SCHEME

for

BACHELOR OF TECHNOLOGY PROGRAMME

in

COMPUTER SCIENCE & ENGINEERING

(w.e.f Session 2019-2020)

J. C. Bose University of Science & Technology, YMCA

Haryana

DEPARTMENT OF COMPUTER ENGINEERING

FACULTY OF INFORMATICS & COMPUTING

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA

FARIDABAD

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA

VISION

"J. C. Bose University of Science and Technology, YMCA, Faridabad aspires to be a nationally and internationally acclaimed leader in technical and higher education in all spheres which transforms the life of students through integration of teaching, research and character building.

MISSION

- To contribute to the development of science and technology by synthesizing teaching, research and creative activities.
- To provide an enviable research environment and state-of-the art technological exposure to its scholars.
- To develop human potential to its fullest extent and make them emerge as world class leaders in their professions and enthuse them towards their social responsibilities.

DEPARTMENT OF COMPUTER ENGINEERING

VISION

The department aims to make a place at both national and international level by producing high quality ethically rich computer engineers conversant with the state-of-the-art technology with the ability to adapt the upcoming technologies to cater to the ever changing industrial demands and societal needs. It endeavours to establish itself as a centre of excellence by contributing to research areas having IT impact on the people's life and nation's growth.

MISSION

- To provide the future leaders in the area of computer engineering and information technology through the development of human intellectual potential to its fullest extent.
- To enable the students to acquire globally competence through problem solving skills and exposure to latest developments in IT related technologies.
- To educate the students about their professional and ethical responsibilities.
- To ensure continuous interaction with the industry and academia through collaborative research projects.

ABOUT THE PROGRAM

The Bachelor of Technology (B.Tech) program in Computer Science & Engineering has a strong flavor on design and hands-on experience. The program includes a deeper study of a number of engineering subjects to which students are introduced at the core curriculum level, theoretical and programming solutions of real world problems and design of systems relevant to the software organizations. The areas introduced by the department include software engineering, software testing, web crawlers, information retrieval, computer networks and data structures etc. Besides the theoretical and laboratory based curriculum, students complete an advanced programming project in the final year of the program including one full semester in an industry

This degree provides a solid foundation in core Computer Engineering disciplines, critical thinking and problem-solving skills. Through the academic program, students also develop excellent written and oral communication skills, learn to work as a team and project management.

NOTE:

1. The scheme will be applicable from Academic Session 2019-20 onwards.
2. The syllabus for the theory subjects is provided along with the scheme. For Practicals, syllabus is not defined and depends upon the syllabus content of the related subject. The list of practicals may vary depending on the technological evolution in the concerned area.
3. From session 2019-20 onwards, for B.Tech program, a student has to earn at least 12 credits during the duration of Degree subject to passing of at least one MOOC course of 12 week duration (carrying minimum 3 credits) per year through SWAYAM Platform. The *Credit Transfer/Mobility Policy for Online Courses* approved in 17th Academic Council Dated 11.06.2019 may be referred for the same.

B.TECH PROGRAM

COMPUTER SCIENCE & ENGINEERING

PROGRAM EDUCATION OBJECTIVES

PEO1	To create knowledge about core areas related to the field of computer science and information technology.
PEO2	To enable students to apply mathematics, science and computer engineering principles to model, design and implement software projects to meet customers' business objectives.
PEO3	To develop the ability to evaluate the computing systems from view point of quality, security, privacy, cost effectiveness, utility and ethics.
PEO4	To inculcate lifelong learning by introducing principles of group dynamics, public policies, environmental and societal context

PROGRAM OUTCOMES

PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**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.
PO3	**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.
PO4	**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.
PO5	**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.
PO6	**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.
PO7	**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.
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**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.
PO11	**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.
PO12	**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.

PROGRAM SPECIFIC OUTCOMES

PSO1	Ability to design and develop computing systems using concepts of Mathematics, Computer Engineering and other related disciplines to meet customers' business objectives.
PSO2	Ability to test and analyze the quality of various subsystems and to integrate them in order to evolve a larger computing system.

STRUCTURE OF UNDERGRADUATE ENGINEERING PROGRAM

S.No.	Category	Breakup of Credits (Total 177)
1	Humanities and Social Sciences including Management courses	12
2	Basic Science courses	25
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc	29
4	Professional core courses	49
5	Professional Elective courses relevant to chosen specialization/branch	18
6	Open subjects – Electives from other technical and /or emerging subjects	12
7	Project work, seminar and internship in industry or elsewhere	14
8	MOOCs	12*
9	Mandatory Courses [Environmental Sciences, Induction training, Constitution of India, Understanding Harmony, Message of Bhagwat Gita]	Non-credit
	Total	**177***

SEMESTER WISE SUMMARY OF THE PROGRAM

S.No.	Semester	No. of Contact Hours	Marks	Credits
1.	I	25(A)/26(B)	650(A)/600(B)	19.5(A)/18.5(B)
2.	II	26(A)/25(B)	600(A)/650(B)	18.5(A)/19.5(B)
3.	III	35	800	25
4.	IV	34	850	24
5.	V	35	1000	24
6.	VI	33	900	24
7.	VII	22	700	20
8.	VIII	One Semester	500	10
9.	MOOCs	-	-	12*
Total		**210**	**6000**	**177***

***Student has to earn at least 12 credits during the duration of Degree subject to passing of at least one MOOC course of 12 week duration (carrying minimum 3 credits) per year.

CREDIT DISTRIBUTION IN THE FIRST YEAR OF UNDERGRADUATE ENGINEERING PROGRAM

Subject	Lecture (L)	Tutorial (T)	Laboratory/ Practical(P)	Total credits(C)
Chemistry	3	1	3	5.5
Physics	3	1	3	5.5
Mathematics-1	3	1	0	4
Mathematics -2	3	1	0	4
Programming for Problem solving	3	0	4	5
English	2	0	2	3
Engineering Graphics & Design	0	0	4	2
Workshop	0	0	8	4
Basic Electrical Engg.	3	1	2	5
MOOC	-	-	-	3

COURSE CODE AND DEFINITIONS

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional core courses
OEC	Open Elective courses
LC	Laboratory course
MC	Mandatory courses
PROJ	Project
MOOC	Massive Open Online Course
AC	Audit Course
VAC	Value Added Course

MANDATORY INDUCTION PROGRAM (3-WEEKS DURATION)

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. A 3-week long induction program for the UG students entering the institution, right at the start, has to be planned. Normal classes will start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

Tentative activities which can be planned in this Induction Programme are as follows:

- Physical Activity
- Creative Arts
- Universal Human Values
- Literary
- Proficiency Modules
- Lectures by Eminent People
- Visits to Local Area
- Familiarization to Dept./Branch & Innovations

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT

S.No.	Code No.	Course Title	Hours Per week			Total Credits	Semester
			L	T	P		
1	HSMC101	English	2	0	2	3	1 / 2
2	HSMC-01	Humanities –I (Effective Technical Communication)	3	0	0	3	3
3	HSMC-03/ HSMC-04	Management-I (Organizational Behaviour/ Finance & Accounting)	3	0	0	3	4
4	HSMC-02	Humanities – II(Economics for Engineers)	3	0	0	3	5
					Total Credits	**12**	

BASIC SCIENCE COURSES (BSC)

S.No.	Code No.	Course	Hours Per Week			Total Credits	Semester
			L	T	P		
1	BSC101D	Physics(SemiConductor Physics)	3	1	3	5.5	1 / 2
2	BSC103E	Mathematics –I (Calculus & Linear Algebra)	3	1	0	4	1
3	BSC106E	Mathematics –II (Probability & Statistics)	3	1	0	4	2
4	BSC-102	Chemistry	3	1	3	5.5	1 / 2
5	BSC-301	Mathematics –III (Calculus and Ordinary Differential Equations)	3	0	0	3	3
6	BSC-01	Biology	2	1	0	3	7
					Total Credits	**25**	

ENGINEERING SCIENCE COURSE (ESC)

S.No.	Code No.	Course Title	Hours Per Week			Total Credits	Semester
			L	T	P		
1	ESC101	Basic Electrical Engineering	3	1	2	5	1 / 2
2	ESC102	Engineering Graphics & Design	0	0	4	2	1 / 2
3	ESC103	Programming for Problem Solving	3	0	2	4	1 / 2
4	ESC104	Workshop– I	0	0	4	2	1
5	ESC106	Workshop – II	0	0	4	2	2
6	ESC-301, ESC-303	Analog Electronic Circuits	3	0	4	5	3
7	ESC-302, ESC-304	Digital Electronics	3	0	4	5	3
8	ESC-501	Signals & Systems	3	0	0	3	5
					Total Credits	**29**	

PROFESSIONAL CORE COURSES (PCC)

S.No.	Code No.	Course Title	Hours Per Week			Total Credits	Semester
			L	T	P		
1	PCC-CS-301, PCC-CS-303	Data Structures& Algorithms	3	0	4	5	3
2	PCC-CS-302	IT Workshop(MATLAB)	0	0	4	2	3
3	PCC-CS-401	Discrete Mathematics	3	1	0	4	4
4	PCC-CS-402, PCC-CS-405	Computer Organization & Architecture	3	0	4	5	4
5	PCC-CS-403, PCC-CS-406	Operating System	3	0	4	5	4
6	PCC-CS-404, PCC-CS-407	Design & Analysis of Algorithms	3	0	4	5	4
7	PCC-CS-501, PCC-CS-504	Database Management System	3	0	4	5	5
8	PCC-CS-506	Formal Languages &Automata	3	0	0	3	5
9	PCC-CS-503, PCC-CS-505	Object Oriented Programming	3	0	4	5	5

10	PCC-CS-605, PCC-CS-606	Compiler Design	3	0	4	5	6
11	PCC-CS-602, PCC-CS-604	Computer Networks	3	0	4	5	6
Total Credits						**49**	

PROFESSIONAL ELECTIVE COURSES (PEC)

S.No.	**Course Title**	**Hours Per Week**			**Total Credits**	**Semester**
		L	**T**	**P**		
1	Elective-I	3	0	0	3	5
2	Elective-II	3	0	0	3	6
3	Elective-III	3	0	0	3	6
4	Elective-IV	3	0	0	3	7
5	Elective-V	3	0	0	3	7
6	Elective-VI	3	0	0	3	7
Total Credits					**18**	

OPEN ELECTIVE COURSES (OEC)

S. No.	**Course Title**	**Hours Per Week**			**Total Credits**	**Semester**
		L	**T**	**P**		
1	Open Elective-I	3	0	0	3	6
2	Open Elective-II	3	0	0	3	6
3	Open Elective-III	3	0	0	3	7
4	Open Elective-IV	3	0	0	3	7
Total Credits					**12**	

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
B.Tech. (COMPUTER SCIENCE & ENGINEERING)

Scheme of Studies/Examination

Semester- 3

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	ESC	ESC-301	Analog Electronic Circuits	3	0	0	3	25	75	100
2	PCC	PCC-CS-301	Data Structures& Algorithms	3	0	0	3	25	75	100
3	ESC	ESC-302	Digital Electronics	3	0	0	3	25	75	100
4	BSC	BSC-301	Mathematics- III (Calculus and Ordinary Differential Equations)	3	0	0	3	25	75	100
5	HSMC	HSMC-01	Effective Technical Communication	3	0	0	3	25	75	100
6	Project	PROJ-CS-301	Project-I	0	0	4	2	25	75	100
7	PCC	PCC-CS-302	IT Workshop (MATLAB)	0	0	4	2	15	35	50
8	ESC	ESC-303	Analog Electronic Circuits LAB	0	0	4	2	15	35	50
9	ESC	ESC-304	Digital Electronics LAB	0	0	4	2	15	35	50
10	PCC	PCC-CS-303	Data Structures & Algorithms LAB	0	0	4	2	15	35	50
Total				**15**	**0**	**20**	**25**	**210**	**590**	**800**

Note:

(a) Theory exams will be of 03 hours duration and Practical exams will be of 02 hours duration

(b) Additional 3 credits per year to be earned through MOOCs

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Scheme of Studies/Examination

Semester- 4

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC	PCC-CS-401	Discrete Mathematics	3	1	0	4	25	75	100
2	PCC	PCC-CS-402	Computer Organization & Architecture	3	0	0	3	25	75	100
3	PCC	PCC-CS-403	Operating System	3	0	0	3	25	75	100
4	PCC	PCC-CS-404	Design & Analysis of Algorithms	3	0	0	3	25	75	100
5	HSMC	HSMC-03 / HSMC-04	Organizational Behaviour/ Finance & Accounting	3	0	0	3	25	75	100
6	MC	MC-03	Environmental Sciences	2	0	0	0	25	75	100
7	Project	PROJ-CS-401	Project-II	0	0	4	2	25	75	100
8	PCC	PCC-CS-405	Computer Organization & Architecture LAB	0	0	4	2	15	35	50
9	PCC	PCC-CS-406	Operating System LAB	0	0	4	2	15	35	50
10	PCC	PCC-CS-407	Design & Analysis of Algorithms LAB	0	0	4	2	15	35	50
Total				**17**	**1**	**16**	**24**	**220**	**630**	**850**

Note:

(a) Theory exams will be of 03 hours duration and Practical exams will be of 02 hours duration

(b) Additional 3 credits per year to be earned through MOOCs

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
B.Tech. (COMPUTER SCIENCE & ENGINEERING)

Scheme of Studies/Examination
Semester- 5

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	ESC	ESC-501	Signals & Systems	3	0	0	3	25	75	100
2	PCC	PCC-CS-501	Database Management Systems	3	0	0	3	25	75	100
3	PCC	PCC-CS-506	Formal Languages&Automata	3	0	0	3	25	75	100
4	PCC	PCC-CS-503	Object Oriented Programming	3	0	0	3	25	75	100
5	HSMC	HSMC-02	Economics for Engineers	3	0	0	3	25	75	100
6	PEC	PEC-CS-<Stream>-501	Elective -I	3	0	0	3	25	75	100
7	MC	MC-01	Constitution of India	2	0	0	0	25	75	100
8	VAC	H-102	Universal Human Values 2: Understanding Harmony	2	1	0	0	50	50	100
9	Project	PROJ-CS-501	Project-III	0	0	4	2	25	75	100
10	PCC	PCC-CS-504	Database Management Systems LAB	0	0	4	2	15	35	50
11	PCC	PCC-CS-505	Object Oriented Programming LAB	0	0	4	2	15	35	50
Total				**22**	**1**	**12**	**24**	**280**	**720**	**1000**

Note:

(a) Theory exams will be of 03 hours duration and Practical exams will be of 02 hours duration
(b) Additional 3 credits per year to be earned through MOOCs

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
B.Tech. (COMPUTER SCIENCE & ENGINEERING)

Scheme of Studies/Examination

Semester- 6

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PCC	PCC-CS-605	Compiler Design	3	0	0	3	25	75	100
2	PCC	PCC-CS-602	Computer Networks	3	0	0	3	25	75	100
3	PEC	PEC-CS-<Stream>-601	Elective-II	3	0	0	3	25	75	100
4	PEC	PEC-CS-<Stream>-602	Elective-III	3	0	0	3	25	75	100
5	OEC	OEC-CS-601	Open Elective-I (Humanities)	3	0	0	3	25	75	100
6.	OEC	OEC-CS-602	Open Elective-II	3	0	0	3	25	75	100
7.	AC	AC02	Message of Bhagwat Gita	2	1	0	0	25	75	100
8.	Project	PROJ-CS-601	Project-IV	0	0	4	2	25	75	100
9.	PCC	PCC-CS-606	Compiler Design Lab	0	0	4	2	15	35	50
10.	PCC	PCC-CS-604	Computer Networking Lab	0	0	4	2	15	35	50
Total				**20**	**1**	**12**	**24**	**230**	**670**	**900**

Note:

(a) Theory exams will be of 03 hours duration and Practical exams will be of 02 hours duration

(b) Additional 3 credits per year to be earned through MOOCs

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
B.Tech. (COMPUTER SCIENCE & ENGINEERING)

Scheme of Studies/Examination

Semester- 7 (May be carried out in 8th Semester*)

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Marks for Sessional	Marks for End Term Examination	Total
				L	T	P				
1	PEC	PEC-CS-<Stream>-701	Elective-IV	3	0	0	3	25	75	100
2	PEC	PEC-CS-<Stream>-702	Elective-V	3	0	0	3	25	75	100
3	PEC	PEC-CS-<Stream>-703	Elective-VI	3	0	0	3	25	75	100
4	OEC	OEC-CS-701	Open Elective-III	3	0	0	3	25	75	100
5	OEC	OEC-CS-702	Open Elective-IV	3	0	0	3	25	75	100
6	BSC	BSC-01	Biology	2	1	0	3	25	75	100
7	Project	PROJ-CS-701	Project-V	0	0	4	2	25	75	100
Total				**17**	**1**	**4**	**20**	**175**	**525**	**700**

* The course contents of 7th Semester may be pursued by the students of UTDs/Departments of Affiliated colleges in 8th semester. In the case of pursuance of internship in 7th semester, the course contents of 7th semester will be taught in 8th semester and vice-versa. The approval of such interchangeability should be requested from the authority before the commencement of 7th semester.

Note:

(a) Theory exams will be of 03 hours duration and Practical exams will be of 02 hours duration
(b) Additional 3 credits per year to be earned through MOOCs

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Scheme of Studies/Examination

Semester- 8 (May be carried out in 7th semester*)

S. No.	Category	Course Code	Course Title	Duration	Credits	Marks for Sessional	Marks for End Term Examination	Total
1.	Project	PROJ-CS-801	Industry Internship*	6 Months	10	200	300	500
Total					**10**	**200**	**300**	**500**

Note: Additional 3 credits per year to be earned through MOOCs

Procedure for Annual Examination and continuous Assessment

(A) Annual Exams Marks

1. Project Evaluation 50 Marks
2. Project Seminar 50 Marks
3. Project Viva 100 marks

(B) Continuous Assessment Marks

1. Assessment by Institute faculty 100 Marks
2. Assessment by Industrial Guide 150 Marks
3. Conduct Marks 50 Marks

* The Industry Internship may be pursued by UTDs/Departments of Affiliated colleges in 7th or 8th semester. In the case of pursuance of internship in 7th semester, the course contents of 7th semester will be taught in 8th semester and vice-versa. The approval of such interchangeability should be requested from the authority before the commencement of 7th semester.

PROFESSIONAL ELECTIVE COURSES

Electives	Stream-1 **Theory and Algorithms Code: PEC-CS-T<number>**	Stream-2 **Systems Code: PEC-CS-S<number>**	Stream-3 **Data Science and Machine Intelligence Code: PEC-CS-D<number>**	Stream-4 **Applications Code: PEC-CS-A<number>**
Elective-I	Introduction to Graph Theory (PEC-CS-T-501)	Advanced Computer Architecture (PEC-CS-S-501)	Basics of Machine Learning (PEC-CS-D-501(I)) Intelligent Systems (PEC-CS-D-501(II))	Image Processing (PEC-CS-A-501)
Elective-II	Advanced Algorithms (PEC-CS-T-601)	Software Engineering (PEC-CS-S-601)	Data Mining (PEC-CS-D-601)	Digital Signal Processing (PEC-CS-A-601)
Elective-III	Parallel and Distributed Algorithms (PEC-CS-T-602)	Distributed Systems (PEC-CS-S-602(I)) Basics of Embedded Systems (PEC-CS-S-602(II))	Soft Computing (PEC-CS-D-602)	Computer Graphics (PEC-CS-A-602)
Elective-IV	Queuing Theory and Modeling (PEC-CS-T-701)	Advanced Operating Systems (PEC-CS-S-701(I)) Real Time Systems (PEC-CS-S-701(II))	Speech and Natural Language Processing (PEC-CS-D-701)	Theory of Optimization Techniques (PEC-CS-A-701)
Elective-V	Game Theory (PEC-CS-T-702)	Ad-Hoc and Sensor Networks (PEC-CS-S-702)	Data Analytics (PEC-CS-D-702(I)) Information Retrieval (PEC-CS-D-702(II))	Web and Internet Technology (PEC-CS-A-702)
Elective-VI	Information Theory and Coding (PEC-CS-T-703)	Internet of Things (PEC-CS-S-703)	Neural Networks and Deep Learning (PEC-CS-D-703)	Cryptography and Network Security (PEC-CS-A-703)

OPEN ELECTIVE COURSES*

Open Elective-I	Open Elective-II	Open Elective-III	Open Elective-IV
Soft Skills and Interpersonal Communication (OEC-CS-601(I))	Human Resource Management (OEC-CS-602(I))	Financial Management (OEC-CS-701(I))	Economic Policies in India (OEC-CS-702(I))
Cyber Law and Ethics (OEC-CS-601(II))	ICT for Development (OEC-CS-602(II))	E-commerce and Entrepreneurship (OEC-CS-701(II))	Basics of Cloud Computing (PEC-IT-I-703)
Data Analysis using Python (PCC-IT- 601)	Intellectual Property Rights (OEC-CS-602(III))	R programming (OEC-CS-701(III))	Optical Network Design (OEC-CS-702(III))
Electronic Devices (OEC-CS-601(IV))	International Business Environment (OEC-CS-602(IV))	Non-Conventional Energy Sources (OEC-CS-701(IV))	High Speed Network (OEC-CS-702(IV))
Digital System Design (OEC-CS-601(V))	Basics of Operations Research (OEC-CS-602(V))	-	-

*** The list is non-exhaustive and may be appended with new courses time to time with the approval of Board of Studies.**

VALUE ADDED COURSE [VAC]*

S. No.	Code	Course Title	Hours Per Week			Semester	Credits	Marks for Sessional	Marks for End Term Examination	Total
			L	T	P					
1.	HSMC (H-102)	Universal Human Values 2: Understanding Harmony	2	1	0	V	0	50	50	100
Total							**0**	**50**	**50**	**100**

AUDIT COURSE [AC]*

S. No.	Code	Course Title	Hours Per Week			Semester	Credits	Marks for Sessional	Marks for End Term Examination	Total
			L	T	P					
1.	AC02	Messageof Bhagwat Gita	2	1	0	VI	0	25	75	100
Total							**0**	**25**	**75**	**100**

***As approved in 20th Meeting of Academic Council, the above subjects are to be included in the curriculum**

ADDITIONAL REQUIREMENTS FOR B.TECH (Hons.)

