BAPATLA ENGINEERING COLLEGE:: BAPATLA

(Autonomous)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Scheme
(w.e.f. 2020-2021)

4 Year B.Tech Program
of
Computer Science and Engineering

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

BAPATLA ENGINEERING COLLEGE :: BAPATLA

(AUTONOMOUS UNDER ACHARYA NAGARJUNA UNIVERSITY)
(SPONSORED BY BAPATLA EDUCATION SOCIETY)
BAPATLA - 522102 GUNTUR DISTRICT, A.P.
www.becbapatla.ac.in

BAPATLA ENGINEERING COLLEGE:: BAPATLA
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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISION

- To produce Computer Science Engineers with Global Standards who can handle the challenges of the society and industry with their innovations and services.

MISSION

- To impart high quality education with effective teaching and learning process.
- To provide an environment where the students can handle research problems confidently.
- To prepare the students with latest technologies with fidelity towards industry.
- To inculcate professional ethics and human values in handling the engineering challenges.

PROGRAM EDUCATIONAL OBJECTIVES

PEO1: Choose diverse professional careers in software industry, research, academia, engineering, and administrative services.

PEO2: Apply the principles of basic sciences, mathematics and computer science to solve real world problems using digital computing systems.

PEO3: Analyze, design, implement and evaluate robust, scalable and cost-effective computer-based systems and processes in the industry with sustained self learning.

PEO4: Be aware of professional and ethical practices in the context of social impacts of computing.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Transitory Regulations - R18 to R20 - Equivalence Subjects

R-20 1-1 SEM		R-18 1-1 SEM		SEM
20CS101/MA01	Linear algebra and differential equations	18MA001	Linear Algebra and ODE	1.1
20CS102/CY01	Engineering Chemistry	18CY001	Engineering Chemistry	1.1
20CS103/EL01	Communicative English	18EL001	Communicative English	1.1
20CS104/CS02	Introduction to Problem Solving	18MEL01	Engineering Graphics	1.1
20CSL102/CYL01	Chemistry Lab	18CYL01	Chemistry Lab	1.1
20CSL103/ELL01	English Communication skills Lab	18ELL01	English Communication Lab	1.1
20CSL101/CSL02	Fundamentals of Computer Lab	18MEL02	Workshop	1.1
20CS105/MC01	Environmental Studies	18CE001	Environmental Studies	1.1

R-20 1-2 SEM		R-18 1-2 SEM		SEM
20CS201/MA02	Numerical methods& Advanced Calculus	18MA002	Numerical methods and Advanced Calculus	1.2
20CS202/PH03	Semiconductor Physics	18PH001	Semiconductor Physics	1.2
20CS203/EE01	Basic Electrical & Electronics Engineering	18EE001	Basic Electronics & Electrical Engineering	1.2
20CS204/CS01	Programming for Problem Solving	18CS001	Problem Solving using Programming	1.2
20CS205	Digital Logic Design	18CS204	Digital Logic Design	1.2
20CS206	Discrete Mathematics	18CS303	Discrete Mathematics	2.1
20CSL201/PHL02	Semiconductor Physics Lab	18PHL01	Semiconductor Physics Lab	1.2
20CSL202/EEL01	Basic Electrical & Electronics Engineering Lab	18EEL01	Basic Electronics & Electrical Engineering Lab	1.2
20CSL203/CSL01	Programming for Problem Solving Lab	18CSL01	Problem Solving using Programming Lab	1.2

R-20 2-1 SEM		R-18 2-1 SEM		SEM
20CS301/MA03	Probability & Statistics	18MA003	Probability & Statistics	2.1
20CS302	Data Structures	18CS302	Data Structures	2.1

20CS303	Object Oriented Programming	18CS304	Object Oriented Programming	2.1
20CS304	Operating System	18CS305	Operating System	2.1
20CS305	Computer Organization	18CS404	Computer Organization	2.2
20CSL301/SO01	Linux Essentials	18CSL31	Unix Programming Lab	2.1
20CSL302	Data Structures Lab	18CSL32	Data Structures Lab	2.1
20CSL303	Object Oriented Programming Lab	18CSL33	OOPs Lab	2.1
20CS306/MC02	Professional Ethics & Human Values	18CS203	Professional Ethics & Human Values	1.2

R-20 2-2 SEM		R-18 2-2 SEM		SEM
20CS401	Microprocessor & Microcontrollers	18CS306	Microprocessor & Microcontrollers	2.1
20CS402	Web Technologies	18CS402	Web Technologies	2.2
20CS403	Database Management System	18CS403	Database Management System	2.2
20CS404	Design and Analysis of Algorithms	18CS406	Design and Analysis of Algorithms	2.2
20CS405/EL02	Technical English	18EL002	Technical English	2.2
20CSL401/SO02	Python Programming	18CSL41	Python Programming Lab	2.2
20CSL402	Web Technologies Lab	18CSL42	Web Technologies Lab	2.2
20CSL403	RDBMS Lab	18CSL43	RDBMS Lab	2.2

R-20 3-1 SEM		R-18 3-1 SEM		SEM
20CS501	Automata Theory & Formal Languages	18CS502	Automata Theory & Formal Languages	3.1
20CS502	Computer Networks	18CS504	Computer Networks	3.1
20CS503	Software Engineering	18CS501	Software Engineering	3.1
20CS504/PE_ _	Professional Elective - 1	18CSD1_	Department Elective-I	3.1
20CS505/JO_ _	Job Oriented Elective - 1	18CS503	Enterprise Programming	3.1
20CSL501/SO03	Soft Skills	18ELL02	Soft Skills Lab	3.1
20CSL502	Software Engineering Lab			
20CSL503	Job Oriented Elective-1 Lab	18CSL52	Enterprise Programming Lab	3.1
20CSL504 /INT01	Summer Internship			
20CS506/MC03	Essence of Indian Traditional Knowledge	18CS505	Essence of Indian Traditional Knowledge	3.1

R-20 3-2 SEM		R-18 3-2 SEM		SEM
20CS601	Compiler Design	18CS602	Compiler Design	3.2
20CS602	Machine Learning	18CS601	Machine Learning	3.2
20CS603	Cryptography & Network Security	18CS603	Cryptography & Network Security	3.2
20CS604/PE_ _	Professional Elective -2	18CSD3_	Department Elective-III	3.2
20CS605/JO_ _	Job Oriented Elective - 2	18CSD2_	Department Elective-II	3.2
20CSL601/SO04	Advanced Skill Oriented - 1			
20CSL602	Machine Learning Lab	18CSL61	Machine Learning Lab	3.2
20CSL603	Job Oriented Elective - 2 Lab	18CSLD2_	Department Elective-II LAB	3.2
20CS606/MC04	Constitution of India	18CS705	Constitution of India	4.1

R-20 4-1 SEM	R-18 4-1 SEM		SEM
The students have to continue with R18 regulation only	18CS701	Full Stack Development	4.1
	18CS702	Wireless Networks	4.1
	18_ _I_ _	Institutional Elective -I	4.1
	18CSD4_	Department Elective-IV	4.1
	18CS705	Constitution of India	4.1
	18CSL71	Unified Modeling Language Lab	4.1
	18CSL72	Full Stack Development Lab	4.1
	18CSLD4_	Dept. Elective-IV Lab	4.1
	18CSP01	Project - I	4.1
	18CSII1	Internship	4.1

R-20 4-2 SEM	R-18 4-2 SEM		SEM
The students have to continue with R18 regulation only	18ME005	Industrial Management & Entrepreneurship	4.2
	18_ _I_ _	Institutional Elective -II	4.2
	18CSD5_	Department Elective - V	4.2
	18CSP02	Project - II	4.2

List of Residual Subjects **to be completed by students** of R-18 Regulations who migrate into R-20 Regulations

R-18 Stream	R-20 Stream	Code	Subject Name
1-1 SEM	1-2 SEM	NIL	NIL
1-2 SEM	2-1 SEM	20CS206	Discrete Mathematics
2-1 SEM	2-2 SEM	20CS305	Computer Organization
2-2 SEM	3-1 SEM	20CSL504/INT01	Summer Internship
3-1 SEM	3-2 SEM	20CSL502	Software Engineering Lab
		20CSL504/INT01	Summer Internship
3-2 SEM	4-1 SEM	20CSL502	Software Engineering Lab
		20CSL504/INT01	Summer Internship
		20CSL601/SO04	Full stack Development Lab
		20CS606/MC04	Constitution of India
4-1, 4-2 SEM	The students have to continue with R18 regulation only		

Course Structure Summary

S.No	Category	Credits	% of Credits
1	Humanities & Social Science including Management Courses	10.5	6.5
2	Basic Science Courses	18	11.5
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	22.5	14.0
4	Professional Core Courses	48	23.5
5	Professional Elective Courses	12	7.5
6	Job Oriented/Open Elective Courses	16.5	10.5
7	Project work, seminar, and internship in industry or elsewhere	16.5	16.5
8	Skill Oriented Courses	16	10.0
9	Mandatory Courses [Environmental Science, PEHV, Indian Constitution, Essence of Indian Traditional Knowledge etc]	-	-
Total		**160**	**100**

Semester Wise Credits Summary

Semester	Credits	With Honor Credits
Semester-I	16.5	16.5
Semester-II	22.5	22.5
Semester-III	21.5	21.5
Semester-IV	21.5	25.5
Semester-V	21.5	25.5
Semester-VI	21.5	25.5
Semester-VII	23	27
Semester-VIII	12	16
Total	**160**	**180**

List of Abbreviations

CIE	Continuous Internal Evaluation
SEE	Semester End Examination
L	Lecture
T	Tutorial
P	Practical
BS	Basic Science Courses
HS	Humanities and Social science
ES	Engineering Science Courses
MC	Mandatory Course
NCC	National Cadet Corps
NSS	National Service Scheme
SO	Skill Oriented Elective
PC	Professional Core Course
PE	Professional Elective
JO	Job Oriented Elective
INT	Internship
OE	Open Elective
PW	Project Work
MOOC	Massive Open Online Course

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SCHEME OF INSTRUCTION & EXAMINATION (Semester System)
For
Computer Science & Engineering
First Year B.Tech (SEMESTER – I) structure as per APSCHE

Code No.	Category Code	Subject	Scheme of Instruction (Hours per week)				Scheme of Examination (Maximum marks)			No. of Credits
			L	T	P	Total	CIE	SEE	Total Marks	
20CS101/MA01	BS	Linear algebra and differential equations	2	1	0	3	30	70	100	3
20CS102/CY01	BS	Engineering Chemistry	3	0	0	3	30	70	100	3
20CS103/EL01	HS	Communicative English	3	0	0	3	30	70	100	3
20CS104/CS02	ES	Introduction to Problem Solving	2	0	2	4	30	70	100	3
20CSL102/CYL01	BS	Engineering Chemistry Lab	0	0	3	3	30	70	100	1.5
20CSL103/ELL01	HS	English Communication skills Lab	0	0	3	3	30	70	100	1.5
20CSL101/CSL02	ES	Fundamentals of Computer Lab	0	0	3	3	30	70	100	1.5
20CS105/MC01	MC	Environmental Studies	2	0	0	2	30	0	30	0
INDUCTION PROGRAM	First Three Weeks (Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Familiarization to Dept./Branch & Innovations)									
TOTAL			**12**	**1**	**11**	**24**	**240**	**490**	**730**	**16.5**

1 Hr. Lecture (L) per week - 1 credit
1 Hr. Tutorial (T) per week - 1 credit
1 Hr. Practical (P) per week - 0.5 credits
2 Hours Practical (Lab)/week - 1 credit

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SCHEME OF INSTRUCTION & EXAMINATION (Semester System)
For
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First Year B.Tech (SEMESTER – II)

Code No.	Category Code	Subject	Scheme of Instruction (Periods per week)				Scheme of Examination (Maximum marks)			No. of Credits
			L	T	P	Total	CIE	SEE	Total Marks	
20CS201/MA02	BS	Numerical methods& Advanced Calculus	2	1	0	3	30	70	100	3
20CS202/PH03	BS	Semiconductor Physics	3	0	0	3	30	70	100	3
20CS203/EE01	ES	Basic Electrical & Electronics Engineering	3	0	0	3	30	70	100	3
20CS204/CS01	ES	Problem Solving using Programming	2	1	0	3	30	70	100	3
20CS205	ES	Digital Logic Design	3	0	0	3	30	70	100	3
20CS206	ES	Discrete Mathematics	3	0	0	3	30	70	100	3
20CSL201/PHL02	BS	Semiconductor Physics Lab	0	0	3	3	30	70	100	1.5
20CSL202/EEL01	ES	Basic Electrical & Electronics Engineering Lab	0	0	3	3	30	70	100	1.5
20CSL203/CSL01	ES	Problem Solving using Programming Lab	0	0	3	3	30	70	100	1.5
NCC/NSS			0	0	3	3				0
TOTAL			**16**	**2**	**12**	**30**	**270**	**630**	**900**	**22.5**

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SCHEME OF INSTRUCTION & EXAMINATION (Semester System)
For
Computer Science & Engineering
Second Year B.Tech (SEMESTER – III)

Code No.	Category Code	Subject	Scheme of Instruction (Periods per week)				Scheme of Examination (Maximum marks)			No. of Credits
			L	T	P	Total	CIE	SEE	Total Marks	
20CS301/MA03	BS	Probability & Statistics	2	1	0	3	30	70	100	3
20CS302	PC	Data Structures	2	1	0	3	30	70	100	3
20CS303	PC	Object Oriented Programming	2	1	0	3	30	70	100	3
20CS304	PC	Operating Systems	3	0	0	3	30	70	100	3
20CS305	PC	Computer Organization	3	0	0	3	30	70	100	3
20CSL301/SO01	SO	Linux Essentials	2	0	3	5	30	70	100	3.5
20CSL302	PC	Data Structures Lab	0	0	3	3	30	70	100	1.5
20CSL303	PC	Object Oriented Programming Lab	0	0	3	3	30	70	100	1.5
20CS306/MC02	MC	Professional Ethics & Human Values	2	0	0	2	30	0	30	0
TOTAL			**16**	**3**	**9**	**28**	**270**	**560**	**830**	**21.5**

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SCHEME OF INSTRUCTION & EXAMINATION (Semester System)
For
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Second Year B.Tech (SEMESTER – IV)

Code No.	Category Code	Subject	Scheme of Instruction (Periods per week)				Scheme of Examination (Maximum marks)			No. of Credits
			L	T	P	Total	CIE	SEE	Total Marks	
20CS401	ES	Microprocessor & Microcontrollers	3	0	0	3	30	70	100	3
20CS402	PC	Web Technologies	3	0	0	3	30	70	100	3
20CS403	PC	Database Management System	3	0	0	3	30	70	100	3
20CS404	PC	Design and Analysis of Algorithms	2	1	0	3	30	70	100	3
20CS405/EL02	HS	Technical English	3	0	0	3	30	70	100	3
20CSL401/SO02	SO	Python Programming	2	0	3	5	30	70	100	3.5
20CSL402	PC	Web Technologies Lab	0	0	3	3	30	70	100	1.5
20CSL403	PC	RDBMS Lab	0	0	3	3	30	70	100	1.5
TOTAL			**16**	**1**	**9**	**26**	**240**	**560**	**800**	**21.5**
20CSM4_/ 20CSH4_	**Honors/Minor Course (Pool 1)**		**3**	**1**	**0**	**4**	**30**	**70**	**100**	**4**
Grand Total			**19**	**2**	**9**	**30**	**270**	**630**	**900**	**25.5**

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SCHEME OF INSTRUCTION & EXAMINATION (Semester System)
For
Computer Science & Engineering
Third Year B.Tech (SEMESTER – V)

Code No.	Category Code	Subject	Scheme of Instruction (Periods per week)				Scheme of Examination (Maximum marks)			No. of Credits
			L	T	P	Total	CIE	SEE	Total Marks	
20CS501	PC	Automata Theory & Formal Languages	2	1	0	3	30	70	100	3
20CS502	PC	Computer Networks	3	0	0	3	30	70	100	3
20CS503	PC	Software Engineering	3	0	0	3	30	70	100	3
20CS504/PE_ _	PE	Professional Elective - 1	3	0	0	3	30	70	100	3
20CS505/JO_ _	JO	Job Oriented Elective - 1	3	0	0	3	30	70	100	3
20CSL501/SO03	SO	Soft Skills	1	0	2	3	30	70	100	2
20CSL502	PC	Software Engineering Lab	0	0	3	3	30	70	100	1.5
20CSL503	JO	Job Oriented Elective-1 Lab	0	0	3	3	30	70	100	1.5
20CSL504 /INT01	INT	Summer Internship	0	0	0	0	0	0	0	1.5
20CS506/MC03	MC	Essence of Indian Traditional Knowledge	2	0	0	2	30	0	30	0
TOTAL			**17**	**1**	**8**	**26**	**270**	**560**	**830**	**21.5**
20CSM5_/ 20CSH5_	**Honors/Minor Course (Pool 2)**		**3**	**1**	**0**	**4**	**30**	**70**	**100**	**4**
Grand Total			**20**	**2**	**8**	**30**	**300**	**630**	**930**	**25.5**

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SCHEME OF INSTRUCTION & EXAMINATION (Semester System)
For
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Third Year B.Tech (SEMESTER – VI)

Code No.	Category Code	Subject	Scheme of Instruction (Periods per week)				Scheme of Examination (Maximum marks)			No. of Credits
			L	T	P	Total	CIE	SEE	Total Marks	
20CS601	PC	Compiler Design	3	0	0	3	30	70	100	3
20CS602	PC	Machine Learning	2	1	0	3	30	70	100	3
20CS603	PC	Cryptography & Network Security	3	0	0	3	30	70	100	3
20CS604/PE_ _	PE	Professional Elective -2	3	0	0	3	30	70	100	3
20CS605/JO_ _	JO	Job Oriented Elective - 2	3	0	0	3	30	70	100	3
20CSL601/SO_ _	SO	Advanced Skill Oriented - 1	2	0	3	5	30	70	100	3.5
20CSL602	PC	Machine Learning Lab	0	0	3	3	30	70	100	1.5
20CSL603	JO	Job Oriented Elective -2 Lab	0	0	3	3	30	70	100	1.5
20CS606/MC04	MC	Constitution of India	2	0	0	2	30	0	30	0
TOTAL			**18**	**1**	**9**	**28**	**270**	**560**	**830**	**21.5**
20CSM6_/ 20CSH6_	**Honors/Minor Course (Pool 3)**		**3**	**1**	**0**	**4**	**30**	**70**	**100**	**4**
Grand Total			**21**	**2**	**9**	**32**	**300**	**630**	**930**	**25.5**

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SCHEME OF INSTRUCTION & EXAMINATION (Semester System)
For
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Fourth Year B.Tech (SEMESTER – VII)

Code No.	Category Code	Subject	Scheme of Instruction (Periods per week)				Scheme of Examination (Maximum marks)			No. of Credits
			L	T	P	Total	CIE	SEE	Total Marks	
20CS701/PE_ _	PE	Professional Elective – 3 / MOOCs *	3	0	0	3	30	70	100	3
20CS702/PE_ _	PE	Professional Elective – 4 / MOOCs *	3	0	0	3	30	70	100	3
20CS703/JO_ _	JO	Job Oriented Elective - 3	3	0	0	3	30	70	100	3
20CS704/OE_ _	OE	Open Elective	3	0	0	3	30	70	100	3
20CS705/ME05	HS	Industrial Management & Entrepreneurship Development	3	0	0	3	30	70	100	3
20CSL701/SO_ _	SO	Advanced Skill Oriented - 2	2	0	3	5	30	70	100	3.5
20CSL702	JO	Job Oriented Elective – 3 Lab	0	0	3	3	30	70	100	1.5
20CSL703/ INT02	INT	Industrial/ Research Internship	0	0	0	0	0	0	0	3
TOTAL			**17**	**0**	**6**	**23**	**210**	**490**	**700**	**23**
20CSM7_/ 20CSH7_	**Honors/Minor Course (Pool 4)**		**3**	**1**	**0**	**4**	**30**	**70**	**100**	**4**
Grand Total			**20**	**1**	**6**	**27**	**240**	**560**	**800**	**27**

* For Professional Elective-3 and/or Professional Elective-4, a student can exercise the option of registering either to the department offered elective (classroom teaching) or any department approved MOOCs course by submitting MOOCs course registration application to the department.

