REFERENCE BOOKS:

1. *Michael Dawson,* ***"Python Programming for the Absolute Beginner",*** *Premier Press, 2003.*
2. *Charles Dierbach,* ***"Introduction to Computer Science Using Python: A Computational Problem-Solving Focus",*** *Wiley Publications, 2012.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to,

CO1: Use various data types. **[Understand]**
CO2: Use control statements and functions. **[Understand]**
CO3: Analyze the arrangement of data elements in Lists and Dictionary structures. **[Analyze]**
CO4: Handle exceptions and perform file operations**. [Understand]**
CO5: Develop application using object oriented programming and GUI. **[Analyze]**

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	L		L	L		L	L			L		L	L
CO2	M	L		L	L		L	L			L		L	L
CO3	M	M	L	M	L		L	L			L		M	L
CO4	M	M	L	M	L		M	M			L		M	L
CO5	M	M	L	M	L		M	M			M	L	M	L
18IOE $22	**M**	**M**	**L**	**M**	**L**		**M**	**M**			**L**	**L**	**M**	**L**

L - Low, M - Moderate (Medium), H – High

18IOE$23	**BIG DATA SCIENCE** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Big Data and its characteristics.
- Technologies used for Big Data Storage and Analysis.
- Mining larger data streams.
- Concepts related to Link analysis and handle frequent data sets.

UNIT – I : THE FUNDAMENTALS OF BIG DATA	**(9 Periods)**
Understanding Big Data-Concepts and Technology-Big Data Characteristics-Types of data-Case Study-Business Motivation and Drivers for Big Data Adoption- Planning Considerations-Enterprise Technologies and Big Data Business Intelligence- OLTP-OLAP-Extract Transform Load-Data Warehouses-Data Mart-Traditional and Big Data BI-Case Study.	
UNIT – II : BIG DATA STORAGE AND PROCESSING	**(9 Periods)**
Big Data Storage Concepts- Clusters-File systems and Distributed File Systems-NoSQL- Sharding - Replication -Sharding and Replication-CAP Theorem-ACID-BASE-Case Study- Big Data Processing Concepts- Parallel Data Processing-Distributed Data Processing-Hadoop-Processing Workloads-Cluster-Processing in Batch mode-Processing in RealTime mode-Case study	
UNIT – III : BIG DATA STORAGE AND ANALYSIS TECHNOLOGY	**(9 Periods)**
Big Data Storage Technology: On-Disk Storage devices-NoSQL Databases-In-Memory Storage Devices-Case study, Big Data Analysis Techniques: Quantitative Analysis-Qualitative Analysis-Data Mining-Statistical Analysis-Machine Learning-Semantic Analysis-Visual Analysis-Case Study.	
UNIT – IV : MINING DATA STREAMS	**(9 Periods)**
The stream data model – Sampling data streams – counting distinct elements in a stream – Estimating moments. Finding similar items – Applications of nearest neighbor search – shingling of documents - similarity preservation – locality sensitive hashing- distance measures – methods for high degree similarity.	
UNIT – V : LINK ANALYSIS AND FREQUENT ITEMSETS	**(9 Periods)**
Link analysis – Page rank – Efficient computation of a page rank – topic sensitive page rank – link spam –Frequent datasets – the market basket model – Apriori algorithm – handling larger datasets in main memory –limited pass algorithm – counting frequent items in a stream.	

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. *Thomas Erl, WajidKhattak, and Paul Buhler,* ***"Big Data Fundamentals Concepts, Drivers & Techniques",*** *Prentice Hall,2015.*
2. *AnandRajaraman and Jeffrey David Ullman,* ***"Mining of Massive Datasets",*** *Cambridge University Press, 2012.*

REFERENCE BOOKS:

1. *Paul Zikopoulos, Chris Eaton, Paul Zikopoulos,* ***"Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data",*** *McGraw Hill, 2011.*
2. *Frank J Ohlhorst,* ***"Big Data Analytics: Turning Big Data into Big Money",*** *Wiley and SAS Business Series, 2012.*
3. *Bill Franks,* ***"Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics",*** *Wiley and SAS Business Series, 2012.*
4. *Paul Zikopoulos, Dirk deRoos, Krishnan Parasuraman, Thomas Deutsch , James Giles, David Corrigan,* ***"Harness the Power of Big data – The big data platform",*** *McGraw Hill, 2012.*
5. *Colleen Mccue,* ***"Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis",*** *Elsevier, 2007*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to,

CO1: Understand the Big Data and usage in Enterprise Technologies. **[Understand]**
CO2: Store and Process Big Data using suitable Processing Methods. **[Understand]**
CO3: Handle Big Data using appropriate analysis Techniques. **[Analyze]**
CO4: Mine larger data streams using suitable algorithms. **[Understand]**
CO5: Rank pages and handle large data sets efficiently. **[Analyze]**

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	L	M	L	H	L							M	L
CO2	M				H			L				L	M	L
CO3		H			H							L	M	L
CO4	M	H	M		M							L	M	L
CO5	L	M	H									L	M	L
18IOE $23	**M**	**H**	**M**	**L**	**H**	**L**		**L**				**L**	**M**	**L**

L - Low, M - Moderate (Medium), H - High

18IOE$24	**OBJECT ORIENTED PROGRAMMING USING C++** *(Common to All Branches)*

PRE-REQUISITES: NIL **Category: OE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with,

- Fundamentals of object oriented programming
- Classes and objects
- Concepts of overloading and type conversions
- Inheritance and Polymorphisms
- Files, templates and exception handling

UNIT – I : PRINCIPLES OF OBJECT ORIENTED PROGRAMMING	**(9 Periods)**
Basic concepts- benefits – applications of object oriented programming – beginning with C++ - tokens – expressions and control structures – C++ stream classes – Formatted and Unformatted I/O operations. Managing output with manipulators.	
UNIT – II : CLASSES AND OBJECTS	**(9 Periods)**
Introduction – specifying class – defining member functions – memory allocation constructors and destructors - parameterized, copy, default, dynamic and multiple constructors – destructors.	
UNIT – III : FUNCTIONS AND TYPE CONVERSIONS	**(9 Periods)**
Introduction – function prototyping call by reference – return by reference – inline function – recursion – friend function – function overloading – operator overloading – manipulation of strings using operators – type conversions.	
UNIT – IV : INHERITANCE AND POLYMORPHISM	**(9 Periods)**
Defining derived classes – single, multiple, multilevel, hierarchical and hybrid inheritance – virtual base classes – abstract base classes – nesting of classes - pointers – pointers to objects – this pointer – pointers to derived classes – virtual functions – pure virtual functions virtual constructors and destructors.	
UNIT – V : FILES AND TEMPLATES	**(9 Periods)**
Classes for file stream operations – opening and closing a file – detecting EOF – open file modes – file pointers and their manipulations – sequential I/O operations – updating and error handling of file. Class and function template – template with multiple parameters – overloading, member function and non-type template arguments-Exception handling.	

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. *Lafort Robert,* ***"Object oriented profframming in C++",*** *4th Edition.*
2. *E.Balagurusamy,* ***"Object oriented Programming with C++",*** *McGraw Hill Education Ltd, 7th Edition 2017.*

REFERENCE BOOKS:

1. *R.Rajaram,* ***"Object Oriented Programming and C++",*** *New Age International 2nd edition, 2013.*
2. *K.R. Venugopal, Rajkumar, T. Ravishankar,* ***"Mastering C++",*** *Tata McGraw Hill Education, 2nd edition, 2013.*
3. *Yashavant P. Kanetkar,* ***"Let us C++",*** *BPB Publications, 2nd edition 2003.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to,

CO1: Understand the principles of object oriented programming. **[Understand]**
CO2: Develop programs using classes and objects. **[Analyze]**
CO3: Use functions and type conversions in programs. **[Understand]**
CO4: Apply inheritance and polymorphism to develop applications. **[Analyze]**
CO5: Use files, templates and handle exceptions. **[Understand]**