A student will be eligible to get Under-Graduate (B.Tech) with Honours if he/she completes additional credits through MOOC's. (AICTE Model Curriculum, Chapter1(B)). Following pattern will be followed for earning additional credits for the award of Honours degree:

Program	**Duration**	**Credits to be earned***	**Minimum CGPA**
B.Tech	Semester I to VIII	12	8.0

Note: From session 2019-20 onwards, for B.Tech program, a student has to earn at least 12 credits during the duration of the Degree subject to the passing of at least one MOOC course (carrying minimum 3 credits) per year. The MOOC chosen by the student should not be on offer/scheme of the degree.

The *Credit Transfer/Mobility Policy for Online Courses* approved in 17th Academic Council Dated 11.06.2019 may be referred for the same.

DETAILED 4-YEAR CURRICULUM CONTENTS

Undergraduate Degree in Engineering & Technology

Branch/Course: COMPUTER SCIENCE & ENGG.

Second year (Third semester onwards)

PROFESSIONAL CORE COURSES

CODE: ESC-301

SUBJECT NAME: ANALOG ELECTRONIC CIRCUITS

CREDITS: 3

B.TECH. 3rd SEMESTER		SESSIONAL:	25
L T P		THEORY EXAM:	75
3 0 0		TOTAL :	100

MODULE 1: DIODE CIRCUITS

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

MODULE 2: BJT CIRCUITS

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

MODULE 3: MOSFET CIRCUITS

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, ransconductance, high frequency equivalent circuit.

MODULE 4: DIFFERENTIAL, MULTI-STAGE AND OPERATIONAL AMPLIFIERS

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

MODULE 5: LINEAR APPLICATIONS OF OP-AMP

Idealized analysis of op-amp circuits, Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.

MODULE 6: NONLINEAR APPLICATIONS OF OP-AMP

Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the characteristics of transistors.
2. Design and analyse various rectifier and amplifier circuits.
3. Design sinusoidal and non-sinusoidal oscillators.
4. Understand the functioning of OP-AMP and design OP-AMP based circuits.

REFERENCES

1. **A. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press, 1998.**
2. **J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.**
3. **J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.**
4. **P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.**
5. **P. R. Gray, R. G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.**

CODE: PCC-CS-301

SUBJECT NAME: DATA STRUCTURES & ALGORITHMS

CREDITS: 3

B.TECH. 3rd SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL:	100

Pre-requisites: Fundamentals of Computer and Programming in C

Course Objectives:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To enable them to write algorithms for solving problems with the help of fundamental data structures

MODULE 1: INTRODUCTION

Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. **Searching:** Linear Search and Binary Search Techniques and their complexity analysis.

MODULE 2: STACKS AND QUEUES

ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

MODULE 3: LINKED LISTS

Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees, B Tree, B+ Tree: definitions, algorithms and analysis.

MODULE 4: SORTING AND HASHING

Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods. Hashing and collision resolution.

Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Course Outcomes:

1. For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.
2. For a given Search problem (Linear Search and Binary Search) student will able to implement it.
3. For a given problem of Stacks, Queues, linked list and Tree, student will able to implement it and analyze the same to determine the time and computation complexity.
4. Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
5. Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity.

REFERENCES

1. **A. M. Tenenbaum, Langsam, Moshe J. Augentem , "*Data Structures using C*," PHI Pub.**
2. **A.V. Aho, J.E. Hopcroft and T.D. Ullman, "*Data Structures and Algorithms*" Original edition, Addison-Wesley, 1999, Low Priced Edition.**
3. **Ellis Horowitz & Sartaj Sahni, "*Fundamentals of Data structures*" Pub, 1983,AW**

CODE: ESC-302

SUBJECT NAME: DIGITAL ELECTRONICS

CREDITS: 3

B.TECH. 3rd SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites:

Course Objectives:

MODULE 1: FUNDAMENTALS OF DIGITAL SYSTEMS AND LOGIC FAMILIES

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

MODULE 2: COMBINATIONAL DIGITALCIRCUITS

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

MODULE 3: SEQUENTIAL CIRCUITS AND SYSTEMS

A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

MODULE 4: A/D AND D/A CONVERTERS

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter,

A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs

MODULE 5: SEMICONDUCTOR MEMORIES AND PROGRAMMABLE LOGIC DEVICES

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand working of logic families and logic gates.
2. Design and implement Combinational and Sequential logic circuits.
3. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
4. use PLDs to implement the given logical problem.

REFERENCES:

1. **R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.**
2. **M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.**
3. **A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.**

CODE: BSC-301

SUBJECT NAME: CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS

NO OF CREDITS: 3

B.TECH3rd SEMESTER		SESSIONAL:	25
L T P		THEORY EXAM:	75
3 0 0		TOTAL :	100

Pre-requisites: Calculus, Multivariable Calculus (Differentiation)

Course Objectives:

MODULE 1: SEQUENCES AND SERIES

Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series or exponential, trigonometric and logarithmic functions.

MODULE 2: MULTIVARIABLE CALCULUS (DIFFERENTIATION)

Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

MODULE 3: MULTIVARIABLE CALCULUS (INTEGRATION)

Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar). Theorems of Green, Gauss and Stokes, orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

MODULE 4: FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS

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.

MODULE 5: ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDERS

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Course Outcomes:

REFERENCES

1. **G.B. Thomas and R.L. Finney, "*Calculus and Analytic geometry*" , 9th Edition, Pearson, Reprint, 2002.**
2. **2. Veerarajan T., "*Engineering Mathematics for first year*", Tata McGraw-Hill, New Delhi, 2008.**
3. **Ramana B.V., "*Higher Engineering Mathematics*", Tata McGraw Hill New Delhi, 11th Reprint, 2010.**
4. **N.P. Bali and Manish Goyal, "*A text book of Engineering Mathematics*", Laxmi Publications, Reprint, 2010.**
5. **B.S. Grewal, "*Higher Engineering Mathematics*", Khanna Publishers, 35th Edition, 2000.**
6. **Erwin Kreyszig, "*Advanced Engineering Mathematics*", 9th Edition, John Wiley & Sons, 2006.**
7. **W. E. Boyce and R. C. DiPrima, "*Elementary Differential Equations and Boundary Value Problems*, 9th Edition, Wiley India, 2009.**
8. **S. L. Ross, "*Differential Equations*", 3rd Ed., Wiley India, 1984.**
9. **E. A. Coddington, "*An Introduction to Ordinary Differential Equations*", Prentice Hall India, 1995.**
10. **E. L. Ince, "*Ordinary Differential Equations*", Dover Publications, 1958.**
11. **G.F. Simmons and S.G. Krantz, "*Differential Equations*", Tata McGraw Hill, 2007.**

CODE: HSMC-01

SUBJECT NAME: EFFECTIVE TECHNICAL COMMUNICATION

CREDITS: 3

B.TECH. 3rd SEMESTER		SESSIONAL:	25
L T P		THEORY EXAM:	75
3 0 0		TOTAL :	100

Pre-requisites:

Course Objectives:

MODULE 1: INFORMATION DESIGN AND DEVELOPMENT

Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.

MODULE 2: TECHNICAL WRITING, GRAMMAR AND EDITING

Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Hunan factors, Managing technical communication projects, time estimation, Single sourcing, Localization.

MODULE 3: SELF DEVELOPMENT AND ASSESSMENT

Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity

MODULE 4: COMMUNICATION AND TECHNICAL WRITING

Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.

MODULE 5: ETHICS

Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.

Course Outcomes:

REFERENCES:

1. **David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004**
2. **Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN 0312406843)**
3. **Shiv Khera, You Can Win, Macmillan Books, New York, 2003.**
4. **Raman Sharma, Technical Communications, Oxford Publication, London, 2004.**
5. **Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4)**
6. **Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi 2002.**
7. **Xebec, Presentation Book, TMH New Delhi, 2000. (ISBN 0402213)**

CODE: PCC-CS-302

SUBJECT NAME: IT WORKSHOP (MATLAB)

CREDITS: 2

B.TECH. 3rd SEMESTER		SESSIONAL:	15
L T P		PRACTICAL EXAM:	35
0 0 4		TOTAL :	50

Pre-requisites: There are no formal prerequisites for this course.

Course Objectives:

The course is intended to assist undergraduates in learning the basics of programming in general and programming MATLAB in particular. Basics of programming in MATLAB will be covered, with the goal of having students become comfortable enough to continue learning MATLAB and other programming languages on their own.

MODULE 1: INTRODUCTION

Data types and variables: Introduction to MATLAB, Data Types, Inter-conversion of Data types, MATLAB Variables, Keywords and Constant, Session Command. *MATLAB Operators and Operations:* Operators (Arithmetic, Relational, Logical, Bitwise), Set Operations, Operator Precedence, Mathematical Functions.

MODULE 2: PROGRAMMING IN MATLAB

Script and Function: Decision Making, Loops, branches, Functions, Working on Script File (Creating, Saving and Executing), MATLAB I/O, Formatted I/O Method,.

MODULE 3: ARRAYS AND GRAPHICS

Matrices and Arrays: Introduction to Matrices, Operations on Arrays/Matrices, Manipulations of Arrays/Matrices, Expansion of Matrix Size, Reduction of Matrices/Arrays order,

Graphics: Introduction to plot, Basic 2-D Plots(Style options, Labels, Axis control, etc.), specialized 2-D Plots, drawing multiple plots. Using MATLAB for fractals and chaos and Conway game of life

MODULE 4: FILE HANDLING AND DEBUGGING

File Handling: Introduction to file handling, working on files, accessing of Text File, Saving/ Loading MATLAB Variables, reading data without opening file, reading and writing Excel.

Debugging: Introduction to debugging, Break points, debugger, stepping, watching variable values, debugging commands.

Course Outcomes:

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

1. Use MATLAB for programming purposes
2. Learn and explore MATLAB further on their own
3. Use this learning experience to learn other programming languages.

REFERENCES:

1. **Delores M. Etter, David C. Kuncicky, Holly Moore, "*Introduction to MATLAB 7.0*", Pearson, 2013.**
2. **Rudra Pratap, "*Getting Started with MATLAB*", OXFORD University Press, 2010.**
3. **Agam Kumar Tyagi, "*MATLAB and Simulink for Engineers*", University Press, 2012.**

WEB REFERENCES

https://ocw.mit.edu/courses/mathematics/18-s997-introduction-to-matlab- programming-fall-2011/syllabus/

CODE: PCC-CS-401

SUBJECT NAME: DISCRETE MATHEMATICS

NO OF CREDITS: 3

B.TECH 4th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	1	0	TOTAL :	100

Course Objectives:

Throughout the course, students will be expected to demonstrate their understanding of Discrete Mathematics by being able to do each of the following:

1. Use mathematically correct terminology and notation.
2. Construct correct direct and indirect proofs.
3. Use division into cases in a proof.
4. Use counterexamples.
5. Apply logical reasoning to solve a variety of problems.

MODULE-1:

Sets, Relation and function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem.

Principles of Mathematical Induction: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

MODULE-2:

Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination.

MODULE-3:

Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. **Proof Techniques:** Some Terminology, Proof Methods and Strategies,

Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.

MODULE-4:

Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form

MODULE-5:

Graphs and Trees: Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distances.

Course Outcomes:

1. For a given logic sentence express it in terms of predicates, quantifiers, and logical connectives
2. For a given a problem, derive the solution using deductive logic and prove the solution based on logical inference
3. For a given a mathematical problem, classify its algebraic structure
4. Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra
5. Develop the given problem as graph networks and solve with techniques of graph theory.

REFERENCES:

1. **Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill**
2. **Susanna S. Epp, Discrete Mathematics with Applications,4th edition, Wadsworth Publishing Co. Inc.**
3. **C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw – Hill.**
4. **J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and It's Application to Computer Science", TMG Edition, TataMcgraw-Hill**
5. **Norman L. Biggs, Discrete Mathematics, 2nd Edition, Oxford University Press. Schaum's Outlines Series, Seymour Lipschutz, Marc Lipson, Discrete Mathematics, Tata McGraw - Hill**

CODE: PCC-CS-402

SUBJECT NAME: COMPUTER ORGANIZATION & ARCHITECTURE

NO OF CREDITS: 3

B.TECH 4th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Pre-requisites: Digital Electronics

Course Objectives: To expose the students to the following:

1. How Computer Systems work and the basic principles.
2. Concept of computer architecture and Micro programming.
3. The basic principles for accessing I/O devices and memory unit.
4. Concepts of advanced processors, parallel and pipelining techniques.

MODULE-1:

Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU – registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common CPUs.

Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic.

MODULE-2:

Introduction to x86 architecture.

CPU control unit design: hardwired and micro-programmed design approaches, Case study – design of a simple hypothetical CPU.

Memory system design: semiconductor memory technologies, memory organization.

Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers – program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes – role of interrupts in process state transitions, I/O device interfaces – SCII, USB

MODULE-3:

Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.

Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.

MODULE-4:

Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size Vs block size, mapping functions, replacement algorithms, write policies.

Course Outcomes:

After completion of this course, the students will be able to perform the following:

1. Draw the functional block diagram of single bus architecture of a computer and describe the function of the instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set.
2. Write assembly language program for specified microprocessors using different data representations.
3. Design the ALU, Control Unit and CPU of a computer system.
4. Design a memory module and analyze its operation by interfacing with a given CPU organization and instruction
5. Given a CPU organization, assess its performance, and apply design techniques to enhance performance using pipelining, parallelism and RISC methodology.

REFERENCES:

1. **"Computer Organization and Design: The Hardware/Software Interface", 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.**
2. **"Computer Organization and Embedded Systems", 6th Edition by Carl Hamacher, McGraw Hill Higher Education.**
3. **"Computer Architecture and Organization", 3rd Edition by John P. Hayes WCB/McGraw-Hill**
4. **"Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.**
5. **"Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education.**

CODE: PCC-CS-403

SUBJECT NAME: OPERATING SYSTEM

NO OF CREDITS: 3

B.TECH 4th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Pre-requisites: Fundamentals of Computers, Computer Organization & Architecture

Course Objectives:

1. To learn the fundamentals of Operating Systems.
2. To learn the mechanisms of OS to handle processes, threads and their communication.
3. To know the components and management aspects of concurrency management viz. Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols.
4. To learn the mechanisms involved in memory management in contemporary OS.
5. To gain knowledge on Input/Output management aspects of Operating systems.

MODULE-1:

Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.

MODULE-2:

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching

Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads,

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

MODULE-3:

Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer/Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.

MODULE-4:

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

MODULE-5:

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging.
Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

MODULE-6:

I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms
File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.
Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks

Course Outcomes:

After the completion of the course, the students will be able to:

1. Learn the basic concepts of operating system, its various types and architecture
2. Learn and implement process management issues including process life cycle, scheduling, synchronization and deadlocks
3. Learn and implement memory management issues including memory partitioning, memory allocation and virtual memory concept
4. Learn and implement files systems and I/O systems including file management, disk management and kernel I/O subsystems

REFERENCES:

1. **Abraham Silberschatz, Peter Galvin, Greg Gagne, "*Operating System Concepts Essentials*", 9th Edition, Wiley Asia Student Edition.**

2. **William Stallings, "*Operating Systems: Internals and Design Principles*", 5th Edition, Prentice Hall of India.**
3. **Charles Crowley, "*Operating System: A Design-oriented Approach*", 1st Edition, Irwin Publishing.**
4. **Gary J. Nutt, "*Operating Systems: A Modern Perspective*", 2nd Edition, Addison-Wesley**
5. **Maurice Bach, "*Design of the Unix Operating Systems*", 8th Edition, PHI**
6. **Daniel P. Bovet, Marco Cesati, "*Understanding the Linux Kernel*", 3rd Edition, O'Reilly and Associates**

CODE: PCC-CS-404

SUBJECT NAME: DESIGN & ANALYSIS OF ALGORITHMS

NO OF CREDITS: 3

B.TECH 4th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Pre-requisites: Data Structures and Algorithms

Course Objectives:

1. Analyze the asymptotic performance of algorithms.
2. Write rigorous correctness proofs for algorithms.
3. Demonstrate a familiarity with major algorithms and data structures.
4. Apply important algorithmic design paradigms and methods of analysis.
5. Synthesize efficient algorithms in common engineering design situations.

MODULE-1: INTRODUCTION

Characteristics of algorithm, Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.

MODULE-2: FUNDAMENTAL ALGORITHMIC STRATEGIES

Brute-Force, Greedy, Dynamic Programming, Branch and-Bound and backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving, Bin Packing, Knapsack, Job sequencing with deadline, Optimal Binary Search tree, N-Queen problem, Hamiltonian Cycle, TSP, Heuristics – characteristics and their application domains.

MODULE-3:GRAPH AND TREE TRAVERSAL ALGORITHMS

Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

MODULE-4:TRACTABLE AND INTRACTABLE PROBLEMS

Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard, Cook's theorem, Standard NP-complete problems and Reduction techniques.

MODULE-5:ADVANCED TOPICS

Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE

Course Outcomes:

1. For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.
2. Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.
3. Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.
4. Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For a given problems of dynamic-programming and develop the dynamic programming algorithms, and analyze it to determine its computational complexity.
5. For a given model engineering problem model it using graph and write the corresponding algorithm to solve the problems.
6. Explain the ways to analyze randomized algorithms (expected running time, probability of error).
7. Explain what an approximation algorithm is. Compute the approximation factor of an approximation algorithm (PTAS and FPTAS).

REFERENCES

1. **Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, "*Introduction to Algorithms*", MIT Press/McGraw-Hill; 3rd edition, [ISBN: 978-0262533058], 2009.**
2. **Ellis Horowitz, Sartaj Sahni and SanguthevarRajasekaran, "*Fundamentals of Algorithms*", Universities Press; 2nd edition [ISBN:978-8173716126],2008.**
3. **Jon Kleinberg and ÉvaTardos, "*Algorithm Design*", Pearson Publisher; 1st edition [ISBN:978-0321295354],2012.**
4. **Michael T Goodrich and Roberto Tamassia, "*Fundamentals of Algorithms*" Wiley Press; 1st edition [ISBN:978-8126509867],2006.**

CODE:HSMC-03

SUBJECT NAME: MANAGEMENT-I (ORGANIZATIONAL BEHAVIOUR)

NO OF CREDITS: 3

B.TECH 4TH SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Course Objectives:

The objective of this course is to expose the students to basic concepts of management and provide insights necessary to understand behavioural processes at individual, team and organizational level.

MODULE-1

Introduction to management: concept, nature; evolution of management thoughts –traditional, behavioural, system, contingency and quality viewpoints; Managerial levels, skills and roles in an organization; Functions of Management: Planning, Organizing, Directing, Controlling, Problem solving and Decision making; Management control; managerial ethics and social responsibility; Management Information System (MIS).

MODULE-2

Fundamentals of Organizational Behavior: Concept, evolution, importance and relationship with other Fields; Contemporary challenges of OB; Individual Processes and Behavior – differences, Personality concept, determinant, theories and applications; Values, Attitudes and Emotions, Perception- concept, process and applications, Learning and Reinforcement; Motivation: concept, theories and applications; Stress management.

MODULE-3

Interpersonal Processes- Work teams and groups- Definition of Group, Stages of group development, Group cohesiveness, Types of groups, Group processes and Decision Making; Team Building; Conflict- concept, sources, types, management of conflict; Power and Political Behavior; Leadership: concept, function and styles.

MODULE-4

Organizational Processes and structure: organizational design: various organizational structures and their effect on human behavior; Organizational climate; Organizational culture; Organizational change: Concept, Nature, Resistance to Change, Change Management, Implementing Change and Organizational Development

Course Outcomes:

1. The students learn how to influence the human behaviour.
2. Students will be able to understand behavioural dynamics in organizations.
3. Students will be able to apply managerial concepts in practical life.
4. Students will be able to understand organizational culture and change.

REFERENCES:

1. **Robbins, S.P. and Decenzo, D.A. Fundamentals of Management, Pearson Education Asia, New Delhi.**
2. **Stoner, J et. al, Management, New Delhi, PHI, New Delhi**
3. **Satya Raju, Management – Text & Cases, PHI, New Delhi**
4. **Kavita Singh, OrganisationalBehaviour: Text and cases. New Delhi: Pearson Education.**
5. **Pareek, Udai, Understanding Organisational Behaviour, Oxford University Press, New Delhi**
6. **Robbins, S.P. & Judge, T.A., Organisational Behaviour, Prentice Hall of India, New Delhi**

CODE:HSMC-04

SUBJECT NAME: MANAGEMENT-I (FINANCE & ACCOUNTING)

NO OF CREDITS: 3

B.TECH 4TH SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Course Objectives:

The purpose of the course is to understand nature of accounting and its interaction with other accounting and their comparison. It also focuses what kind of information the manager need, from where these can be obtained and how this information can be used to carry out important managerial decision.

MODULE-1:
Meaning nature and scope of different types of accounting and their comparison. Accounting principles and Indian accounting standards, IFRS, Preparation of final accounts of company with basic adjustments.Reading and understanding of Annual report.

MODULE-2:
Analysis and interpretation of financial statements – meaning, importance and techniques, ratio analysis; fund flow analysis; cash flow analysis (AS-3)

MODULE-3:
Classification of costs, preparation of cost sheet, inventory valuation, overview of standard costing and variance analysis; material variance and labour variance.

MODULE-4:
Budgetary control- meaning, need, objectives, essentials of budgeting, different types of budgets cash budget, flexible budget zero base budget; marginal costing, BEP analysis, decision making for optimum sales mix, exploring new markets, make/Buy decisions, expand/ contract, accepting and rejecting decisions

Course Outcomes:

1. This course will impart knowledge to the students regarding preparation of financial statements their analysis.

2. The students will be able to understand applications of cost accounting and cost control techniques like standard costing etc.
3. The course will help them to take better managerial decisions.
4. Students will be able to know about budget control techniques.