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SCHEME OF INSTRUCTION & EXAMINATION (Semester System)
For
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Fourth Year B.Tech (SEMESTER – VIII)

Code No.	Category Code	Subject	Scheme of Instruction (Periods per week)				Scheme of Examination (Maximum marks)			No. of Credits
			L	T	P	Total	CIE	SEE	Total Marks	
20CS801/PW01	PW	Project Work	0	0	0	0	50	100	150	12
20CSM8_/ 20CSH8_	**Honors/Minor Courses (MOOCs - 1)**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
20CSM8_/ 20CSH8_	**Honors/Minor Courses (MOOCs - 2)**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
Grand Total			**0**	**0**	**0**	**0**	**50**	**100**	**150**	**16**

List of Professional Electives	
PE01	Wireless Networks
PE02	Data Warehousing & Data Mining
PE03	Distributed Systems
PE04	Artificial Intelligence
PE05	Block chain Technologies
PE06	Protocols for Secure Electronic Commerce
PE07	Artificial Neural Networks and Deep Learning
PE08	Natural Language Processing

List of Job Oriented Electives	
JO01	Enterprise Programming
	Enterprise Programming Lab
JO02	Mobile Application Development
	Mobile Application Development Lab
JO03	Cloud Programming
	Cloud Programming Lab
JO04	Cyber Security
	Cyber Security Lab
JO05	Internet of Things
	Internet of Things Lab
JO06	Big Data Analytics
	Big Data Analytics Lab

Skill Oriented Elective	
20CSL301/SO01	Linux Essentials
20CSL401/SO02	Python Programming
20CSL501/SO03	Soft Skills

Advanced Skill Oriented Elective	
SO04	Full Stack Development
SO05	DevOps
SO06	Robotic Process Automation

List of Subjects offered under Open Elective	
20CEOE01	Air Pollution and Control
20CEOE02	Remote Sensing and GIS
20CSOE01	Database Management System
20CSOE02	Java Programming
20ECOE01	Digital Image Processing
20EEOE01	Non-Conventional Energy Sources
20EEOE02	Electrical Energy Conservation and Auditing
20EIOE01	Sensors And Signal Conditioning
20ELOE01	Professional Communication
20ITOE01	Web Technologies
20ITOE02	Cyber Security
20MEOE01	Automobile Engineering
20MEOE02	Renewable Energy Sources
20PHOE01	Nano Materials
20PHOE02	Opto Electronic Devices and Applications
20PHOE03	Fiber Optic Communications

List of Subjects offered under Honors in CSE

Note: - Students must acquire 20 credits for the award of Honors in CSE.

i. 16 credits (04 courses@ 4 credits each) should be earned through the following list of courses.

ii. 4 credits (02 courses@ 2 credits each) must be acquired through two MOOCs from the following list of courses with a minimum duration of 8/12weeks.

iii. Before choosing those courses, students must complete prerequisites.

Code	List of HONOR Courses	Mode
A	Advanced Data Structures	Class Room
B	Advanced Computer Architecture	Class Room
C	Graph Theory	Class Room
D	Prompt Engineering & AI Tools	Class Room
E	Advanced Database Systems	Class Room
F	Real Time Operating Systems	Class Room
G	Parallel Processing	Class Room
H	Embedded Systems	Class Room
I	Web Mining	Class Room
J	High speed Networks	Class Room
K	Software Project Management	Class Room
L	Numerical Optimization	Class Room
M	Web Semantics	Class Room
N	Spatial Informatics	MOOC
O	Perception & Computer Vision	MOOC
P	Virtual Reality	MOOC
Q	Cloud Computing	MOOC
R	Computational Complexity	MOOC
S	Competitive Programming	MOOC
T	Realtime Systems	MOOC
U	Computer Vision and Image Processing fundamentals and applications	MOOC
V	Social Networks	MOOC
W	Ethical Hacking	MOOC

List of Subjects offered under Minor in CSE

Students must acquire 20 additional credits for the award of Minor in CSE.

i. 16 credits (04 courses@ 4 credits each) should be earned through the following pool.

ii. 04 credits (02 courses@ 2 credits each) must be acquired by two courses of the following list, through the MOOCs/NPTEL with a minimum duration of 8/12weeks.

iii. Before choosing the courses from Minor Pool, students must complete prerequisites.

MINOR Courses	
A	Computer System Architecture
B	Operating Systems
C	Data Structures using C
D	Object Oriented Programming using Java
E	Discrete Mathematics
F	Statistics with R
G	Design & Analysis of Algorithms
H	Database Management Systems
I	Software Engineering
J	Computer Networks
K	Web Application Programming
L	Artificial Intelligence

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Syllabus
(w.e.f. 2020-2021)

4 Year B.Tech Program
of
Computer Science and Engineering

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

BAPATLA ENGINEERING COLLEGE :: BAPATLA

(AUTONOMOUS UNDER ACHARYA NAGARJUNA UNIVERSITY)
(SPONSORED BY BAPATLA EDUCATION SOCIETY)
BAPATLA - 522102 GUNTUR DISTRICT, A.P.
www.becbapatla.ac.in

LINEAR ALGEBRA AND DIFFERENTIAL EQUATIONS
I B.Tech – I Semester (Code: 20CS101/MA01)

Lectures	:	2 Hours/Week, 1 Hour Tutorial	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- Learn about solving a system of linear homogeneous and non-homogeneous equations, finding the inverse of a given square matrix and also its Eigen values and Eigen vectors.
- Identify the type of a given differential equation and select and apply the appropriate Analytical technique for finding the solution of first order and higher order ordinary differential equations.
- Create and analyze mathematical models using first and second order differential equations to solve application problems that arises in engineering.
- To learn about solving linear Differential equations with constant coefficients with the given initial conditions using Laplace transform technique.

Course Outcomes: Students will be able to

CO-1	Find the eigen values and eigen vectors of a given matrix and its inverse.
CO-2	Apply the appropriate analytical technique to find the solution of a first order ordiniary differential equation.
CO-3	Solve higher order linear differential equations with constant coefficients arise in engineering applications.
CO-4	Apply Laplace transform to solve differential equations arising in engineering

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	3	2	-	2	-	-	-	-	-	-	2	-	3	-
CO-2	3	3	3	-	2	-	-	-	-	-	-	2	-	2	-
CO-3	3	3	3	-	-	-	-	-	-	-	-	2	-	2	-
CO-4	3	3	3	-	1	-	-	-	-	-	-	2	-	2	-

UNIT-1 12 Hours

Linear Algebra: Rank of a Matrix; Elementary transformations of a matrix; Gauss-Jordan method of finding the inverse;
Consistency of linear System of equations: Rouches theorem, System of linear Non-homogeneous equations, System of linear homogeneous equations; vectors; Eigen values; properties of Eigen values (without proofs); Cayley-Hamilton theorem (without proof).
[Sections: 2.7.1; 2.7.2; 2.7.6; 2.10.1; 2.10.2; 2.10.3; 2.12.1; 2.13.1; 2.14; 2.15.]

UNIT-2 12 Hours

Differential Equations of first order: Definitions; Formation of a Differential equation; Solution of a Differential equation; Equations of the first order and first degree; variables separable; Linear Equations; Bernoulli's equation; Exact Differential equations.
Equations reducible to Exact equations: I.F found by inspection, I.F of a Homogeneous equation, In the equation M dx+ N dy=0.

Applications of a first order Differential equations: Newton's law of cooling; Rate of decay of Radio-active materials. [Sections: 11.1; 11.3; 11.4; 11.5; 11.6; 11.9; 11.10; 11.11; 11.12.1; 11.12.2; 11.12.4; 12.6; 12.8]	
UNIT-3	12 Hours
Linear Differential Equations: Definitions; Theorem; Operator D; Rules for finding the complementary function; Inverse operator; Rules for finding the Particular Integral; Working procedure to solve the equation; Method of Variation of Parameters; **Applications of Linear Differential Equations:** Oscillatory Electrical Circuits. [Sections: 13.1; 13.2.1; 13.3; 13.4; 13.5; 13.6; 13.7;13.8.1;14.1;14.5]	
UNIT-4	12 Hours
Laplace Transforms: Definition; conditions for the existence; Transforms of elementary functions; properties of Laplace Transforms; Transforms of derivatives; Transforms of integrals; Multiplication by t^n; Division by t; Inverse transforms- Method of partial fractions; Other methods of finding inverse transforms; Convolution theorem(without proof); **Application to differential equations**: Solution of ODE with constant coefficients using Laplace transforms. [Sections:21.2.1; 21.2.2; 21.3; 21.4; 21.7; 21.8; 21.9; 21.10; 21.12; 21.13; 21.14; 21.15.1]	
Text Books :	B.S.Grewal, "Higher Engineering Mathematics", 44thedition, Khanna publishers, 2017.
References :	1. ErwinKreyszig, "Advanced Engineering Mathematics", 9th edition, John Wiley & Sons. 2. N.P.Bali and M.Goyal, "A Text book of Engineering Mathematics" Laxmi Publications, 2010.

ENGINEERING CHEMISTRY I B. Tech. – II Semester (Code: 20CS102/CY01)					
Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- With the principles of water characterization and treatment of water for industrial purposes and methods of producing water for potable purposes.
- To understand the thermodynamic concepts, energy changes, concept of corrosion & its control.
- With the conventional energy sources, solid, liquid and gaseous Fuels & knowledge of knocking and anti-knocking characteristics
- With aim to gain good knowledge of organic reactions, plastics, conducting polymers & biodegradable polymers.

Course Outcomes: Students will be able to

CO-1	Develop innovative methods to produce soft water for industrial use and potable water at cheaper cost
CO-2	Apply their knowledge in converting various energies of different systems and protection of different metals from corrosion
CO-3	Have the capacity of applying energy sources efficiently and economically for various needs.
CO-4	With aim to gain good knowledge of organic reactions, plastics, conducting polymers & biodegradable polymers

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	2	3	2	3	-	2	3	-	-	-	-	3	-	2	-
CO-2	2	3	2	3	-	2	3	-	-	-	-	3	2	-	-
CO-3	2	3	2	3	-	2	3	-	-	-	-	3	-	-	3
CO-4	2	3	3	3	-	2	3	-	-	-	-	3	2	-	-

UNIT-1 — 12 Hours

Introduction: water quality parameters
Characteristics: Alkalinity, Hardness **-** Estimation & simple numerical problems,
Boiler Troubles - Sludges, Scales, Caustic embrittlement, boiler corrosion, Priming and foaming;
Internal conditioning- phosphate, calgon and carbonate methods.
External conditioning - Ion exchange process & Zeolite process WHO Guidelines, Potable water, Sedimentation, Coagulation, Filtration.
Disinfection methods: Chlorination, ozonization and UV treatment.
Salinity – Treatment of Brackish water by Reverse Osmosis and Electrodialysis.

UNIT-2 — 12 Hours

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications.
Corrosion: Types of corrosion - Chemical or dry corrosion, Electrochemical or wet corrosion; Galvanic, stress, pitting and differential aeration corrosion; Factors effecting corrosion, **Corrosion control** – Cathodic protection, and electro plating (Au) & electrodes Ni plating.

UNIT-3	12 Hours
Fuels: Classification of fuels; Calorific value of fuels (lower, higher) **Solid fuels**: Determination of calorific value (Bomb Calorimeter) & related problems, Coal ranking. **Liquid Fuels:** Petroleum refining and fractions, composition and uses. Knocking and anti- knocking Agents, Octane number and Cetane number; Bio fuels- Biodiesel, general methods of preparation and advantages **Gaseous fuels:** CNG and LPG, **Flue gas analysis –** Orsat apparatus.	
UNIT-4	12 Hours
Organic reactions and synthesis of a drug molecule Introduction to reactions involving substitution (SN^1, SN^2), addition (Markownikoff's and anti-Markwnikoff's rules) , elimination (E_1& E_2), Synthesis of a commonly used drug molecule.(Aspirin and Paracetamol) **Polymers:** Conducting polymers: Classification, Intrinsic and Extrinsic conducting polymers and their applications**.** Plastics: Thermoplasts and thermosetting plastics, Bskelite and PVC. Bio degradable polymers: types, examples-Polyhydroxybuterate (PHB), Polyhydroxybuterate-co-β-hydroxyvalerate (PHBV), applications.	
Text Books :	1. P.C. Jain and Monica Jain, "Engineering Chemistry" DhanpatRai Pub, Co., New Delhi 17th edition (2017). 2. SeshiChawla, "Engineering Chemistry" DhanpatRai Pub, Co LTD, New Delhi 13 th edition, 2013.
References :	1. Essential of Physical Chemistry by ArunBahl, B.S. Bahl, G.D.Tuli, by ArunBahl, B.S. Bahl, G.D.Tuli, Published by S Chand Publishers, 12th Edition, 2012. 2. Engineering Chemistry by C.P. Murthy, C.V. Agarwal, A. Naidu B.S. Publications, Hyderabad (2006). 3. Engineering Chemistry by K. Maheswaramma, Pearson publishers 2015.

COMMUNICATIVE ENGLISH

I B. Tech. – I Semester (Code: 20CS103/EL01)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- To comprehend the importance, barriers and strategies of listening skills in English.
- To illustrate and impart practice Phonemic symbols, stress and intonation.
- To practice oral skills and receive feedback on learners' performance.
- To practice language in various contexts through pair work, role plays, group work and dialogue conversations

Course Outcomes: Students will be able to

CO-1	Understand how to build academic vocabulary to enrich their writing skills
CO-2	Produce accurate grammatical sentences
CO-3	Analyse the content of the text in writing
CO-4	Produce coherent and unified paragraphs with adequate support and detail

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	-	-	-	-	-	-	-	2	-	3	2	2	-	2	1
CO-2	-	-	-	-	-	-	-	2	-	3	2	2	-	2	1
CO-3	-	-	-	-	-	-	-	2	-	3	2	2	-	2	1
CO-4	-	-	-	-	-	-	-	2	-	3	2	2	-	2	1

UNIT-1 12 Hours

1.1 **Vocabulary Development:** Word formation-Formation of Nouns, Verbs & Adjectives from Root words-Suffixes and Prefixes
1.2 **Essential Grammar:** Prepositions, Conjunctions, Articles
1.3 **Basic Writing Skills:** Punctuation in writing
1.4 **Writing Practices:** Mind Mapping, Paragraph writing (structure-Descriptive, Narrative, Expository & Persuasive)

UNIT-2 12 Hours

2.1 **Vocabulary Development:** Synonyms and Antonyms
2.2 **Essential Grammar:** Concord, Modal Verbs, Common Errors
2.3 **Basic Writing Skills**: Using Phrases and clauses
2.4 **Writing Practices**: Hint Development, Essay Writing

UNIT-3 12 Hours

3.1 **Vocabulary Development:** One word Substitutes
3.2 **Essential Grammar:**Tenses, Voices
3.3 **Basic Writing Skills:** Sentence structures (Simple, Complex, Compound)
3.4 **Writing Practices:** Note Making

UNIT-4	12 Hours
4.1 **Vocabulary Development**: Words often confused 4.2 **Essential Grammar**: Reported speech, Common Errors 4.3 **Basic Writing Skills**: Coherence in Writing: Jumbled Sentences **Writing Practices**: Paraphrasing &Summarizing	
Text Books :	1. Communication Skills, Sanjay Kumar &PushpaLatha. Oxford University Press:2011. 2. Practical English Usage, Michael Swan. Oxford University Press:1995. 3. Remedial English Grammar, F.T.Wood. Macmillan:2007. 4. Study Writing, Liz Hamplyons & Ben Heasley. Cambridge University Press:2006

INTRODUCTION TO PROBLEM SOLVING I B.Tech – I Semester (Code: 20CS104/CS02)					
Lectures	:	2T + 2P / Week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None

UNIT-1	(15 Hours)

Introduction to components of a computer system: Memory, processor, I/O Devices, storage.

Software: system software, application software, computer classifications, generation of computer.

Procedure: steps involved in problem solving, Algorithm, Steps involved in algorithm development. Flow Chart, Advantages of Flowcharts, Symbols used in Flow Charts, Simple problems using flow chart, pseudo code method.

UNIT-2	(15 Hours)

Fundamental algorithms: exchange the values of two variables, counting, summation of a set of numbers, factorial computation, sine function computation, generation of the Fibonacci sequence, reverse the digits of an integer, base conversion, charter to number conversion.

UNIT-3	(15 Hours)

Factoring methods: finding the square root of a number, the smallest divisor of an integer, the greatest common divisor of two integers, generate prime numbers, computing the prime factors of an integer, generation of pseudo-random numbers, raising a number to a large power.

UNIT-4	(15 Hours)

Array Techniques: array order reversals, remove of duplicates from an order array, finding the Kth smallest element, finding the kth largest element and higher dimensional arrays.

Efficiency of algorithm: redundant computation, referencing array elements, inefficiency duo to late termination, early detection of desired output conditions, trading storage for efficiency gain.

Analysis of algorithms: computational complexity, order notation, best, worst and average case behavior.

Text Books :	How to Solve it by Computer, R.G. Dromey, First Edition, 2006, Pearson.

ENGINEERING CHEMISTRY LAB
I B.Tech – II Semester (Code: 20CSL102/CYL01)

Practicals	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- With the principles of water characterization and treatment of water for industrial purposes and methods of producing water for potable purposes.
- To understand the thermodynamic concepts, energy changes, concept of corrosion & its control.
- With the conventional energy sources, solid, liquid and gaseous Fuels & knowledge of knocking and anti-knocking characteristics
- With aim to gain good knowledge of organic reactions, plastics, conducting polymers & biodegradable polymers.

Course Outcomes: Students will be able to

CO-1	Develop innovative methods to produce soft water for industrial use and able to solve the industrial problems
CO-2	the students will be familiar with applications of polymers in domestic and engineering areas & the most recent surface characterization techniques
CO-3	Have the capacity of classifying fuels, their calorific value determination and applying energy sources efficiently and economically for various needs.
CO-4	Explain features, classification, applications of newer class materials like smart materials, refrocteries, abbrasives, lubriants and composite materials etc.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	2	-	-	-	-	-	-	-	3	2	-	-	2	-	-
CO-2	2	2	2	2	-	2	-	-	3	2	-	1	-	-	-
CO-3	2	2	2	2	-	2	-	-	3	2	-	1	1	-	-
CO-4	2	2	2	2	-	-	-	-	3	2	-	1	-	-	-

LIST OF EXPERIMENTS

1. Introduction to Chemistry Lab (the teachers are expected to teach fundamentals like Calibration of Volumetric Apparatus, Primary, Secondary Solutions, Normality, Molarity, Molality etc. and error, accuracy, precision, theory of indicators, use of volumetric titrations).

2. **Volumetric Analysis:**
   a. Estimation of Washing Soda.
   b. Estimation of Active Chlorine Content in Bleaching Powder
   c. Estimation of Mohr's salt by permanganometry.
   b. Estimation of given salt by using Ion-exchange resin using Dowex-50.

3. **Analysis of Water**:
   a. Determination of Alkalinity of Tap water.
   b. Determination of Total Hardness of ground water sample by EDTA method
   c. Determination of Salinity of water sample.

4. **Estimation of properties of oil:**
   a. Estimation of Acid Value
   b. Estimation of Saponification value.

5. **Preparations:**
   a. Preparation of Soap
   b. Preparation of Urea-formaldehyde resin
   c. Preparation of Phenyl benzoate.

Text Books :	1. Practical Engineering Chemistry by K.Mukkanti, Etal, B.S. Publicaitons, Hyderabad, 2009. 2. Inorganic quantitative analysis, Vogel, 5th edition, Longman group Ltd. London, 1979.
References :	1. Text Book of engineering chemistry by R.n. Goyal and HarrmendraGoel. 2. A text book on experiments and calculations- Engineering Chemistry. S.S. Dara. 3. Instrumental methods of chemical analysis, Chatwal, Anand, Himalaya Publications.

ENGLISH COMMUNICATION SKILLS LAB
I B. Tech. – I Semester (Code: 20CSL103/ELL01)

Practicals	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- To comprehend the importance, barriers and strategies of listening skills in English.
- To illustrate and impart practice Phonemic symbols, stress and intonation.
- To practice oral skills and receive feedback on learners' performance.
- To practice language in various contexts through pair work, role plays, group work and dialogue conversations

Course Outcomes: Students will be able to

CO-1	Better understand the nuances of English language through audio- visual experience and group activities
CO-2	Develop neutralization of accent for intelligibility
CO-3	Build confidence to enhance their speaking skills
CO-4	Use effective vocabulary both in formal and informal situations

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	-	-	-	-	-	-	-	-	3	3	2	2	-	2	1
CO-2	-	-	-	-	-	-	-	-	2	3	2	2	-	2	1
CO-3	-	-	-	-	-	-	-	-	3	3	2	2	-	2	1
CO-4	-	-	-	-	-	-	-	-	3	3	2	2	-	2	1

1.1 Listening Skills; Importance – Purpose- Process- Types
1.2 Barriers to Listening
1.3 Strategies for Effective Listening

2.1 Phonetics; Introduction to Consonant, Vowel and Diphthong sounds
2.2 Stress
2.3 Rhythm
2.4 Intonation

3.1Formal and Informal Situations
3.2 Expressions used in different situations
3.3 Introducing Yourself & Others-Greeting & Parting-Congratulating-Giving Suggestions & Advices-Expressing Opinions-Inviting People-Requesting-Seeking Permission-Giving Information- Giving Directions- Sympathizing- Convincing People- Complaining & Apologizing-Thanking Others- Shopping- Travelling- Conversational Gambits

4.1 JAM Session
4.2 Debates
4.3 Extempore

Text Books :	1. Communication Skills, Sanjay Kumar and Pushpa Lata. Oxford University Press. 2011 2. Better English Pronunciation, J.D. O' Connor. Cambridge University Press:1984 3. New Interchange (4rth Edition), Jack C Richards. Cambridge University Press:2015 4. English Conversation Practice, Grant Taylor. McGraw Hill:2001
Software:	1. Buzzers for conversations, New Interchange series 2. English in Mind series, Telephoning in English 3. Speech Solutions, A Course in Listening and Speaking

FUNDAMENTALS OF COMPUTER LAB I B.Tech – I Semester (Code: 20CSL101/CSL02)					
Practicals	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None.