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	H	H	M			M						M	L
CO2	M	H	H	H			M						H	L
CO3	M	H	H	H			M						H	L
CO4	M	H	H	H			M						H	L
CO5	M	H	H	H			M						H	L
18IOE $24	M	H	H	H			M						H	L

L - Low, M - Moderate (Medium), H - High

18BOE$25	COMPUTATIONAL BIOLOGY *(Common to All Branches)*

Category: OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Understand the basic concepts and role of computation in biological analysis
- Familiarize with sequence alignment methods
- Understand the machine learning tools used for biological analysis

UNIT – I : BASICS OF BIOLOGY	**(9 Periods)**
Biomolecules of life: Structure and Composition of DNA, RNA & Protein. Protein Structure basics-Primary, Secondary and tertiary Structure of protein.	
UNIT – II : BIOLOGICAL DATABASES	**(9 Periods)**
Concept of Relational database, Data archiving, Data mining, Primary databases-NCBI, EMBL, DDBJ; Structure databases-PDB	
UNIT – III : SEQUENCE ANALYSIS	**(9 Periods)**
Pairwise alignment tools-Dot matrix analysis, Dynamic programming-Smith Waterman and Needleman Wunsch algorithm ,Heuristic methods- BLAST,FASTA; Multiple sequence alignment methods-Progressive alignment (Clustal)	
UNIT – IV : STRUCTURE ANALYSIS AND DRUG DESIGN	**(9 Periods)**
Protein secondary prediction-Chou fasman method, GOR method; Tertiary structure prediction-Homology modelling, Introduction to Computer aided drug design.	
UNIT – V : MACHINE LEARNING	**(9 Periods)**
Genetic Algorithm, Neural networks, Artificial Intelligence, Hidden markov model -application in bioinformatics	

Contact Periods:
Lecture: 45 Periods **Tutorial: 00 Periods** **Practical: 00 Periods** **Total: 45 Periods**

TEXT BOOKS:

*1.David W. Mount , **"Bioinformatics: Sequence and Genome Analysis"** , Cold Spring Harbor Laboratory Press, Second Edition, 2004*
*2. Arthur M. Lesk, **"Introduction to Bioinformatics"**, Oxford University Press, 2008.*
*3.Pierre Baldi, Soren Brunak. , **"Bioinformatics: The machine learning approach"**, MIT Press, 2001*

REFERENCE BOOKS:

*1. Andreas D. Baxevanis, **"Bioinformatics, A Practical Guide to the Analysis of Genes and Proteins"**, Third edition; Wiley-Interscience, 2004.*
*2. Baxevanis A.D. and Oullette, B.F., **"A Practical Guide to the Analysis of Genes and Proteins"**, 2nd ed., John Wiley, 2002*
*3. David L. Nelson, Michael M. Cox., **"Lehninger: Principles of Biochemistry"**, Sixth edition, Freeman, W. H. & Co. Publisher, 2012.*

COURSE OUTCOMES:

Upon completion of the course the students will be able to
CO1: Understand the basic structure of Biological macromolecules
CO2: Acquire the knowledge of biological databases and its importance.
CO3: Perform pair wise and multiple sequence alignment
CO4: Predict the secondary and tertiary structure of proteins.
CO5: Understand the machine learning approaches in computational biology

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	L	L		L			M				L	
CO2	M	L	L	L					L			L	L	L
CO3	L		L			M			L			L	L	
CO4	M	M	L	M	M								M	
CO5		M		H	H	M	L		M				H	H
18BOE $25	M	M	L	M	M	M	L		M			L	M	H

L - Low, M-Moderate (Medium), H- High

18BOE$26	FUNDAMENTAL CONCEPTS OF BIOLOGY FOR ENGINEERS *(Common to All Branches)*

Category: OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basic functions of the cell and their mechanisms in transport process.
- To get familiarize human anatomy and physiology.
- To learn about microbes, immune system and biomolecules.
- To know the concepts of applied biology.