REFERENCES:

1. **Singhal, A.K. and Ghosh Roy, H.J., Accounting for Managers, JBC Publishers and Distributors, New Delhi**
2. **Pandey, I.M., Management Accounting, Vikas Publishing House, New Delhi**
3. **Horngren, Sundem and Stratton, Introduction to Management Accounting, Pearson Education, New Delhi.**
4. **Jain, S.P and Narang, K.L., Advanced Cost Accounting, Kalyani Publishers, Ludhiana.**
2. **Khan, M.Y. and Jain, P.K., Management Accounting, TMH, New Delhi**

CODE: MC-03

SUBJECT NAME: ENVIRONMENTAL SCIENCES

NO OF CREDITS: 0

B.TECH 4th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
2	0	0	TOTAL:	100

Pre-requisites: None

Course Objectives:

The prime objective of the course is to provide the students a detailed knowledge on the threats and challenges to the environment due to developmental activities. The students will be able to identify the natural resources and suitable methods for their conservation and sustainable development. The focus will be on awareness of the students about the importance of ecosystem and biodiversity for maintaining ecological balance. The students will learn about various attributes of pollution management and waste management practices. The course will also describe the social issues both rural and urban environment and environmental legislation

MODULE-1: The Multidisciplinary Nature of Environmental Studies

Definition, scope and importance. Need for public awareness.

MODULE-2: Natural Resources: Renewable and Non-Renewable Resources

Natural resources and associated problems:

- Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
- Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
- Mineral resources: Use and exploitation, environmental effects of extracting and mineral resources, case studies.
- Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
- Energy resources: Growing energy needs, renewable and non- renewable energy sources, use of alternate energy sources. Case studies.

- Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
- Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

MODULE-3: Ecosystems

- Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers.
- Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of thefollowing ecosystem: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

MODULE-4: Biodiversity and its Conservation

- Introduction – Definition: genetic, species and ecosystem diversity.
- Biogeographical classification of India. Value of biodiversity: consumptive• use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels.
- India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: insitu and ex-situ conservation of biodiversity

MODULE-5: Environmental Pollution Definition

- Causes, effects and control measures of: a) Air pollution b) Water pollution c)Soil pollution d) Marine pollution e) Noise pollution f) Thermal pollution g) Nuclear hazards
- Solid waste Management: Causes, effects and control measures of urban andindustrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides.

MODULE-6: Social Issues and the Environment

- From Unsustainable to Sustainable development Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case studies.
- Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products.

- Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act
- Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation Public awareness.

MODULE-7: Human Population and the Environment

Population growth, variation among nations. Population explosion – Family Welfare Programme. Environment and human health. Human Rights. Value Education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health. Case Studies.

MODULE-8: Field Work

- Visit to a local area to document environmental assets-river / forest / grassland / hill / mountain.
- Visit to a local polluted site – Urban / Rural / Industrial / Agricultural.
- Study of common plants, insects, birds.
- Study of simple ecosystems – pond, river, hill slopes, etc.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Understand environmental legislation and policies of national and international regime.
2. No regulations applicable to industries and other organizations which significant environmental aspects.
3. Get knowledge of the legal system operating in India and will be in a position to prepare compliance report for getting environmental clearance.
4. Prepare the environmental management system for an organization.

RERERENCES

1. **Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.**
2. **Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela 2008 PHI Learning Pvt Ltd.**
3. **Environmental Science by Daniel B. Botkin& Edwards A. Keller, Wiley INDIA edition.**
4. **Fundamentals of Ecology by Odum, E.P., Barrick, M. and Barret, G.W. Thomson Brooks/Cole Publisher, California, 2005.**

CODE: PCC-CS-501

SUBJECT NAME: SIGNALS & SYSTEMS

NO OF CREDITS: 3

B.TECH 5th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites:

Course Objectives:

MODULE-1: INTRODUCTION TO SIGNALS AND SYSTEMS

Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

MODULE-2: BEHAVIOR OF CONTINUOUS AND DISCRETE-TIME LTI SYSTEMS

Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

MODULE-3: FOURIER, LAPLACE AND Z- TRANSFORMS

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The DiscreteTime Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

MODULE-4: SAMPLING AND RECONSTRUCTION

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the concepts of continuous time and discrete time systems
2. Analyse systems in complex frequency domain
3. Understand sampling theorem and its implications.

REFERENCES:

1. **A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and systems", Prentice Hall India, 1997.**
2. **J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson, 2006.**
3. **H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.**
4. **S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.**
5. **A. V. Oppenheim and R. W. Schafer, "Discrete-Time Signal Processing", Prentice Hall, 2009.**
6. **M. J. Robert "Fundamentals of Signals and Systems", McGraw Hill Education, 2007.**
7. **B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009.**

CODE: PCC-CS-501

SUBJECT NAME: DATABASE MANAGEMENT SYSTEMS

NO OF CREDITS: 3

B.TECH 5th SEMESTER		SESSIONAL:	25
L T P		THEORY EXAM:	75
3 0 0		TOTAL :	100

Pre-requisites: Operating Systems

Course Objectives:

1. To understand the different issues involved in the design and implementation of a database system.
2. To study the physical and logical database designs, database modeling, relational, hierarchical, and network models
3. To understand and use data manipulation language to query, update, and manage a Database
4. To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.
5. To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

MODULE-1:

Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML).

Data models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.

MODULE-2:

Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server.

Relational database design: Domain and data dependency, Armstrong's axiom, Normal forms, Dependency preservation, Lossless design.

Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.

MODULE-3:

Storage strategies: Indices, B-trees, hashing.

MODULE-4:

Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.

MODULE-5:

Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.

MODULE-6:

Advanced topics: Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.

Course Outcomes

1. For a given query write relational algebra expressions for that query and optimize the developed expressions
2. For a given specification of the requirement design the databases using ER method and normalization.
3. For a given specification construct the SQL queries for Open source and Commercial DBMS -MYSQL, ORACLE, and DB2.
4. For a given query optimize its execution using Query optimization algorithms
5. For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.
6. Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling

REFERENCES:

1. **"Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.**
2. **"Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.**
3. **"Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe, Pearson Education**
4. **"Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley**

CODE: PCC-CS-506

SUBJECT NAME: FORMAL LANGUAGES & AUTOMATA

CREDITS: 3

B.TECH. 5th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Pre-requisites: Operating System

Course Objectives:

1. Develop a formal notation for strings, languages and machines.
2. Design finite automata to accept a set of strings of a language.
3. Prove that a given language is regular and apply the closure properties of languages.
4. Design context free grammars to generate strings from a context free language and convert them into normal forms.
5. Prove equivalence of languages accepted by Push Down Automata and languages generated by context free grammars
6. Identify the hierarchy of formal languages, grammars and machines.
7. Distinguish between computability and non-computability and Decidability and undecidability.

MODULE 1:

Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages. Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata. Context-free languages and pushdown automata: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs. Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG. Turing machines: The basic model for Turing machines (TM), Turing recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators. Undecidability: Church-Turing thesis,

universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice s theorem, undecidable problems about languages.

Course Outcomes:

1. Write a formal notation for strings, languages and machines.
2. Design finite automata to accept a set of strings of a language.
3. For a given language determine whether the given language is regular or not.
4. Design context free grammars to generate strings of context free language .

REFERENCES:

1. **John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.**
2. **Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.**
3. **Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.**
4. **Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.**
5. **John Martin, Introduction to Languages and The Theory of Computation, Tata McGraw Hill.**

CODE:PCC-CS-503

SUBJECT NAME: OBJECT ORIENTED PROGRAMMING

NO OF CREDITS: 3

B.TECH 5th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites: Data Structures & Algorithms

Course Objectives:

The course will introduce standard tools and techniques for software development, using object oriented approach, use of a version control system, an automated build process, an appropriate framework for automated unit and integration tests.

MODULE-1: ABSTRACT DATA TYPES

Decomposition & Abstraction, Abstraction Mechanisms – parameterization, specification, Kind of Abstractions – Procedural, Data, Type hierarchies, Iteration. ADT implementation - Concrete state space, concrete invariant, abstraction function. Implementing operations, illustrated by the Text example

MODULE-2: FEATURES OF OBJECT-ORIENTED PROGRAMMING

Encapsulation, object identity, polymorphism – Inheritance in OO design. Implementing OO language features.- Classes, Objects and variables, Type Checking, Procedures - Commands as methods and as objects, Exceptions, Polymorphic procedures, Templates, Memory management

MODULE-3: DESIGN PATTERNS

Introduction and classification. Creational Pattern – Abstract Factory Pattern, Factory Method, Singleton, Structural Pattern – Bridge, Flyweight, Behavioural Pattern - The iterator pattern, Observer pattern, Model-view-controller pattern

MODULE-4: GENERIC TYPES AND COLLECTIONS

Simple Generics, Generics and Subtyping, Wildcards, Generic Methods, Set Interface, List Interface, Queue Interface, Deque Interface, Map Interface, Object Ordering, SortedSet Interface, SortedMap Interface

MODULE-5: GUIS. GRAPHICAL PROGRAMMING WITH SCALA AND SWING

Swing components, Laying out components in a container, Panels, Look & Feel, Event listener, concurrency in swing.

MODULE-6: THE SOFTWARE DEVELOPMENT PROCESS

Requirement specification and analysis,Data Model, Design, Implementation, Testing.

Course Outcomes:

After taking the course, students will be able to:

1. Specify simple abstract data types and design implementations, using abstraction functions to document them.
2. Recognize features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.
3. Name and apply some common object-oriented design patterns and give examples of their use.
4. Design applications with an event-driven graphical user interface.

REFERENCES

1. Barbara Liskov, *Program Development in Java*, Addison-Wesley, 2001

CODE: HSMC-02

SUBJECT NAME: ECONOMICS FOR ENGINEERS

NO OF CREDITS: 3

B.TECH 5th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

MODULE-1:

Introduction to the subject: Micro and Macro Economics, Relationship between Science, Engineering, Technology and Economic Development. Production Possibility Curve, Nature of Economic Laws.

MODULE-2:

Time Value of Money: concepts and application. Capital budgeting; Traditional and modern methods, Payback period method, IRR, ARR, NPV, PI (with the help of case studies)

MODULE-3:

Meaning of Demand. Law of Demand, Elasticity of Demand; meaning, factors effecting it and its practical application and importance. Demand forecasting (a brief explanation)

MODULE-4:

Meaning of Production and factors of production, Law of variable proportions and returns to scale. Internal and external economies and diseconomies of scale. Concepts of cost of production, different types of costs; accounting cost, sunk cost, marginal cost, Opportunity cost. Break even analysis, Make or Buy decision (case study). Relevance of Depreciation towards industry.

MODULE-5:

Meaning of market, types of market, perfect competition, Monopoly, Monopolistic, Oligopoly. (main features). Supply and law of supply, Role of demand and supply in price determination.

MODULE-6:

Indian Economy, nature and characteristics. Basic concepts; fiscal and monetary policy, LPG, Inflation, Sensex, GATT, WTO and IMF. Difference between Central bank and Commercial banks

REFERENCES:

1. **Jain T.R., Economics for Engineers, VK Publication**
2. **Chopra P. N., Principle of Economics, Kalyani Publishers**
3. **Dewett K. K., Modern economic theory, S. Chand**
4. **H. L. Ahuja., Modern economic theory, S. Chand**
5. **DuttRudar&Sundhram K. P. M., Indian Economy**
6. **Mishra S. K., Modern Micro Economics, Pragati Publications**
7. **Pandey I.M., Financial Management; Vikas Publishing House**
8. **Gupta Shashi K., Management Accounting, Kalyani Publication**

CODE: MC-01

SUBJECT NAME: CONSTITUTION OF INDIA

NO OF CREDITS: 0

B.TECH 5th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
2 0 0	TOTAL :100

CONSTITUTION OF INDIA– BASIC FEATURES AND FUNDAMENTAL PRINCIPLES

The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950.

The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

COURSE CONTENT

1. Meaning of the constitution law and constitutionalism.
2. Historical perspective of the Constitution of India.
3. Salient features and characteristics of the Constitution of India.
4. Scheme of the fundamental rights.
5. The scheme of the Fundamental Duties and its legal status.
6. The Directive Principles of State Policy – Its importance and implementation.
7. Federal structure and distribution of legislative and financial powers between the Union and the States.
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

REFERENCES:

1. **The Constitutional Law Of India 9th Edition, by Pandey. J. N.**
2. **The Constitution of India by P.M.Bakshi**
3. **Constitution Law of India by Narender Kumar**
4. **Bare Act by P. M. Bakshi**

CODE: PCC-CS-605

SUBJECT NAME: COMPILER DESIGN

CREDITS: 3

B.TECH. 5th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Pre-requisites: Formal language & automata,

Course Objectives:

1. To understand and list the different stages in the process of compilation.
2. Identify different methods of lexical analysis
3. Design top-down and bottom-up parsers
4. Identify synthesized and inherited attributes
5. Develop syntax directed translation schemes
6. Develop algorithms to generate code for a target machine

MODULE 1:

The aim is to learn how to design and implement a compiler and also to study the underlying theories. The main emphasis is for the imperative language. Introduction: Phases of compilation and overview. Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, from regular expressions to finite automata, scanner generator (lex, flex). Syntax Analysis (Parser): Context-free languages and grammars, push-down automata, LL(1) grammars and top-down parsing, operator grammars, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom up parsing, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison)Semantic Analysis: Attribute grammars, syntax directed definition, evaluation and flow of attribute in a syntax tree. Symbol Table: Its structure, symbol attributes and management. Run-time environment: Procedure activation, parameter passing, value return, memory allocation, and scope. Intermediate Code Generation: Translation of different language features, different types of intermediate forms. Code Improvement (optimization): Analysis: control-flow, data-flow dependence etc.; Code improvement local optimization, global optimization, loop optimization, peep-hole optimization etc. Architecture dependent code improvement: instruction scheduling (for pipeline), loop optimization (for cache memory) etc. Register allocation and target code generation Advanced topics: Type systems, data abstraction, compilation of Object Oriented features and non-imperative programming languages.

Course Outcomes

1. For a given grammar specification develop the lexical analyser
2. For a given parser specification design top-down and bottom-up parsers
3. Develop syntax directed translation schemes
4. Develop algorithms to generate code for a target machine

REFERENCES:

1. **A.V. Aho, M.S. Lam, R. Sethi, and J.D. Ullman, *Compilers:Principles, Techniques, and Tools*, Pearson Education, 2007 (second ed.).**
2. **K.D. Cooper, and L. Torczon, *Engineering a Compiler*, Elsevier, 2004.**

CODE:PCC-CS-602

SUBJECT NAME: COMPUTER NETWORKS

NO OF CREDITS: 3

B.TECH 6th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Pre-requisites: Computer Organization & Architecture, Operating Systems

Course Objectives:

1. To develop an understanding of modern network architectures from a design and performance perspective.
2. To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
3. To provide an opportunity to do network programming
4. To provide a WLAN measurement ideas.

MODULE-1:DATA COMMUNICATION COMPONENTS

Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

MODULE-2: DATA LINK LAYER AND MEDIUM ACCESS SUB LAYER

Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA

MODULE-3: NETWORK LAYER

Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

MODULE-4: TRANSPORT LAYER

Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

MODULE-5: APPLICATION LAYER

Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography

Course Outcomes

After taking the course, students will be able to:

2. Explain the functions of the different layer of the OSI Protocol.
3. Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) describe the function of each block.
4. For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component
5. For a given problem related TCP/IP protocol developed the network programming.
6. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

REFERENCES:

5. **Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGrawHill.**
6. **Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.**
7. **Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.**
8. **Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.**
9. **TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America**

CODE: BSC-01

SUBJECT NAME: BIOLOGY

NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
2 1 0	TOTAL : 100

Pre-requisites: None

Course Objectives:

MODULE 1: INTRODUCTION

Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry.

Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

MODULE 2: CLASSIFICATION

Purpose: To convey that classification *per se* is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted.

Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilisation -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. Musculus.

MODULE 3: Genetics

Purpose: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences"

Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

MODULE 4: BIOMOLECULES

Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine

Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

MODULE 5: ENZYMES

Purpose: To convey that without catalysis life would not have existed on earth.

Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

MODULE 6: INFORMATION TRANSFER

Purpose: The molecular basis of coding and decoding genetic information is universal

Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

MODULE 7: MACROMOLECULAR ANALYSIS

Purpose: How to analyse biological processes at the reductionist level

Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

MODULE 8: METABOLISM

Purpose: The fundamental principles of energy transactions are the same in physical and biological world.

Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of K_{eq} and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO_2 + H_2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy Charge.

MODULE 9: MICROBIOLOGY

Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.

Course Outcomes:

After studying the course, the student will be able to:

1. Describe how biological observations of 18th Century that lead to major discoveries.
2. Convey that classification *per se* is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological
3. Highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring
4. Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine
5. Classify enzymes and distinguish between different mechanisms of enzyme action.
6. Identify DNA as a genetic material in the molecular basis of information transfer.
7. Analyse biological processes at the reductionistic level
8. Apply thermodynamic principles to biological systems.
9. Identify and classify microorganisms.

REFERENCES

1. ***"Biology: A global approach"*** **Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd**
2. **"*Outlines of Biochemistry*" , Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons**
3. **"*Principles of Biochemistry(V Edition)*", By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company**

4. **"*Molecular Genetics (Second edition)*", Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher**
5. **"*Microbiology*" , Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C.Brown Publishers**

DETAILED 4-YEAR CURRICULUM CONTENTS

Undergraduate Degree in Engineering & Technology

Branch/Course: COMPUTER SCIENCE & ENGG.

PROFESSIONAL ELECTIVE COURSES

STREAM-1

CODE: PEC-CS-T-501

SUBJECT NAME: INTRODUCTION TO GRAPH THEORY

NO OF CREDITS: 3

B.TECH SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Pre-requisites: Basic math and basic programming (functions, loops, recursion).

Course Objectives:

1. To introduce different types of graphs and their applications.
2. To enable the students to find different types of paths and circuits in the graph.
3. To understand about trees and fundamental circuits.
4. To understand about different representations of graphs.
5. To enable the students to solve different types of problems related to graphs.

MODULE-1: INTRODUCTION TO GRAPHS

Definition of a graph and directed graph, simple graph. Degree of a vertex, regular graph, bipartite graphs, subgraphs, complete graph, complement of a graph, operations of graphs, isomorphism and homomorphism between two graphs, directed graphs and relations.

MODULE-2:PATHS AND CIRCUITS

Walks, paths and circuits, connectedness of a graph, Disconnected graphs and their components, Konigsberg 7-bridge problem, Around the world problem, Euler graphs, Hamiltonian paths and circuits, Existence theorem for Eulerian and Hamiltonian graphs.

MODULE-3:TREES AND FUNDAMENTAL CIRCUITS

Trees and their properties, distance and centre in a tree and in a graph, rooted and binary trees, spanning trees and forest, fundamental circuits, cut sets, connectivity and separability,1-isomorphism, 2-isomorphism, breadth first and depth first search.

MODULE-4:MATRIX REPRESENTATION OF GRAPHS

Incidence matrix and its sub matrices, Reduced incidence matrix, circuit matrix, fundamental circuit matrix, cut set matrix, fundamental cut set matrix, path matrix, adjacency matrix of a graph and of digraph.

MODULE-5:PLANAR AND DUAL GRAPH

Planar graphs, Euler's formula, Kuratowski's graphs, detections of planarity, geometric dual, combinatorial dual.

Coloring of planar graphs: Chromatic number, independent set of vertices, maximal independent set, chromatic partitioning, dominating set, minimal dominating set, chromatic polynomial, coloring and four colour problem, coverings, matchings in a graph.

MODULE-6: GRAPH ALGORITHMS

Network flows, Ford-Fulkerson algorithm for maximum flow, Dijkstra algorithm for shortest path between two vertices, Kruskal's and Prim's algorithms for minimum spanning tree.

Course Outcomes:

After successful completion of course students will be able to:

1. Understand different types of graphs and their applications.
2. Find different types of paths and circuits in the graph.
3. Solve problems related to trees and fundamental circuits.
4. Represent the graphs in different ways.
5. Solve different types of problems related to graphs such as graph coloring, maximum flow and other related problems.

REFERENCES

1. **Deo Narsingh, Graph Theory with Applications to engineering and computer science, Prentice Hall of India, 1992.**
2. **Clark John and Holton D.A., A first Look At Graph Theory, Allied Publishers Ltd., New Delhi,1995.**
3. **Aldous and Wilson, Graphs and Applications: An Introductory Approach, Springer,2000.**
4. **Mott J.L., Kandel A and Baker T.P., . Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall of India,2001.**
6. **Reinhard Diestel, Graph Theory, Springer International Edition..2004**

CODE: PEC-CS-T-601

SUBJECT NAME: ADVANCED ALGORITHMS

NO OF CREDITS: 3

B.TECH 6th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites: Analysis & Design of Algorithms

Course Objectives:

MODULE-1:

Sorting: Review of various sorting algorithms, topological sorting

Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

MODULE-2:

Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.

Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

MODULE-3:

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.

Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

MODULE-4:

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.

Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation, Extension to polynomials, Application: Interpolation problem.

Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring, Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm

MODULE-5:

Linear Programming: Geometry of the feasibility region and Simplex algorithm

NP-completeness: Examples, proof of NP-hardness and NP-completeness.