LIST OF EXPERIMENTS

Experiment 1: Computer Hardware Basics: PC Hardware introduces the students to a personal computer and its basic peripherals, the process of assembling a personal computer, installation of system software like MS Windows, Linux and the required device drivers. In addition, hardware and software level troubleshooting process, tips and tricks would be covered.
Every student should identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor. Every student should disassemble and assemble the PC back to working condition.

Experiment 2: Installation of Software: Every student should individually install operating system like Linux or MS windows on the personal computer. The system should be configured as dual boot with both windows and Linux.

Experiment 3: Hardware Troubleshooting: Students have to be given a PC which does not boot due to improper assembly or defective peripherals. They should identify the problem and fix it to get the computer back to working condition.

Experiment 4: Software Troubleshooting: Students have to be given a malfunctioning CPU due to system software problems. They should identify the problem and fix it to get the computer back to working condition.

Experiment 5: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally students should demonstrate how to access the websites and email.

Experiment 6: Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured. Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. Usage of search engines like Google, Yahoo, ask.com and others should be demonstrated by student.

Experiment 7: Cyber Hygiene: Students should learn about viruses on the internet and install antivirus software. Student should learn to customize the browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

Experiment 8: Drawing flowcharts (Raptor Tool): Students should draw flowcharts for the problems validating an email id entered by user, printing first fifty numbers and preparing electricity bill.

Experiment 9: Productivity tool: Microsoft (MS) office: Importance of MS office, Details of the three tasks and features that should be covered in each, MS word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter. Formatting Styles, Inserting table,

Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

Experiment 10: Practice with MS Word to create project certificate: Features to be covered: - Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colours, Inserting Header and Footer, Using Date and Time option in Word.

Experiment 11: Orientation on Spread sheet: Accessing, overview of toolbars, saving spreadsheet files, Using help and resources. Creating a Scheduler: - Gridlines, Format Cells, Summation, auto fill, Formatting Text

Experiment 12: Creating Power Point: Student should work on basic power point utilities and tools in Ms Office which help them create basic power point presentation. PPT Orientation, Slide Layouts, Inserting Text, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows, Hyperlinks, Inserting Images, Tables and Charts.

Text Books :	1. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education. 2. Comdex Information Technology course tool kit Vikas Gupta, WILEY Dreamtech. 3. Computer Fundamentals, l e, Anita Goel, Person Education.
References :	1. IT Essentials PC Hardware and Software Companion Guide Third Edition by David Anfinson and Ken Quamme. – CISCO Press, Pearson Education.

ENVIRONMENTAL STUDIES
I B. Tech. – I Semester (Code: 20CS105/MC01)

Lectures	:	2 Hours/Week	Continuous Assessment	:	30
Final Exam	:	---	Final Exam Marks	:	---

Pre-Requisite: None.

Course Objectives: Students will be able to

- To develop an awareness, knowledge, and appreciation for the natural environment.
- To understand different types of ecosystems exist in nature.
- To know our biodiversity.
- To understand different types of pollutants present in Environment.
- Create awareness among the youth on environmental concerns important in the long-term interest of the society

Course Outcomes: Students will be able to

CO-1	Develop an appreciation for the local and natural history of the area.
CO-2	Hope for the better future of environment in India which is based on many positive factors like Biodiversity, successive use of renewable energy resources and other resources, increasing number of people's movements focusing on environment.
CO-3	Know how to manage the harmful pollutants. Gain the knowledge of Environment.
CO-4	Create awareness among the youth on environmental concerns important in the long-term interest of the society

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	-	-	-	-	-	2	2	-	1	1	-	2	-	-	-
CO-2	-	-	-	-	-	2	2	-	2	1	-	1	-	-	-
CO-3	-	-	-	-	-	3	3	1	2	3	2	1	-	-	-
CO-4	-	-	-	-	-	1	2	1	2	1	-	3	-	-	-

UNIT-1 — 8 Hours

Introduction: Definition, Scope and Importance, Need for public awareness. Ecosystems: Definition, Structure and Functions of Ecosystems, types - Forest, Grassland, Desert, Aquatic (Marine, pond and estuaries).

Biodiversity: Definition and levels of Biodiversity; Values of Biodiversity - Consumptive, Productive, Social, Aesthetic, Ethical and Optional; Threats and Conservation of Biodiversity; Hot Spots of Biodiversity, Bio-geographical Classification of India, India as a mega diversity nation. Chipko movement case study

UNIT-2 — 8 Hours

Natural resources: Land: Land as a resource, Causes and effects of land degradation - Soil erosion, Desertification. **Forest**: Use of forests, Causes and effects of deforestation, Afforestation, Mining - benefits and problems. **Water**: Uses, floods and drought, Dams - benefits and problems.
Energy: Importance of energy, Environmental Impacts of Renewable and Non-renewable energy resources. Silent Valley Project and Narmada BachaoAndolan case studies
Sustainability: Definition, Concept and Equitable use of resources for sustainable development; Rain water harvesting and Watershed management. Fieldwork on Rain water harvesting and Watershed management.

UNIT-3	8 Hours

Pollution: Definition; Causes, effects and control of air, water and nuclear pollution; Chernobyl Nuclear Disaster case study; Solid Waste: urban, Industrial and hazardous wastes; Integrated waste management - 3R approach, composting and vermicomposting.
Environmental acts: Water and air (Prevention and Control of pollution) acts, Environmental protection act, Forest Conservation act.

UNIT-4	8 Hours

Environmental issues: Green House effect & Global warming, Ozone layer depletion, Acid rains, Green Revolution, Population Growth and environmental quality, Environmental Impact Assessment. Environmental Standards (ISO 14000, etc.)
Case Studies: Bhopal Tragedy, Mathura Refinery and TajMahal, and Ralegan Siddhi (Anna Hazare).

Field work: Visit to a local area to document environmental assets – Pond/Forest/Grassland. Visit to a local polluted site- Urban and industry/ Rural and Agriculture.

Text Books :	1. "Environmental Studies" by Benny Joseph, Tata McGraw-Hill Publishing Company Limited, New Delhi. 2. "Comprehensive environmental studies"- JP Sharma, Laxmi Publications. 3. Text Book of environmental Studies – ErachBharucha
References :	1. "Environmental studies", R.Rajagopalan, Oxford University Press. 2. "Introduction to Environmental Science", Anjaneyulu Y, B S Publications 3. "Environmental Science", 11th Edition – Thomson Series – By Jr. G. Tyler Miller.

NUMERICAL METHODS AND ADVANCED CALCULUS
I B. Tech. – II Semester (Code: 20CS201/MA02)

Lectures	:	2 Hours/Week, 1 Hour Tutorial	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- To learn about some advanced numerical techniques e.g. solving a non-linear equation
- linear system of equations, Interpolation and Approximation techniques
- To learn about evaluation of double and triple integrals and their applications
- To learn some basic properties of scalar and vector point functions and their applications to line, surface and volume integrals.

Course Outcomes: Students will be able to

CO-1	Solve non-linear equations and system of linear equations with the help of Numerical techniques.
CO-2	Solve the first order ordinary differential equations numerically with the given initial condition.
CO-3	Find the area and volume of plane and three dimensional figures using multiple integrals.
CO-4	Apply vector integral theorems to obtain the solutions of engineering problems involving circulation, flux, and divergence in vector fields.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	3	2	2	-	-	-	-	-	-	-	2	-	3	-
CO-2	3	3	2	2	-	-	-	-	-	-	-	2	-	3	-
CO-3	3	3	2	1	2	-	-	-	-	-	-	2	-	2	-
CO-4	3	3	2	1	2	-	-	-	-	-	-	2	-	3	-

UNIT-1 12 Hours

Numerical Solution of Equations: Introduction; Solution of algebraic and transcendental equations: Bisection method, Method of false position, Newton-Raphson method; Useful deductions from the Newton-Raphson formula; Solution of linear simultaneous equations; Direct methods of solution: Gauss elimination method, Gauss-Jordan method, Factorization method; Iterative methods of solution: Jacobi's iterative method, Gauss-Seidel iterative method.

[Sections: 28.1; 28.2; 28.3; 28.5; 28.6; 28.7.1;28.7.2].

UNIT-2 12 Hours

Finite differences and Interpolation: Finite differences: Forward differences, Backward differences; Newton's interpolation formulae: Newton's forward interpolation formula, Newton's backward interpolation formula; Interpolation with unequal intervals; Lagrange's interpolation formula; Divided differences; Newton's divided difference formula; Numerical integration; Trapezoidal rule; Simpson's one-third rule; Simpson's three-eighth rule; Numerical solution of ODE's: Introduction; Picard's method; Euler's method; Runge-Kutta method.

[Sections:29.1; 29.1-1; 29.1.2; 29.6; 29.9; 29.10; 29.11; 29.12; 30.4; 30.6; 30.7; 30.8; 32.1; 32.2; 32.4; 32.7].	
UNIT-3	12 Hours
Multiple Integrals: Double integrals; Change of order of integration; Double integrals in polar coordinates; Area enCOsed by plane curves; Triple integrals; Volumes of solids: Volume as Triple integrals, Change of variables. [Sections: 7.1; 7.2; 7.3; 7.4; 7.5; 7.6.2; 7.7.2].	
UNIT-4	12 Hours
Vector calculus and its Applications: Scalar and vector point functions; Del applied to scalar point functions-Gradient: Definition, Directional derivative; Del applied to vector point functions: Divergence, Curl; Line integral; Surfaces: Surface integral, Flux across a surface; Green's theorem in the plane (without proof); Stokes theorem (without proof); Gauss divergence theorem (without proof). [Sections: 8.4; 8.5.1; 8.5.3; 8.6; 8.11; 8.12; 8.13; 8.14; 8.16]	
Text Books :	1. B.S.Grewal, "Higher Engineering Mathematics", 44thedition, Khanna publishers, 2017.
References :	1. ErwinKreyszig, "Advanced Engineering Mathematics", 9th edition, John Wiley & Sons. 2. N.P.Bali and M.Goyal, "A Text book of Engineering Mathematics" Laxmi Publications, 2010.

SEMICONDUCTOR PHYSICS
I B. Tech. - I semester (Code: 20CS202/PH03)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Objectives: Students will be able to

- This unit aim to build the foundation and inspires interest of freshmen into electrical and electronics and to focus on fundamental concepts and basic principles regarding electrical conduction.
- This unit provides various properties of semiconductor materials and their importance in various device fabrications
- This unit aim to educate the student on various opto-electronic devices and their applications.
- This unit provide information about the principles of processing, manufacturing and characterization of nano materials, nanostructures and their applications

Course Outcomes: Students will be able to

CO-1	Recognize the concepts of hole, effective mass of the electron in semiconductors, and band structure of solids.
CO-2	Know the concept of Fermi level and various semiconductor junctions.
CO-3	Knowledge the principles of operation and applications of various opto-electronic devices.
CO-4	Recognize the significance of nanomaterials and their distinctive features.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	2	2	-	1	-	-	-	-	-	-	-	-	-	-	-
CO-2	3	1	2	2	-	-	-	-	-	-	-	-	2	-	-
CO-3	3	2	2	-	2	-	-	-	-	-	-	-	2	-	-
CO-4	3	2	2	-	2	-	-	-	-	-	-	-	2	-	-

UNIT-1 12 Hours

ELECTRONIC MATERIALS:
Somerfield free electron theory, Fermi level and energy, density of states, Failure of free electron theory (Qualitative), Energy bands in solids, E-K diagrams, Direct and Indirect band gaps. Types of Electronic materials: Metals, Semi conductors and Insulators, Occupation Probability, effective mass, Concept of hole

UNIT-2 12 Hours

SEMICONDUCTORS:
Introduction to semiconductors, intrinsic and extrinsic semiconductors, carrier concentrations, Fermi level and temperature dependence, Continuity equation, Diffusion and drift, P-N junction (V-I characteristics), Metal – Semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for opto- electronic devices.

UNIT-3 12 Hours

OPTO-ELECTRONIC DEVICES AND DISPLAY DEVICES:

Photo voltaic effect, principle and working of LED, Applications of Photo diode, Solar cell, PIN & APD Diode, Liquid crystal display, Opto electric effect: Faraday Effect and Kerr effect.

UNIT-4	12 Hours

NANO-MATERIALS:

Introduction to nano technology, quantum confinement, surface to volume ratio, properties of nano materials, synthesis of nano-materials: CVD, sol-gel methods, laser ablation.

Carbon nano tubes: types, properties, applications. Characterization of nano materials: XRD, SEM, applications of nano materials.

Text Books :	1. A text book of engineering physics by Avadhanulu and KshirsagarS.Chand& Co. (2013) 2. Applied physics by Dr.*P.SrinivasaRao*. Dr.K.*Muralidhar* 3. Introduction to solid state state physics, Charles Kittel, 8th edition 4. Solid state physics, S.O. Pillai
References :	1. Text book on Nanoscience and Nanotechnology (2013): B.S. Murty, P. Shankar, Baldev Raj, B.B. Rath and J. Murday, Springer Science & Business Media. 2. Basic Engineering Physics ,Dr.*P.SrinivasaRao*. Dr.K.*Muralidhar.* Himalaya Publications, 2016

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING
I B. Tech. – I Semester (Code: 20CS203/EE01)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- To understand basic Laws in circuits, analysis of simple DC circuits, Theorems and its applications, fundamentals of AC circuits & its analysis and concepts of three phase balanced circuits
- To learn basic properties of magnetic materials and its applications.
- To understand working principle, construction, applications and performance of DC machines, AC machines.
- To learn basic concepts, working principal, characteristics and applications of semiconductor diode and transistor family.
- To gain knowledge about the static converters and regulators.
- To learn basic concepts of power transistors and operational amplifiers closer to practical applications.

Course Outcomes: Students will be able to

CO-1	Solve problems involving with DC and AC excitation sources in electrical circuits.
CO-2	Compare properties of magnetic materials and its applications
CO-3	Analyze construction, principle of operation, application and performance of DC machines and AC machines.
CO-4	Explore characteristics and applications of semiconductor diode and transistion family.
CO-5	Make the static converters and regulators
CO-6	Analyze concepts of power transistors and operational amplifiers closer to practical applications

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	-	-	2	2	-	-	-	-	-	-	-	3	2	-
CO-2	3	2	-	1	-	-	-	-	-	-	-	-	3	3	-
CO-3	3	3	-	2	1	-	-	-	-	-	-	-	3	2	-
CO-4	3	2	2	-	-	-	-	-	-	-	-	-	2	1	-
CO-5	2	2	-	-	-	-	-	-	-	-	-	-	3	2	-
CO-6	2	1	-	2	-	-	-	-	-	-	-	-	2	3	-

UNIT-1 12 Hours

Electrical Circuits

Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation.Superposition, Thevenin and Norton Theorems. Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase AC circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-2	12 Hours
Electrical Machines Magnetic materials, BH characteristics, Construction, working of DC machines, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency.Auto-transformer and three-phase transformer connections.Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor.Single-phase induction motor.Construction and working of synchronous generators.	
UNIT-3	12 Hours
Semiconductor Diodes and applications Semiconductor materials, semiconductor diode, Resistance levels, Diode equivalent circuits, Zener diode, Light emitting diode, Load line analysis, half wave rectification, Full wave rectification, Bridge rectifier, Use of capacitor filter in rectifier, Zener diode voltage regulator, Clippers, Clampers **Bipolar Junction Transistors** Transistor construction and operation, Common base configuration, Transistor amplifying action, Common emitter configuration, Common collector configuration, Limits of operation. DC load line and bias point, Voltage divider bias of transistor.	
UNIT-4	12 Hours
Field Effect Transistors Construction and characteristics of JFET and MOSFET **Operational Amplifiers** Introduction, Differential and common mode operation, OP-AMP Basics, Practical OP-AMP circuits: Inverting amplifier, Non inverting amplifier, Unity follower, summing amplifier, Integrator and differentiator	
Text Books :	1. S.K. Bhattacharya, "Basic Electrical and Electronics Engineering", Pearson Publications 2. Robert L. Boylestad& Louis Nashelsky, ' Electronic Devices and circuit theory', PHI Pvt.Limited, 11th edition 3. "Basics of Electrical and Electronics Engineering", Nagsarkar T K and Sukhija M S, Oxford press University Press.
References :	1. David A. Bell, 'Electronic Devices and Circuits', oxford publisher,5th edition 2. "Basic Electrical, Electronics and Computer Engineering", Muthusubramanian R, Salivahanan S and Muraleedharan K A, Tata McGraw Hill, Second Edition, (2006).

PROBLEM SOLVING USING PROGRAMMING

I B.Tech – II Semester (Code: 20CS204/CS01)

Lectures	:	3 Hours/Week, 1 Hour Tutorial	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite:

Course Objectives: Students will be able to

- Understand basic concepts of C Programming such as: C-tokens, Operators, Input/output, Arithmetic rules.
- Develop problem-solving skills to translate "English" described problems into Programs written using C language.
- Use Conditional Branching, Looping, and Functions.
- Apply pointers for parameter passing, referencing and differencing and linking data structures.
- Manipulate variables and types to change the problem state, including numeric, character, array and pointer types, as well as the use of structures and unions, File.

Course Outcomes: Students will be able to

CO-1	Formulate simple algorithms for arithmetic and logical problems and remember the basics of computer fundamentalsof computer history.
CO-2	Translate the algorithms to programs also to test and execute the programs and correct syntax and logical errors and implementing conditional branching, iteration and recursion.
CO-3	Analyze the problem for its decomposition into functions.
CO-4	Understand the file handling and dynamic memory allocation using c programming language.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	2	-	1	-	1	1	-	-	-	-	-	-	3	2
CO-2	-	1	3	2	1	1	-	-	-	-	-	-	-	2	1
CO-3	-	1	2	3	-	1	1	-	-	-	-	-	-	2	2
CO-4	2	1	1	2	-	1	-	-	-	-	-	-	-	2	1

UNIT-1 12 Hours

Overview of C, Constants, Variables and Data Types, Operators and Expressions, Managing I/O Operations. Decision Making and Branching.

Programming Exercises for Unit I: C-expressions for algebraic expressions, evaluation of arithmetic and Boolean expressions. Syntactic and logical errors in a given program, output of a given program, values of variables at the end of execution of a program fragment, Programs using Scientific and Engineering formulae. Finding the largest of the three given numbers. Computation of discount amount on different types of products with different discount percentages. Finding the class of an input character, finding the type of triangle formed with the given sides, computation of income-tax, finding given year is leap year or not, and conversion of lower case character to its uppercase.

UNIT-2	12 Hours
Decision Making and Looping, Arrays, Character Arrays and Strings. **Programming Exercises for UnitII:** To print the sum of the digits of a given number and to display the image of a given number. To find whether a given number is prime, printing Fibonacci sequence and to find prime factors of a given number. To print graphic patterns of symbols and numbers. To find the length of a string, compare strings, reverse a string, copy a string and to find whether the given string is palindrome or not with and without using String Handling Functions. Transpose of a matrix and sorting of names using arrays.	
UNIT-3	12 Hours
User-defined Functions, Structures and Unions, Pointers **Programming Exercises for Unit -III:** Functions-Recursive functions to find factorial & GCD (Greatest Common Divisor), string operations using pointers and pointer arithmetic. Swapping two variable values. Sorting a list of student records on register number using array of pointers.	
UNIT-4	12 Hours
File Management in C, Dynamic Memory Allocation, Preprocessor **Programming Exercises for Unit - IV**: Operations on complex numbers, and to read an input file of marks and generate a result file, sorting a list of names using command line arguments. Copy the contents of one file to another file. Allocating memory to variables dynamically.	
TextBooks :	1. "Programming in ANSIC" by E. Balaguruswamy, Fifth Edition, McGraw Hill Education India. 2. "Let us C" by Yashavant P.Kanetkar, 14th Edition, BPB Publications.
References:	1. Kernighan BW and Dennis Ritchie M, "C programming language", 2nd edition, Prentice Hall. 2. HerbertSchildt,"C:TheCompleteReference",4thedition,TataMcgraw-Hill. 3. AshokN.Kamthane,"ProgramminginC",PEARSON2ndEdition. 4. ReemaThareja, "Programming in C", Oxford University Press, 2nd Edition, 2015

DIGITAL LOGIC DESIGN
I B.Tech – II Semester (Code: 20CS205)

Lectures	:	3 Hours /Week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: Basic Computer Knowledge.

Course Objectives: Students will be able to

- Understand of the fundamental concepts and techniques used in digital electronics, and Number conversions.
- Understand basic arithmetic operations in different number systems and simplification of Boolean functions using Boolean algebra and K-Maps.
- Simplify the Boolean functions using Tabulation method, Concepts of combinational logic circuits.
- Understand the concepts of Flip-Flops, Analysis of sequential circuits
- Understand the concepts of Registers, Counters and classification of Memory units.