UNIT – I : BASICS OF CELL BIOLOGY	**(9 Periods)**
An overview of cells – origin and evolution of cells-cell theory-classification of cells – prokaryotic cells and eukaryotic cells; Structure of prokaryotic and eukaryotic cells and their organelles-comparison of prokaryotic and eukaryotic cells; Transport across membranes – diffusion - active and passive diffusion.	
UNIT – II : BASICS OF MICROBIOLOGY	**(9 Periods)**
Classification of microorganism-microscopic examination of microorganisms; Structural organization and multiplication of bacteria-viruses-algae and fungi; Microorganism used for the production of penicillin-alcohol and vitamin B-12.	
UNIT – III : HUMAN ANATOMY AND PHYSIOLOGY	**(9 Periods)**
Basics of human anatomy-tissues of the human body-epithelial-connective-nervous and muscular; Nervous system-Respiratory System-Circulatory system and Digestive system.	
UNIT – IV : BIO MOLECULES AND IMMUNE SYSTEM	**(9 Periods)**
Introduction to Biochemistry-classification-structure and properties of carbohydrates-proteins- lipids and nucleic acids; Innate and acquired immunity; Types of immune responses.	
UNIT – V : APPLIED BIOLOGY FOR ENGINEERS	**(9 Periods)**
Overview of biosensors - glucometer applications-medicine; Microarray analysis to diagnose the cancer; Microbial production of biofuels; Applications of stem cells.	

Contact Periods:
Lecture: 45 Periods **Tutorial: 00 Periods** **Practical: 00 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. Darnell J, Lodish H, Baltimore D. ***"Molecular Cell Biology"****, W.H.Freeman; 8th Edition, 2016.*
2. Pelczar MJ, Chan ECS and Krein NR, ***"Microbiology"****, Tata McGraw Hill, 5th Edition, New Delhi.2001.*
3. Wulf Cruger and Anneliese Cruger, ***"A Textbook of Industrial Microbiology"****, Panima Publishing Corporation, 2nd Edition, 2000.*

REFERENCE BOOKS:

1. *David L. Nelson and Michael M Cox,* ***"Lehninger's Principles of Biochemistry"****, Macmillan Worth Publisher, 4th edition, 2004.*
2. *Brain R.Eggins ,* ***"Chemical Sensors and Biosensors"****, John Wiley & Sons, 2002.*
3. *Anton Moser,* ***"Bioprocess Technology, Kinetics and Reactors"****, Springer, Berlin (Verlag),1st edition, 1998*
4. *Kuby J,* ***"Immunology"****, WH Freeman & Co., 7th edition, 2013.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to
CO1: Understand the functions of cell and their structural organization
CO2: Describe the mechanisms and role of cell in immune system
CO3: Get familiarized biomolecules and human anatomy system
CO4: Illustrate the applications of microbes in industrial process
CO5: Apply the engineering concepts in biology

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	L	L	-	-	-	-	-	-	-	-	-	H	M
CO2	L	M	-	L	-	-	L	M	-	-	-	-	M	M
CO3	L	M	L	L	-	-	-	L	M	-	-	L	H	H
CO4	L	L	L	L	M	-	-	-	L	-	-	-	M	H
CO5	-	-	-	-	-	-	-	-	-	-	-	-	H	H
18BOE $26	L	M	L	L	M	-	L	M	M	-	-	L	H	H

L - Low, M-Moderate (Medium), H- High

18BOE$27	FUNDAMENTALS OF BIOENGINEERING *(Common to All Branches)*

Category: OE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To make the students aware of the overall industrial bioprocess.
- To understand the basic configuration and parts of a fermentor.
- To study the production of primary and secondary metabolites.
- To understand the production of modern biotechnology products.