One or more of the following topics based on time and interest

Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm

MODULE-6:

Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

REFERENCES:

1. **"Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.**
2. **"The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.**
3. **"Algorithm Design" by Kleinberg and Tardos.**

CODE: PEC-CS-T-602

SUBJECT NAME: PARALLEL AND DISTRIBUTED ALGORITHMS

NO OF CREDITS: 3

B.TECH 6th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites: Analysis and Design of Algorithms

Course Objectives:

1. To make the students familiar with Parallel Computation and techniques for parallelization
2. To enable students understand how to reduce the number of processors and calculating cost of communication
3. To give knowledge about parallel search, elementary parallel algorithm, graph algorithm, P- complete classes
4. To enable students understand the concept of Mutual exclusion and Clock Synchronization, Distributed Graph algorithms
5. To make the students understand basics of Cover MPI programming

MODULE-1: THE IDEA OF PARALLELISM

A Parallelised version of the Sieve of Eratosthenes, PRAM Model of Parallel Computation, Pointer Jumping and Divide & Conquer: Useful Techniques for Parallelization

MODULE-2: PRAM ALGORITHMS

Parallel Reduction, Prefix Sums, List Ranking, Preorder Tree Traversal, Merging Two Sorted Lists, Graph Coloring, Reducing the Number of Processors and Brent's Theorem, Dichotomy of Parallel Computing Platforms, Cost of Communication

MODULE-3: PARALLEL COMPLEXITY

The P-Complete Class, Mapping and Scheduling, Elementary Parallel Algorithms, Matrix Multiplication, Sorting, Dictionary Operations: Parallel Search, Graph Algorithms

MODULE-4: DISTRIBUTED ALGORITHMS

Models and complexity measures, Safety, liveness, termination, logical time and event ordering, Global state and snapshot algorithms, Mutual exclusion and Clock Synchronization, Distributed Graph algorithms

MODULE-5: DISTRIBUTED MEMORY PARALLEL PROGRAMMING

Cover MPI programming basics with simple programs and most useful directives; Demonstrate Parallel Monte Carlo

Course Outcomes:

1. The students will be able to understand basics of PRAM Model of Parallel Computation, techniques for parallelization like pointer jumping and Divide and Conquer
2. The students would be able to perform preorder traversal and understand parallel computing platforms and find the cost of communication.
3. The students will be able define elementary parallel algorithms and Dictionary operations
4. The students will be able to measure complexity,
5. The students would be able to demonstrate Parallel Monte Carlo and write simple programs using MPI programming

REFERENCES

1. **Michael J Quinn, Parallel Computing, TMH**
2. **Joseph Jaja, An Introduction to Parallel Algorithms, Addison Wesley**
3. **Mukesh Singhal and Niranjan G. Shivaratri, Advanced Concepts in Operating Systems, TMH**
4. **Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Introduction to Parallel Computing, Pearson**

CODE: PEC-CS-T-701

SUBJECT NAME: QUEUING THEORY AND MODELING

NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites:

Course Objectives:

1. It provides an essential base for mathematical modeling which is normally used to solve the problems of pattern recognition and machine learning.
2. It is used in the research of various science and engineering problem.

MODULE-1:

Introduction to Queues and Queueing Theory, Stochastic Processes, Markov Processes and Markov Chains, Birth-Death Process, Basic Queueing Theory (M/M/-/- Type Queues, Departure Process from M/M/-/- Queue, Time Reversibility, Method of Stages, Queues with Bulk Arrivals, Equilibrium Analysis of the M/G/1 Queue

MODULE-2:

Analyzing the M/G/1 Queue using the Method of Supplementary Variables, M/G/1 Queue with Vacations, M[x] /G/1 Queue, Priority Operation of the M/G/1 Queue, M/M/n/K Queue with Multiple Priorities

MODULE-3:

M/G/1/K Queue, G/M/1, G/G/1 G/G/m, and M/G/m/m Queues, Queueing Networks - Classification and Basic Concepts, Open and Closed Networks of M/M/m Type Queues, Jackson's Theorem

MODULE-4:

Analysis of Closed Queueing Networks using Convolution and Mean Value Algorithms, Norton's Theorem for Closed Queueing Networks, Mixed Queueing Networks, Queueing Network Analyzer (QNA) Approach, Simulation Techniques for Queues and Queuing Networks, Discrete Time Queues.

Course Outcomes:

After undergoing the course, students will be able to

1. develop an understanding to the basic concepts of Queuing theory and type of queues.
2. understand and apply the Queuing theory to Science and Engineering problems and applications.
3. calculate the n-step transition probabilities for any Markov chain and understand about the birth and death of processes.
4. apply Markov chain & Birth Death process to real life problems.
5. develop an understanding of various Queuing Systems.

REFERENCES

1. **Donald Gross, James M. Thompson, John F. Shortle and Carl W. Harris, Fundamentals of Queueing Thoery, Wiley 2008.**
2. **Sanjay K. Bose, An Introduction to Queueing Systems, Springer 2002.**

CODE: PEC-CS-T-702

SUBJECT NAME: GAME THEORY

NO OF CREDITS: 3

B.TECH 7th SEMESTER		SESSIONAL:	25
L T P		THEORY EXAM:	75
3 0 0		TOTAL:	100

Pre-requisites: Mathematics (With applied calculus& Set theory)

Course Objectives:

1. To provide an introduction of game theory which has found wide applications in economics, political science, sociology, engineering apart from disciplines like mathematics and biology
2. To enable the students to choose different types and forms of the games depending upon the need and impact on the performance.
3. To enable the students to explore learning mechanisms in an environment of perfect/incomplete information and to understand the need of repeated game.
4. To enable the students to design mechanisms usinggame theory to understand and analyze real life situations such as market behavior, decentralized network model.

MODULE-1: INTRODUCTION TO GAME THEORY

Games and solutions, Game theory and mechanism design.

MODULE-2: STRATEGIC FORM GAMES

Matrix and continuous games, Iterated strict dominance, Rationalizability, Nash Equilibrium: existence and uniqueness, Mixed and correlated equilibrium, Super-modular games, Potential/congestion games

MODULE-3:LEARNING, EVOLUTION, AND COMPUTATION

Myopic learning: fictitious play, Bayesian learning, evolutionarily stable strategies, Computation of Nash equilibrium in matrix games.

MODULE-4: EXTENSIVE GAMES WITH PERFECT / INCOMPLETE INFORMATION

Backward induction and sub-game perfect equilibrium, Applications in bargaining games, Nash bargaining solution; Mixed and behavioral strategies, Bayesian Nash equilibrium, Applications in auctions, Different auction formats, Revenue and efficiency properties of different auctions.

MODULE-5: REPEATED GAMES

Infinitely/finitely repeated games, Trigger strategies, Folk theorems, Imperfect monitoring and perfect public equilibrium.

MODULE-6: MECHANISM DESIGN

Optimal auctions, revenue-equivalence theorem, Social choice viewpoint. Impossibility results, Revelation principle, Incentive compatibility, VCG mechanisms, Mechanisms in networking, decentralized mechanisms.

Course Outcomes:

After the successful completion of the course, student will be able to:

1. Understand the use of game theory in economics, political science, sociology, engineering apart from disciplines like mathematics and biology.
2. Use different types and forms of the games and choose the type depending upon the need.
3. Apply learning mechanisms in an environment of perfect/incomplete information and understand the need of repeated game.
4. Design mechanisms using game theory to understand and analyze real life situations such as market behaviour, decentralized network model.

REFERENCES

1. **Osborne, M. J., *"An Introduction to Game Theory"*, Oxford University Press, 2004**
2. **Mas-Colell, A., M.D. Whinston and J.R. Green ,*"Microeconomic Theory"*, Oxford University Press, 1995.**
3. **Gibbons, R. ,*"A Primer in Game Theory"*, Pearson Education, 1992.**

CODE: PEC-CS-T-703

SUBJECT NAME: INFORMATION THEORY AND CODING

NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites:

Course Objectives:

1. Students will able to learn concept of information and entropy
2. Understand Shannon's theorem for coding and Huffman coding
3. Students will able to calculate channel capacity
4. Able to apply various coding techniques

MODULE-1:

Basics of information theory, entropy for discrete ensembles; Shannon's noiseless coding theorem; Encoding of discrete sources.

MODULE-2:

Markov sources; Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Application to continuous channels.

MODULE-3:

Techniques of coding and decoding; Huffman codes and uniquely detectable codes; Cyclic codes, Convolutional arithmetic codes.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the concept of information and entropy
2. Understand Shannon's theorem for coding
3. Calculation of channel capacity
4. Apply coding techniques

REFERENCES:

1. **N. Abramson, Information and Coding, McGraw Hill, 1963.**
2. **M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.**
3. **R.B. Ash, Information Theory, Prentice Hall, 1970.**
4. **Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.**

DETAILED 4-YEAR CURRICULUM CONTENTS

Undergraduate Degree in Engineering & Technology

Branch/Course: COMPUTER SCIENCE & ENGG.

PROFESSIONAL ELECTIVE COURSES

STREAM-2

CODE: PEC-CS-S-501

SUBJECT NAME: ADVANCED COMPUTER ARCHITECTURE

NO OF CREDITS: 3

B.TECH 5th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites: Computer Organization and Architecture

Course Objectives:

1. To learn the basic aspects of computer architecture, microprogramming and data representations in different IEEE format.
2. Architectures exploiting instruction-level parallelism (ILP), data-level parallelism (DLP), thread-level and task-level parallelisms are treated. Furthermore, new code generation techniques needed for exploiting ILP will be treated.
3. To understand the memory hierarchy, crosscutting issues in memory hierarchy design, the caches and concept of virtual memory.
4. The student is exposed to the major differences of RISC and CISC architecture and learn the various techniques to improve performance in shared memory multiprocessors.

MODULE-1: INTRODUCTION

Some definition and terms, interpretation and microprogramming. Basic data types, Instructions set (L/S, R/M, R+M architecture), instructions (Classes, mnemonics, conventions), Computer Architectural Classification schemes, Flynn's Classification, System attributes to performance.

MODULE-2: PROGRAM AND NETWORK PROPERTIES

Conditions of parallelism, Data and resource Dependences, Hardware and software parallelism, Program partitioning and scheduling, Grain Size and latency, Program flow mechanisms, Control flow versus data flow, Data flow Architecture, Demand driven mechanisms, Comparisons of flow mechanisms.

Introduction to Data level-parallelism- SIMD and Vector, Introduction to Thread- level parallelism- Symmetric and shared memory architectures, Symbolic processors.

MODULE-3: CACHE MEMORY NOTION

Basic Notion, Cache Organization (direct, associative, set-associative and sectored), Write policies and Strategies for replacement, Introduction to different types of caches- Split I and D-Caches, on chip caches and Two level Caches.

MODULE–4: MEMORY SYSTEM DESIGN

The physical memory; memory module, error detection and correction, memory buffer, partitioning the address space, models of simple memory processor interaction (Hellerman's, Strecker's, Rau's) memory hierarchy Technology: inclusion, coherence and locality; Interleaved memory organization Virtual memory technology: models, TLB, paging and segmentation, memory replacement policies.

Course Outcomes

By the end of the course, a student should be able to:

1. Discuss the organization of computer-based systems and the advanced concepts of computer architecture. The student will be able to expose the major differences of RISC and CISC architecture. Alsoanalyze the L/S, R/M and R+M architectures
2. Evaluate performance of different architectures with respect to various parameters and how a range of design choices are influenced by applications
3. Understand and identify cache and memory related issues in parallel computer systems, including multiprocessor systems.
4. Incorporate parallelism in systems to improve their performance.

REFERENCES:

1. **Advance computer architecture by Kai Hwang , TMH, ed 2001.**
2. **Pipelined and Parallel processor design by Michael J. Fiynn – 1995, Narosa.**
3. **Computer Architecture A Quantitative Approach, John L Hennessey and David A Patterson, Morgan Kaufmann/ Elsevier, Fifth Edition, 2012.**

CODE: PEC-CS-S-601

SUBJECT NAME: SOFTWARE ENGINEERING

NO OF CREDITS: 3

B.TECH 6th SEMESTER				SESSIONAL:	25
L	T	P		THEORY EXAM:	75
3	0	0		TOTAL :	100

Pre-requisites:

Course Objectives:

1. To enable the students to apply a systematic application of scientific knowledge in creating and building cost effective software solutions to business and other types of problems.
2. To make the students understand project management concepts & their metrics.
3. To make the students understand requirement engineering and its models (Information, functional, behavioral).
4. Making the students understand to develop quality software, its maintenance & introduce about software reliability.

MODULE-1: INTRODUCTION

Evolving role of software, Software Characteristics, Software crisis, Silver bullet, Software myths, Software process, Personal Software Process (PSP), Team Software Process (TSP), emergence of software engineering, Software process, project and product, Software Process Models: Waterfall Model, Prototype Model, Spiral, Model ,RAD Model, Iterative Model, Incremental Model, Aspect-oriented Model, Agile Model.

MODULE-2: SOFTWARE PROJECT MANAGEMENT

Project management concepts, Planning the software project, Estimation—LOC based, FP based, Use-case based, empirical estimation COCOMO- A Heuristic estimation techniques, staffing level estimation, team structures, staffing, risk analysis and management.

MODULE-3: REQUIREMENTS, ANALYSIS AND SPECIFICATION

Software Requirements engineering, Requirement engineering process, Requirement Engineering Tasks, Types of requirements, SRS. System modeling: Data Modeling, Functional modeling and information flow: Data flow diagrams, Behavioral Modeling, The mechanics of

structured analysis: Creating entity/ relationship diagram, data flow model, control flow model, the data dictionary.

MODULE-4: SYSTEM DESIGN

Design principles, the design process; Design concepts: Abstraction, refinement, modularity, software architecture, control hierarchy, structural partitioning, data structure, software procedure, information hiding; Effective modular design: Functional independence, Cohesion, Coupling;

MODULE-5: SOFTWARE TESTING AND MAINTENANCE

Testing terminology- error, bug/defect/fault, failure, Verification and validation, Test case design, Static testing ,Dynamic testing--- Black box testing—Boundary value analysis, White box testing-- basis path testing, Unit testing, Integration testing, Acceptance Testing

MODULE-6: SOFTWARE QUALITY MODELS AND STANDARDS

Quality concepts, Software quality assurance, SQA activities, Formal approaches to SQA; Statistical software quality assurance; CMM, The ISO 9126 Standard

Course Outcomes:

The student will be able to

1. Implement Software life cycle models and have a knowledge of different phases of Software life cycle
2. Identify, formulate, review, estimate and schedule complex software projects using principles of mathematics.
3. Create a bug free software with good design and quality by using appropriate techniques and modern engineering and IT tools.
4. Analyze verification, validation activities, static, dynamic testing, debugging tools and techniques and importance of working in teams.

REFERENCES:

1. **Software Engineering – A Practitioner's Approach, Roger S. Pressman, 1996, MGH.**
2. **Fundamentals of software Engineering,Rajib Mall, PHI**
3. **Software Engineering by Ian sommerville, Pearson Edu, 5th edition, 1999, AW,**
4. **Software Engineering – David Gustafson, 2002, T.M.H**
5. **Software Engineering Fundamentals Oxford University, Ali Behforooz and Frederick J. Hudson 1995,JW&S,**
6. **An Integrated Approach to software engineering by Pankaj jalote , 1991 Narosa**

CODE:PEC-CS-S-602(I)

SUBJECT NAME: DISTRIBUTED SYSTEMS

NO OF CREDITS: 3

B.TECH 6th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites: Database Management Systems

Course Objectives:

1. To introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment
2. To provide insight into related research problems.

MODULE-1: INTRODUCTION

Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts. Distributed Database Management System ArchitectureTransparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues/

MODULE-2:DISTRIBUTED DATABASE DESIGN

Alternative design strategies; Distributed design issues; Fragmentation; Data allocation Semantics Data Control : View management; Data security; Semantic Integrity Control

Query Processing Issues**:** Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data

MODULE-3: DISTRIBUTED QUERY OPTIMIZATION

Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms

Transaction Management: The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models

Concurrency Control: Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management

MODULE-4: RELIABILITY

Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols

Course Outcomes:

After completion of course, students would be:

1. Design trends in distributed systems.
2. Apply network virtualization.
3. Apply remote method invocation and objects.

REFERENCES

1. **Principles of Distributed Database Systems, M.T. Ozsu and P. Valduriez, Prentice-Hall, 1991.**
2. **Distributed Database Systems, D. Bell and J. Grimson, Addison-Wesley, 1992.**

CODE: PEC-CS-S-602(II)

SUBJECT NAME: BASICS OF EMBEDDED SYSTEMS

NO OF CREDITS: 3

B.TECH 6th SEMESTER		SESSIONAL:	25
L	T P	THEORY EXAM:	75
3	0 0	TOTAL:	100

Pre-requisites: Microprocessor, Programming Language

Course Objectives:

1. The student will learn about the basic of Emdedded systems.
2. The student will learn about the basic of microprocessor and microcontroller.
3. Able to understand the Fault types and redundancy.

MODULE-1:

What is an embedded system? Categories: Stand-alone, Real-time, Networked appliances, mobile devices. Requirements of Embedded systems, Challenges and issues in Embedded software development. Embedded Software Development Tools: Host and Target machines, Linker/ locators for embedded software, Getting embedded software into target system

MODULE-2:

Timing and clocks in embedded systems; processor Architectures: Harvard V/S Princeton, CISC V/S RISC, Microcontroller's memory types, Microcontroller's features: clocking, I/O pins, interrupts, timers, peripherals,

MODULE-3:

Task Modeling and management, saving memory space. Real time operating system issues, Recent Trends in Embedded Processors, Operating System and Development programming Languages.

MODULE-4:

Fault-Tolerance, Formal verification, Redundancy: Hardware, software and time redundancy.

Course Outcomes:

1. The students will be able to understand the basics of embedded systems and familiar with the issues and challenges in the embedded system design.

2. The students will be able to familiar with the host and target machine and able to transfer the software to target machine.
3. Understand the recent trend for Embedded system development and operating system.
4. Able to apply thefault tolerance technique for real time embedded systems.

REFERENCES

1. **Programming for Embedded systems by Dreamtech software team, Wiley Dreamtech India Pvt. Ltd.**
2. **Embedded Realtime systems programming, by Sriram V. Iyer and Pankaj Gupta, TMH**
3. **Emdedded software primer by Davis E. Simen, TMH**
4. **Embeddes System Architecture by RAJ Kamal**

CODE: PEC-CS-S-701(I)

SUBJECT NAME: ADVANCED OPERATING SYSTEMS

NO OF CREDITS: 3

B.TECH 7th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Pre-requisites: Operating Systems

Course Objectives:

1. To learn the fundamentals of different types of Operating Systems.
2. To learn the mechanisms to handle processes scheduling, synchronization and memory management in Distributed OS.
3. To understand the system architecture of Multiprocessor OS and learn the mechanisms to handle processes scheduling, synchronization, memory management and fault tolerance in Multiprocessor OS.
4. To understand the characteristics and system architecture of Real-Time OS and learn the mechanisms of processes scheduling, real-time OS protocols and Case studies.
5. To learn the mechanisms to design fast OS with proper resource utilization.

MODULE-1: INTRODUCTION

Introduction of Operating Systems, Evolution of OS, Types of OS: Batch OS, single user & Multi-user OS, Multiprogramming and Multi-tasking, Multi-threading, Time-sharing, Embedded OS, Distributed Operating Systems, Multi-processor Operating Systems, Real-time Operating Systems, Mobile Operating Systems

MODULE-2: DISTRIBUTED OPERATING SYSTEMS

Introduction, Characteristics, Network OS & Distributed OS, Various issues, Communication in Distributed Systems, Clock Synchronization, Mutual Exclusion Algorithms, Deadlock Detection and Prevention, Distributed Process Scheduling Algorithms, Distributed File Systems.

MODULE-3: MULTI-PROCESSOR OPERATING SYSTEMS

Introduction, System Architecture, Structure of Multi-processor OS, Process Synchronization, Processor Scheduling Algorithms, Memory Sharing, Process Migration, Fault Tolerance

MODULE-4: REAL-TIME OPERATING SYSTEMS

Introduction, Characteristics, Structure of a Real-time System, Scheduling Algorithms, Mutual Exclusion, Priority Inheritance Protocol, Priority Ceiling Protocol, Case Studies

MODULE-5: MOBILE OPERATING SYSTEMS

Introduction, Mobile Devices, Characteristics of Mobile Devices, Resource management in Mobile OS: Power Management, Battery Management, Thermal Management, Memory Management, Scheduling, File System, Security, Android OS.

Course Outcomes:

After the successful completion of the course students will be able to:

1. Understand the characteristics of different OS.
2. Develop algorithms for process scheduling, synchronization for different OS.
3. For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time for different OS.
4. Design and implement file management system for different OS.
5. Design and implement security policies in OS.

REFERENCES

1. **Mukesh Singhal, Niranjan G. Shivaratri, "*Advanced Concepts In Operating Systems*",Tata McGraw-Hill Education; 2nd edition, [ISBN: 007057572X], 2001.**
2. **Andrew S. Tanenbaum, Herbert Bos,"*Modern Operating Systems*",Pearson Prentice Hail™; 4th edition, [ISBN: 9781292061429],2014.**
3. **D. M. Dhamdhere," *Operating Systems*",Tata McGraw Hill; 1st edition, [ISBN: 9781282187245],2006.**

CODE: PEC-CS-S-701(II)

SUBJECT NAME: REAL TIME SYSTEMS

NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites: Operating System

Course Objectives:

1. The student will learn abort the basic of real time system.
2. The student will learn abort the basic of embedded system.
3. Able to understand the RTOS and scheduling techniques.
4. The student will able to understand the Fault tolerance techniques.

MODULE-1: EMBEDDED SYSTEMS

What is an embedded system? Categories: Stand-alone, Real-time, Networked appliances, mobile devices. Requirements of Embedded systems, Challenges and issues in Embedded software development. Embedded Software Development Tools: Host and Target machines, Linker/ locators for embedded software, Getting embedded software into target system.

MODULE-2: REAL TIME SYSTEMS

Definition, characteristics, classification, release times, deadlines and timing constraints, temporal parameters of real-time workload, periodic task model, issues involved in real time system design.

MODULE-3: REAL TIME OPERATING SYSTEMS

Typical structure of an RTOS, Scheduling strategies, priority structures, task management, memory management, code sharing, task co-operation and communication, interrupt routines in an RTOS environment, mutual exclusion, Liveness, Minimum operating system Kernel, Capabilities of commercially available real time operating systems like VXworks Micro C OS2 etc.

MODULE-4:TASK ASSIGNMENT AND SCHEDULING

Allocation / Scheduling problem, offline scheduling, online scheduling, pre-emptive / non-pre-emptive scheduling, static / dynamic scheduling, Rate-monotonic scheduling algorithm, problem

of priority inversion, priority inheritance protocol, priority ceiling protocol, earliest-deadline-first scheduling algorithm.

MODULE-5: FAULT TOLERANCE TECHNIQUES & REAL TIME LANGUAGES

Fault types, fault detection measures, fault detection mechanisms, fault and error containment, Redundancy: Hardware and software redundancy, time redundancy, Desirable characteristics of Real time languages.

Course Outcomes:

1. The students will be able to understand the basics of real time systems and familiar withthe issues and challenges in the embedded system design.
2. The students will be able to familiar with the host and target machine and understand therelease time, deadline and timing constraints with issues involved in real time system design.
3. Understand the structure of RTOS its properties together with task management with multi-task scheduling algorithms
4. Able to familiar with the fault types and error containment zone with the concepts of hardware and software redundancy.