Course Outcomes: Students will be able to

CO-1	Understand different number systems and binary codes and conversion between number system. Understand and apply boolean algebra and K-maps to simplify boolean functions
CO-2	Understand and apply tabulation method to simplify the boolean functions. Understand, analyze and design various combinational circuits.
CO-3	Know the fundamentals of various flip flops and analyze and design sequential curcuits.
CO-4	Understand various registers, design various counters. Design various PLD's for boolean functions.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	-	3	-	-	-	-	-	-	-	-	-	2	-	-
CO-2	3	3	3	-	-	-	-	-	-	-	-	-	2	-	-
CO-3	3	3	3	-	-	-	-	-	-	-	-	-	2	-	-
CO-4	3	3	3	-	-	-	-	-	-	-	-	-	2	-	-

UNIT-1 12 Hours

DIGITAL SYSTEMS AND BINARY NUMBERS: Digital System, Binary Numbers, Number base Conversions, Octal and Hexadecimal Numbers, Complements of Numbers, Signed Binary Numbers, Binary Codes, Binary Storage and Registers, Binary Logic, Error Detection and Correction: 7 bit Hamming Code.

BOOLEAN ALGEBRA & LOGIC GATES: Introduction, Basic definitions, Axiomatic definition of Boolean algebra, Basic theorems and properties of Boolean algebra, Boolean functions, Canonical and Standard Forms, Other Logic Operations, Digital logic gates.

GATE –LEVEL MINIMIZATION: Introduction, The map method, Four-variable K-Map, Product-of-Sums Simplification, Don't –Care Conditions, NAND and NOR implementation, Other Two level Implementations.

UNIT-2 12 Hours

MINIMIZATION: The Tabulation method, Determination of prime implicants, Selection of prime-implicants. **COMBINATIONAL LOGIC:** Introduction, Combinational Circuits, Analysis Procedure, Design Procedure, Binary Adders - Subtractor, Decimal Adder, Magnitude Comparator, Decoders, Encoders, Multiplexers.	
UNIT-3	12 Hours
SYNCHRONOUS SEQUENTIAL LOGIC: Introduction, Sequential Circuits, Storage Elements - Latches, Storage Elements -Flip Flops, Analysis of Clocked Sequential Circuits: State Equations, State Table, State Diagram, Flip Flop Input Equations, Analysis with D, JK and T Flip Flops; State reduction and Assignment, Design Procedure.	
UNIT-4	12 Hours
REGISTERS and COUNTERS: Registers, Shift registers, Ripple Counters, Synchronous Counters. **MEMORY and PROGRAMMABLE LOGIC:** Introduction, Random Access Memory: Read and Write Operations, Types of Memories; Read Only Memory, Programmable Logic Devices: PROM, PLA, PAL.	
Text Books :	1. M. Morris Mano, Michael D. Ciletti, "Digital Design", 5thEdition,PrenticeHall, 2013. 2. A. Anand Kumar, "fundamentals of digital circuits", 4th Edition, PHI.
References :	1. John F. Wakerly, "Digital Design: Principles and Practices", 4th Edition, Pearson, 2006. 2. Brian Holdsworth , Clive Woods, "Digital Logic Design", 4th Edition, Elsevier Publisher, 2002. 3. Donald E Givone, "digital principles and design", TMT.

DISCRETE MATHEMATICS
I B.Tech – II Semester(Code: 20CS206)

Lectures	:	3 Hours /week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- Understand operations on discrete structures such as sets, functions, and relations. Formulate short proofs using methods of proof of an implication. Verify the correctness of an argument using propositional logic and truth tables. Construct mathematical arguments using logical connectives and quantifiers.
- Verify the correctness of an argument using rules of inference for quantified propositions. Apply algorithms and use definitions to solve problems to prove statements in elementary number theory. Understand counting and indirect counting techniques and combinatory in the context of discrete probability.
- Understand sequences, generating functions, and recurrence relations. Understand and compute coefficients for generating functions. Understand and solve homogeneous recurrence relations.
  Understand and solve Inhomogeneous recurrence relations.
- Understand the properties of binary relations, partial orderings and lattices. Construct graphs and adjacency matrices for binary relations.

Course Outcomes: Students will be able to

CO-1	Understand the basic principles of sets,relations,functions and inference rules for validating arguments.
CO-2	Prove that the given statement is valid by using mathematical induction and utilize a variety of counting strategies to solve computational problems.
CO-3	Discuss different methods for solving different types of recurrence relations.
CO-4	Understand various operations and representations of a binary relation.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	3	1	-	-	-	-	1	-	-	-	2	-	2	1
CO-2	3	3	1	1				1	-	-	-	2	-	2	1
CO-3	3	3	1	-	-	-	-	1	-	-	-	1	-	2	-
CO-4	3	3	1	-	-	-	-	1	-	-	1	3	-	2	1

UNIT-1 — 15 Hours

Foundations: Sets, Relations and Functions, Fundamentals of Logic, Logical Inferences, Methods of Proof of an implication, First order Logic & Other methods of proof.

UNIT-2 — 15 Hours

Rules of Inference for Quantified propositions, Mathematical Induction.
Elementary Combinatorics: Basics of Counting, Combinations and Permutations, Enumeration of Combinations and Permutations, Enumerating Combinations and Permutations with repetitions, Enumerating Permutation with Constrained repetitions..

UNIT-3	15 Hours
Recurrence relations: Generating functions of sequences, Calculating Coefficients of Generating Functions **Recurrence Relations:** Solving recurrence relations by Substitution and generating functions, The methods of characteristic roots.	
UNIT-4	15 Hours
Recurrence Relations: solutions of Inhomogeneous recurrence relations. **Relations:** Special properties of binary relations, Operations on relation. Ordering relations, Lattice, Paths and Closures, Directed Graphs and Adjacency Matrices.	
Text Books :	Toe L.Mott, Abraham Kandel &TheodoreP.Baker, "Discrete Mathematics Computer Scientists & Mathematicians", PHI 2nd edition, 2012.
References :	1. C.L. Liu, "Elements of Discrete Mathematics", McGraw-Hill Education, 2nd edition. 2. Rosen, "Discrete Mathematics". ", McGraw-Hill Education, 8th edition.

SEMICONDUCTOR PHYSICS LAB
I B.Tech – I Semester (Code: 20CSL201/PHL02)

Practicals	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- This unit aim to build the foundation and inspires interest of freshmen into electrical and electronics and to focus on fundamental concepts and basic principles regarding electrical conduction.
- This unit provides various properties of semiconductor materials and their importance in various device fabrications
- This unit aim to educate the student on various opto-electronic devices and their applications.
- This unit provide information about the principles of processing, manufacturing and characterization of nano materials, nano structures and their applications

Course Outcomes: Students will be able to

CO-1	Acknowledge the important aspects of earth magnetic field, realize the use of
CO-2	Maxwells equations in various magnetic applications
CO-3	Use the fundamentals of optics, one can estimate physical parameters.
CO-4	Realization of material properties and parameters.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	2	2	-	1	-	-	-	-	-	-	-	-	-	-	-
CO-2	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO-3	2	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO-4	2	2	3	-	1	-	-	-	-	-	-	-	2	-	-

LIST OF EXPERIMENTS

1. Determination of acceleration due to gravity at a place using compound pendulum.
2. Study the variation of intensity of magnetic field along the axis of a circular coil usingStewart-Gee's apparatus.
3. Determination of thickness of thin wire using air wedge interference bands
4. Determination of radius of curvature of a Plano convex lens by forming Newton's rings..
5. Determination of wavelengths of mercury spectrum using grating normal incidencemethod.
6. Determination of dispersive power of a given material of prism using prism minimumdeviation method.
7. Draw the resonant characteristic curves of L.C.R. series circuit and calculate the resonantfrequency.
8. Draw the characteristic curves of a photocell and calculate the maximum velocity of electron.
9. Verify the laws of transverse vibration of stretched string using sonometer.
10. Determine the rigidity modulus of the given material of the wire using Torsionalpendulum.
11. Draw the load characteristic curves of a solar cell.
12. Determination of Hall coefficient of a semiconductor.

13. Determination of voltage and frequency of an A.C. signal using C.R.O. 14. Determination of Forbidden energy gap of Si &Ge. 15. Determination of wavelength of laser source using Diode laser. **Any three experiments are virtual**

Text Books :	Engineering physics laboratorymanualP.Srinivasarao & K.Muraldhar, Himalaya publications.

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB

I B.Tech – II Semester (Code: 20CSL202/EEL01)

Practicals	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- To understand basic Laws in circuits, analysis of simple DC circuits, Theorems and its applications, fundamentals of AC circuits & its analysis and concepts of three phase balanced circuits
- To learn basic properties of magnetic materials and its applications.
- To understand working principle, construction, applications and performance of DC machines, AC machines.
- To learn basic concepts, working principal, characteristics and applications of semiconductor diode and transistor family.
- To gain knowledge about the static converters and regulators.
- To learn basic concepts of power transistors and operational amplifiers closer to practical applications.

Course Outcomes: Students will be able to

CO-1	Solve Problems involving with DC and AC excitation sources in electrical circuits
CO-2	Compare properties of magnetic materials and its applications
CO-3	Analyze construction, principle of operation, application and performance of DC machines and AC machines
CO-4	Explore characteristics and applications of semi conductor diode and transistor family
CO-5	Make the static converts and regulators

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	3	3	2	-	-	-	-	-	-	-	-	3	-	-
CO-2	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-
CO-3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	-
CO-4	3	3	1	2	-	-	-	-	-	-	-	-	3	2	-
CO-5	3	2	3	3	-	-	-	-	-	-	-	-	3	3	-

LIST OF EXPERIMENTS

1. Verification of KCL and KVL
2. Verification of Superposition theorem
3. Verification of Thevenin's theorem
4. Verification of Norton's theorem
5. Parameters of choke coil
6. Measurement of low and medium resistance using volt ampere method
7. OC & SC test of single phase transformer
8. Load test on single phase transformer
9. V-I characteristics of PN junction Diode

10. V-I characteristics of Zener Diode
11. Characteristics of CE Configuration
12. Transfer and Drain Characteristics of JFET
13. Calculation of Ripple factor using Half wave rectifier
14. Calculation of Ripple factor using Full wave rectifier
15. Non linear wave shaping – clippers/clampers

Note: Minimum 10 experiments should be carried.

PROBLEM SOLVING USING PROGRAMMING LAB

I B.Tech – II Semester (Code: 20CSL203/CSL01)

Practical	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- Understand basic concepts of C Programming such as: C-tokens, Operators, Input/output, Arithmetic rules.
- Develop problem-solving skills to translate "English" described problems into Programs written using C language.
- Use Conditional Branching, Looping, and Functions.
- Apply pointers for parameter passing, referencing and differencing and linking data structures.
- Manipulate variables and types to change the problem state, including numeric, character, array and pointer types, as well as the use of structures and unions, File.

Course Outcomes: Students will be able to

CO-1	Address the challenge, pick and analyze the appropriate data representation formats and algorithms.
CO-2	Choose the best programming construct for the job at hand by comparing it to other structures and considering their constraints.
CO-3	Develop the program on a computer, edit, compile, debug, correct, recompile and run it.
CO-4	Identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	2	2	-	-	-	-	-	-	-	-	-	-	3	2
CO-2	2	3	2	-	-	-	-	-	-	-	-	-	-	2	1
CO-3	2	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO-4	2	1	2	-	-	-	-	-	-	-	-	-	-	2	1

LIST OF EXPERIMENTS

1. A program for electricity bill taking different categories of users, different slabs in each category. (Using nested if else statement).

Domestic Customer:		
Consumption Units	**Rate of Charges(Rs.)**	
0 – 200	0.50 per unit	
201 – 400	100 plus	0.65 per unit
401 – 600	230 plus	0.80 per unit

601 and above	390 plus	1.00 per unit
Commercial Customer:		
Consumption Units	**Rate of Charges(Rs.)**	
0 – 50	0.50 per unit	
100 – 200	50 plus	0.60 per unit
201 – 300	100 plus	0.70 per unit
301 and above	200 plus	1.0 per unit

2. Write a C program to evaluate the following (using loops):
   a) $1 + x^2/2! + x^4 / 4!+ \ldots$upto ten terms
   b) $x + x^3/3! + x^5/5!+ \ldots$ upto 7 digit accuracy
3. Write a C program to check whether the given number is
   a) Prime or not.
   b) Perfect or Abundant or Deficient.
4. Write a C program to display statistical parameters (using one – dimensional array).
   a) Mean
   b) Mode
   c) Median
   d) Variance.
5. Write a C program to read a list of numbers and perform the following operations
   a) Print the list.
   b) Delete duplicates from the list.
   c) Reverse the list.
6. Write a C program to read a list of numbers and search for a given number using Binary search algorithm and if found display its index otherwise display the message "Element not found in the List".
7. Write a C program to read two matrices and compute their sum and product.
8. A menu driven program with options (using array of character pointers).
   a) To insert a student name
   b) To delete astudent name
   c) To print the names of students
9. Write a C program to read list of student names and perform the following operations
   a) To print the list of names.
   b) To sort them in ascending order.
   c) To print the list after sorting.
10. Write a C program that consists of recursive functions to
    a) Find factorial of a given number
    b) Solve towers of Hanoi with three towers (A, B & C) and three disks initially on tower A.
11. A Bookshop maintains the inventory of books that are being sold at the shop. The list includes details such as author, title, price, publisher and stock position. Whenever a customer wants a book the sales person inputs the title and the author, and the system searches the list and displays whether it is available or not. If it is not, an appropriate message is displayed, if it is, then the system displays the book details and request for the

number of copies required, if the requested copies are available the total cost of the requested copies is displayed otherwise the message "required copies not in stock" is displayed. Write a program for the above in structures with suitable functions.

12. Write a C program to read a data file of students' records with fields (Regno, Name, M1,M2,M3,M4,M5) and write the successful students data (percentage > 40%) to a data file.

PROBABILITY & STATISTICS
II B. Tech. – III Semester (Code: 20CS301/MA03)

Lectures	:	2 Hours /Week, 1 Hour Tutorial	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- The Aptitude to learn about the concept of random variables and their properties
- Evaluation of various Sampling Distributions
- Statistical analysis for making decisions and choosing actions.
- The Capability to infer the meaningful conclusions to the given data using statistical methods like Point Estimation

Course Outcomes: Students will be able to

CO-1	Apply discrete and continuous probability distributions to various problems arising in Engineering applications.
CO-2	Perform Test of Hypothesis for a population parameter for single sample.
CO-3	Perform Test of Hypothesis for population parameters for multiple samples.
CO-4	Interpret the results of correlation, regression and one way ANOVA for the given data.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	3	-	2	-	-	-	-	-	-	-	1	-	3	-
CO-2	3	3	1	2	-	-	-	-	-	-	-	2	-	3	-
CO-3	3	3	1	2	-	-	-	-	-	-	-	2	-	3	-
CO-4	3	3	3	2	-	-	-	-	-	-	-	2	-	3	-

UNIT-1 12 Hours

Continuous Random Variables, Normal Distribution, Normal Approximation to the Binomial Distribution, Uniform Distribution, Gamma Distribution and its applications, Beta Distribution and its applications, Joint Distributions (Discrete),Joint Distributions (Continuous).Populations and Samples, Law of large numbers, Central limit theorem and its applications, The sampling distribution of the mean (σ unknown),The sampling distribution of the variance.
(Sections 5.1, 5.2, 5.3, 5.5,5.7, 5.8, 5.10, 6.1, 6.2, 6.3, 6.4 of Text Book [1])

UNIT-2 12 Hours

Point estimation, Interval estimation, Tests of Hypotheses, Null Hypothesis and Tests of Hypotheses, Hypothesis concerning one mean, Comparisons-Two independent Large samples, Comparisons-Two independent small samples, Paired sample t test.
(Sections 7.1,7.2, 7.4, 7.5, 7.6, 8.2, 8.3, 8.4 of Text Book [1])

UNIT-3 12 Hours

The Estimation of variances, Hypotheses concerning one variance, Hypotheses Concerning two variances, Estimation of proportions, Hypotheses concerning one proportion, Hypotheses concerning several proportions, Procedure for Analysis of Variance (ANOVA) for comparing the means of k (>2) groups- one way classification (Completely randomized designs), Procedure

for Analysis of Variance (ANOVA) for comparing the means of k (>2) groups- two way classification (Randomized block designs). (Sections 9.1, 9.2, 9.3, 10.1, 10.2, 10.3, 12.2, 12.3 of Text Book [1])	
UNIT-4	12 Hours
Multivariate Analysis: The concept of bivariate relationship, scatter diagram, Pearson‟s correlation and correlation matrix. Simple linear regression model and assumptions, Least Squares Estimation of the parameters of the model, Testing the significance of the model. Regression versus Correlation, Multiple linear regression model with k explanatory variables and assumptions of the model. . Test for significance of the regression model and individual regression coefficients. Applications of multiple regression analysis. (1st and 2nd Chapters of Text Book [2])1	
Text Books :	1. Miller & Freund‟s “Probability and Statistics for Engineers”,Richard A. Johnson,8th Edition, PHI. 2. Introduction to Linear Regression Analysis, Douglas C. Montgomery, E.A. Peck and G.G. Vining, 3rd edition, Wiley.
References :	1. R.E Walpole, R.H. Myers & S.L. Myers „Probability & Statistics for Engineers and Scientists‟, 6th Edition, PHI. 2. Fundamentals of Mathematical Statistics, S. C. Gupta and V.K.Kapoor, 11th Edition, Sultan Chand & Sons. 3. Murray R Spiegel , John J. Schiller, R. Alu Srinivas Probability & Satistics‟, Schaum’s outline series. 4. K.V.S. Sarma, Statistics Made Simple – Do it yourself on PC‟, Prentice Hall India, Second Edition, 2015.

DATA STRUCTURES
II B.Tech – III Semester(Code: 20CS302)

Lectures	:	2 Hours /Week, 1 Hour Tutorial	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: Problem Solving using Programming (20CS204)

Course Objectives: Students will be able to

- Understand the role of Data structures in structuring and analysis procedure of an algorithm.
- Learn the concept of Stack, Queue and various Sorting techniques.
- Understand the concept of Binary Tree, Binary Search Tree and AVL tree.
- Learn the concept of Hashing and Heap Data Structures.

Course Outcomes: Students will be able to

CO-1	Analyse the concepts of algorithm evolution and compute their time & space complexities.To elaborate various lists along with their operations.
CO-2	Solve various real time problems using stack and queue data structures.Develop algorithms and programs for various sorting techniques.
CO-3	Analyze the concepts of trees,binary trees and AVL trees.
CO-4	Analyze various hashing techniques and priority queues.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	2	3	-	-	-	-	-	1	-	1	-	1	3	3	3
CO-2	2	2	2	2	3	-	-	1	-	1	-	1	3	3	3
CO-3	2	3	-	-	-	-	-	1	-	1	-	1	3	3	3
CO-4	2	3	-	-	-	-	-	-	-	-	-	-	3	3	3

UNIT-1 12 Hours

Algorithm Analysis: Mathematical Background, Model, what to Analyze, Running Time Calculations.
Lists: Abstract Data Types, The List ADT, Singly Linked List ADT, Doubly Linked List ADT, Circular Linked List ADT, Polynomial ADT: addition, multiplication operations.

UNIT-2 12 Hours

Stacks and Queues: The Stack ADT and its applications such as Infix to Postfix expression conversions, Evaluation of Postfix expressions. The Queue ADT, Queue Application-Radix sort.
Basic Sorting Techniques: Bubble sort, Selection sort, Insertion sort, Shell sort

UNIT-3 12 Hours

Trees: Preliminaries, Binary Trees, Expression trees, The Search Tree ADT, Binary Search Trees, Implementations, AVL Trees-Single Rotations, Double rotations, Implementations.	
UNIT-4	12 Hours
Hashing: General Idea, Hash Function, Separate Chaining, Open Addressing. **Priority Queues (Heaps)**: Model, Simple implementations, Binary Heap, Heap Sort.	
Text Books :	Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education , 2013, Second Edition, ISBN- 978-81-7758-358-8.
References :	1. Y.Langsam, M.J.Augeustein and A.M.Tenenbaum, "Data Structures Using C", Pearson Education Asia, 2006, Second Edition, ISBN- 81-203-1177-9. 2. Richard F.Gilberg, Behrouz A. Forouzan, "Data Structures – A Pseudocode Approach with C", Thomson Brooks / COLE, 1998, Second Edition, ISBN-978-0-534-39080-8 3. Aho, J.E. Hopcroft and J.D. Ullman, "Data Structures andAlgorithms", Pearson Education Asia, 1983, 1st edition, ISBN- 978-0201000238.

OBJECT ORIENTED PROGRAMMING
II B. Tech. – III Semester (Code: 20CS303)

Lectures	:	2 Hours /Week, 1 Hour Tutorial	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- Understand advantages of OO programming over procedural oriented programming, learn the basics of variables, operators, control statements, arrays, classes and objects.
- Understand, write and implement the following concepts: Inheritance, Interfaces, Packages, Strings and Collections.
- Understand and write programs on Exception Handling, I/O, and Multithreading.
- Understand and implement applications using Applets, AWT, Swings and Events.