UNIT I: INTRODUCTION TO INDUSTRIAL BIOPROCESS	**(9 Periods)**
Fermentation - Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology - A brief survey of organisms, processes, products. Basic concepts of Upstream and Downstream processing in Bioprocess.	
UNIT II : FERMENTATION INDUSTRY	**(9 Periods)**
Overview of fermentation industry, Basic configuration of Fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes. Types of fermentation – Solid state, submerged, batch, continuous, fed batch fermentation methods.	
UNIT III : PRODUCTION OF PRIMARY METABOLITES	**(9 Periods)**
A brief outline of processes for the production of some commercially important organic acids - Citric acid, lactic acid ,acetic acid; amino acids - glutamic acid, phenylalanine; ethanol.	
UNIT IV: PRODUCTION OF SECONDARY METABOLITES	**(9 Periods)**
Study of production processes for various classes of secondary metabolites: Antibiotics: beta lactams – penicillin and cephalosporin; aminoglycosides – streptomycin; macrolides - erythromycin, vitamin - B9, B12.	
UNIT V: PRODUCTS THROUGH MODERN BIOTECHNIQUES	**(9 Periods)**
Production of industrial enzymes - proteases, amylases, lipases; Production of single cell protein from wastes; biopreservatives – Bacterosin; biopolymers - xanthan gum and PHA. Industrial uses of enzymes in detergents, beverage and food.	

Contact Periods:
Lecture: 45 Periods **Tutorial: 00 Periods** **Practical: 00 Periods** **Total: 45 Periods**

TEXT BOOKS

1. *Peter F. Stanbur., Stephen J. Hall., A. Whitake.,* ***"Principles of Fermentation Technology"****, Science & Technology Books. 2007.*
2. *Presscott, S.C., Cecil G., Dun,* ***"Industrial Microbiology"****, Agrobios (India), 2005.*
3. *Casida, L.E.,* ***"Industrial Microbiology"****, New Age International (P) Ltd, 1968.*

REFERENCE BOOK

1. *Crueger, W., Anneliese Cruege.,* ***"Biotechnology: A Textbook of Industrial Microbiology"****, Panima Publishing Corporation, Edition 2, 2003.*
2. *Sathyanarayana, U.,* ***"Biotechnology"****, Books and Allied (P) Ltd. Kolkata, 2005.*
3. *Ratledge C., Kristiansen B.,* ***"Basic Biotechnology"****, Cambridge University Press, second Edition, 2001.*
4. *Michael J. Waites.,* ***"Industrial Microbiology: An Introduction"****, Blackwell Publishing,2001.*

COURSE OUTCOMES:

Upon completion of the course in Bioprocess Principles graduates will be able to

CO1: Understand the basics of industrial bioprocess.

CO2: Explain the principle of a fermentation process and the chronological development of fermentation industry.

CO3: Understand the basic configuration of a fermentor and its ancillaries.

CO4: Learn the production of various primary and secondary metabolites.

CO5: Understand the production of biotechnological products.

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	M	H	H	-	-	-	-	-	-	-	-	-	M	-
CO 2	H	M	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	H	H	H	M	M	M	-	L	H	-	-	-	-	H
CO 4	H	L	L	-	-	L	-	L	-	-	-	-	-	H
CO 5	H	M	H	L	M	-	-	L	-	-	-	-	-	H
18BOE $27	H	M	H	M	M	M	-	L	H	-	-	-	M	H

L- Low , M-Moderate(Medium), H- High

18SVA$01	DECISION SCIENCE, DATA ANALYTICS AND DEEP LEARNING

PRE-REQUISITES: NIL

Category : VA

L	T	P	C
1	0	0	1

COURSE MODULES (15 Periods)

Statistical Models and Exploratory Analysis

Topics

* Statistical Models
* Data Fusion/Prunining
* PCA
* Decision Trees
* Regression Models
* Exploratory Data Models

Case Studies

Healthcare and Transportation, Airlines Delay Prediction

Optimization and ML/DL

* Deterministic and Stochastic Modelling
* Solving Data and Decision Problems: Classes of Solution Approaches, Solution approach design
* Dynamic and Robust Decision Science Problems
* Clustering, Supervised/Unsupervised Learning, Predictive Models
* Page Rank, AdaBoost, KNN: k-nearest neighbourhood classification, Navie Bayes

Use Cases

Staff Scheduling; Cab Routing