REFERENCES:

1. **Programming for Embedded systems by Dreamtech software team, Wiley Dreamtech India Pvt. Ltd.**
2. **Embedded Realtime systems programming, by Sriram V. Iyer and Pankaj Gupta, TMH**
3. **Realtime computer control by Stuart Bennett, Pearson Education**
4. **Real time systems by C. M. Krishna, McGraw-Hill**

CODE: PEC-CS-S-702

SUBJECT NAME: AD-HOC AND SENSOR NETWORKS

NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites: Computer Networks

Course Objectives:

1. To make the students familiar with the basics of adhoc and wireless network along with the difference between the two.
2. To make the student understand the concept of routing and different strategies/protocols available for efficient routing in adhoc network.
3. To make the student aware about the quality of service in adhoc& wireless network.
4. To make the student understand the need, limitations of secured routing in ad hoc networks and wireless networks.

MODULE-1:

Introduction: Wireless Networks, Infrastructure and Infrastructure less Wireless Networks, Ad hoc Wireless Networks, Heterogeneity in Mobile Devices, Types of Adhoc Mobile Communications,

MANET & WSN: Concepts & architecture of MANET & WSN, Applications & Design Challenges of Adhoc& Sensor Networks.

MODULE-2:

Routing Protocols in MANET : Destination Sequenced Distance Vector (DSDV), Wireless Routing Protocol (WRP), Cluster Switch Gateway Routing (CSGR) Ad hoc On–Demand Distance Vector Routing (AODV) , Dynamic Source Routing (DSR) ,Temporally Ordered Routing Algorithm (TORA) , Signal Stability Routing (SSR) , Location–Aided Routing (LAR)

Hybrid Routing Protocol: Zone Routing Protocol (ZRP).

QoS in Ad-hoc Networks: Introduction to QoS, Issues and Challenges in Providing QoS in Ad hoc Wireless Networks , classifications of QoS Solutions , Network Layer Solutions (Ticket

Based QoS Routing, Predictive Location Based QoS Routing, QAODV) , QoS Frameworks for Ad hoc Wireless Networks (IntServ, DiffServ, FQMM, INSIGNIA,INORA)

MODULE-3:

Wireless Sensor Networks (WSN): Protocol Stack of WSN, Origin ,need and Enabling Technologies for WSN, WSN Middleware Principles, Middleware Architecture, Existing Middleware (Milan, IrisNET,CLMF,MLM),Operating systems Design Issues

MAC Protocols : Challenges for MAC, Classification of MAC Protocols , Contention free and Contection Based MAC Protocols.

MODULE-4:

WSN Routing, Localization &QoS : Challenges for Routing,Classification of Protocols, Data–Centric and Flat Architecture Protocols (Flooding,Gossiping,SPIN) Heirarchical protocols (LEACH,PEGASIS,TEEN,APTEEN), Location Based(Unicast, Multicast, GeoCast) and QoS based(Sequential Assignment,SPEED) Routing Protocols.

Security in WSN: Challenges of Security in WSN, Security Attacks in WSN, Protocols and Mechanisms for Security, IEEE 802.15.4 and ZigBee Security

Course Outcomes:

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

1. Describe the concept of ad-hoc network and differentiate between infrastructure based and infrastructure less networks.
2. Comprehending different categories of ad-hoc and wireless sensor network protocols available for efficient routing.
3. Understand the importance of QoS in communication and various routing protocols proposed for QoS achievement in mobile adhoc network. ClassifyQoS Parameter in adhoc environment and design routing algorithms for adhoc network using them.
4. Classification of Routing protocols for WSN.
5. Identify the need of security in WSN along with the understanding of different types of attacks and available protocols..

REFERENCES

1. **C. Siva Ram Murthy and B. S. Manoj, "Ad *Hoc Wireless Networks Architectures and Protocols*", Prentice Hall, PTR, 2004.**
2. **C. K. Toh, "*Ad Hoc Mobile Wireless Networks Protocols and Systems*", Prentice Hall, PTR, 2001.**
3. **Charles E. Perkins, "*Ad Hoc Networking*", Addison Wesley, 2000**
4. **Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003, ISBN : 0-470-86736-1**

5. **Holger Karl & Andreas Willig, " Protocols And Architectures for Wireless SensorNetworks" , John Wiley, 2005, ISBN : 0-470-09510-5.**
6. **Ian F. Akyildiz and Mehmet Can Varun ” Wireless Sensor Networks” John Wiley ISBN 978-0- 470-03601-3.**
7. **Kazem Sohraby, Daniel Minoli, &TaiebZnati, “Wireless Sensor Networks-Technology, Protocols, And Applications”, John Wiley, 2007, ISBN :978-0-471-74300-2**

CODE: PEC-CS-S-703

SUBJECT NAME: INTERNET OF THINGS

NO OF CREDITS: 3

B.TECH 7th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Pre-requisites: Internet and web Technology, Computer Networks

Course Objectives:

1. Student will be able to learn the basics of IOT.
2. Student will be able to analyse basic protocols of wireless and MAC.
3. Students will get familiar with web of things.
4. Students will get basic knowledge of resource management.

MODULE-1: INTRODUCTION TO IoT

Introduction to IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs ,IoT & M2M Machine to Machine, Difference between IoT and M2M, Software define Network, Challenges in IoT(Design ,Development, Security).

MODULE-2: NETWORK AND COMMUNICATION ASPECTS

Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination.

MODULE-3: WEB OF THINGS

Web of Things vs Internet of things, two pillars of web, Architecture and standardization of IoT, Unified multitier-WoT architecture, WoT portals and Business intelligence, Cloud of things: Grid/SOA and cloud computing, Cloud middleware, cloud standards

MODULE-4: RESOURCE MANAGEMENT IN IOT

Domain specific applications of IoT, Home automation, Industry applications, Surveillance applications, Other IoT applications Clustering, Synchronization, Software agents.

Course Outcomes:

On successful completion of the course, the student will:

1. Understand the concepts of Internet of Things
2. Analyze basic protocols network
3. Understand the concepts of Web of Things along with its architecture and will be able to differentiate WoT from IoT.
4. Design IoT applications in different domain and be able to analyze their performance.

REFERENCES:

1. **Vijay Madisetti, ArshdeepBahga, "Internet of Things: A Hands-On Approach"**
2. **WaltenegusDargie,ChristianPoellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"**

DETAILED 4-YEAR CURRICULUM CONTENTS

Undergraduate Degree in Engineering & Technology

Branch/Course: COMPUTER SCIENCE & ENGG.

PROFESSIONAL ELECTIVE COURSES

STREAM-3

CODE: PEC-CS-D-501 (I)

SUBJECT NAME: BASICS OF MACHINE LEARNING

NO OF CREDITS: 3

B.TECH 5th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Pre-requisites: Internet and web Technology, Computer Networks
Course objectives:

1. To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
2. To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
3. Explore supervised and unsupervised learning paradigms of machine learning.
4. To explore Deep learning technique and various feature extraction strategies.

MODULE-1: SUPERVISED LEARNING (REGRESSION/CLASSIFICATION)

Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes Linear models: Linear Regression, Logistic Regression, Generalized Linear Models

Support Vector Machines, Nonlinearity and Kernel Methods

Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

MODULE-2: UNSUPERVISED LEARNING

Clustering: K-means/Kernel K-means
Dimensionality Reduction: PCA and kernel PCA
Matrix Factorization and Matrix Completion
Generative Models (mixture models and latent factor models)

MODULE-3:

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

MODULE-4:

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

MODULE-5:

Scalable Machine Learning (Online and Distributed Learning), Introduction to Bayesian Learning and Inference, Recent trends in various learning techniques of machine learning and classification methods.

Course outcomes:

After completion of course, students would be able to:

1. Extract features that can be used for a particular machine learning approach in various IOT applications.
2. To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
3. To mathematically analyse various machine learning approaches and paradigms.

REFERENCES:

1. **Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012**
2. **Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)**
3. **Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007**

CODE: PCC-CS-501 (II)

SUBJECT NAME: INTELLIGENT SYSTEMS

NO OF CREDITS: 3

B.TECH 6th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Pre-requisites: Basics of Data Structures and Mathematics

Course Objectives:

The aim of the course is to introduce to the field of Artificial Intelligence (AI) with emphasis on its use to solve real world problems for which solutions are difficult to express using the traditional algorithmic approach. It explores the essential theory behind methodologies for developing systems that demonstrate intelligent behaviour including dealing with uncertainty, learning from experience and following problem solving strategies found in nature.

MODULE-1:

Biological foundations to intelligent systems I: Artificial neural networks, Backpropagation networks, Radial basis function networks, and recurrent networks.

MODULE-2:

Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks.

MODULE-3:

Search Methods Basic concepts of graph and tree search. Three simple search methods: breadth-first search, depth-first search, iterative deepening search. Heuristic search methods: best-first search, admissible evaluation functions, hill climbing search. Optimisation and search such as stochastic annealing and genetic algorithm.

MODULE-4:

Knowledge representation and logical inference Issues in knowledge representation. Structured representation, such as frames, and scripts, semantic networks and conceptual graphs. Formal logic and logical inference, Knowledge-based systems structures, its basic components. Ideas of Blackboard architectures.

MODULE-5:

Reasoning under uncertainty and Learning Techniques on uncertainty reasoning such as Bayesian reasoning, Certainty factors and Dempster-Shafer Theory of Evidential reasoning, A study of different learning and evolutionary algorithms, such as statistical learning and induction learning.

Course Outcomes:

1. Able to Demonstrate knowledge of the fundamental principles of intelligent systems
2. able to analyse and compare the relative merits of a variety of AI problem solving techniques

REFERENCES:

1. **Luger G.F. and Stubblefield W.A. (2008). Artificial Intelligence: Structures and strategies for Complex Problem Solving. Addison Wesley, 6th edition.**
2. **Russell S. and Norvig P. (2009). Artificial Intelligence: A Modern Approach. Prentice-Hall, 3rd edition.**

CODE: PEC-CS-D-601

SUBJECT NAME: DATA MINING

NO OF CREDITS: 3

B.TECH 6th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Pre-requisites: Database Management System

Course Objectives:

1. To familiarize the students with the basic roadmap of data mining and various data mining techniques.
2. To introduce the techniques of frequent pattern mining and Clustering
3. To acquaint students with classification and prediction techniques in data mining.
4. To introduce students with time series data and data streams
5. To introduce various advance mining applications areas like web mining, social network analysis etc.

MODULE-1: INTRODUCTION

Introduction to Data Warehousing, Architecture, Data warehouse schemas, OLAP operations, KDD process, Data Mining: Predictive and Descriptive models, Data Mining primitives and Applications

MODULE-2: FREQUENT PATTERN MINING AND CLUSTERING

Mining frequent patterns, association and correlations; Association Rule Mining, Sequential Pattern Mining concepts, Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns,

MODULE-3: CLASSIFICATION AND PREDICTION

Classification by Decision tree induction, Bayesian classification, Rule based classification, backpropagation through Neural Networks, Genetic Algorithm, Support Vector Machines, Prediction: linear and non-linear regression techniques.

MODULE-4: MINING TIME SERIES DATA AND DATA STREAMS

Mining Time series Data, Periodicity Analysis for time related sequence data, Similarity search in Time-series analysis; Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Classification of dynamic data streams.

MODULE-5: ADVANCED MINING APPLICATIONS

Web Mining, Web page layout structure; mining web link structure, content and usage patterns; Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis

Course Outcomes:

1. The students will be able to understand basic concepts of data warehouse and data mining, techniques and applications
2. The students will be able to understand the techniques to extract patterns from transactional database using Association and Apriori algorithms
3. The students will be able to understand different clustering techniques and will be able to cluster data sets
4. The students will be able to classify data set into different classes and acquire the knowledge to make predications based on classified data
5. The students will be able to understand and analyze time series data
6. The students will be able to understand types of web mining viz. content, structure and usage mining.Web content mining in detail.
7. The students can extend the Graph mining algorithms to Web mining
8. Students will understand advance applications of data mining

REFERENCES

1. **Jiawei Han and M Kamber, Data Mining Concepts and Techniques,, Second Edition, Elsevier Publication, 2011.**
2. **Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Addison Wesley, 2006. 3. G Dong and J Pei, Sequence Data Mining, Springer**, 2007.

CODE: PEC-CS-D-602

SUBJECT NAME: SOFT COMPUTING

NO OF CREDITS: 3

B.TECH 6th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Pre-requisites: Basics knowledge of Mathematics and Computer Science.

Course Objectives:

1. To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
2. To implement soft computing based solutions for real-world problems.
3. To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.
4. To provide students a hand-on experience on MATLAB to implement various strategies.

MODULE-1: INTRODUCTION TO SOFT COMPUTING

Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics

MODULE-2: FUZZY LOGIC: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

MODULE-3: NEURAL NETWORKS: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks

MODULE-4: GENETIC ALGORITHMS: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning : Machine Learning Approach to Knowledge Acquisition.

MODULE-5: MATLAB

Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic

Course Outcomes:

After completion of course, students would be able to:

1. Identify and describe soft computing techniques and their roles in building intelligent Machines.
2. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
3. Apply genetic algorithms to combinatorial optimization problems.
4. Evaluate and compare solutions by various soft computing approaches for a given problem.

REFERENCES

1. **George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", PHI**
2. **Satish Kumar, "Neural Networks: A classroom approach" Tata McGraw Hill.**
3. **Haykin S., "Neural Networks-A Comprehensive Foundations", PHI**
4. **Anderson J.A., "An Introduction to Neural Networks", PHI**
5. **M.Ganesh, "Introduction to Fuzzy sets and Fuzzy Logic" PHI.**
6. **N P Padhy and S P Simon, " Soft Computing with MATLAB Programming", Oxford University Press**

CODE: PEC-CS-D-701

SUBJECT NAME: SPEECH AND NATURAL LANGUAGE PROCESSING

NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites:

Course Objectives:

1. To make the students familiar with difference levels/stages of natural language processing and to introduce concept of Formal languages and grammars: Chomsky hierarchy and problems associated (like Left-Associative grammars, ambiguous grammars) with them.
2. To introduce the students with Morphology and Part of Speech Tagging by taking examples from Hindi, English.
3. To introduce the top down and the bottom up parsing approaches and their respective types of parsers.
4. To make the students familiar with grammar types like ATN & RTN.
5. To make the students familiar with the basic techniques of parsing like CKY, Earley& Tomita's algorithms and role Hidden Markov Model in NLP
6. To make the students familiar with Semantics-knowledge and its utilization.

MODULE-1: AUTOMATIC SPEECG RECOGNITION

Introduction to Automatic Speech Recognition (ASR), Components in ASR, Challenges in ASR, Issues in ASR based Application development.

MODULE-2: COMPONENTS OF NATURAL LANGUAGE PROCESSING

Lexicography, syntax, semantics, pragmatics: word level representation of natural languages prosody& natural languages.

MODULE-3 FORMAL LANGUAGES AND GRAMMARS

Chomsky hierarchy, Left-Associative grammars, ambiguous grammars, resolution of ambiguities. Introduction of top down and bottom up parsers.

MODULE-4: COMPUTATION LINGUISTICS:

Morphology of natural languages like Hindi, English etc.,Part of Speech Tagging (POS), recognition and parsing of natural language structures: ATN & RTN, General techniques of parsing: CKY, Earley& Tomita's algorithms. Introduction to Hidden Markov Model (HMM)

MODULE-5: SEMANTICS-KNOWLEDGE REPRESENTATION

Semantic networks logic and inference pragmatics, graph models and optimization, Prolog for natural language semantic (e.g. DCG).

MODULE-6: APPLICATION OF NLP: INTELLIGENT WORK PROCESSORS

Machine translation, user interfaces, Man-Machine interfaces, natural language querying, tutoring and authoring systems, speech recognition, commercial use of NLP.

Course outcomes:

Upon successful completion of the course, the student will be able to understand:

1. Difference levels/stages of natural language processing and the concept of Formal languages and grammars: Chomsky hierarchy and problems associated (like Left Associative grammars, ambiguous grammars) with them.
2. The top down and the bottom up parsing approaches and their respective types of parsers like CKY, Earley& Tomita's.
3. The Hidden Markov Model and its application in NLP.
4. The student will be able to write small ATN & RTN grammars for simple English sentences.
5. The student will be able to do Morphology of words from natural languages like Hindi, English and Semantics-knowledge and its important to understand the documents.

REFERENCES

1. **"Natural Language Understanding" James Allen, -1995Benjamin/cummings Pub. Comp. Ltd**
2. **"Language as a cognitive process", Terry Winograd 1983, AW**
3. **"Natural Language processing in prolog", G. Gazder, 1989, Addison Wesley.**
4. **" Introduction of Formal Language Theory", MdljArbib&Kfaury, 1988, Springer Verlog.**

CODE: PEC-CS-D-702(I)

SUBJECT NAME: DATA ANALYTICS

NO OF CREDITS: 3

B.TECH 7th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Pre-requisites:High-school level linear algebra, and calculus, Knowledge of probability theory, statistics, and programming

Course Objectives:

1. to get the students familiar about the Concepts of Descriptive and Inferential Statics through tests
2. to study the concepts of ANOVA and Machine learning
3. to study in detail Supervised Learning and Classification techniques
4. to study the basic and advanced concepts of Unsupervised Learning and Challenges for Big Data Analytics

MODULE-1: DESCRIPTIVE STATISTICS & INFERENTIAL STATISTICS

Introduction to the course Descriptive Statistics Probability Distributions Inferential Statistics through hypothesis tests Permutation & Randomization Test

MODULE-2: REGRESSION & MACHINE LEARNING

Regression and ANOVA Regression ANOVA (Analysis of Variance)
Machine Learning: Introduction and Concepts Differentiating algorithmic and model based frameworks Regression: Ordinary Least Squares, Ridge Regression, Lasso Regression, K Nearest Neighbours, Regression & Classification

MODULE-3:SUPERVISED LEARNING WITH REGRESSION AND CLASSIFICATION TECHNIQUES

Bias-Variance Dichotomy, Model Validation Approaches Logistic Regression, Linear Discriminant Analysis Quadratic Discriminant Analysis Regression and Classification Trees Support Vector Machines, Ensemble Methods: Random Forest, Neural Networks Deep learning

MODULE-4:UNSUPERVISED LEARNING AND CHALLENGES FOR BIG DATA ANALYTICS

Clustering Associative Rule Mining Challenges for big data analytics, Creating data for analytics through designed experiments Creating data for analytics through Active learning Creating data for analytics through Reinforcement learning

Course Outcomes:

After completion of the course:

1. Students will be able to understand the statistical analysis methods.
2. Students will be able to understand the concepts of Regression and Machine Learning
3. Students will be able to Compare and contrast Supervised and Unsupervised learning
4. Students will be able to understand the major challenges related to Big Data Analytics

REFERENCES

1. **Hastie, Trevor, et al. The elements of statistical learning. Vol. 2. No. 1. New York: springer, 2009.**
2. **Montgomery, Douglas C., and George C. Runger. Applied statistics and probability for engineers. John Wiley & Sons, 2010.**
3. **Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.**
4. **Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.**

CODE: PEC-CS-D-702(II)

SUBJECT NAME: INFORMATION RETRIEVAL

NO OF CREDITS:3

B.TECH 7th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Pre-requisites:

Course Objectives:

1. To build an understanding of the fundamental concepts of Information Retrieval
2. To understand the elements of Web Search Engines and Crawlers
3. To familiarize students with the basic taxonomy and terminology of Indices and to understand Heap's Law for estimation and Zipf's law for modeling distribution of terms
4. To understand dictionary compression and posting list compression and to introduce the scoring ,tf-idf weighting and vector space model for scoring

MODULE-1: INTRODUCTION TO INFORMATION RETRIEVAL

Information retrieval problem, an inverted index, Processing Boolean queries, The extended Boolean model versus ranked retrieval, an inverted index, Bi-word indexes, Positional indexes, Combination schemes

MODULE-2: SEARCH ENGINES

Basic Building Blocks and Architecture, Text Acquisition, Text Transformation, Index Creation, User Interaction, Ranking, Evaluation.

MODULE-3: CRAWL SAND FEEDS

Crawling the Web, Retrieving Web Pages, The Web Crawler, Freshness, Focused Crawling, Deep Web, Crawling Documents and Email, Storing the Documents, Detecting Duplicates

MODULE-4: INDEX CONSTRUCTION AND COMPRESSION

Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, Dynamic indexing

Index compression: Statistical properties of terms in information retrieval, Heaps' law: Estimating the number of terms, Zipf's law: Modeling the distribution of terms, Dictionary compression, Dictionary as a string, Blocked storage, Postings file compression

MODULE-5: SCORING, TERM WEIGHTING AND THE VECTOR SPACE MODEL

Parametric and zone indexes, Weighted zone scoring, Learning weights, The optimal weight, Term frequency and weighting, Inverse document frequency, Tf-idf weighting, The vector space model for scoring , Computing scores in a complete search system.

Course Outcomes:

After completion of the course, students will be able to:

1. Understand basic Information Retrieval Systems and learn how Boolean queries are processed.
2. understand the basic concept of Search Engines their architecture and its various functional components and understand the basic concept of Web crawlers and their architecture
3. identify the different types of indices: inverted index, positional index, bi-word index and be able make estimations and model distribution of terms and compressions
4. enumerate various types of indices and also understand the concept of efficient storage of indices and learn tf-idf scoring and vector space model scoring for ranking

REFERENCES

1. **C.D.Manning, P. Raghavan and H.Schutze Introduction to Information Retrieval, Cambridge University Press, 2008 (available at http://nlp.stanford.edu/IR-book).**
2. **B.Croft, D.Metzler, T.Strohman, Search Engines : Information Retrieval in Practice, AddisionWesley, 2009 (available at http://ciir.cs.umass.edu/irbook/).**

CODE: PEC-CS-D-703

SUBJECT NAME: NEURAL NETWORKS AND DEEP LEARNING

NO OF CREDITS: 3

B.TECH 7th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Pre-requisites**:** Basics knowledge of Mathematics and Algorithms.

Course Objectives:

1. To introduce neural networks concepts and associated techniques
2. To design appropriate neural network based technique for a given scenario.
3. To introduce the concept of associative memories and their capabilities in pattern completion and repair.
4. To introduce the unsupervised learning self organizing maps

MODULE-1: INTRODUCTION TO NEURAL NETWORKS

Artificial neurons, Neural networks and architectures, Feedforward and feedback architectures, Learning types-supervised, unsupervised and reinforced, learning mechanisms-Gradient Descent, Boltzmann, and Hebbian, Single Perceptron as classifier, Multi-layer perceptron model. .