Course Outcomes: Students will be able to

CO-1	Demonstrate variables, conditional and iterative execution techniques, etc., and comprehend basic java language syntax and semantics.
CO-2	Understand the concepts of Inheritance, Packages, Interfaces, Strings and Collections
CO-3	Explain the concepts of Exception Handling, Multithreading programming, and I/O.
CO-4	Apply AWT and Swing concepts to demonstrate and develop GUI applications.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	2	2	2	-	-	-	-	1	-	2	3	3	3	2
CO-2	3	2	2	2	-	-	-	-	1	-	2	3	3	3	2
CO-3	3	2	2	2	-	-	-	-	1	-	2	3	3	3	2
CO-4	3	2	2	2	-	-	-	-	1	-	2	3	3	3	2

UNIT-1 — 12 Hours

The History and Evolution of Java
An Overview of Java
Data Types, Variables and Arrays
Operators
Control Statements
Introducing Classes
A Closer Look at Methods and Classes

UNIT-2 — 12 Hours

Inheritance
Packages and Interfaces
Strings: String Constructors, Any 10 String class methods, StringBuffer class, Any 10 StringBuffer class methods, Introducing StringBuilder class.
Type Wrappers: Auto boxing/unboxing.
Collections: Collections Overview, Names of Collection Interfaces,
Collection Classes: LinkedList<String>, Array List<String>

UNIT-3	12 Hours
Exception Handling **Multithreaded Programming** **I/O:** I/O Basics, Reading Console Input, Writing Console Output, The Print Writer class, Reading and Writing Files, Automatically Closing a File.	
UNIT-4	12 Hours
The Applet Class: Applet Architecture, An Applet Skeleton, Applet program to draw shapes, setting Color, Font using Graphics class **Event Handling:** **Introducing the AWT:** Window Fundamentals, **AWT components:** Label, Text Field, Text Area, Checkbox, Checkbox Group, Button, **Layout Managers:** Flow Layout, Grid Layout, and Border Layout. **GUI Programming with Swing:** The Origins of Swing, Advantages of Swing over AWT, The MVC Connection, **Swing Components:** JLabel, JText Field, JText Area, JCheck box, JButton, JTabbed Pane, JTable, JTree, JCombo Box	
Text Books :	"Java The Complete Reference", 9th Edition, Herbert Schildt, TMH Publishing Company Ltd, New Delhi, 2014.
References :	1. "Big Java ", 4th Edition, Cay Horstman, John Wiley & Sons, 2009. 2. "Java How to Program (Early Objects)", H. M. Dietel and P. J. Dietel, 11th edition Pearson Education, 2018.

OPERATING SYSTEMS
II B.Tech – III Semester(Code: 20CS304)

Lectures	:	3 Hours /week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Objectives: Students will be able to

- To learn the mechanism of OS to handle processes & Threads and their communication.
- To learn the algorithms involved in CPU scheduling.
- To gain knowledge on concepts that includes Dead locks, Main Memory and Virtual Memory.
- To know the concepts related to File Access Methods & Mass Storage structure.

Course Outcomes: Students will be able to

CO-1	Know the various operating system services, how to use scheduling, and how to operate on processes and threads.
CO-2	Develop various process scheduling algorithms for a given specification of CPU utilization, throughput, TAT, WT & RT.
CO-3	Develop various Memory Organization Techniques for optimally allocate memory to process by increasing Memory Utilization & Access time.
CO-4	Design & implement various file allocation methods & Disk SchedulingAlgorithms.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	-	-	-	1	-	1	-	1	1	1	-	1	1	-	1
CO-2	2	3	2	1	-	-	-	1	-	-	-	-	1	2	-
CO-3	1	2	2	1	-	-	-	1	-	-	-	-	1	2	-
CO-4	1	2	2	1	-	-	-	1	-	-	1	1	1	2	-

UNIT-1 12 Hours

Introduction: What OSs Do, Computer System Operation, Storage structure, OS Structure, OS Operations.

Operating-System Structures: OS Services, User and operating system Interface, System Calls, Types of System Calls, System Programs, OS Design and Implementation, OS Structure.

Processes: Process Concept, Process Scheduling, Operations on Processes, Inter- process Communication.

Threads: Overview, Multicore Programming, Multithreading Models.

[Sections:1.1, 1.2.1, 1.2.2,1.4,1.5, 1.5.1,2.1, 2.2,2.3,2.4, 2.5, 2.6, 2.7,2.7.1,2.7.2,2.7.3,2.7.4 3.1, 3.2,3.3,3.4, 4.1,4.2,4.3]	
UNIT-2	12 Hours
CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms. **Process Synchronization:** Background, The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic problems of Synchronization, Monitors. [Sections : 6.1,6.2,6.3, 5.1,5.2,,5.3,5.4,5.5,5.6,5.7,5.8]	
UNIT-3	12 Hours
Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Avoidance, Detection and Recovery. **Main Memory:** Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of Page Table. **Virtual-Memory: Background**, Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing, Other Considerations. [Sections; 7.1,7.2,7.3,7.4,7.5,7.6,7.7,8.1,8.2,8.3,8.4,8.5,8.6,9.1, 9.2,9.3,9.4,9.5,9.6,9.9]	
UNIT-4	12 Hours
File System Interface: File concept, Access Methods, Directory and Disk Structure, **File System Implementation**: File System Structures, Directory Implementation, Allocation Methods **Protection**: Goals of Protection, Principles of Protection, Domain of Protection- Domain Structure, Access Matrix, Implementation of Access Matrix. **Mass Storage Structure**: Over View, Disk Structure, Disk Scheduling, Disk Management, RAID levels [Sections:10.1,10.2,10.4,10.5,10.7,11.1,11.2,11.3,11.5,12.1,12.3,12.4,14.1,14.2,14.3,14.3.1,14.4,14.5]	
Text Books :	Silberschatz & Galvin, "Operating System Concepts", 10th edition, John Wiley & Sons (Asia) Pvt.Ltd. **ISBN 9781118063330**.
References :	1. William Stallings, "Operating Systems –Internals and Design Principles", 9/e, Pearson**. ISBN 9789352866717** 2. Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill Co., 2019 edition. **ISBN-9780074635513** 3. Andrew S.Tanenbaum, "Modern Operating Systems", 4nd edition,2017 PHI.**ISBN-9781292061429**

COMPUTER ORGANIZATION
II B. Tech. – III Semester (Code: 20CS305)

Lectures	:	3 Hours /week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: Digital logic design (20CS205)

Course Objectives: Students will be able to

- Represent the data, micro-operations, and hardware implementation of arithmetic, logic and shift unit.
- Know about the instruction codes and generation of control signals using hardwired and micro-programmed approaches.
- Learn about the different types of instructions and arithmetic operations.
- Understand the organization of the memory and I/O units.

Course Outcomes: Students will be able to

CO-1	Understand the basic structure of computer and analyzing the concepts.
CO-2	Various arithmetic operations,recognize how the CPU executes instructions and how the control unit is designed utilizing hardwired and microprogrammed methods.
CO-3	Study the instruction set of basic computer and draw the flowcharts of the arithmetic operations.
CO-4	Recognize the I/O and memory organizations.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	2	2	3	2	-	-	-	-	-	-	-	2	2	3	1
CO-2	3	2	2	2	-	-	-	-	-	-	-	1	3	2	1
CO-3	2	3	1	-	-	-	-	-	-	-	-	2	2	3	1
CO-4	2	-	3	-	1	-	-	-	-	-	-	2	3	2	1

UNIT-1 — 11 Hours

DATA REPRESENTATION: Data Types, Complements, Fixed-Point Representation, Floating-Point Representation.
REGISTER TRANSFER LANGUAGE AND MICROOPERATIONS: Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro Operations, Logic micro operations, Shift Micro Operations, Arithmetic Logic Shift Unit.

UNIT-2 — 11 Hours

BASIC COMPUTER ORGANIZATION AND DESIGN: Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input-Output and Interrupt, Design of Accumulator Logic.

MICRO PROGRAMMED CONTROL: Control Memory, Address Sequencing, Microprogram Example, Design of Control Unit.	
UNIT-3	11 Hours
CENTRAL PROCESSING UNIT: General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer vs Complex Instruction Set Computers. **COMPUTER ARITHMETIC:** Addition and Subtraction, Multiplication Algorithms, Division Algorithms.	
UNIT-4	12 Hours
THE MEMORY SYSTEM: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware. **INPUT-OUTPUT ORGANIZATION**: Peripheral Devices, Input-Output Interface, Modes of Transfer, Priority Interrupt, Direct Memory Access, Input-Output Processor.	
Text Books :	Computer System Architecture, M.MorrisMano, 3rdEdition, Pearson/PHI
References :	1. Computer Organization, Carl Hamacher, ZvonksVranesic, SafeaZaky, 5th Edition, McGraw Hill. 2. Computer Organization and Architecture, William Stallings, Sixth Edition, Pearson/PHI.

LINUX ESSENTIALS

II B. Tech. – III Semester (Code: 20CSL301/SO01)

Practicals	:	5 Hours/Week (2T+3P)	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- Organize and manipulate files and directories
- Use the vi text editor to create and modify files
- Use SED command for insertion, deletion, and search and replace (substitution).
- Understand pattern scanning and processing using AWK.
- Create structured shell programming which accept and use positional parameters and exported variables.
- Understand File management system calls to provide I/O support for storage device types and multiple users.

Course Outcomes: Students will be able to

CO-1	Organize and manipulate files and directories, Use the vi text editor to create and modify files
CO-2	Use SED command for insertion, deletion and search and replace (substitution)
CO-3	Learn how to use AWK for pattern scanning and processing.
CO-4	Create structured shell programming which accepts and uses positional parameters and export variables. Understand file management system calls to provide I/O support for storage device types and multiple users.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	2	-	2	3	-	-	-	-	-	-	2	2	2	2
CO-2	2	2	-	2	2	-	-	-	-	-	-	2	2	2	2
CO-3	2	2	-	2	2	-	-	-	-	-	-	2	2	3	2
CO-4	2	2	-	2	2	-	-	-	-	-	-	2	2	2	3

UNIT-1 4 Hours

Directory commands – pwd, cd, mkdir, rmdir commands. The dot (.) and double dots (..) notations to represent present and parent directories and their usage in relative path names. File related commands –Editing with vi, cat, mv, rm, cp , wc . File attributes and permissions and knowing them. The ls command with options. Changing file permissions: (chmod) the relative and absolute permissions changing methods. Recursively changing file permissions. Directory Permissions. Other Basic commands: cal, date, df, du, find, jobs, kill ,less and more, ps, set, wc, who.

LIST OF EXPERIMENTS

1. Obtain the following results (i) To print the name of operating system (ii) To print the login name (iii) To print the host name
2. Find out the users who are currently logged in and find the particular user too.
3. Display the calendar for (i) Jan 2000 (ii) Feb 1999 (iii) 9th month of the year 7

A.D (iv) For the current month (v) Current Date Day Abbreviation , Month Abbreviation along with year

4. Display the time in 12-Hour and 24 Hour Notations.
5. Display the Current Date and Current Time.
6. Display the message "GOOD MORNING" in enlarged characters.
7. Display the name of your home directory.
8. Create a directory SAMPLE under your home directory.
9. Create a subdirectory by name TRIAL under SAMPLE.
10. Change to SAMPLE.
11. Change to your home directory.
12. Change from home directory to TRIAL by using absolute and relative pathname.
13. Remove directory TRIAL.
14. Create a directory TEST using absolute pathname.
15. Using a single command change from current directory to home directory.
16. Remove a directory using absolute pathname.
17. Create files my file and your file under Present Working Directory.
18. Display the files my file and your file.
19. Append more lines in the my file and your file files.
20. How will you create a hidden file?.
21. Copy myfile file to emp.
22. Write the command to create alias name for a file.
23. Move yourfile file to dept.
24. Copy emp file and dept file to TRIAL directory
25. Compare a file with itself.
26. Compare myfile file and emp file.

UNIT-2	4 Hours

The Stream editor(sed):Line addressing, multiple instructions, context addressing, writing selected lines to a file, text editing ,substitution, basic regular expressions.
File Handling and Text Processing utilities: grep, egrep, fgrep.
AWK: sample awk filtering , splitting a line into fields, formatting output, variables and expressions, comparison operators, number processing, storing awk programs in a file, the BEGIN and END sections, Built in variables and arrays, control structures.

LIST OF EXPERIMENTS

1. A. Create the following file as sed.lab: unix is great os. unix is open source. unix is free os. learn operating system. Unix linux which one you choose.(*Each sentence in a line*)

1. Replace 'unix' with 'linux'.
2. Replace only the third (3rd) instance of 'unix' with 'linux'.
3. Try sed 's/unix/linux/g' sed.lab.
4. Replace 'unix' with 'linux' but only on line 3.
5. Add a new line, 'Actually Windows is best' after the second line.

B.

1. Viewing a range of lines of a document
2. Viewing the entire file except a given range
3. Viewing non-consecutive lines and ranges
4. Replacing words or characters inside a range
5. Using regular expressions
6. Viewing lines containing with a given pattern
7. Inserting spaces in files
8. Performing two or more substitutions at once

C.

1. Design a command **"wishme"** that will great you "good morning","good Afternoon", according to current time.

2. Design a command **"fags"** thats will list the files and their ages, to date.
3. Design a command **"word-freq"** that will print the words and number of Occurrences of that word in the given text.

UNIT-3	4 Hours

Shell programming: shell, functions of shell, metacharacters, input redirections and output redirections, pipes, shell as a programming language, shell variables, predefined local variables, predefined environment variables, arithmetic and conditional expressions, control structures, positional parameters, passing command line arguments, built in shell commands, shell programs, functions and arrays.

LIST OF EXPERIMENTS

1.
A. Design a command **" which"** that prints the path of the command given as Argument
B. Design a command **"filelist[-c <char>]"** which prints all file names beginning with The charter specified as argument to the command ,if the position is not specified It should print all the file names.
C. Design a command **getline[-f <filename> -n <line number>]** which prints the line number **lineno** in the file specified with -f option.If the line number is not specified it should list all the lines in the given file
D. Design a command **monthly-file[-m <month>]** which list the files created in a given month where month is argument to be command. If the options is not specified it list the files in all the months.

2.
A. Design a command **list lines[-f <file name> -v <varname>]** which prints the line from the given file **file name** ,which containing the variable **varname**.if **arname** Is not specified it should list ,all the lines.
B. Design a command **avg[-n <colon> -f <file name>]** which prints the average of the given column in a file where **colon** and **file name** are arguments to the commands

UNIT-4	4 Hours

File management System calls: Regular File management system calls: open(), read(), write(), lseek(), close(), unlink(), stat(), getdents().

LIST OF EXPERIMENTS

1. Write a C program to copy data from source file to destination file, where the file names are provided as command-line arguments.
2. Write a C program that reads every 100th byte from the file, where the file name is given as command-line argument.
3. Write a C program to display information of a given file which determines the type of file and inode information, where the file name is given as command-line arguments.

Text Books :	1. UNIX Concepts and Applications, Sumitabha Das, 4th edition, TATA McGraw Hill. 2. UNIX for programmers and users", 3rd edition, Graham Glass, King Ables, Pearson education.
References :	1. "The Design of UNIX operating System", Maurice J.Bach, PHI. 2. "Advanced programming in the UNIX environment", W Richard Stevens, 2nd Edition, Pearson education.

	3. "UNIX programming environment", Kernighan and pike, Pearson Education. 4. "Your UNIX the ultimate guide, Sumitabha Das, TMH, 2nd edition. 5. "Advanced UNIX programming", Marc J. Rochkind, 2nd edition,Pearson Education.

DATA STRUCTURES LAB
II B. Tech. – III Semester (Code: 20CSL302)

Practicals	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- Understand and program basic data structures like arrays and linked lists with their applications.
- Understand and Program data structures like stacks and queues with their applications. Understand and implement sorting algorithms.
- Understand and program on trees, binary trees, binary search trees, avl trees, expression trees and their traversal methods.
- Understand and program on priority queues, hashing and their mechanisms. Basic knowledge of graphs representations and traversing methods.

Course Outcomes: Students will be able to

CO-1	Apply programming techniques using pointers,DMA and structures to implement SLL and DLL.
CO-2	Design and implement ADTs of stack,queue and its applications.
CO-3	Analyze and implement different sorting techniques.
CO-4	Analyze and implement BST,AVL tree and priority queue.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	-	-	-	-	-	-	1	-	1	-	1	3	3	3
CO-2	1	2	2	2	3	-	-	1	-	1	-	1	3	3	3
CO-3	2	3	-	-	-	-	-	1	-	1	-	1	3	3	3
CO-4	2	3	-	-	-	-	-	1	-	1	-	1	3	3	3

LIST OF EXPERIMENTS

1. Write a program to perform the following operations on Array List
   a). Creation, b). Insertion, c). Deletion, d). Search, e). Display.
2. Write a program that reads two lists of elements, prints them, reverses them, prints the reverse list, sort the lists, print the sorted lists, merges the list, prints merge list using array list.
3. Write a program to perform the following operations on Single Linked List.
   a). Creation, b). Insertion, c). Deletion, d). Search, e). Display.
4. Write a program to perform the following operations on Doubly Linked List.
   a). Creation, b). Insertion, c). Deletion, d). Search, e). Display.
5. Write a program to perform addition and multiplication of two polynomials using single Linked List.
6. Write a program to convert the given infix expression into postfix expression using stack.
7. Write a program to evaluate the postfix expression using stack.
8. Write a program that performs Radix sort on a given set of elements using queue.

9. Write a program to read n numbers in an array. Redisplay the array list with elements being sorted in ascending order using the following techniques a). Bubble Sort, b). Selection Sort, c). Insertion Sort, d).Shell Sort. 10. Write a program to perform Binary Search tree operations and traversals. 11. Write a program to implement AVL tree that interactively allows a). Insertion, b). Deletion, c). Find_min, d). Find_max. 12. Write a program to read n numbers in an array. Redisplay the arraylist with elements being sorted in ascending order using Heap Sort.

Text Books :	Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education
References :	1. Y.Langsam, M.J.Augeustein and A.M.Tenenbaum, "DataStructures Using C", Pearson Education Asia, 2004. 2. Richard F.Gilberg, Behrouz A. Forouzan, "Data Structures – A Pseudocode Approach with C", ThomsonBrooks / COLE, 1998.

OBJECT ORIENTED PROGRAMMING LAB
II B.Tech – III Semester (Code: 20CSL303)

Practicals	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- Understand advantages of OO programming over procedural oriented programming, learn the basics of variables, operators, control statements, arrays, classes and objects.
- Understand, write and implement the following concepts: Inheritance, Interfaces, Packages, Strings and Collections.
- Understand and write programs on Exception Handling, I/O, and Multithreading.
- Understand and implement applications using Applets, AWT, Swings and Events.

Course Outcomes: Students will be able to

CO-1	Implement OOP concepts using its advantages over structured programming.
CO-2	Develop and implement inheritance, polymorphism.
CO-3	Analyze Exception Handling, Multithreading, I/O.
CO-4	Create code for Event Handling, Applets, AWT and Swings.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	2	2	2	-	-	-	-	1	-	2	3	3	3	2
CO-2	3	2	2	2	-	-	-	-	1	-	2	3	3	3	2
CO-3	3	2	2	2	-	-	-	-	1	-	2	3	3	3	2
CO-4	3	2	2	2	-	-	-	-	1	-	2	3	3	3	2

LIST OF EXPERIMENTS

1. Write a Java program to declare, initialize and accessing the elements of Single dimensional Arrays, Multidimensional Arrays.
2. Write a Java program to demonstrate recursion.
3. Write a Java program to demonstrate static member, static method and static block.
4. Write a Java program to demonstrate method overloading and method overriding using simple inheritance.
5. Write a Java program to demonstrate multiple inheritance using interfaces.
6. Write a Java program to demonstrate packages.
7. Write a Java program to demonstrate String class methods.
8. Write a Java program to create user defined exception class, use couple of built-in Exception classes.
9. Write a Java program to demonstrate inter-thread communication.
10. Write an Applet program to demonstrate passing parameters to Applet, Graphics, Color and Font classes.
11. Write a Java program to demonstrate handling Action events, Item events, Key events, Mouse events, Mouse Motion events.

12. Write a GUI application which uses the following AWT components Label, Text Field, Text Area, Checkbox, Checkbox Group, Button. 13. Write a GUI application using JTable, JTree, JCombo Box.	
Text Books :	"Java The Complete Reference", 9th Edition, Herbert Schildt, TMH Publishing Company Ltd, New Delhi, 2014.
References :	2. "Big Java ", 4th Edition, Cay Horstman, John Wiley & Sons, 2009. 3. "Java How to Program (Early Objects)", H. M. Dietel and P. J. Dietel, 11th edition Pearson Education, 2018.

PROFESSIONAL ETHICS & HUMAN VALUES
II B. Tech. – III Semester (Code: 20CS306/MC02)

Lectures	:	2 Hours/Week	Continuous Assessment	:	30
Final Exam	:	---	Final Exam Marks	:	---

Pre-Requisite: None.

Course Objectives: Students will be able to

- Comprehend a specific set of behavior and values any professional must know and must abide by, including confidentiality, honesty and integrity. Understand engineering as social experimentation.
- Know, what are safety and Risk and understand the responsibilities and rights of an engineer such as collegiality, loyalty, bribes/gifts.
- Recognize global issues visualizing globalization, cross-cultural issues, computer ethics and also know about ethical audit
- Discuss case studies on Bhopal gas tragedy, Chernobyl and about codes of Institute of Engineers, ACM

Course Outcomes: Students will be able to

CO-1	Identify and analyze an ethical issue in the subject matter under investigation or in a relevant field and the multiple ethical interests at stake in a real-world situation or practice
CO-2	Articulate what makes a particular course of action ethically defensible, Assess their own ethical values and the social context of problems.Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data.
CO-3	Demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work integrate, synthesize, and apply knowledge of ethical dilemmas and resolutions in academic settings, including focused and interdisciplinary research
CO-4	Paticipate in the discussion of the case studies like bhopal gas tragedy,Chernobyl disasters.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	-	-	-	-	-	3	1	3	-	-	-	-	-	-	-
CO-2	-	-	-	-	-	3	1	3	-	-	-	-	-	-	-
CO-3	-	-	-	-	-	3	1	3	-	-	-	-	-	-	-
CO-4	-	-	-	-	-	3	1	3	-	-	-	-	-	-	-

UNIT-1 8 hours

Human Values: Morals, Values and Ethics, Integrity, Work Ethics, Service and Learning, Civic Virtue, Respect for Others, Living Peacefully, Caring and Sharing, Honesty, Courage, Value Time, Cooperation, Commitment and Empathy, Spirituality, Character.
Engineering Ethics: History of Ethics, Engineering Ethics, Consensus and Controversy, Profession and Professionalism, Professional Roles of Engineers, Self Interest, Customs and Religion, Uses of

Ethical Theories, Professional Ethics, Types of Inquiry, Kohlberg's Theory, Gilligan's Argument, Heinz's Dilemma. **Engineering as Social Experimentation**: Comparison with Standard Experiments, Knowledge Gained, Conscientiousness, Relevant Information, Learning from the Past, Engineers as Managers, Consultants, and Leaders, Accountability, Roles of Codes, Codes and Experimental Nature of Engineering.	
UNIT-2	8 hours
Engineers' Responsibility for Safety and Risk: Safety and Risk, Types of Risks, Safety and the Engineer, Designing for Safety, Risk-Benefit Analysis, Accidents. **Responsibilities and Rights**: Collegiality, Two Senses of Loyalty, Obligations of Loyalty, Misguided Loyalty, Professionalism and Loyalty, Professional Rights, Professional Responsibilities, Conflict of Interest, Self-interest, Customs and Religion, Collective Bargaining, Confidentiality, Acceptance of Bribes/Gifts, Occupational Crimes, Whistle Blowing.	
UNIT-3	8 hours
Global Issues: Globalization, Cross-cultural Issues, Environmental Ethics, Computer Ethics, Weapons Development, Ethics and Research, Analyzing Ethical Problems in Research, Intellectual Property Rights (IPRs). **Ethical Audit:** Aspects of Project Realization, Ethical Audit Procedure, The Decision Makers, Variety of Interests, Formulation of the Brief, The Audit Statement, The Audit Reviews.	
UNIT-4	8 hours
Case Studies: Bhopal Gas Tragedy, The Chernobyl Disaster. **Appendix 1**: Institution of Engineers (India): Sample Codes of Ethics. **Appendix 2**: ACM Code of Ethics and Professional Conduct.	
Text Books :	"Professional Ethics & Human Values", M.GovindaRajan, S.Natarajan, V.S.SenthilKumar, PHI Publications 2013.
References :	"Ethics in Engineering", Mike W Martin, Ronald Schinzinger, TMH Publications.

MICROPROCESSORS & MICROCONTROLLERS
II B. Tech. – IV Semester (Code: 20CS401)

Lectures	:	3 Hours /week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Objectives: Students will be able to

- Identify the hardware and software elements of the 8086 microprocessor.
- Understand instruction set of 8086 microprocessor with examples.
- Interface the interrupt device with 8086 microprocessor.
- Comprehend the architecture of 8051 microcontroller and its applications.

Course Outcomes: Students will be able to

CO-1	Identification of the functional blocks of hardware and describe the assembly language programming structure of the 8086 microprocessor.
CO-2	Understand the different instructions of 8086 microprocessor and apply these in assembly language programming for solving problems.
CO-3	Describe the interrupt responses of an 8086 microprocessor with interrupt applications.
CO-4	Identification of hardware and software elements of the 8051 microcontroller and develop the applications using 8051 microcontroller.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	2	1	2	-	1	-	-	-	-	-	-	1	1	1	1
CO-2	2	2	3	1	1	-	-	-	-	-	-	1	1	1	1
CO-3	2	-	1	1	-	-	-	-	-	-	-	1	1	1	1
CO-4	2	-	1	-	1	-	-	-	-	-	-	1	1	1	1

UNIT-1 — 15 Hours

Introduction to 8086: The 8086 Microprocessor family-overview; 8086 internal architecture: the execution unit, the BIU;
8086 family assembly language programming: program development steps, constructing the machine codes for 8086 instructions, writing program for use with an assembler, assembly language program development tools.

UNIT-2 — 15 Hours

Implementing standard Program Structures in 8086 Assembly language: simple sequence programs, jumps flags and conditional jumps, if-then if-then-else multiple if-then-else programs, while do programs, repeat-until programs, instruction timing and delay loops;
Strings and procedures: the 8086 string instructions, writing and using procedures; assembler directives.

UNIT-3 — 15 Hours

8086 system connections and timing: The basic 8086 Microcomputer system, 8086 Bus activities during the read machine cycle, 8086 Bus activities during the write machine cycle 8086 pin diagram; **8086 Interrupts and Interrupt Applications:** 8086 Interrupts and Interrupts Responses, 8259A priority interrupt controller.

UNIT-4 — 15 Hours

8051 MICROCONTROLLERS: Microcontrollers and embedded processors, overview of the 8051 family; architecture of 8051, pin diagram of 80851; 8051 assembly language programming; JUMP, LOOP, CALL instructions; I/O port programming; addressing modes; LCD and keyboard interfacing.	
Text Books :	1. Douglas V. Hall, "Microprocessors and Interfacing", Tata McGraw-Hill, 3rd Edition,2017. 2. Muhammad Ali Mahadi and Janice Gillespie Mazidi, "The 8051 Microcontroller and Embedded Systems", Pearson Education 2021.
References :	1. Yu-cheng Liu, Glenn A. Gibson, "Microcomputer systems: The 8086 /8088 Family architecture, Programming and Design", Second edition, Prentice Hall of India, 2003. 2. Barry B. Brey, "The Intel Microprocessors, 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, PentiumPro Processor, Pentium II, Pentium III, Pentium IV, Architecture, Programming & Interfacing", Sixth Edition, Pearson Education Prentice Hall of India, 2002.

WEB TECHNOLOGIES

II B. Tech. – IV Semester (Code: 20CS402)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- Know elements and tags of HTML and apply Styles using Cascading Style Sheets.
- Know basics of Java Script, Functions, Events, Objects and Working with browser objects.
- Know basics of XML, DOM and advanced features of XML.
- To convert XML documents into other formats and XSLT.

Course Outcomes: Students will be able to:

CO-1	Create HTML document using appropriate tags to structure content.
CO-2	Analyze the structure of web page and asses the use of display values for layout and evaluate the usability of an interactive element on a web page.
CO-3	Create a dynamic web pager that utilizes browser objects and DOM interfaces to create,modify and remove elements and attributes in an HTML.
CO-4	Develop HTML documents based on specific DTD (or) XML schema definitions and XSLT style sheets to transform XML data into different formats.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	2	1	3	-	1	-	-	-	1	-	2	2	3	1	-
CO-2	2	2	3	-	1	-	-	-	1	-	2	1	3	1	-
CO-3	2	2	3	-	1	-	-	-	1	-	1	1	3	1	-
CO-4	2	2	3	-	1	-	-	-	1	-	2	1	3	1	-

UNIT-1 — 12 hours

HTML5: Fundamentals of HTML, Working with Text, Organizing Text in HTML, Working with Links and URLs, Creating Tables, Working with Images, Colors, and Canvas, Working with Forms.

UNIT-2 — 12 hours

CSS: Overview of CSS, Backgrounds and Color Gradients in CSS, Fonts and Text Styles, Creating Boxes and Columns Using CSS, Displaying, Positioning, and Floating an Element, List Styles, Table Layouts.

Dynamic HTML: Overview of JavaScript, JavaScript Functions, Events, Image Maps, and Animations.

UNIT-3 — 12 hours

Dynamic HTML (Cont..): JavaScript Objects, Working with Browser Objects, Working with Document Object.

Document Object Model: Understanding DOM Nodes, Understanding DOM Levels, Understanding DOM Interfaces- Node, Document, Element, Attribute.

UNIT-4 — 12 hours

XML: Working with Basics of XML, Implementing Advanced Features of XML, Working with XSLT.

AJAX: Overview of AJAX, Asynchronous Data Transfer with XML Http Request, Implementing AJAX Frameworks, Working with jQuery.

Text Books :	KogentLearningSolutionsInc.,HTML5BlackBook:CoversCSS3,Javascript, XML, XHTML, Ajax, PHP and Jquery
References :	1. Harvey M.Deitel and Paul J. Deitel, "Internet &World Wide Web How to Program", 4/e, Pearson Education. 1. Jason Cranford Teague, "Visual Quick Start Guide CSS DHTML & AJAX", 4e, Pearson Education. 2. Tom Nerino Doli smith, "Java Script & AJAX for the web", Pearson Education2007. 3. Joshua Elchorn, "Understanding AJAX",PrenticeHall2006.

DATABASE MANAGEMENT SYSTEM
II B. Tech. – IV Semester (Code: 20CS403)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- Familiarize with fundamental concepts of database and various database architectures and Design relations for Relational databases using conceptual data modeling.
- Implement formal relational operations in relational algebra and SQL.
- Identify the Indexing types and normalization process for relational databases
- Use mechanisms for the development of multi user database applications.

Course Outcomes: Students will be able to

CO-1	Apply knowledge of database design methodology which give a good formal foundation in relational data model and Understand and apply the principles of data modeling using ER Model.
CO-2	Create relational algebra expressions, relational calculus, and SQL for queries and be familiar with relational database theory
CO-3	Design database schema and Identify and solve the redundancy problem in database tables using normalization.
CO-4	Learn about transaction processing, concurrency management, and recovery methods.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	2	1	-	-	-	-	-	-	-	-	2	2	-	-
CO-2	2	1	2	1	3	-	-	-	-	-	-	1	3	-	-
CO-3	2	3	-	-	1	-	-	-	-	-	-	1	2	-	-
CO-4	1	1	2	1	-	-	-	-	-	-	-	1	2	-	-

UNIT-1 12 hours

Databases and Database Users: Introduction - An Example, Characteristics of the Database Approach, Actorson the Scene, Workers behind the Scene, Advantages of Using the DBMS Approach.

Database System Concepts and Architecture : DataModels, Schemas and Instances ,Three-SchemaArchitecture and Data Independence, Database Languages and Interfaces, The Database System Environment, Centralized and Client/Server Architectures for DBMSs.

Data Modeling Using the Entity-Relationship (ER) Model : Using High-Level Conceptual Data Models forDatabase Design, An Example Database Application, Entity Types, Entity Sets, Attributes, and Keys - Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak Entity Types, Refining the ER Design for the COMPANY Database - ER Diagrams, Naming Conventions, and Design Issues

UNIT-2 12 hours

The Relational Algebra and Relational Calculus : Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from Set Theory, Binary Relational Operations: JOIN and DIVISION, The Tuple Relational Calculus, The Domain Relational Calculus.

Schema Definition, Constraints, Queries, and Views : SQL Data Definition and Data Types, Specifying Constraints in SQL, Schema Change Statements in SQL, Basic Queries in SQL,INSERT, DELETE, and UPDATE Statements in SQL , Views (Virtual Tables) in SQL

UNIT-3	12 hours

Indexing Structures for Files: Types of Single-Level Ordered Indexes, Multilevel Indexes - Dynamic Multilevel Indexes Using B+-Trees.

Functional Dependencies and Normalization for Relational Databases: Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms Based on Primary Keys - General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form.

Relational Database Design Algorithms and Further Dependencies: Properties of Relational Decompositions -Lossless Join Decomposition and Dependency Preserving Decomposition, Multi-valued Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form.

UNIT-4	12 hours

Introduction to Transaction Processing Concepts and Theory: Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing Schedules Based on Recoverability, Characterizing Schedules Based on Serializability

Concurrency Control Techniques: Two-Phase Locking Techniques for Concurrency Control, Concurrency Control Based on Timestamp Ordering,Validation (Optimistic) Concurrency Control Techniques, Multiple Granularity.

Database Recovery Techniques : Recovery Techniques Based on Deferred Update, Recovery Techniques Based on Immediate Update, Shadow Paging.

Text Books :	Fundamentals of Database Systems, Ramez Elmasri and Navathe Pearson Education, 6thedition
References :	1. Introduction to Database Systems, C.J. Date Pearson Education 2. Database Management Systems, Raghu Rama krishnan, Johannes Gehrke, TATA McGraw Hill3rdEdition 3. Database System Concepts, Silberschatz, Korth, McGraw hill,5thedition

DESIGN AND ANALYSIS OF ALGORITHMS
II B. Tech. – IV Semester (Code: 20CS404)

Lectures	:	2 Hours/Week, 1 Hour Tutorial	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Data Structures (20CS302)

Course Objectives: Students will be able to

- Understand about designing and effectiveness of an algorithm, and applying of Master Theorem to find the complexity.
- Strengthen divide and conquer paradigms andknow the optimal solution finding with the greedy method.
- Acquaintance of algorithm design strategies of Dynamic programming and easy know the major graph algorithms and their analyses.
- Get the ability to backtracking,branch with bound values and NP problems.

Course Outcomes: Students will be able to

CO-1	Analyze the performance of algorithms through various strategies and apply the Master theorem to estimate the complexity of divide-and-conquer algorithms.
CO-2	Apply the divide-and-conquer and greedy techniques to solve problems and perform complexity analysis.
CO-3	Articulate on graph problems and identify the applicability of the dynamic-programming paradigm for designing solutions to problems.
CO-4	Utilize the Backtracking and Branch and Bound algorithms, find every potential solution to the combinatorial and optimixation issues. In addition, classify the P and NP complicated problems.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	2	3	2	3	-	2	-	-	2	2	3	3	3	1
CO-2	2	2	2	2	2	-	2	-	-	2	2	2	2	3	1
CO-3	3	3	3	3	3	-	2	-	-	2	2	3	2	3	2
CO-4	2	2	1	2	2	-	2	-	-	2	2	2	2	3	2

UNIT-1 — 12 hours

Introduction: Algorithm, Pseudo code for expressing algorithms, Performance Analysis-Space complexity, Time complexity, Asymptotic Notation-Bigoh-notation, Omega notation, Theta notation and Little oh notation, Probabilistic analysis, Amortized analysis.
Master Theorem: Introduction, Generic Form- Case1, Case2, Case3, Inadmissible equations, Application to common algorithms.

UNIT-2 — 12 hours

Divide and conquer: General method, applications-Quicksort, Merge sort, Stassen's matrix multiplication.
Greedy method: General method, applications-Job sequencing with deadlines, Fractional knapsack problem, Minimum cost spanning trees-Prims, Kruskal, Single source shortest path problem-Dijkstra.

UNIT-3 — 12 hours

Dynamic Programming: General method, applications-0/1 knapsack problem, Travelling salesperson problem, Longest common sequence algorithm, Multi stage graphs using Forward& Backward approach, Reliability design. **Graph Applications**: Graph traversals – Depth first, Breadth first, Bio Connected Components, Strongly Connected Components.	
UNIT-4	12 hours
Backtracking: General method, applications-n-queen problem, sum of subsets problem. Branch and Bound: General method, applications- 0/1 knapsack problem-LC Branch and Bound solution. **NP-Hard and NP-Complete problems:** Basic concepts, non-deterministic algorithms, NP-Hardand NP Complete classes, Cook's theorem.	
Text Books :	E. Horowitz, S.Sahniand S. Rajasekaran, "Fundamentals of Computer Algorithms" ,GalgotiaPublication.
References :	1. T. H. Cormen, Leiserson, Rivestand Stein, "Introduction of Computer Algorithm", PHI. 2. SaraBasse, A.V.Gelder, "Computer Algorithms", Addison Wesley.

TECHNICAL ENGLISH
II B.Tech – IV Semester (Code: 20CS405/EL02)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- At enhancing the vocabulary competency of the students
- To enhance the understanding of the elements of grammar
- To enable the students to use proper spelling, grammar in constructing the sentences
- To enhance the learner's ability to communicate accurately

Course Outcomes: Students will be able to

CO-1	Make use of contextual clues to infer meanings of unfamiliar words from context
CO-2	Understand how to apply technical information and knowledge in practical documents for a variety of purposes
CO-3	Analyse the content of the text in writing use grammatical, stylistic, and mechanical formats and conventions appropriate to various audiences and disciplines
CO-4	Build confidence to participate actively in writing activities (individually and in collaboration) that model effective technical communication in the workplace

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	-	-	-	-	-	-	-	2	-	3	2	2	-	2	1
CO-2	-	-	-	-	-	-	-	2	-	3	2	2	-	2	1
CO-3	-	-	-	-	-	-	-	2	-	3	2	2	-	2	1
CO-4	-	-	-	-	-	-	-	2	2	3	2	2	-	2	1

UNIT-1 — 12 hours

1.1 Vocabulary Development: Familiarizing Idioms &Phrases
1.2 Grammar for Academic Writing: Making Requests
1.3 Language Development: Using Transition & Link words
1.4 Technical Writing: Letter Writing &Email Writing

UNIT-2 — 12 hours

2.1 Vocabulary Development: Analogous words, Gender Sensitive language
2.2 Grammar for Academic Writing: Tenses: Simple Past /Present Perfect, The Future: Predicting &Proposing
2.3 Language Development: Cloze tests
2.4 Technical Writing: Technical Reports

UNIT-3 — 12 hours

3.1 Vocabulary Development: Abbreviations &Acronyms
3.2 Grammar for Academic Writing: Describing(People/Things/Circumstances) : Adjectival &Adverbial groups
3.3 Language Development: Transcoding (Channel conversion from chart to text)
3.4 Technical Writing: Circular, Memos, Minutes of Meeting

UNIT-4 — 12 hours

4.1 Vocabulary Development: Corporate vocabulary

4.2 Grammar for Academic Writing: Inversions &Emphasis 4.3 Language Development: Reading Comprehension 4.4 Technical Writing: Resume Preparation	
References :	1. Communication Skills, Sanjay Kumar & Pushpa Latha. Oxford University Press:2011. 2. Technical Communication Principles and Practice. Oxford University Press:2014. 3. Advanced Language Practice, Michael Vince. Macmillan Publishers:2003. 4. Objective English (Third Edition), Edgar Thorpe & Showick. Pearson Education:2009 5. English Grammar: A University Course (Second Edition), Angela Downing Philip Locke, Routledge Taylor &Francis Group 2016

PYTHON PROGRAMMING
II B.Tech – III Semester (Code: 20CSL401/SO02)

Practicals	:	5 Hours/Week (2T+3P)	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- Understand and write code using the basics of Python, Statements, Expressions, Conditional Executions, and Functions.
- Write code for Iteration, Strings, File I/O.
- Write code in creating, usage of Lists, Dictionaries, and Tuples.
- Understand the concepts of Object Orientation, Databases and write code implementing them.

Course Outcomes: Students will be able to

CO-1	Identify the basic python constructs with a view of using them in problem solving.
CO-2	Explore the usability of functions and strings in modular programming
CO-3	Apply lists,dictionaries,tuples and file operations to organize the data in real world problems.
CO-4	Implement the problems in terms of real world objects using object oriented and database concepts.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	2	1	-	3	-	-	-	-	1	-	2	3	1	-
CO-2	3	2	1	-	3	-	-	-	-	1	-	2	3	2	1
CO-3	3	2	2	2	3	-	-	-	-	1	1	2	3	2	1
CO-4	3	2	2	2	3	-	-	-	-	1	2	2	3	2	1

UNIT-1 32 Hours

Introduction: Overview, History of Python, Python Features, Environment Setup. Variables, expressions, and statements: values and types, variables, names and keywords, statements, operators and operands, expressions, order of operations, modulus operator, string operations, asking the user for input, comments, choosing mnemonic variable names.

Conditional execution: Boolean expressions, logical operators, conditional execution,
Alternative execution, chained conditionals, nested conditionals, catching exceptions using try and except, short-circuit evaluation of logical expressions.

Functions: function calls, built-in functions, type conversion functions, random numbers, math functions, adding new functions, definitions and uses, flow of execution, parameters and arguments, fruitful functions and void functions.