MODULE-2: RECURRENT NETWORKS

Attractor Neural Networks, Associative learning and Memory Model, Discrete Hopfield Network, Condition for Perfect Recall in Associative Memory, Bi-direction Associative memories (BAM)-Auto and Hetro-association, Boltzmann machine, Introduction to Adaptive Resonance Networks.

MODULE-3: FEED FORWARD NETWORKS

Gradient Descent and Least Mean Squares Algorithm, Back Propagation Algorithms, Multi-Class Classification Using Multi-layered Perceptrons., Support Vector Machine (SVM), Radial Basis Function Networks: Cover's Theorem, Learning Mechanisms in RBF.

MODULE-4: PRINCIPAL COMPONENTS AND ANALYSIS

Introduction to PCA, Dimensionality reduction Using PCA, Hebbian-Based Principal Component Analysis, Introduction to Self OrganizingMaps : Cooperative and Adaptive Processes in SOM, and Vector-Quantization Using SOM.

Course Outcomes:

After successful completion of the course, the students will be able to:

1. Use neural networks concepts and associated techniques for solving classification and regression problems.
2. Design and Use neural networks for pattern recall, completion and repair.
3. Design and Use neural networks for self learning and unsupervised classifications.
4. Choose the appropriate classifier.

REFERENCES:

1. **Haykin S., *"Neural Networks-A Comprehensive Foundations"*, Prentice-Hall International, New Jersey, 1999.**
2. **Anderson J.A., *"An Introduction to Neural Networks"*, PHI, 1999.**
3. **Satish Kumar, *"Neural Networks: A Classroom Approach"***
4. **Hertz J, Krogh A, R.G. Palmer, *"Introduction to the Theory of Neural Computation"*, Addison-Wesley, California, 1991.**

DETAILED 4-YEAR CURRICULUM CONTENTS

Undergraduate Degree in Engineering & Technology

Branch/Course: COMPUTER SCIENCE & ENGG.

PROFESSIONAL ELECTIVE COURSES

STREAM-4

CODE: PEC-CS-A-501

SUBJECT NAME: IMAGE PROCESSING

NO OF CREDITS: 3

B.TECH 5th SEMESTER		SESSIONAL:	25
L T P		THEORY EXAM:	75
3 0 0		TOTAL :	100

Pre-requisites:

Course Objectives:

To learn and understand the fundamentals of digital image processing, and various image Transforms, Image Enhancement Techniques, Image restoration Techniques and methods, image compression and Segmentation used in digital image processing.

MODULE-1: DIGITAL IMAGE FUNDAMENTALS

Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

MODULE-2: IMAGE ENHANCEMENTS AND FILTERING

Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

MODULE-3: COLOR IMAGE PROCESSING

Color models–RGB, YUV, HSI; Color transformations– formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

MODULE-4: IMAGE SEGMENTATION

Detection of discontinuities, edge linking and boundary detection, thresholding – global and adaptive, region-based segmentation. Wavelets and Multi-resolution image processing-Uncertainty principles of Fourier Transform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Sub band filter banks, wavelet packets.

MODULE-5: IMAGE COMPRESSION

Redundancy–inter-pixel and psycho-visual; Loss less compression – predictive, entropy; Lossy compression- predictive and transform coding; Discrete Cosine Transform; Still image compression standards – JPEG and JPEG-2000.

Course Outcomes

At the end of the course, students will demonstrate the ability to:

1. Mathematically represent the various types of images and analyze them.
2. Process these images for the enhancement of certain properties or for optimized use of the resources.
3. Develop algorithms for image compression and coding

REFERENCES

1. **R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008**
2. **Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004**
3. **Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015**

CODE: ELPE613

SUBJECT NAME: DIGITAL SIGNAL PROCESSING

NO OF CREDITS: 3

B.TECH6th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

MODULE-1: DISCRETE-TIME SIGNALS AND SYSTEMS

Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Samplingand reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.

MODULE-2: Z-TRANSFORM

z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.

MODULE-3: DISCRETE FOURIER TRANSFORM

Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Connvolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

MODULE-4: DESIGNOF DIGITAL FILTERS

Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Bandstop and High-pass filters. Effect of finite register length in FIR filter design; Parametric and non-parametric spectral estimation; Introduction to multi-rate signal processing.

MODULE-5: APPLICATIONS OF DIGITAL SIGNAL PROCESSING

Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

1. Represent signals mathematically in continuous and discrete-time, and in the frequency domain.
2. Analyse discrete-time systems using z-transform.

3. Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms.
4. Design digital filters for various applications.
5. Apply digital signal processing for the analysis of real-life signals.

REFERENCES:

1. **S. K. Mitra, "Digital Signal Processing: A computer based approach", McGraw Hill, 2011.**
2. **A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall, 1989.**
3. **J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms And Applications", Prentice Hall, 1997.**
4. **L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall, 1992.**
5. **J. R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall, 1992.**

a. **D. J. DeFatta, J. G. Lucas andW. S. Hodgkiss, "Digital Signal Processing", John Wiley & Sons, 1988.**

CODE: PEC-CS-A-602

SUBJECT NAME: COMPUTER GRAPHICS

NO OF CREDITS: 3

B.TECH 6th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites: Problem Solving and Programming

Course Objectives:

1. Understand the basics of computer graphics, different graphics systems and applications of computer graphics.
2. Learn the various algorithms for scan conversion and filling of basic objects and their comparative analysis. To improve the object appearance by filling relevant parts of the area.
3. Learning to use composite geometric transformations on graphical objects in 2D and 3D.
4. Understand the techniques for improving the object appearance with the help of clipping objects outside the view. Explore projections for display of 3D scene on 2D screen.
5. Study different techniques that help to remove the surfaces outside the view of user by understanding the concept of rendering.

MODULE-1: INTRODUCTION TO COMUTERGRAPHICS

Computer Graphics and Its Types, Application of computer graphics, Refresh CRT, Flat Panel displays, Raster Scan Systems, Random Scan Systems, shadow-mask method, beam-penetration method, color models- RGB, CMY, setting the color attributes of pixels.

MODULE-2: SCAN-CONVERSION

Output Primitives- Points, Lines, Circle, polygons; Attributes of Output Primitives: Line Attributes, Color and Grayscale Levels, Area fill Attributes, Character Attributes, Bundled Attributes; Scan–converting Lines- DDA line drawing algorithm, Bresenhams line drawing algorithm;

Scan-Converting Circles- parametric, trigonometric ,Brsenham's circle drawing algorithm; Scan–converting polygon; Region Filling-Boundary fill and Flood fill algorithm , Anti-aliasing Techniques.

MODULE-3: TRANSFORMATIONS

Two-dimensional Geometric Transformations:Basic Transformations, Matrix Representation and Homogeneous Coordinates, Composite Transformations, Reflection and Shearing; Two-Dimension Viewing : The viewing Pipeline, Window to viewport coordinate transformation ; Three-Dimensional Transformations.

MODULE-4: PROJECTION AND CLIPPING

Three dimensional Viewing Pipeline , Mathematics of projection- Taxonomy of projection, Perspective and parallel Projection; Clipping-Point Clipping, Line Clipping- Cohen-Sutherland Algorithm (4-bit code), polygon Clipping- Sutherland Hodgman Algorithm

MODULE-5: HIDDEN SURFACES

Image-space and Object-Space Method, Coherence and its types, Depth Comparison, Z-buffer (Depth Buffer), Area-subdivision

Course Outcomes:

Students completing this course are expected to be able to:

1. Understand the basics of computer graphics, different graphics systems and applications of computer graphics.
2. Implement the various algorithms for scan conversion and filling of basic objects and their comparative analysis.
3. Apply geometric transformations on graphics objects and their application in composite form in 2D and 3D.
4. Apply projection techniques for improving the object appearance from 3-D scene to 2-D Scene and remove the area of objects that lie outside the viewing window.
5. Apply different hidden surface removal algorithms to eliminate the surface outside the view world.

REFERENCES

1. **Foley & Van Dam : Fundamentals of Interactive Computer Graphics, Addison-Wesley.**
2. **Plastock : Theory & Problem of Computer Gaphics, Schaum Series.**
3. **Donald Hearn and M. Pauline Baker : Computer Graphics, PHI Publications.**

CODE: PEC-CS-A-701

SUBJECT NAME: THEORY OF OPTIMIZATION TECHNIQUES

NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites:Linear Algebra and Numerical Methods

Course Objectives:

1. The objective of this course is to provide insight to the mathematical formulation of real world problems.
2. To optimize these mathematical problems using naturebased algorithms. And the solution is useful, especially for NP-Hard problems.

MODULE-1:

Engineering applications of optimization, Formulation of design problems as mathematical programming problems.

MODULE-2:

General Structure of Optimization Algorithms, Constraints, The Feasible Region.

MODULE-3:

Branches of Mathematical Programming: Optimization using calculus, Graphical Optimization, Linear Programming, Quadratic Programming, Integer Programming, Semi Definite Programming.

MODULE-4:

Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc.

MODULE-5:

Real life Problems and their mathematical formulation as standard programming problems.

Course Outcomes:

After completion of course, students would be able to:

1. Apply basic concepts of mathematics to formulate an optimization problem

2. Understand and apply the concept of optimality criteria for various types of optimization problems.
3. Solve various constrained and unconstrained problems in Single variable as well as multivariable.
4. Apply the methods of optimization in real life situations.

REFERENCES

1. **Laurence A. Wolsey (1998, "*Integer programming".* Wiley. ISBN 978-0-471-28366-9.**
2. **Andreas Antoniou, "Practical Optimization Algorithms and Engineering Applications".**
3. **Edwin K., P. Chong & Stanislaw h. Zak, "*An Introduction to Optimization*".**
4. **Dimitris Bertsimas; Robert Weismantel (2005), "*Optimization over integers. Dynamic Ideas".* ISBN 978-0-9759146-2-5.**
5. **John K. Karlof (2006), "*Integer programming: theory and practice"* .CRC Press. ISBN 978-0-8493-1914-3.**
6. **H. Paul Williams (2009), *"Logic and Integer Programming".* Springer. ISBN 978-0-387-92279-9.**
7. **Michael Jünger; Thomas M. Liebling; Denis Naddef; George Nemhauser; William R. Pulleyblank; Gerhard Reinelt; Giovanni Rinaldi; Laurence A. Wolsey, eds. (2009), "*50 Years of Integer Programmin".* 1958-2008: From the Early Years to the State-of-the- Art. Springer. ISBN 978-3-540-68274-5.**
8. **Der-San Chen; Robert G. Batson; Yu Dang (2010), " *Applied Integer Programming: Modeling and Solution".* John Wiley and Sons. ISBN 978-0-470-37306-4.**

CODE: PEC-CS-A-702

SUBJECT NAME: WEB AND INTERNET TECHNOLOGY

NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites: Computer Networks

Course Objectives:

1. To familiarize the students with the basic concepts of internet, its history, ways to connect to internet and basics of world wide web and search engines.
2. To familiarize the student with the fundamental language of internet i.e. HTML
3. To teach the student aware of the concepts of cascading style sheets
4. To teach the student the students the basics of client side and Server side scripting

MODULE-1: INTRODUCTION TO NETWORKS AND WWW

Introduction to internet, history, Working of Internet, Modes of Connecting to Internet, Internet Address, standard address, classful and classless ip addressing, subnetting, supernetting, w3c consortium, searching the www: Directories search engines and Meta search engines, search fundamentals, search strategies, Architecture of the search engines, Crawlers and its types, Delivering multimedia over web pages, VRML.

MODULE-2:HYPERTEXT MARKUP LANGUAGE

The anatomy of an HTML document: Marking up for structure and style: basic page markup, absolute and relative links, ordered and unordered lists, embedding images and controlling appearance, table creation and use, frames, nesting and targeting.

MODULE-3:STYLE SHEETS

Separating style from structure with style sheets, Internal style specifications within HTML, External linked style specification using CSS, page and site design considerations.

MODULE-4:CLIENT SIDE PROGRAMMING

Introduction to Client side programming, Java Script syntax, the Document object model, Event handling, Output in JavaScript, Forms handling, cookies, Introduction to VBScript, Form Handling.

MODULE 5 :SERVER SIDE SCRIPTING

CGI, Server Environment, Servlets, Servlet Architecture, Java Server Pages, JSP Engines, Beans, Introduction to J2EE.

Course Outcomes:

At the end of the course/session the student would be

1. Acquainted with the basics of internet &search engines.
2. Have a hands on HTML
3. Learned the need and basics of CSS
4. Learned the concepts of client side and server side scripting.

REFERENCES

1. **Fundamentals of the Internet and the World Wide Web, Raymond Greenlaw and Ellen Hepp 2001, TMH .**
2. **Internet & World Wide Programming, Deitel,Deitel& Nieto, 2000, Pearson Education**
3. **Complete idiots guide to java script,. Aron Weiss, QUE, 1997.**
4. **Network firewalls, Kironjeetsyan - New Rider Pub.**

CODE: PEC-CS-A-703

SUBJECT NAME: CRYPTOGRAPHY AND NETWORK SECURITY

NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites: Computer Networks

Course Objectives:

1. Understand the basic concept of Cryptography and Network Security, their mathematical models.
2. To impart knowledge of major issues in network and computer system security, focusing mainly on threats from malicious software and To understand common attacks on computer networks and methods to detect and remediate such attacks.
3. To study various issues in security of MANETS and study various attacks.
4. To provide the students with the competences required for understanding various issues in security of Wireless Security Networks and also various attacks against security mechanism and routing.

MODULE-1:

Introduction What is security?, Need of security, Why is security so hard?, various goals of security, Difference between Vulnerability, Threats, Attacks and control, Security goals, aspects of security, security services, security attacks Encryption Techniques Terminology of encryption, Requirement of encryption, cryptography, cryptanalysis, cryptanalytic attacks, symmetric ciphers: Substitution ciphers, Transposition ciphers, Data Encryption Standard (DES, Advanced Encryption Standard (AES), location of encryption devices, key distribution, Public Key Cryptography and RSA, Diffie-Hellman Key Exchange, Message Authentication and Hash Functions, MD5, SHA

MODULE-2:

Network Security Security services, Message confidentiality, Message integrity, message authentication, digital signature, entity authentication. Authentication applications: Kerberose95, X.509 Authentication service, Public key infrastructure. Electronic mail Security: Preety Good Privacy (PGP), IP Security: IP security overview, IP security architecture, Authentication header, Encapsulating security Payload, Combining security associations, Key management.

MODULE-3:

Security Attacks in MANET Security issues in MANET, Attacks in MANET: External Attack, Internal attack, Black hole attack, warm hole attack, grey hole attack, Byzantine attack, Sleep Deprivation attack, Flooding attack: RREQ flooding attack, Data flooding Attack.

MODULE-4:

Security Attacks in Wireless Sensor Networks Security issues in WSN, Attacks in WSN : Attack against Security mechanism, Attack against basic mechanism like routing: Spoofed, altered, replayed routing, Information, Selective forwarding , Sinkhole attacks , Sybil attacks, Wormholes, HELLO flood attacks

Course Outcomes:

After the completion of this course the student will able to:

1. Understand theory of fundamental cryptography, encryption and decryption algorithms,
2. Build secure systems by use of block ciphers like AES, DES.
3. To be familiar with network security designs using available secure solutions and advanced security issues and technologies.
4. To develop basic security enhancements in MANETS.
5. To know how authentication is implemented in wireless systems and understand authentication protocols and processes.

REFERENCES:

1. P. Pfleeger, Shari Lawrence Pfleeger Charles: Security in Computing, PHI.
2. William Stalling, Cryptography and Network Security, 3rd Edition. PHI New Delhi
3. William Stalling, Network Security Essentials, 2nd Edition. PHI New Delhi
4. Bruce Schneier, Niels Ferguson : Practical Cryptography, Wiley Dreamtech India Pvt. Ltd.

DETAILED 4-YEAR CURRICULUM CONTENTS

Undergraduate Degree in Engineering & Technology

Branch/Course: COMPUTER SCIENCE & ENGG.

OPEN ELECTIVE COURSES

CODE: OEC-CS-601(I)

SUBJECT NAME: SOFT SKILLS AND INTERPERSONAL COMMUNICATION

NO OF CREDITS: 3

B.TECH 6th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites: Basic knowledge of reading and writing English.

Course Objectives:

The course aims at creating awareness among the stock holders of the corporate world in which the role of individuals as team players and also as responsible leaders materializes to a great extent. The course, with its interactive and need based modules, will address various challenges of communication as well as behavioral skills faced by individuals at workplace and organizations in bridging the gaps through effective skills of interviews, group discussions, meeting management, presentations and nuances of drafting various business documents for sustainability in today's global world.

MODULE-1: INTRODUCTION

Introduction to Soft Skills, Aspects of Soft Skills, Effective Communication Skills, Classification of Communication, Personality Development

Positive Thinking, Telephonic Communication Skills, Telephonic Communication Skills, Communicating Without Words, Paralanguage, Proxemics, Haptics: The Language of Touch, Meta-communication, Listening Skills, Types of Listening, Negotiation Skills , Culture as Communication, Communicating across Cultures , Organizational Communication.

MODULE-2: COMMUNICATION BREAKDOWN

Advanced Writing Skills, Principles of Business Writing, Types of Business Writing, Business Letters, Business Letters: Format and Style, Types of Business Letter.

MODULE-3: SKILL DEVELOPMENT

Writing Reports, Types of Report, Strategies for Report Writing, Strategies for Report Writing, Evaluation and Organization of Data,

Structure of Report, Report Style, Group Communication Skills, Leadership Skills, Group Discussion, Meeting Management, Adaptability & Work Ethics.

Advanced Speaking Skills, Oral Presentation, Speeches & Debates, Combating Nervousness, Patterns & Methods of Presentation, Oral Presentation: Planning & Preparation

MODULE-4: PRESENTATION AND INTERVIEWS

Making Effective Presentations, Speeches for Various Occasions, Interviews, Planning & Preparing, Effective Résumé, Drafting an Effective Résumé, Facing Job Interviews, Emotional Intelligence & Critical Thinking, Applied Grammar

Course Outcomes:

After completion of the course student will be able to :

1. Understand the concept of soft skills including communication skills, listening skills, positive thinking and also will be able to enhance own personality.
2. Able to write business letters.
3. Able to write reports.
4. Able to make effective resume and will also be able to present himself/herself in interview, speeches, presentations, talks etc.

REFERENCES:

1. **Butterfield, Jeff. *Soft Skills for Everyone*. New Delhi: Cengage Learning. 2010.**
2. **Chauhan, G.S. and Sangeeta Sharma. *Soft Skills*. New Delhi: Wiley. 2016.**
3. **Goleman, Daniel. *Working with Emotional Intelligence*. London: Banton Books. 1998.**
4. **Hall, Calvin S. et al. *Theories of Personality*. New Delhi: Wiley. rpt. 2011.**
5. **Holtz, Shel. *Corporate Conversations*. New Delhi: PHI. 2007.**
6. **Kumar, Sanajy and Pushp Lata. *Communication Skills*. New Delhi: OUP. 2011.**
7. **Lucas, Stephen E. *The Art of Public Speaking*. McGraw-Hill Book Co. International Edition, 11th Ed. 2014.**
8. **Penrose, John M., et al. *Business Communication for Managers*. New Delhi: Thomson South Western. 2007.**
9. **Sharma, R.C. and Krishna Mohan. *Business Correspondence and Report Writing*. New Delhi: TMH. 2016.**
10. **Sharma, Sangeeta and Binod Mishra. *Communication Skills for Engineers and Scientists*. New Delhi: PHI Learning. 2009, 6th Reprint 2015.**
11. **Thorpe, Edgar and Showick Thorpe. *Winning at Interviews*. Pearson Education. 2004.**
12. **Turk, Christopher. *Effective Speaking*. South Asia Division: Taylor & Francis. 1985.**

CODE: OEC-CS-601(II)

SUBJECT NAME: CYBER LAW AND ETHICS

NO OF CREDITS: 3

B.TECH 6th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Pre-requisites:Basics of Data Structures and Mathematics

Course objectives:

MODULE- 1: INTRODUCTION

Computers and its Impact in Society, Overview of Computer and Web Technology, Need for Cyber Law, Cyber Jurisprudence at International and Indian Level

MODULE- 2: CYBER LAW- INTERNATIONAL PERSPECTIVES

UN & International Telecommunication Union (ITU) Initiatives Council of Europe - Budapest Convention on Cybercrime, Asia-Pacific Economic Cooperation (APEC), Organization for Economic Co-operation and Development (OECD), World Bank, Commonwealth of Nations

MODULE- 3: CONSTITUTIONAL & HUMAN RIGHTS ISSUES IN CYBERSPACE

Freedom of Speech and Expression in Cyberspace, Right to Access Cyberspace – Access to Internet, Right to Privacy, Right to Data Protection

MODULE- 4: CYBER CRIMES & LEGAL FRAMEWORK

Cyber Crimes against Individuals, Institution and State, Hacking, Digital Forgery, Cyber Stalking/Harassment, Cyber Pornography, Identity Theft &Fraud, Cyber terrorism, Cyber Defamation, Different offences under IT Act, 2000

MODULE- 5: CYBER TORTS

Cyber Defamation, Different Types of Civil Wrongs under the IT Act, 2000

MODULE- 6: INTELLECTUAL PROPERTY ISSUES IN CYBER SPACE

Interface with Copyright Law, Interface with Patent Law, Trademarks & Domain Names Related issues

MODULE- 7: E-COMMERCE CONCEPT

E-commerce-Salient Features, Online approaches like B2B, B2C & C2C Online contracts, Click Wrap Contracts, Applicability of Indian Contract Act, 1872

MODULE- 8: DISPUTE RESOLUTION IN CYBERSPACE

Concept of Jurisdiction, Indian Context of Jurisdiction and IT Act, 2000, International Law and Jurisdictional Issues in Cyberspace, Dispute Resolutions, Information warfare policy and ethical Issues.