Iteration: updating variables, the while statement, infinite loops and break, finishing iterations with continue, definite loops using for, loop patterns.

Strings: string is a sequence, getting the length of a string using len, traversal through a string with a loop, string slices, strings are immutable, looping and counting, the in operator, string comparison, string methods, parsing strings, format operator.

Files I/O:persistence, opening files, text files and lines, reading files, searching through a file, letting the user choose the file name, using try except and open, writing files.

Lists: a list is a sequence, lists are mutable, traversing, operations, slices, methods, deleting elements, functions, strings, parsing lines, objects and values, aliasing, arguments.
Dictionaries: dictionary as a set of counters, dictionaries and files, looping and dictionaries, advanced text parsing.
Tuples: tuples are immutable, comparing tuples, tuple assignment, dictionaries and tuples, multiple assignment with dictionaries, the most common words, using tuples as keys in dictionaries, sequences.
Object-Oriented Programming: Managing Larger Programs, Using Objects, starting with Programs, Subdividing a Problem–Encapsulation, First Python Object, Classes as Types, Object Lifecycle, Many Instances, Inheritance.
Using Databases and SQL: Database concepts, Database Browser for SQLite, creating a database table, Structured Query Language summary, Basic data modeling, Programming with multiple tables, three kinds of keys, Using JOIN to retrieve data.

LIST OF EXPERIMENTS

1. Write a python program to check if the number is positive or negative or zero and display an appropriate message.
2. Write a python program to take a string from user and count number of vowels present and percentage of vowels in it.
3. Write a python program to find the most frequent words in a text file.
4. Write a Python Program to Find the Sum of first n Natural Numbers.
5. Write a python program to find the numbers which are divisible by 7 and multiple of 5 between 1500 and 2700.
6. Write a Python Program to solve Quadratic Equation.
7. Create a program that ask the user for a number and then prints out a list of all the divisors of that number.
8. Write a Python Program to Find HCF or GCD.
9. Write a Python Program to Find LCM.
10. Write a Python program to construct the following pattern, using a nested loop number.

    1
    22
    333
    4444
    55555
    666666

11. Write a Python Program to sort the given words in Alphabetic Order.
12. Write a Python function to create the HTML string with tags around the word(s).
13. Write a Python program to reverse words in a string.
14. Write a Python program to strip a set of characters from a string.
15. Write a python function to find the maximum and minimum of a list of numbers.
16. Write a Python Program to Find the Square Root.
17. Write a Python Program to Convert Decimal to Binary Using Recursion.
18. Write a python recursive function to a find the factorial of a given number.
19. Write a python program to find the longest word in each line of given file.
20. Write a Python program to combine each line from first file with the corresponding line in second file.
21. Write a Python program to read a random line from a file.
23. Write a Python program to split a list every Nth element.

    Sample list: ['a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j', 'k', 'l', 'm', 'n']
    Expected Output: [['a', 'd', 'g', 'j', 'm'], ['b', 'e', 'h', 'k', 'n'], ['c', 'f', 'i', 'l']]

24. Write a Python program to compute the similarity between two lists.

Sample data: ["red", "orange", "green", "blue", "white"], ["black", "yellow", "green", "blue"]
Expected Output:
Color1-Color2: ['white', 'orange', 'red'] Color2-Color1: ['black', 'yellow']

25. Write a Python program to replace the last element in a list with another list.
Sample data: [1, 3, 5, 7, 9, 10], [2, 4, 6,8] Expected Output: [1, 3, 5, 7, 9, 2, 4, 6, 8]
26. Write a Python program to find the repeated items of a tuple.
27. Write a Python program to convert a list with duplicates to a tuple without duplicates.
28. Write a Python program to reverse the elements of a tuple.
29. Write a Python program to replace last value of tuples in a list.
Sample list: [(10, 20, 40), (40, 50, 60), (70, 80, 90)]
Expected Output: [(10, 20, 100), (40, 50, 100), (70, 80, 100)]
31. Write a Python program to combine two dictionaries by adding values for common keys.
d1 = {'a': 100, 'b': 200, 'c':300}
d2 = {'a': 300, 'b': 200, 'd':400}
Sample output: Counter({'a': 400, 'b': 400, 'd': 400, 'c': 300})
33. Write a Python program to create and display all combinations of letters, selecting each letter from a different key in a dictionary.
Sample data : {'1':['a','b'], '2':['c','d']} Expected Output:
ac ad bc bd
34. Write a Python program to get the top three items in a shop.
Sample data: {'item1': 45.50, 'item2':35, 'item3': 41.30, 'item4':55, 'item5': 24} Expected Output:
item4 55 item1 45.5
item3 41.3
35. Write a Python program to match both key values in two dictionaries.
Sample dictionary: {'key1': 1, 'key2': 3, 'key3': 2}, {'key1': 1, 'key2': 2}
Expected output: key1: 1 is present in both x and y
36. Write a Python class named Rectangle constructed by a length and width and a method which will compute the area of a rectangle.
37. Write a Python class named Circle constructed by a radius and two methods which will compute the area and the perimeter of a circle.
38. Write a Python program to create a Single Linked List using classes.
39. Write a Python program to create a FIFO queue using classes.
40. Predict the output of following Python programs and write the justification. class X(object):

```
    def __init__(self,a):
      self.num = a
    def doubleup(self):
      self.num *= 2

class Y(X):
   def __init__(self,a): X.__init__(self, a)
   def tripleup(self):
      self.num *= 3

obj = Y(4)
print(obj.num)

obj.doubleup()
print(obj.num)
```

```
obj.tripleup()
print(obj.num)
```

41. Predict the output of following Python programs and write the justification.

```
# Base or Super class class Person(object):
   def __init__(self, name):
      self.name = name

   def getName(self):
      return self.name

   def isEmployee(self):
      return False

# Inherited or Subclass (Note Person in bracket)
class Employee(Person):
  def __init__(self, name, eid):
  ''' In Python 3.0+, "super().__init__(name)" also works'''
      super(Employee, self).__init__(name)
      self.empID = eid

   def isEmployee(self):
      return True

   def getID(self):
      return self.empID

# Driver code
emp = Employee("Geek1", "E101")
print(emp.getName(), emp.isEmployee(), emp.getID())
```

42. Create a employees database with the following attributes and insert rows. employee_id, first_name, last_name, email, phone_number, hire_date, job_id, salary, commission_pct, manager_id, department_id
43. Write a query to get the highest, lowest, sum, and average salary of all employees.
44. Write a query to get the average salary for all departments employing more than 10 employees.
45. Write a query to find the names (first_name, last_name), the salary of the employees whose salary is greater than the average salary.
46. Write a query to get nth max salaries of employees.

Text Books :	1. A Python Book: Beginning Python, Advanced Python, and Python Exercises, Dave Kuhlman, Open Source MIT License. 2. Python for Data Analysis, Wes McKinney, O' Reilly.
References :	1. Python Data Science Handbook-Essential Tools for Working with 2. Data Science from Scratch, JoelGrus, O'Reilly.

WEB TECHNOLOGIES LAB
II B.Tech – IV Semester (Code: 20CSL402)

Practicals	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- Know elements and tags of HTML and apply Styles using Cascading Style Sheets.
- Know basics of Java Script, Functions, Events, Objects and Working with browser objects.
- Know basics of XML, DOM and advanced features of XML.
- To convert XML documents into other formats and XSLT.

Course Outcomes: Students will be able to

CO-1	Create a web page layout using HTML5 elements and CSS stylings.
CO-2	Implement functions to modularize code,use arrays for storing and manipulating data efficiently and event handling techniques to create dynamic and interactive web applications.
CO-3	Demonstrate the knowledge of Javascript objects and DOM to develop interactive and responsive web applications.
CO-4	Demonstrate how to handle XML for data exchange and use of Jquery in creating dynamic,data-driven and interactive web applications.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	2	3	-	1	-	-	1	-	1	-	2	1	1	-
CO-2	2	2	3	1	1	-	-	1	-	1	-	2	1	2	-
CO-3	1	2	3	1	1	-	-	-	-	1	-	1	2	1	-
CO-4	1	3	3	1	1	-	-	-	-	1	-	1	2	3	-

LIST OF EXPERIMENTS

1. Write HTML5 document to design a webpage. (Using all fundamental elements, Organizing text, Links, URLs and Tables).
2. Write HTML5 document to design a webpage. (Using Images, Colors, Canvas & Forms).
3. Write codes for different types of styles in CSS3.
4. Write java scripts covering Function, Arrays and Events.
5. Demonstrate JavaScript objects.
6. Demonstrate browser objects.
7. Demonstrate Document Object Model for an HTML document.
8. Write well-formed and valid XML documents.
9. Write code for converting XML document to HTML using XSLT.
10. Build a webpage using JQuery and its components.

Text Books :	Kogent Learning Solutions Inc.,HTML5 BlackBook: Covers CSS3, Javascript, XML, XHTML, Ajax, PHP and Jquery.
References :	1. Harvey M. Deitel and Paul J.Deitel, "Internet &World Wide Web How to Program", 4/e, Pearson Education.

	2. Joshua Elchorn, "Understanding AJAX", Prentice Hall 2006.

RDBMS LAB

II B.Tech – IV Semester (Code: 20CSL403)

Practicals	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- Analyze the student on database languages.
- Interpret the Knowledge on database design.
- Determine the knowledge on key constraints and Normalization.
- Determine the knowledge on procedures and functions.

Course Outcomes: Students will be able to:

CO-1	Design database by using ER Diagrams
CO-2	Implement DDL, DML, DCL Commands using SQL.
CO-3	Apply key constrains to get a normalized database.
CO-4	Implement procedures and functions using PL/SQL

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	2	2	-	-	-	-	-	-	-	-	-	-	1	-
CO-2	2	2	3	1	-	-	-	-	-	-	-	-	-	2	-
CO-3	1	2	3	1	-	-	-	-	-	-	-	-	-	1	-
CO-4	1	3	3	1	-	-	-	-	-	-	-	-	-	3	-

LIST OF EXPERIMENTS

Experiment 1: Working with ER Diagram

Example: ER Diagram for Sailors Database

Entities:

1. Sailor

2. Boat Relationship:
   Reserves

Primary Key Atributes:

1. SID (Sailor Entity)
2. BID (Boat Entity)

Experiment 2: Working with DDL, DML, DCL and Key Constraints

Creation, Altering and Dropping of Tables and Inserting Rows into a Table (Use Constraints While Creating Tables) Examples Using Select Command.

Experiment 3: Working with Queries and Nested QUERIES

Queries (along with sub Queries) using ANY, ALL, IN, EXISTS, NOTEXISTS, UNION, INTERSET, Constraints

Expriment 4: Working with Queries USING Aggregate Operators & views

Queries using Aggregate Functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and Dropping of Views

Experiment 5: Working with Conversion Functions & String Functions

Queries using Conversion Functions (TO_CHAR, TO_NUMBER AND TO_DATE), String Functions (CONCATENATION, LPAD, RPAD, LTRIM, RTRIM, LOWER, UPPER, INITCAP, LENGTH, SUBSTR AND INSTR), Date Functions (SYSDATE, NEXT_DAY, ADD_MONTHS, LAST_DAY, MONTHS_BETWEEN), LEAST, GREATEST, TRUNC, ROUND, TO_CHAR, TO_DATE

Experiment 6: Working with LOOPS using PL/SQL

Program Development using WHILE LOOPS, FOR LOOPS, Nested Loops using ERROR Handling.

Experiment 7: Working with Functions Using PL/SQL

Program Development using Creation of Stored Functions, Invoke Functions in SQL Statements and Write Complex Functions.

Experiment 8: Working with Stored Procedures

Programs Development using Creation of Procedures, Passing Parameters IN and OUT of

PROCEDURES

Experiment 9: Working with CURSORS

Develop Programs using Features Parameters in a CURSOR, FOR UPDATE CURSOR, WHERE CURRENT of Clause and CURSOR Variables.

Experiment 10: Working with Triggers using PL/SQL

Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers and INSTEAD OF Triggers

Text Books :	1. Oracle PL/SQL by Example, Benjamin Rosenzweig, Elena Silvestrova, Pearson Education 3rdEd 2. Oracle Database Logic PL/SQL Programming, ScottUrman, TataMc-Graw Hill. 3. SQL and PL/SQL for Oracle 10g, Black Book, Dr.P.S.Deshpande

AUTOMATA THEORY AND FORMAL LANGUAGES
III B.Tech - V Semester (Code: 20CS501)

Lectures	:	2 Hours/Week, Tutorial:1	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: Discrete Mathematical Structures (20CS205)

Course Objectives: The student will be able to

- Understand the theory of automata and formal languages. Construct finite automata, and conversion between DFA and NFA.
- Demonstrate the connection between regular expressions, languages, and finite automata
- Demonstrate the connection between pushdown automata and context-free languages and Context Free Grammars.
- Construct Turing machines for a given task. Understand undecidability problems about Turing Machine and post correspondence problem (PCP).

Course Outcomes: Students will be able to

CO-1	Illustrate comprehension of automata and its practical applications through the creation of finite automata, as well as the conversion between deterministic and non-deterministic implementations.
CO-2	Convert regular expression to finite automata and vice versa. Construct minimized DFA.
CO-3	Construct push down automata for various context free languages. Demonstrate the connection between PDA and context-free grammars.
CO-4	Construct Turing machines for various languages. Understand Undecidability and Undecidable problems about TM and Post Correspondence Problem.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	1	1	-	-	-	-	-	-	-	-	1	-	-	2
CO-2	2	1	1	-	1	-	-	-	-	-	-	1	1	2	2
CO-3	3	3	3	1	-	-	-	-	-	-	-	1	1	2	2
CO-4	3	3	3	2	-	-	-	-	-	-	-	1	1	2	2

UNIT-I 15 Periods

Automata: Why Study Automata Theory, The central concepts of automata theory - Alphabets, Strings, Languages, Problems.

Finite Automata: An Informal picture of finite automata, Deterministic finite automata (DFA) - Definition of DFA, DFA processing strings, Notations for DFA, Extended transition function, the language of DFA, Non deterministic finite automata (NFA) – Definition ofNFA, Extended transition function, the language of NFA, Equivalence of DFA and NFA.

Automata with ϵ transitions: Use of ϵ - transition, notation for an ϵ - NFA, Epsilon closures, extended transitions and languages, Eliminating ϵ - transitions.

UNIT-2	15 Periods
Regular Expressions and Languages: Regular expressions, finite automata and regular expressions, Algebraic laws of regular expressions. **Properties of Regular Languages:** Proving languages are not regular – Pumping lemma for regular languages, Applications of the pumping lemma, Closure Properties of Regular Languages, Equivalence and minimization of automata – Minimization of DFA.	
UNIT-3	15 Periods
(Construction based treatment & proofs are excluded) **Context Free Grammars:** Context Free Grammars, Parse Trees, ambiguous grammars. **Pushdown Automata:** Definition of the Pushdown automata, the languages of PDA, Equivalences of PDA‘s and CFG‘s. **Context free languages:** Normal form‘s for context- Free grammars, the pumping lemma for context free languages.	
UNIT-4	15 Periods
Properties of Context free languages: closure properties for context free languages, Decision properties for CFL‘s. **Introduction to Turing Machines:** The Turing Machine, programming techniques forTuring machines. **Undecidability:** a language that is not recursively enumerable, an undecidable problem that is RE, Undecidability problems about TM, Post‘s Correspondence problem.	
Text Books :	John E.Hopcroft, Rajeev Motwani, & Jeffery D. Ullman, “Introduction to Automata Theory Languages and Computations”, Pearson Education, 2008, Third Edition, ISBN: 978-8131720479.
References :	1. KLP Mishra & N.Chandrasekharan, -“Theory of Computer Science: Automata, Languages and Computation”, PHI,2006,Third Edition, ISBN: 978-8120329683. 2. 2. H.R.Lewis, C.H.Papadimitriou, –“Elements of The theory of Computation“,Pearson Education, 2015, Second Edition, ISBN: 978-93-325-4989-0.

COMPUTER NETWORKS

III B. Tech. – V Semester (Code: 20CS502)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Operating Systems (20CS304)

Course Objectives: Students will be able to

- Understand the basic concepts of data communication, layered model, protocols and OSI&TCP layers
- Understand the basic concepts of Data Link control, Network Layer Design Issues, Routing Algorithms & Congestion.
- Understand the basic concepts of Quality of service, Network Layer & Transport Layer
- Understand the basic concepts of TCP, UDP & Application Layer

Course Outcomes: Students will be able to

CO-1	Understand the fundamentals of networks,network reference models and various error coeerection and detection techniques in data communication.
CO-2	Analyze error control,flow control mechanisms used at data link layer and various routing and congestion control protocols in network design.
CO-3	Understand the basic principles of OPV4 and its addressing mechanisms,elements of transport protocols in transport layer.
CO-4	Analyze the underlying protocols in transport layer and application layer.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	1	1	-	1	-	1	1	-	3	1	1	1	2	1
CO-2	1	1	2	-	2	1	1	-	1	2	-	1	2	2	1
CO-3	2	2	2	1	1	-	-	-	3	1	1	2	1	3	1
CO-4	1	2	2	2	1	-	-	-	-	1	1	1	1	3	1

UNIT-1 — 14 Hours

Data Communications & Networking Overview: A Communications Model, Data Communications, Data Communication Networking.

Protocol Architecture: The Need for a Protocol Architecture, A Simple Protocol Architecture, OSI, The TCP/IP Protocol Architecture.

Digital Data Communication Techniques: Asynchronous & Synchronous Transmission, Types of Errors, Error Detection, Error Correction.

UNIT-2 — 16 Hours

DATA Link Control: Flow Control, Error Control.

Network Layer: Network Layer Design Issues: Store-and-Forward Packet Switching, Services Provided to the Transport Layer, Implementation of Connectionless Service, Implementation of Connection-Oriented Service, Comparison of Virtual-Circuit & Datagram Subnets.

Routing Algorithms: The Optimality Principle, Shortest Path Routing, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing. **Congestion Control Algorithms:** General Principles of Congestion Control, Congestion Prevention Policies, Congestion Control in Virtual-Circuit Subnets, Congestion Control in Datagram Subnets, Load Shedding, Jitter Control.	
UNIT-3	16 Hours
Quality of Service: Requirements, Techniques for Achieving Good Quality of Service The Network Layer in the Internet: The IP Protocol, IP Addresses, Internet Control Protocols. The **Transport Layer, The Transport Service:** Services Provided to the Upper Layers, Transport Service Primitives, Berkeley sockets **Elements of Transport Protocols:** Addressing, Connection Establishment, Connection Release, Flow Control and Buffering, Multiplexing, Crash Recovery.	
UNIT-4	14 Hours
The Internet Transport Protocol (UDP): Introduction to UDP, Remote Procedure Call, The Real-Time Transport Protocol. **The Internet Transport Protocols (TCP):** Introduction to TCP, The TCP Service Model, The TCP Protocol, The TCP Segment Header, TCP Connection Establishment, TCP Connection Release, Modeling TCP Connection Management, TCP Transmission Policy, TCP Congestion Control, TCP Timer Management. **Application Layer:** The Domain Name System (DNS): The DNS Name Space, Resource Records, Name Servers.	
Text Books :	1. Behrouz A.Forouzan, "Data Communications and Networking", 4th edition, TMH. 2. Tanenbaum,"Computer Networks",5th Edition, Pearson Education, 2011
References :	1. Wayne Tomasi, "Introduction to Data Communications and Networking", PHI. 2. Behrouz A.Forouzan, "Data Communications and Networking", Fourth edition, TMH 3. God Bole, "Data Communications & Networking", TMH. 4. Kurose & Ross, "COMPUTER NETWORKS– A Top-down approach featuring the Internet", Pearson Education, AlbertoLeon, Garciak. 5. Leon Gartia, Indra Widjaja, "Communication Networks Fundamental Concepts and Key Architectures", TMH. 6. Nader F.Mir, "Computer and Communication Networks", PHI.

SOFTWARE ENGINEERING
III B.Tech – V Semester (Code: 20CS503)

Lectures	:	3 Hours/Week,	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- Understand different process models of Software Engineering and
- Understand Agile Software Development. How to collect requirements from client and how to analyze the collected requirements.
- Understand how to design and implement the Software Product or Project.
- Understand the concepts of Testing and Measuring the software project or Product.

Course Outcomes: Students will be able to

CO-1	Gain insight into various generic process models.
CO-2	Attain a comprehension of agile process models, and then formulating distinct analysis models for the software project.
CO-3	Develop different design models for the software project.
CO-4	Acquire diverse testing strategies, as well as software metrics and measures.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	2		-	1	-	-	-	-	-	2	-	2	1	-
CO-2	-	3	1	-	-	-	1	1	2	1	2	-	1	1	-
CO-3	-	3	1	-	-	-	1	1	2	1	2	-	2	1	-
CO-4	-	3	1	2	-	-	-	-	-	-	2	-	2	1	-

UNIT-1 — 15 Periods

INTRODUCTION TO SOFTWARE ENGINEERING: The Evolving Role of Software, Software, the Changing Nature of Software, Legacy Software, Software Myths.