References:

- **Chris Reed & John Angel, Computer Law, OUP, New York, (2007).**
- **Justice Yatindra Singh, Cyber Laws, Universal Law Publishing Co, New Delhi, (2012)**
- **Verma S, K, Mittal Raman, Legal Dimensions of Cyber Space, Indian Law Institute, New Delhi, (2004)**
- **JonthanRosenoer, Cyber Law, Springer, New York, (1997).**
- **Sudhir Naib, The Information Technology Act, 2005: A Handbook, OUP, New York, (2011)**
- **S. R. Bhansali, Information Technology Act, 2000, University Book House Pvt. Ltd., Jaipur (2003).**
- **Vasu Deva, Cyber Crimes and Law Enforcement, Commonwealth Publishers, New Delhi, (2003).**

CODE: PCC-IT- 601

SUBJECT NAME: DATA ANALYSIS USING PYTHON

NO OF CREDITS: 3

B.TECH 6th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL:	100

Pre-requisites:Basics of Data Structures and Mathematics

Course objectives: The student will learn how to apply

1. Fundamentals and Data structures of pythons programming language.
2. Object oriented concepts in python programming language.
3. Retrieving, processing, storing and visualization of data using python.

MODULE-1: INTRODUCTION TO PYTHON

Brief history of python, Data types - Built-in, Sequence, Sets, Strings, Literals, constants, keywords, variables, naming convention. Operators – Types, Precedence & Associativity, Input, Output, file handling, Control Statements.

MODULE-2: FUNCTIONS AND DATA STRUCTURES IN PYTHON

Functions – basics of functions, functions as objects, recursive functions, List –methods to process lists, Shallow & Deep copy, Nested lists, lists as matrices, lists as stacks, Queues, - Deques, Tuples - basic operations on tuples, nested tuples, Dictionaries – operations on dictionary, ordered dictionary, iteration on dictionary, conversion of lists & strings into dictionary, Sets & frozen sets, looping techniques on lists & dictionaries, Lamda, filter, reduce, map, list comprehension, iterators and generators.

MODULE-3: OBJECTS IN PYTHON

Class and instance attributes, inheritance, multiple inheritance, methos resolution order, magic methods and operator overloading, meta classes, abstract and inner classes, exception handling, modular programs and packeges.

MODULE-4: NUMERICAL ANALYSIS IN PYTHON

Introduction to NumPy, NumPy array object, Creating a multidimensional array, NumPy numerical types - Data type objects, Character codes, dtype constructors. dtype attributes. One-dimensional slicing and indexing. Manipulating array shapes -- Stacking arrays, Splitting NumPy

arrays, NumPy array attributes, Converting arrays, Creating array views and copies. Indexing with a list of locations. Indexing NumPy arrays with Booleans. Broadcasting NumPy arrays.

MODULE-5: DATA MANIPULATION AND VISUALIZATION IN PYTHON

Data frames in panda, Creatingdataframes from .csv and excel files, Lists of tuples, Dataframes aggregation and concatenation, plotting data using matplotlib & panda

Course Outcomes:

After completion of course, students would be able to:

1. Write programs efficiently in python
2. Effectively use numerical analysis libraries of python
3. Carry out basic data science operations like retrieving, processing and visualizing using python.

REFERENCES:

1. **Wesley J Chun, Core Python Programming, Prentice Hall, Second Edition, 2006**
2. **Ivan Idris, Python Data Analysis, PacktPublishing,UK, 2014 (freely available online)**
3. **Wes McKinney, Python for Data Analysis, O'Reilly - 2013**

CODE: OEC-CS-601(IV)

SUBJECT NAME: ELECTRONIC DEVICES

NO OF CREDITS: 3

B.TECH 6th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL:	100

Pre-requisites: Computer Organization & Architecture, Digital Electronics

Course objectives:

1. To give exposure to students about Semiconductor Physics.
2. To give the exposure about characteristics of Semiconductor devices
3. To introduce the working of difficult Semiconductor Electronic devices.
4. To introduce the concept of fabrication terminologies semiconductor electronic devices.

MODULE-1: INTRODUCTION TO SEMICONDUCTOR PHYSICS

Review of Quantum Mechanics, Electrons in periodic Lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon;

MODULE-2: CARRIER TRANSPORT

Diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors Generation and recombination of carriers; Poisson and continuity equation P-N junction characteristics, I-Vcharacteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode

MODULE-3: BIPOLAR JUNCTION TRANSISTOR

I-V characteristics, Ebers-Moll Model,MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor, LED, photodiode and solar cell;

MODULE-4: INTEGRATED CIRCUIT FABRICATION PROCESS

Oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the principles of semiconductor Physics

2. Understand and utilize the mathematical models of Semiconductor junctions and 1. MOS transistors for circuits and systems.
3. Understand various Semiconductor, fabrication process.
4. Understand the design & characteristics of Semiconductor devices.

REFERENCES:

1. **G. Streetman, and S. K. Banerjee, "*Solid State Electronic Devices*," 7th edition, Pearson,2014.**
2. **D. Neamen , D. Biswas "*Semiconductor Physics and Devices,*" McGraw-Hill Education**
3. **S. M. Sze and K. N. Kwok, "*Physics of Semiconductor Devices*," 3rd edition, John Wiley & Sons, 2006.**
4. **C.T. Sah, "*Fundamentals of Solid State Electronics*," World Scientific Publishing Co. Inc, 1991.**
5. **Y. Tsividis and M. Colin, "*Operation and Modeling of the MOS Transistor*," Oxford Univ.Press, 2011.**

CODE: OEC-CS-601(V)

SUBJECT NAME: DIGITAL SYSTEM DESIGN

NO OF CREDITS: 3

B.TECH 6th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL:	100

Pre-requisites:

Course objectives:

1. To study the concept of combinational logic circuits
2. To make the student aware about modular combinational circuits with MUX/DEMUX, Decoder, Encoder
3. T o understand the synchronous sequential logic circuits
4. To study Logic families and semiconductor memories.
5. To study VLSI design flow.

MODULE-1: 1 LOGIC SIMPLIFICATION AND COMBINATIONAL LOGIC DESIGN

Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.

MODULE-2: COMBINATIONAL CIRCUITS

Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU

MODULE-3: SEQUENTIAL LOGIC DESIGN

Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation

MODULE-4: LOGIC FAMILIES AND SEMICONDUCTOR MEMORIES

TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.

MODULE-5: VLSI DESIGN FLOW

Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Design and analyze combinational logic circuits
2. Design &analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
3. Design &analyze synchronous sequential logic circuits
4. Use HDL & appropriate EDA tools for digital logic design and simulation

REFERENCES:

1. **R.P. Jain, "*Modern digital Electronics*", Tata McGraw Hill, 4th edition, 2009. Douglas Perry, "*VHDL*", Tata McGraw Hill, 4th edition, 2002.**
2. **W.H. Gothmann, "*Digital Electronics- An introduction to Theory and Practice*", PHI, 2nd edition ,2006.**
3. **D.V. Hall, "*Digital Circuits and Systems*", Tata McGraw Hill, 1989**
4. **Charles Roth, "*Digital System Design using VHDL*", Tata McGraw Hill 2nd edition 2012.**

CODE: OEC-CS-602(I)

SUBJECT NAME: HUMAN RESOURCE MANAGEMENT

NO OF CREDITS: 3

B.TECH 6th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL:	100

Course objectives:

The primary concern of this course is to sensitize students to the various facts of managing people and to create an understanding of the various policies and practices of human resource management.

MODULE-1:

Human Resource Management: concept, evolution and scope; Strategic objectives of HR management; Roles, responsibilities and competencies of HR manager; Challenges to HR professionals; Human Resource Planning & Forecasting: significance and process; Human Resource Information System.

MODULE-2:

HR Sourcing and Recruitment; Selection: process, Placement; Induction and Socialization.

Job Analysis: job Description and job Specification; Job Design: approaches and methods; Job Evaluation-concept & methods; Performance Management System: appraisal and counselling.

MODULE-3:

Training: training process, training need analysis (TNA); training methods and techniques; Designing Training programs; Training evaluation; Career planning and Development; Potential Appraisal and Succession planning; Employee Compensation: basic concepts & determinants; New trends in compensation management.

MODULE-4:

Industrial Relations and Grievance Handling; Employee welfare; Dispute Resolution; International Human Resource Management; Contemporary Issues in HRM: knowledge Management, HR Audit &Accounting, HR in virtual organizations, ethics &corporate social responsibility.

Course Outcomes:

1. The course will help to understand the basics of HRM with roles and responsibilities of a HR manager.

2. This course enables the students to meet HR challenges in present scenario
3. It will facilitate them in employing, maintaining and promoting a motivated force in an organization.
4. Students will be aware about contemporary issues of human resource management.

RERERENCES:

1. **K. Aswathapa Human resource Management: Text and cases, 6th edition, Tata McGraw Hill, New Delhi.**
2. **Uday Kumar Haldar&JuthikaSarkarHuman resource Management New Delhi, Oxford University Press.**
3. **De Cenvo, Da & Robbins S.P. Fundamentals of Human Resource Management, 9th edition, New York, John Wiley & Sons.**
4. **Gary Dessler, Human Resource Management, 11th edition New Delhi: Pearson Prentice Hall.**
5. **TanujaAgarwala, Strategic Human resource Management, Oxford University Press**

CODE: OEC-CS-602(II)

SUBJECT NAME: ICT FOR DEVELOPMENT

NO. OF CREDITS

B.TECH 6th SEMESTER		SESSIONAL:	25
L	T P	THEORY EXAM:	75
3	0 0	TOTAL :	100

Course objectives:

With rising use of Information and Communication technologies available, there is a high potential for these technologies to address sustainability issues. The students must be equipped with the knowledge about their applications in the development field so as to enable them to provide ICT solutions to the target communities. The students will gain knowledge and skills on how ICTs can be best used to overcome sustainability challenges. In order to succeed in the practice of sustainable development, professionals must be trained in a basic set of competencies that integrate cross-disciplinary knowledge for practical problem solving with the use of information and communication technologies.

MODULE-1: INTRODUCTION

Introduction to ICTs for sustainable Development Introduction to Information and Communication Technology (ICT); Role of ICTs in Sustainable Development; Current Status of ICTs in Sustainable Development- Global and India Scenario. Potential of ICTs in various fields, impact of information Technologies on GDP growth

MODULE-2: BUILDING KNOWLEDGE SOCIETIES

The concept of Knowledge Society; identifying stakeholders and target communities; Understanding information needs, Traditional vs. contemporary knowledge systems, information processing and retrieval; Understanding means of communication in different areas, developing an effective communication strategy Case: Warna Unwired

MODULE-3: INFORMATION AND COMMUNICATION TECHNOLOGIES

The hardware and software, the physical infrastructure, satellite, wireless solutions, telecommunication technologies, mobiles, fixed line, internet and world wide web, community radio, technology-user interface, design of relevant ICT products and services.

MODULE-4: ICT APPLICATIONS

Applications of ICT in education, Health (telehealth, telemedicine and health informatics), Gender Equality, Agriculture (e Governance, telecentres, Mobiles for development, climate change and disaster management, ICT Networks for water management (This module will be dealt with the help of country case studies in all the sectors and inputs from ICT4D practitioners Case Studies: eCME, Apollo Telemedicine Network Foundation, Bhoomi, eSewa, Gyandoot, eAgriculture. M-PESA, CYCLETEL)

MODULE-5: ICT FOR DEVELOPMENT IN INDIA

Policy and Institutional Framework in India, e governance, ICT Models in health, education, agriculture, finance, gender equality, Mobiles for Development Experience sharing by ICT for Development practitioners Case Studies: Reuters Market Light, IffcoKisaan Sanchar Ltd.

MODULE-6: ICT4D IMPLEMENTATION

Developing an ICT4D Project, Critical Success factors for technology diffusion and use, Constraints in adoption, The role of national policies, Institutional Policy framework, Multi-stakeholder partnerships, Role of Private Sector Case Studies: echaupal , Lifelines India.

Course Outcomes:

After completion of the course:

1. Students will be familiarized with main theories and conceptual frameworks in the field of ICT for development
2. Students will learn potential of both information and communication technologies in different areas such as health, education, agriculture, finance, gender equality and climate change.
3. Students will be able to understand the existing innovative business models and other applications in the above mentioned areas with reference to India and other developing countries
4. Students will be able to compare and contrast various business models (public, private sector, PPP, civil society) with respect to technology, infrastructure, capacity building, human resource etc.
5. Students will be able to learn how ICT models can be successfully implemented at the field and understand critical success factors and constraints in adoption.

REFERENCES

CODE: OEC-CS-602(III)

SUBJECT NAME: INTELLECTUAL PROPERTY RIGHTS

NO OF CREDITS: 3

B.TECH 6th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Course Objectives:

1. To make the student aware about Intellectual Property and why it is important
2. To study the concept of Patents, history of patent and its categorization.
3. To learn the procedure of obtaining Patents.
4. To make the student learn Assignment and Revocation of Patent
5. To study the concept of infringement and its defence.

MODULE-1: INTRODUCTION TO INTELLECTUAL PROPERTY

Concept of Intellectual Property, Kinds of Intellectual Property, Economic Importance of Intellectual Property, Indian Theory on Private Property: Constitutional Aspects of Property, Constitutional Protection of Property and Intellectual Property, Economic Development and Intellectual Property Rights Protection

MODULE-2: INTRODUCTION TO PATENTS

Overview, Historical Development, Concepts: Novelty, Utility, Patentable Subject-matter: Patent Act, 1970- Amendments of 1999, 2000, 2002 and 2005, Pharmaceutical Products and Process and Patent , Protection, Software Patents, Business Method, Protection of Plant Varieties and Farmers' Rights Act, 2001, Patenting of Micro-organism

MODULE-3: PROCEDURE OF OBTAINING OF PATENTS

Concepts of a Patent Application,, Specification: Provisional, Complete, Disclosure Aspects, Claims: Principal, Dependant, Omnibus, Examination of Application, Opposition of Application, Sealing of Patents

MODULE-4: WORKING OF PATENTS – COMPULSORY LICENSE

Commercialization of Inventions: License- Terms of License Agreement, Assignments of Patents, Revocation of Patents

MODULE-5: INFRINGEMENT

What is Infringement?, How is Infringement determined? Who is an Infringer?, Direct, Contributory and Induced, Defences of Infringement: Research Exemption, Invalidity, Misuse, Failure to mark, Laches and Estoppel and first sale doctrine

Course Outcomes:

After completion of the course student will be able to:

1. Understand the concept of Intellectual Property and its importance.
2. Understand Patents, categorization and procedure for obtaining patents.
3. Understand the commercialization of invention
4. Understand the concept of infringement and its defence.

REFERENCES:

1. **W.R. Cornish, Intellectual Property, Sweet & Maxwell, London (2000)**
2. **P. Narayana, Patent Law, Wadhwa Publication**
3. **Merges, Patent Law and Policy: Cases and Materials, 1996**
4. **Brian C. Reid, A Practical Guide to Patent Law, 2nd Edition, 1993**
5. **Brinkhof (Edited), Patent Cases, Wolters Kluwer.**
6. **Prof. Willem Hoyng& Frank Eijsvogels, Global Patent Litigation, Strategy and Practice, Wolters Kluwer.**
7. **Gregory Stobbs, Software Patents Worldwide, Wolters Kluwer.**
8. **Feroz Ali Khader, The Law of Patents- With a special focus on Pharmaceuticals in India, Lexis Nexis Butterworths Wadhwa, Nagpur.**
9. **Sookman, Computer Law, 1996**
10. **N.S. Gopalakrishnan & T.G. Agitha, Principles of Intellectual Property (2009). Eastern Book Company, Lucknow**

CODE: OEC-CS-602(IV)

SUBJECT NAME: INTERNATIONAL BUSINESS ENVIRONMENT

NO OF CREDITS: 3

B.TECH 6th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Course Objectives:

To provide knowledge about International Business Environment. To provide the framework on basis of which business can be run smoothly.

MODULE-1:

International business environment; Concept of international business; domestic vs international business, stages of internationalization, tariff and non-tariff barriers,Risks involved in international business

MODULE-2:

Theories of international trade: Adam Smith, Ricardo and Ohlin & Heckler theory, Leontif paradox, PLC

MODULE-3:

International Monetary Systems: Historical background and structure. International Financial institutions; IMF, World Bank, Euro Currency.International financial markets and instruments.

MODULE-4:

Free trade zones.Bilateral and Multilateral Trade Laws – General Agreement on Trade and Tariffs, (GATT), World Trade Organization – IPR, TRIPS, TRIMS, GATS. Regional Economic Integrations: NAFTA, EU. Trade Blocks; ASEAN, SAAARC, BRICS

Course Outcomes:

1. The student will be aware of the international organizations in which India is a member or otherwise.
2. The students may take opportunity to take their business from domestic to international.
3. International organizations and their links to India will be understood by students in an easy manner.
4. The students will be aware business environment at international level

RERERENCES:

1. **Lasserre, Philippe Global Strategic Management, Palgrave MacMillan.**
2. **John D Daniels, Lee H Radebaugh Daniel P Sullivan ,PrashantSalwan. International Business Environments and Operations, Pearson Education**
3. **Tamer Cavusgil, Gary Knight International Business: Strategy, Management and the New Realities, 1st Edition, Pearson Education.**
4. **K Aswathappa, International Business, Tata Mcgraw Hill.**
5. **Richard Hodgetts, Fred Luthans, Jonathan Doh. International Management: Culture, Strategy And Behaviour, Pearson Education.**
6. **Deresky, International Management: Managing across borders and culture. Pearson Education.**
7. **Nandi : "International Business Environment" McGraw Hill Education.**

CODE: OEC-CS-602(V)

SUBJECT NAME: BASICS OF OPERATIONS RESEARCH

NO OF CREDITS: 3

B.TECH 6th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Course Objectives:

1. To introduce the student with Different types of OR Models and Linear Programming Model
2. To introduce the students about Dual Sensitive Method and Sensitive Analysis.
3. To introduce the concept of Assignment Problem.
4. To introduce the students with Network Model
5. To introduce the concept of Dynamic Programming and Queuing Model.

MODULE-1:

The origin of OR, Phases of an O.R. study, Impact of OR, Formulation of Linear-programming model, Graphical solution. Converting the linear programming problem to standard form, Simplex method.

MODULE-2:

Big-M method, Two-phase method, Degeneracy, Alternate optima, unbounded and infeasible solution.

MODULE-3:

Definition of the dual problem, prima-dual relationship, Dual Simplex method, Post optimal and sensitivity analysis.

MODULE-4:

Assignment problem and its mathematical formulation, solution of assignment problem (Hyngarian method), Transportation problem and its mathematical formulation. Initial basic feasible solution of transportation problem by North-West corner rule. Lowest-Cost Entry method and Vogel's Approximation method, Optimal solution of transportation problem.

MODULE-5:

Network models, Minimal spanning tree algorithm, Shortest-route problem (Floyd's Algorithm and Dijkstras algorithm), Maximal flow problem, Introduction to CPM & PERT.

MODULE-6:

Introduction to Dynamic Programming, General inventory Model, Static Economic Order Quantity (EOQ) Models.

MODULE-7:

Elements of a Queuing model, Pure Birth & Death model, Generalized Poisson Queuing, Specialized Poisson Queues.

Course Outcomes:

After completion of the course student will be able to:

1. Understand different types of OR Model and solve Linear programming problems.
2. Understand dual simplex problem and sensitive analysis.
3. Solve Assignment problem.
4. Understand Dynamic Programming and Queuing Model.

REFERENCES:

1. **Operations Research by HamdyA Taha**
2. **Introduction to Operations Research by Hiller and Dieherman, TMH**
3. **Optimization Theory and Application: SS Rao, John Wiley.**

CODE: OEC-CS-701(I)

SUBJECT NAME: FINANCIAL MANAGEMENT

NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Course Objectives:

To develop understanding among the students regarding nature of finance and its interaction with other Management functions and the objectives of Financial Management.

MODULE-1:

Financial management-scope finance functions and its organisation, objectives of financial management; time value of money; sources of long term finance.

MODULE-2:

Investment decisions importance, difficulties, determining cash flows, methods of capital budgeting with excel; risk analysis (risk adjusted discount rate method and certainty equivalent method); cost of different sources of raising capital; weighted average cost of capital.

MODULE-3:

Capital structure decisions-financial and operating leverage; EBIT/EPS Analysis, capital structure theories- NI, NOI, traditional and M-M theories; determinants of dividend policy and dividend models -Walter, Gordon & M.M. models.

MODULE-4:

Working Capital- meaning, need, determinants; estimation of working capital need; management of cash, inventory and receivables.

Course Outcomes:

1. It creates understanding among the students regarding the key decisions like Investment, Financing and dividend Decisions of financial Management.
2. They are able to understand the usage and applications of leverages in financial decisions.
3. The students are able to use their best knowledge in finance towards the value creation for the organization.

4. The students will be made aware of working capital management concept.

RERERENCES:

1. **Pandey, I.M., "*Financial Management*", Vikas Publishing House, New Delhi**
2. **Khan M.Y, and Jain P.K., "*Financial Management*", Tata McGraw Hill, New Delhi**
3. **Keown, Arthur J., Martin, John D., Petty, J. William and Scott, David F, "*Financial Management*", Pearson Education**
4. **Chandra, Prasanna, "*Financial Management*", TMH, New Delhi**
5. **Van Horne, James C., "*Financial Management and Policy*", Prentice Hall of India**
6. **Brigham & Houston, "*Fundamentals of Financial Management*", Thomson Learning, Bombay.**
7. **Kishore, R., "*Financial Management*", Taxman's Publishing House, New Delhi**

CODE: OEC-CS-701(II)

SUBJECT NAME: E-COMMERCE AND ENTREPRENEURSHIP

NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Course Objectives:

1. To understand the basic concept of electronic transactions, types of business models and about customer relationship management.
2. To study about various legal and ethical issues related to electronic transactions and also understating the concepts of IPR.
3. To understand the skills of Entrepreneurship, to identify the projects and the analysis and report making.

MODULE-1: INTRODUCTION TO E-COMMERCE

Need, importance, Business models, revenue models and business processes, economic forces & e-commerce, identifying e-commerce opportunities, international nature of e-commerce, technology infrastructure-internet & WWW; Business strategies for ecommerce: Revenue models in transaction, revenue strategic issues, customer behavior and relationship intensity, advertising on the web, e-mail marketing, technology enabled CRM

MODULE-2: BUSINESS TO BUSINESS STRATEGIES

(Overview strategic methods for Developing E-Commerce) Purchasing, logistics and supply activities, electronic data interchange (EDI), electronic data interchange on the internet, supply chain management using internet technologies, electronic market place & portals (Home shopping, E-marketing, Tele marketing), auctions, online auctions, virtual communicative & web portals; legal, and ethical issues in e-commerce — use and protection of intellectual property in online business, online crime, terrorism & warfare, ethical issues.

MODULE-3: ENTREPRENEURSHIP

Definition, Concept, Growth and role. The Entrepreneur: types, Characteristics, theories of Entrepreneurial class, Urges and importance of Entrepreneurship Stimulants; Seed-Beds of Entrepreneurship, Influencing Factors; Problems (Operational and Non-Operational) and Obstacles. Entrepreneurial Management. Role of socio-economic environment

MODULE-4:

Skills for a New Class of Entrepreneurs, The Ideal Entrepreneurs, The Entrepreneurship Audit, Identification of opportunities by an Entrepreneur, The steps to identify the project /ventures, Process of converting business opportunities into reality. Feasibility Report and analysis, Process of setting up a small scale industry / unit

MODULE-5:

Promotion of a venture, External Environment Analysis: Economic, Social, Technological and competition, Legal Framework for establishing and fund raising Venture Capital: Sources and Documents required.

Course Outcomes:

After completion of course, students would be able to:

1. The students will be able to understand the basic concepts of electronic transactions.
2. Study of various types of business models and customer relationship management.
3. Students will be able to understand about various business strategies and marketing strategies.
4. Study of various legal and ethical issues related to electronic transactions.
5. Study of intellectual property rights and its importance.
6. Study of Entrepreneurship management
7. Study of analyzing the external environment, the competition and designing the framework for establishing a venture capital.
8. Study of business intelligence and knowledge management tools.

REFERENCES:

1. **Gary P. Schneider, "Electronic Commerce", Seventh Edition, CENGAGE Learning India Pvt. Ltd., New Delhi.**
2. **K.K.Bajaj, D. Nag "E-Commerce", 2nd Edition, McGraw Hill Education, New Delhi**
3. **P.T. Joseph, "E-Commerce An Indian Perspective", PHI Publication, NewDelhi.**
4. **Bhaskar Bharat, "Electronic Commerce-Technology and Application", McGraw Hill Education, New Delhi**
5. **Mary Sumner, "Enterprise Resource Planning", 2005, PHI Learning India Pvt. Ltd. / Pearson Education, Inc. New Delhi. 6. Chan, " E-Commerce fundamentals and Applications", Wiley India, New Delhi**

CODE: OEC-CS-701(III)

SUBJECT NAME: R PROGRAMMING

NO OF CREDITS: 3

B.TECH 7th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Pre-requisites: Basic Programming

Course Objectives:

1. Understand what R is and what it can be used for
2. Why would you choose R over another tool
3. Troubleshoot software installs (keep your fingers crossed)
4. Gain familiarity with using R from within the RStudio IDE
5. Get to know the basic syntax of R functions
6. Be able to install and load a package into your R library

MODULE-1: INTRODUCTION

Getting **R,** R Version, 32-bit versus 64-bit, The **R** Environment, Command Line Interface, RStudio, Revolution Analytics RPE
R Packages: Installing Packages, Loading Packages, Building a Package
R Basics: Basic Math, Variables, Data Types, Vectors, Calling Functions, Function Documentation, Missing Data
Advanced Data Structures: data frames, Lists, Matrices, Arrays

MODULE-2: R DATA

Reading Data into **R:** Reading CSVs, Excel Data, Reading from Databases, Data from Other Statistical Tools, R Binary Files, Data Included with R, Extract Data from Web Sites
Statistical Graphics: Base Graphics, ggplot2

MODULE-3: R FUNCTIONS & STATEMENTS

Writing **R** Functions: Hello, World!, Function Arguments, Return Values, do.call
Control Statements: if and else, switch, ifelse, Compound Tests
Loops: for Loops, while Loops, Controlling Loops

MODULE-4: DATA MANIPULATION

Group Manipulation: Apply Family, aggregate, plyr, data.table
Data Reshaping: cbind and rbind, Joins, reshape2
Manipulating Strings: paste, sprint, Extracting Text, Regular

MODULE-5: R STATISTICS & LINEAR MODELING

Probability Distributions: Normal Distribution, Binomial Distribution, Poisson
Basic Statistics: Summary Statistics, Correlation and Covariance, T-Tests 200, ANOVA
Linear Models: Simple Linear Regression, Multiple Regression
Generalized Linear Models: Logistic Regression, Poisson
Model Diagnostics: Residuals, Comparing Models, Cross-Validation, Bootstrap, Stepwise Variable Selection

MODULE-6: NON-LINEAR MODELING

Nonlinear Models: Nonlinear Least Squares, Splines, Generalized Additive Models, Decision Trees, Random Forests
Clustering: K-means, PAM, Hierarchical Clustering

Course Outcomes:

After completion of the course, students will be able to:

1. Familiarize themselves with R and the RStudio IDE
2. Understand and use R functions
3. Install and load a package into your R library
4. Get insight into the capabilities of the language as a productivity tool for data manipulation and statistical analyses.

REFERENCES:

1. **Jared P. Lander, R for Everyone: Advanced Analytics and Graphics, Pearson Edu. Inc.**
2. **Christian Heumann, Michael Schomaker and Shalabh, Introduction to Statistics and Data Analysis - With Exercises, Solutions and Applications in R , Springer, 2016**
3. **Pierre Lafaye de Micheaux, Rémy Drouilhet, Benoit Liquet, The R Software-Fundamentals of Programming and Statistical Analysis, Springer 2013**
4. **By Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, A Beginner's Guide to R (Use R) Springer 2009**

CODE: OEC-CS-701(IV)

SUBJECT NAME: NON-CONVENTIONAL ENERY SOURCES

NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Course Objectives:

1. To learn various renewable energy sources
2. To gain understanding of integrated operation of renewable energy sources
3. To understand Power Electronics Interface with the Grid

MODULE-1:

Introduction, Distributed vs Central Station Generation
Sources of Energy such as Micro-turbines
Internal Combustion Engines.

MODULE-2:

Introduction to Solar Energy, Wind Energy, Combined Heat and Power
Hydro Energy, Tidal Energy, Wave Energy
Geothermal Energy, Biomass and Fuel Cells.

MODULE-3:

Power Electronic Interface with the Grid

MODULE-4:

Impact of Distributed Generation on the Power System
Power Quality Disturbances

MODULE-5:

Transmission System Operation
Protection of Distributed Generators
Economics of Distributed Generation

Course Outcomes:

After completion of the course,Students will be able to:

1. Gain knowledge about renewable energy

2. Understand the working of distributed generation system in autonomous/grid connected modes
3. Know the Impact of Distributed Generation on Power System

REDERENCES:

1. **Ranjan Rakesh, Kothari D.P, Singal K.C, "Renewable Energy Sources and Emerging Technologies", 2nd Ed. Prentice Hall of India ,2011**
2. **Math H. Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System", July 2011,Wiley –IEEE Press**
3. **Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators", October 2007, Wiley-IEEE Press.**
4. **Roger A. Messenger, Jerry Ventre, "Photovoltaic System Engineering", 3rd Ed, 2010**
5. **James F. Manwell, Jon G.McGowan, Anthony L Rogers, "Wind energy explained: Theory Design and Application", John Wiley and Sons 2nd Ed, 2010**

CODE: OEC-CS-702(I)

SUBJECT NAME: ECONOMIC POLICIES IN INDIA

NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Course Objectives:

The candidates at the post-graduate level are expected to analyze various issues pertaining to India's economic development. The performance of the economy is to be assessed on the backdrop of various Five Year Plans implemented in the economy. Wherever possible, critical appraisal is expected by taking cognizance of the contemporary developments in the economy.

MODULE-1: FRAMEWORK OF INDIAN ECONOMY

- National Income: Trends and Structure of National Income
- Demographic Features and Indicators of Economic Growth and Development Rural-Urban Migration and issues related to Urbanization
- Poverty debate and Inequality, Nature, Policy and Implications
- Unemployment-Nature, Central and State Government's policies, policy implications, Employment trends in Organized and Unorganized Sector

MODULE-2: DEVELOPMENT STRATEGIES IN INDIA

- Agricultural- Pricing, Marketing and Financing of Primary Sector
- Economic Reforms- Rationale of Economic Reforms, Liberalization, Privatization and Globalization of the Economy,
- Changing structure of India's Foreign Trade
- Role of Public Sector- Redefining the role of Public Sector, Government Policy towards Public Sector, problems associated with Privatization, issues regarding Deregulation-Disinvestment and future of Economic Reforms

MODULE-3: THE ECONOMIC POLICY AND INFRASTRUCTURE DEVELOPMENT

- Energy and Transport
- Social Infrastructure- Education, Health and Gender related issues, Social Inclusion
- Issues and policies in Financing Infrastructure Development

- Indian Financial System- issues of Financial Inclusion, Financial Sector Reforms-review of Monetary Policy of R.B.I. Capital Market in India.

MODULE-4: THE ECONOMIC POLICY AND INDUSTRIAL SECTOR

- Industrial Sector in Pre-reforms period, Growth and Pattern of Industrialization
- Industrial Sector in Post-reform period- growth and pattern of Micro, Small, Medium Enterprises s, problems of India's Industrial Exports
- Labour Market- issues in Labour Market Reforms and approaches to Employment Generation Basic

REFERENCES

1. **Brahmananda, P.R. and V.A. Panchmukhi.[2001], Ed. 'Development Experience in Indian Economy, Inter-state Perspective,' Bookwell, New Delhi.**
2. **Gupta,S.P.[1989],'Planning and Development in India: A Critique,' Allied Publishers Private Limited, New Delhi.**
3. **Bhagwati, Jagdish.[2004],'In Defense of Globalization,' Oxford University**
4. **Dhingra, Ishwar //C.[2006],'Indian Economy,' Sultan Chand and Sons, New Delhi.**
5. **Datt, Ruddar and Sundaram, K.P.M.[Latest edition] ,'Indian Economy,' S. Chand and Co, New Delhi.**

CODE: PEC-IT-I-703

SUBJECT NAME: BASICS OF CLOUD COMPUTING

NO OF CREDITS: 3

B.TECH 7th SEMESTER	SESSIONAL: 25
L T P	THEORY EXAM: 75
3 0 0	TOTAL : 100

Course objectives: The student will learn how to apply

1. Trust-based security model to real-world security problems.
2. An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures.
3. Students will learn the basic Cloud types and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.

MODULE-1: INTRODUCTION TO CLOUD COMPUTING

Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing .

MODULE-2: CLOUD COMPUTING ARCHITECTURE

Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, CPU Virtualization, A discussion on Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model Cloud Deployment Models Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise .

MODULE-3: SECURITY ISSUES IN CLOUD COMPUTING

Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security Identity and Access Management Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management

MODULE-4: SECURITY MANAGEMENT IN THE CLOUD

Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS Privacy Issues Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations

MODULE-5: AUDIT AND COMPLIANCE

Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a-Cloud.

MODULE-6: DATA INTENSIVE COMPUTING

Map-Reduce Programming Characterizing Data-Intensive Computations, Technologies for Data-Intensive Computing, Storage Systems, Programming Platforms, MapReduce Programming, MapReduce Programming Model, Example Application

Course Outcomes:

After completion of course, students would be able to:

1. Identify security aspects of each cloud model
2. Develop a risk-management strategy for moving to the Cloud
3. Implement a public cloud instance using a public cloud service provider

REFERENCES:

1. Gautam Shroff, "Enterprise Cloud Computing Technology Architecture Applications", Cambridge University Press; 1 edition, [ISBN: 978-0521137355], 2010.
2. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, "Distributed and Cloud Computing: From parallel processing to IOT" Morgan Kaufmann Publishers; 1 edition [ISBN: 978-0-12-385880], 2012.

CODE: OEC-CS-702 (III)

SUBJECT NAME: OPTICAL NETWORK DESIGN

NO OF CREDITS: 3

B.TECH 7th SEMESTER		SESSIONAL:	25
L T P		THEORY EXAM:	75
3 0 0		TOTAL :	100

Course Objectives:

1. To make students familiar with SONET and SDH Architecture and add Drop Multiplexer.
2. To make students aware of wavelength division multiplexing techniques.
3. To introduce T-Carrier multiplexed hierarchy.
4. To introduce features of SONET and SDH.
4. To study about LDP protocol in detail

MODULE-1: INTRODUCTION TO OPTICAL NETWORKING

Introduction SONET/SDH and dense wavelength-division multiplexing (DWDM) , Add/drop multiplexers (ADMs), DWDM, CWDM, Time-Division Multiplexing, Synchronous TDMs, Statistical TDMs, Circuit Switched Networks, T-Carrier multiplexed Hierarchy, DS framing, DS multiframing formats, D4 Superframe, D5 extended superframe, E-Carrier multiplexed Hierarchy, TDM network elements, and Ethernet switching.

MODULE-2:SONET ARCHITECTURES

SONET integration of TDM signals, SONET electrical and optical signals, SONET Layers, SONET framing, SONET transport overhead, SONET alarms, multiplexing, virtual tributaries, SONET network elements, SONET topologies, SONET protection mechanisms, APS, two-fiber UPSR, DRI, and two-fiber and four-fiber BLSR rings. SPR,RPR

MODULE-3:SDH ARCHITECTURES

SDH integration of TDM signals, SDH electrical and optical signals, SDH Layers, SDH framing, SDH higher layer graming, SDH transport overhead, SDH alarms, multiplexing, virtual containers, SDH network elements, SDH topologies, SDH protection mechanisms, APS, 1+1 protection, 1:1protection, 1:N protection, Unidirection v/s bidirectionsl rings, Path and multiplex section switching, Subetwork Connection protection rings, DRI, and two-fiber and four-fiber Multiplex section-shared protection rings,

MODULE-4:WAVELENGTH-DIVISION MULTIPLEXING

Wavelength-division multiplexing principles, coarse wavelength-division multiplexing, dense wavelength-division multiplexing, WDM systems, WDM characteristics, impairments to transmission, and dispersion and compensation in WDM systems. Optical link design, factors affecting system design, point-to-point link based on Q-factor and OSNR, OSNR calculations for fiber amplifiers.

MODULE-5:LABEL DISTRIBUTION PROTOCOLS

The Label Distribution Protocol (LDP), Label Spaces, LDP Sessions, and Hello Adjacencies , The LDP PDU Format, The LDP Message Format, The LDP Messages, The Multi-Protocol Label Switching (MPLS) Architecture, Label Allocation Schemes, The Next Hop Label Forwarding Entry (NHLFE), Explicit Routing, An Example of the Use of the Label Stack, Schemes for Setting up an LSP

Course Outcomes:

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

1. SONET and SDH Architecture.
2. wavelength and time division multiplexing techniques.
3. SONET and SDH frames and their architectures
4. LDP protocol in detail.

REFERENCES

1. **"Optical Network Design and Implementation (Networking Technology)", by Vivek Alwayn, Cisco press**
2. **"Handbook of Fiber Optic Data Communication", Third Edition: A Practical Guide to Optical Networking by Casimer De Cusatis**

CODE: OEC-CS-702(IV)

SUBJECT NAME: HIGH SPEED NETWORK

NO OF CREDITS: 3

B.TECH 7th SEMESTER			SESSIONAL:	25
L	T	P	THEORY EXAM:	75
3	0	0	TOTAL :	100

Course Objectives:

1. To make the students familiar with High Speed Network technologies.
2. To make students aware of advantages and disadvantages of high speed technologies.
3. Study of techniques available for congestion control traffic management.
4. How to make congestion control in TCP and ATM.
5. To study integrated and differentiated services architecture.
6. Protocols for high speed communication

MODULE-1: HIGH SPEED NETWORKS

Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture, ATM logical Connection, ATM Cell – ATM Service Categories – AAL.High Speed LANs: Fast Ethernet, Gigabit Ethernet, Fiber Channel – Wireless LANs: applications, requirements – Architecture of 802.11

MODULE-2:CONGESTION AND TRAFFIC MANAGEMENT

Queuing Analysis- Queuing Models – Single Server Queues – Effects of Congestion – Congestion Control – Traffic management – Congestion Control in Packet Switching Networks – Frame Relay Congestion Control.

MODULE-3:TCP AND ATM CONGESTION CONTROL

TCP Flow control – TCP Congestion Control – Retransmission – Timer Management – Exponential RTO backoff – KARN's Algorithm – Window management – Performance of TCP over ATM. Traffic and Congestion control in ATM – Requirements – Attributes – Traffic Management Frame work, Traffic Control – ABR traffic Management – ABR rate control, RM cell formats, ABR Capacity allocations – GFR traffic management.

MODULE-4:INTEGRATED AND DIFFERENTIATED SERVICES

Integrated Services Architecture – Approach, Components, Services- Queuing Discipline, FQ, PS, BRFQ, GPS, WFQ – Random Early Detection, Differentiated Services

MODULE-5: PROTOCOLS FOR QOS SUPPORT

RSVP – Goals & Characteristics, Data Flow, RSVP operations, Protocol Mechanisms – Multiprotocol Label Switching – Operations, Label Stacking, Protocol details – RTP – Protocol Architecture, Data Transfer Protocol, RTCP.

Course outcomes:

1. Students will be able to understand basic high speed networks like Frame relay and ATM.
2. Students will be familiar with advantages and disadvantages of high speed network.
3. Students will be aware of congestion control traffic management techniques.
4. Students will be aware of TCP and ATM congestion control techniques.
5. To learn the functionality of integrated and differentiated services architecture.
6. Familiarity with various high speed protocols currently available.

REFERENCES

1. **William Stallings, "HIGH SPEED NETWORKS AND INTERNET", Pearson Educatin, Second Edition, 2002.**
2. **Warland& Pravin Varaiya, "HIGH PERFORMANCE COMMUNICATION NETWORKS", Jean Harcourt Asia Pvt. Ltd., II Edition, 2001.**
3. **IrvanPepelnjk, Jim Guichard and Jeff Apcar, "MLS and VPN architecture", Cisco Press, Volume1 and 2, 2003.**

DETAILED 4-YEAR CURRICULUM CONTENTS

Undergraduate Degree in Engineering & Technology

Branch/Course: COMPUTER ENGINEERING

VALUE ADDED COURSES

CODE:HSMC (H-102)

SUBJECT NAME: UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY

NO OF CREDITS: 0

B.TECH 5th SEMESTER	SESSIONAL: 50
L T P	THEORY EXAM: 50
2 1 0	TOTAL :100

Pre-requisites: None. Universal Human Values 1 (desirable)

Course Objectives:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act

Human Values Course

This course also discusses their role in their family. It, very briefly, touches issues related to their role in the society and the nature, which needs to be discussed at length in one more semester for which the foundation course named as "H-102 Universal Human Values 2: Understanding Harmony" is designed which may be covered in their III or IV semester. During the Induction Program, students' world get and initial exposure to human values through Universal Human Values –I. This exposure is to be augmented by this compulsory full semester foundation course.

Universal Human Values 2: Understanding Harmony

MODULE-1: COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority

5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

MODULE-2: UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

MODULE-3:UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY-HARMONY IN HUMAN – HUMAN RELATIONSHIP

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

MODULE-4:UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and selfregulation in nature
3. Understanding Existence as Co-existence of mutually interacting units in all pervasive space
4. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

MODULE-:5 IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
7. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Course Outcomes:
By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to

their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction. This is only an introductory foundational input. It would be desirable to follow it up by

a) faculty-student or mentor-mentee programs throughout their time with the institution
b) Higher level courses on human values in every aspect of living. E.g. as a professional

READINGS:

Text Book

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

REFERENCE BOOKS

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

ASSESSMENT

This is a compulsory non-credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:
Assessment by faculty mentor : 10 marks
Self –assessment : 10 marks
Assessment by peers : 10 marks
Socially relevant project/Group Activities/Assignments :20 marks
Semester End Examination : 50 marks

The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

DETAILED 4-YEAR CURRICULUM CONTENTS

Undergraduate Degree in Engineering & Technology

Branch/Course: COMPUTER ENGINEERING

AUDIT COURSES

CODE:AC02

SUBJECT NAME:MESSAGE OF BHAGWAT GITA

NO OF CREDITS: 0

B.TECH 6th SEMESTER SESSIONAL: 25

L T P THEORY EXAM: 75

2 1 0 TOTAL : 100

The value-added courses is for UG/PG students. It may be taught through digital aided learning/class room teaching. Its duration is 35 hours. Minimum 75% attendance is compulsory for students and its evaluation will be done by concerned Dept. through Viva-Voce examination.

Course Objectives:

To enable the students to create an awareness on Message of Bhagwat Gita to instill Moral, Social Values and to appreciate the Karma Yoga.

MODULE-1: Introduction: Relevance of Bhagavad Gita today- Background of Mahabharatha. Arjuna Vishada Yoda: Arjuna's Anguish and Confusion- Symbolism of Arjuna's Chariot. Sankhya Yoga: Imporance of Self-Knowledge- Deathlessness : Indestructibility of Consiousness- Being Established in Wisdom – Qualities of a Sthita-prajna.

MODULE-2: Karma Yoga: Yoga of Action – Living in the present- Dedicated Action without Anxiety over Results – Concept of Swadhrma, Dhyana Yoga: Tuning the Mind- Quantity, Quality and Direction of Thoughts- Reaching Inner Silence.

MODULE-3: Bhakti Yoga: Yoga of Devotion – Form and Formless Aspects of the Divine- Inner Qualities of a True Devotee, GanatrayaVibhaga Yoga: Dynamics of the Three Gunas: Tamas, Rajas, Sattva- Going Beyond the Three Gunas- Description of A Gunatheetha.

Course Outcomes:

Upon completion of the course, the student should be able to realize the Relevance of Bhagavad Gita today Yoga to devotion, realize the responsibilities and duty in the society.

REFERENCES

1. **Swami Chinmayananda, : The Holy Geeta", Central Chinmaya Mission Trust 2002.**
2. **Swami Chinmayananda, "A Manual of Self Unfordment", Central Chinmaya Mission Trust, 2001.**