A GENERIC VIEW OF PROCESS: Software Engineering - A Layered Technology, a Process Framework, the CMMI, Process Patterns, Process Assessment, Personal and Team Process Models, Product and Process.

PROCESS MODELS: Prescriptive Models, the Waterfall Model, Incremental Process Models, Evolutionary Models, the Unified Process.

UNIT-2 — 15 Periods

AN AGILE VIEW OF PROCESS: What Is Agility? , What Is an Agile Process? , Agile Process Models.

REQUIREMENTS ENGINEERING: A Bridge To Design and Construction, Requirements Engineering Tasks, Initiating the Requirements Engineering Process, Eliciting Requirements, Developing Use-cases, Building the Analysis Model, Negotiating Requirements, Validating Requirements.

BUILDING THE ANALYSIS MODEL: Requirements Analysis, Analysis Modeling Approaches, Data Modeling Concepts, Flow-Oriented Modeling, Class Based Modeling Creating a Behavioral Model.

UNIT-3	15 Periods

DESIGN ENGINEERING: Design within the Context of Software Engineering, Design Process and Design Quality, Design Concepts The Design Model, Pattern Based Software Design.

CREATING AN ARCHITECTURAL DESIGN: Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design, Assessing Alternative Architectural Designs.

MODELING COMPONENT-LEVEL DESIGN: What Is a Component? , Designing Class-Based Components, Conducting Component-Level Design, Designing Conventional Components.

PERFORMING USER INTERFACE DESIGN: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

UNIT-4	15 Periods

SOFTWARE PROCESS AND PROJECT METRICS: Introduction: Metrics Process and Project Domains, Software Measurement, Metrics for Software Quality, Integrating Metrics with Process.

SOFTWARE QUALITY ASSURANCE: Quality Concepts, Quality Movement, SQA, Software Reviews, Formal Technical Reviews, Formal Approaches to SQA, Software Reliability, ISO 9000 Quality Standards, SQA Plan.

SOFTWARE TESTING STRATEGIES: Strategic Approach, Strategic Issues, Test strategies for Conventional Software, White box testing, Black Box testing, Test strategies for Object Oriented Software, Validation Testing, System Testing, The Art of Debugging.

Text Books :	Roger S.Pressman, "Software Engineering- A Practitioner's Approach", **McGraw Hill** , 2014, 8th. **McGraw Hill** ISBN- **978-0078022128**
References :	1. K.K. Aggarwal & Yogesh Singh, "Software Engineering", New Age International, 2008, Third Edition,. ISBN- **978-8122423600** 2. Pankaj Jalote, "An Integrated Approach to Software Engineering", Springer, 2005, Second Edition. ISBN- 978-0-387-20881-7 3. Ian Sommerville, "Software Engineering", Pearson Education, 2017, 10th Edition. ISBN-13: 978-9332582699 4. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, "Fundamentals of Software Engineering", PHI, 2002, Second Edition. ISBN - 978-8120322424 5. RajibMall, "Fundamentals of Software Engineering", PHI, 2018, 5thEdition, PHI. ISBN- 978-9388028028

SOFT SKILLS LAB

III B.Tech – V Semester(Code: 20CSL501/SO03)

Practicals	:	3 Hours/Week (1T+2P)	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Objectives: Students will be able to

- To make the engineering students aware of the importance, the role and the content of soft skills through instruction, knowledge acquisition, demonstration and practice.
- To know the importance of interpersonal and intrapersonal skills in an employability setting.
- Actively participate in group discussions / interviews and prepare & deliver Presentations.
- Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, stress management and leadership quality.

Course Outcomes: Students will be able to

CO-1	Use appropriate body language in social and professional contexts.
CO-2	Demonstrate different strategies in presenting themselves in professional contexts.
CO-3	Analyze and develop their own strategies of facing the interviews successfully.
CO-4	Develop team coordinating skills as well leadership qualities.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	-	-	-	-	-	-	-	1	2	3	1	2	2	1	1
CO-2	-	-	-	-	-	-	-	1	1	3	1	2	2	1	1
CO-3	-	-	-	-	-	-	-	1	1	3	1	2	2	1	1
CO-4	-	-	-	-	-	-	-	1	3	3	1	3	2	1	1

LIST OF EXPERIMENTS

1. Body Language & Identity Management

a. Facial Expressions – Kinesics - Occulesics
b. Haptics - Proxemics
c. Para Linguistics
d. Appearance
e. Identity Management Communication

2. Emotional Intelligence & Life Skills

a. Self Awareness through Johari Window and SWOC analysis
b. Self Motivation
c. Empathy
d. Assertiveness & Managing Stress
e. Positive Attitude
f. Time Management
g. Goal Setting: Short term, Long Term, Vision, Mission.

3. Business Presentations

a. Preparing effective Presentations Power Point Presentations b. Power Point Presentations c. Using Visual Aids d. Mock Presentations **4. Employability Skills** a. Group Discussion b. Team Building and Leadership Qualities c. Interview Skills	
References :	1. Personality Development and Soft skills (Second Edition), Barun K. Mithra. Oxford University Press: 2016 2. The Definitive Book of Body Language, Allan & Barbara. Pease International:2004 3. Working with Emotional Intelligence, Daniel Goleman. Bloomsbury:1998 4. English for Jobseekers, Lina Mukhopadhyay. Cambridge University Press:2013 5. The 7 Habits of Highly Effective People, Stephen R.Covey. St. Martin's Press:2014

SOFTWARE ENGINEERING LAB
III B.Tech – V Semester(Code: 20CSL502)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- Able to prepare problem statement and SRS (software requirements specification) document.
- Able to develop various analysis modeling diagrams.(use-case, activity, class etc.)
- Able to develop various design representations (component diagrams and deployment diagrams)
- Able to perform various testing techniques (black box and white box)

Course Outcomes: Students will be able to

CO-1	Prepare SRS document.
CO-2	Develop various analysis modeling representations using StarUML tool.
CO-3	Develop various design representations using StarUML tool.
CO-4	Perform various testing strategies on code.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	2	2	-	-	-	1	-	-	3	3	3	-	3	3	-
CO-2	2	3	2	-	3	1	-	-	3	3	3	-	3	3	-
CO-3	2	-	3	-	3	1	-	-	3	3	3	-	3	3	-
CO-4	2	-	-	2	3	1	-	-	3	3	3	-	2	3	-

LIST OF EXPERIMENTS

Tool Required: StarUML

LIST OF EXPERIMENTS

16. Write down the problem statement for a suggested system of relevance.
17. Do requirement analysis and develop Software Requirement Specification Sheet(SRS) for suggested system.
18. To perform the function oriented diagram: Data Flow Diagram (DFD) and Structured chart.
19. To perform the user‘s view analysis for the suggested system: Use case diagram.
20. To draw the structural view diagram for the system: Class diagram, object diagram.
21. To draw the behavioral view diagram : State-chart diagram, Activity diagram
22. To perform the behavioral view diagram for the suggested system : Sequence diagram,Collaboration diagram
23. To perform the implementation view diagram: Component diagram for the system.
24. To perform the environmental view diagram: Deployment diagram for the system.
25. To perform various testing using the testing tool unit testing, integration testing

for a samplecode of the suggested system.

Note: Minimum 8 experiments should be carried.

List of Practical's

Choose any one project and do the above exercises for that project

1. Student Result Management System
2. Library management system
3. Inventory control system
4. Accounting system
5. Fast food billing system
6. Bank loan system
7. Blood bank system
8. Railway reservation system
9. Automatic teller machine
10. Video library management system
11. Hotel management system
12. Hostel management system
13. E-ticking
14. Share online trading
15. Hostel management system
16. Resource management system
17. Court case management system

Text Books :	Roger S.Pressman, "Software Engineering- A Practitioner's Approach", **McGraw Hill** , 2014, 8th. **McGraw Hill** ISBN- **978-0078022128**
References :	1. K.K. Aggarwal & Yogesh Singh, "Software Engineering", New Age International, 2008, Third Edition,. ISBN- **978-8122423600** 2. Pankaj Jalote, "An Integrated Approach to Software Engineering", Springer, 2005, Second Edition. ISBN- 978-0-387-20881-7 3. Ian Sommerville, "Software Engineering", Pearson Education, 2017, 10th Edition. ISBN-13 : 978-9332582699 4. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, "Fundamentals of Software Engineering", PHI, 2002, Second Edition. ISBN - 978-8120322424 5. RajibMall, "Fundamentals of Software Engineering", PHI, 2018, 5thEdition, PHI. ISBN- 978-9388028028

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE
III B. Tech. – V Semester (Code: 20CS506/MC03)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	---	Final Exam Marks	:	--

Pre-Requisite: None

Course Objectives: Students will be able to

- Generalize the effect of precolonial and colonial period on Indian Traditional Knowledge System, traditional Medicine
- Discover the knowledge of ITK in Production, Construction, Physics, Chemistry, Architecture and Vastu
- Discriminate the contribution of India in Mathematics, Astronomy & Astrology
- Propose the importance of Yoga in holistic living

Course Outcomes: Students will be able to

CO-1	Comprehend the notion of Indian Traditional knowledge and recognize its significance.
CO-2	Compare the Indian traditional knowledge Systems with Other Global systems.
CO-3	Grasp the concept of yoga and identify its interconnections with scientific principles.
CO-4	Study various case studies related to traditional knowledge.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	2	3	-	3	-	-	-	-	-	-	1	3	3	3
CO-2	1	2	3	-	3	-	-	-	-	-	-	1	3	3	3
CO-3	1	2	3	-	3	-	-	-	-	-	-	1	3	3	3
CO-4	1	2	3	-	3	-	-	-	-	-	-	1	3	3	3

UNIT-1 — 8 Hours

Historical Background: TKS during the Pre-colonial and Colonial Period

Indian Traditional Knowledge System

Traditional Medicine: Ayurveda, Simple Definition, Origin, The Great Three Classics of Ayurveda, The Branches of Ayurveda, Basic Concepts of Ayurveda, Purusha/Prakruti, Manifestation of Creation, Mental Constitution, Vata, Pitta and Kapha: The Three Doshas

UNIT-2 — 8 Hours

Traditional Production and Construction Technology: Social Conditions and Technological Progress, The Impetus for Metallurgy, Social Needs and Technological Applications, State Support of Technology, India and the Industrial Revolution.

History of Physics and Chemistry: Philosophy and Physical Science, Optics and Sound, The Laws of Motion, The Five Basic Physical Elements, Indian Ideas about Atomic Physics.

Traditional Art and Architecture and Vastu Shashtra: The Principles of Vastu are simple

UNIT-3 — 8 Hours

Origin of Mathematics: The Decimal System in Harappa, Panini and Formal Scientific Notation, The Indian Numeral System, Emergence of Calculus, The Spread of Indian Mathematics, The

Concept of Zero.

Astronomy and Astrology

TKS and the Indian Union: Protection and the Legislative Frameworks in India, Comment, Sui Generis System, Trade Secrets and Know-how, Geographical Indications Bill, Protection of Plan varieties and Farmers Rights Bill, Rights of Communities, Monitoring Information on Patent Applications World-wide.

UNIT-4	8 Hours

Common Yoga Protocol: Introduction, What is Yoga? Brief History and Development of Yoga, The fundamentals of Yoga,

General Guidelines for Yoga Practice: Before the practice, During the Practice, After the Practice, Food for Thought, How Yoga can Help.

Invocation, 2. Sadilaja/Cālana Kriyās /Loosening Practices,

Yogāsanas:

Standing Postures: Tāḍāsana (Palm Tree Posture), **Vṛkṣāsana** (The Tree Posture), **Pāda-Hastāsana** (The Hands to Feet Posture), **Ardha Cakrāsana** (The Half Wheel Posture), **Trikonāsana** (The Triangle Posture)

Sitting Postures: Bhadrāsana (The Firm/Auspicious Posture), **Vajrāsana** (Thunderbolt Posture), **Uṣṭrāsana** (Camel Posture), **Śaśakāsana** (The Hare Posture), **Vakrāsana** (The Spinal Twist Posture),

Kapālabhāti 5. Prānāyāma: naḍīśodhana or anuloma viloma prānāyāma (Alternate Nostril Breathing), **Śītalī Prāṇāyāma, Bhrāmarī Prāṇāyāma** (Bhrāmarī Recaka) **6. Dhyāna 7. *Sankalpa* 8. Śantih pātha**

Text Books :	1. Traditional Knowledge System in India, Amit Jha, 2009 2. Common YOGA Protocol, Ministry of Ayush
References :	Traditional Knowledge System & Technology in India, Basanta Kumar Mohanta, Vipin Kumar Singh, 2012

COMPILER DESIGN

III B. Tech. – VI Semester (Code: 20CS601)

Lectures	:	4 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Automata Theory & Formal Languages (20CS501)

Course Objectives: Students will be able to

- To comprehend the principles involved in the design and construction of compilers, the algorithms involved in the design and construction of compilers, Understand the design of lexical analyzer.
- To practice Various Bottom up parsing techniques.
- To apply Various Intermediate languages. To understand Code generation algorithm
- Various storage allocation strategies, Various Symbol table data structures.

Course Outcomes: Students will be able to

CO-1	To comprehend the principles involved in the design and construction of compilers, the algorithms involved in the design and construction of compilers, Understand the design of lexical analyzer.
CO-2	To practice Various Bottom up parsing techniques.
CO-3	To apply Various Intermediate languages. To understand Code generation algorithm
CO-4	Various storage allocation strategies, Various Symbol table data structures.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	3	3	2	1	-	-	-	-	-	-	3	3	3	1
CO-2	3	3	3	2	1	-	-	-	-	-	-	3	3	3	1
CO-3	3	3	3	2	-	-	-	-	-	-	-	3	3	3	1
CO-4	2	2	2	-	-	-	-	-	-	-	-	3	3	2	1

UNIT-1 — 15 Hours

Introduction: Language Processors, The Structure of a Compiler.
Lexical Analysis: The Role of the Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, The Lexical-Analyzer Generator Lex.
Syntax Analysis: Introduction, Writing a Grammar: elimination of left recursion, left factoring, Top-Down Parsing: Recursive-Descent Parsing, FIRST and FOLLOW, LL(1) Grammars, Nonrecursive Predictive Parsing.

UNIT-2 — 15 Hours

Bottom-Up Parsing, Introduction to LR Parsing: Simple LR, More Powerful LR Parsers: Canonical LR(1) Items, Constructing LR(1) Sets of Items, Canonical LR(1) Parsing Tables, Constructing LALR Parsing table. The Parser Generator YACC.
Syntax-Directed Translation: Syntax-Directed Definitions, Evaluation Orders for SDD's, Construction of syntax trees.

UNIT-3 — 15 Hours

Intermediate-Code Generation: Variants of Syntax Trees, Three-Address codes, Translation of expressions: Operations within expressions, Incremental translation, control flow: Boolean

expressions: Short circuited code Flow of control statements, Control flow translation of Boolean expressions, Backpatching for Boolean Expressions. **Code Generation:** Issues in the Design of a Code Generator, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, A Simple Code Generator.	
UNIT-4	15 Hours
Run-Time Environments: Storage Organization, Static allocation strategy, Stack Allocation of Space: Activation trees, Activation records, calling sequence, variable length data on the stack. **Symbol Tables:** Symbol table entries, Data structures to symbol tables, representing scope information.	
Text Books :	Alfred V.Aho, RaviSethi, JD Ullman, "Compilers Principles, Techniques and Tools", Pearson Education, Second Edition, 2013.
References :	1. Alfred V.Aho, Jeffrey D. Ullman, "Principles of Compiler Design", Narosa publishing. 2. "Lex&YACC", John R. Levine, Tony Mason, Doug Brown, O'reilly. 3. "Modern Compiler Implementation in C", Andrew N. Appel, Cambridge University Press.

MACHINE LEARNING
III B. Tech. – VI Semester (Code: 20CS602)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Basic Calculus and Probability

Course Objectives: Students will be able to

- Learn a Regression Model.
- Comprehend a Supervised Learning Model.
- Apply Ensemble methods for improving the performance of a Learning Model.
- Apply an Unsupervised Learning Model.

Course Outcomes: Students will be able to

CO-1	Understand a very broad collection of machine learning algorithms,problems and apply the correct regression model for the given problem and implement it.
CO-2	Analyze the supervised discriminative and generate models for the given problem and implement it.
CO-3	Identify the supervised strong learning model for the given problem and implement it.
CO-4	Learn the basics of the learning problem with hypothesis,version spaces and choose the correct clustering algorithm for the given problem and implement it.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	2	3	2	3	-	-	2	-	2	-	1	3	3	3
CO-2	1	2	3	2	3	-	-	2	-	2	-	1	3	3	3
CO-3	1	2	3	2	3	-	-	2	-	2	-	1	3	3	3
CO-4	1	2	3	2	3	-	-	2	-	2	-	1	3	3	3

UNIT-1 — 15 Hours

Machine learning basics: What is machine learning? Key terminology, Types of Machine Learning Systems, how to choose the right algorithm, Steps in developing a machine learning application, Main Challenges of Machine Learning Essential Python Libraries: Scikit-learn, NumPy, matplotlib, Pandas. A First Application: Classifying iris species using Sci-kit learn.
Linear Regression: Simple linear regression. Optimization of model parameters using Batch gradient decent algorithm, Mini batch gradient decent algorithm and Stochastic gradient descent algorithm, Multiple linear regression, locally weighted linear regression, Polynomial Regression. Regularized Linear Models- Ridge Regression and Lasso Regression
Regularization: Bios Variance tradeoff, L1 and L2 regularization.

UNIT-2 — 8 Hours

Generative Classifiers: Classifying with Bayesian decision theory, Bayes' rule, Naïve Bayes classifier.
Discriminative Classifiers: Logistic Regression, Decision Trees: Training and Visualizing a Decision Tree, Making Predictions, Estimating Class Probabilities, The CART Training Algorithm,

Attribute selection measures- Gini impurity; Entropy, Regularization Hyperparameters, Regression Trees, Linear Support vector machines.	
UNIT-3	8 Hours
Evaluation of a Classifier: Measuring Accuracy Using Cross-Validation, Confusion Matrix, Precision and Recall, Precision/Recall Trade-off, The ROC Curve. **Ensemble Learning:** Voting Classifiers, Bagging and Pasting, Random Forests, Boosting-AdaBoost and Gradient Boosting.	
UNIT-4	8 Hours
Computational Learning Theory: Introduction, probably learning an approximately correct hypothesis, sample complexity for finite hypothesis spaces. **Instance-based Learning:** Introduction, K-nearest neighbors. **Unsupervised Learning:** K-means clustering algorithm, Hierarchical clustering algorithm, Gaussian mixture model.	
Text Books :	1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Second Edition, Aurelien Geron, O'Reilly publishers, ISBN: 781492032649. 2. Andreas C. Muller and Sarah Guido. Introduction to Machine Learning with Python. Oreilly, 1 edition, 2016. ISBN 9781449369415.
References :	1. Peter Harrington Machine Learning in Action. Manning, I edition, 2012. 2. Andrew Ng. Machine Learning Lecture Notes. Stanford University. URL https://seeedu/course/CS229. 3. Sebastain Raschka and Vahid Mirjalili. Python Machine Learning. Packt Publishing, 2 edition, 2017. ISBN 97893252136278. 4. Tom M. Mitchell. Machine Learning, 1 edition, 1997. ISBN 0070428077. URL http://www.cs.cmu.edu/~ tom/mlbook.html.

CRYPTOGRAPHY & NETWORK SECURITY
III B. Tech. – VI Semester (Code: 20CS603)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Computer Networks (20CS502)

Course Objectives: Students will be able to

- know about security services, attacks and various encryption techniques.
- understand the concept of public key cryptography and study about message authentication and hash functions.
- Understand the digital signature, key management and email security mechanisms.
- impart knowledge on Transport layer & Network layer security

Course Outcomes: Students will be able to

CO-1	Identify common network security vulnerarabilities/attack and understand various symmetric encryption techniques.
CO-2	Analyze and apply the concepts of various public key encryption and cryptographic hash functions.
CO-3	Evaluate the authentication,key management and describe various application layer mechanisms.
CO-4	Illistrate the various security mechanisms of transport layer and network layer.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO-2	2	3	3	-	-	-	-	-	-	-	-	-	3	1	-
CO-3	2	2	-	-	-	-	-	-	-	-	-	-	-	1	2
CO-4	-	2	3	-	3	-	-	-	-	-	-	-	-	-	2

UNIT-1 16 Hours

Introduction: Security Goals, Attacks, Service and Mechanism, Techniques
Traditional symmetric key ciphers: Introduction, Substitution Ciphers, Transposition Ciphers, Stream and Block Ciphers
Data Encryption Standard (DES): Introduction, DES Structure, DES Analysis, Multiple DES, Security of DES
Encipherment using Modern Symmetric Key Ciphers: Use of Modern Block Ciphers

UNIT-2 16 Hours

Advanced Encryption Standard: Introduction, Transformations, Key Expansion, Ciphers.
Asymmetric Key Cryptography: Introduction, RSA Cryptosystem, Robin Cryptosystem, Elgamal Cryptosystem.
Message Integrity and Message Authentication: Message Integrity, Message Authentication.
Cryptographic Hash Functions: Introduction, SHA-512.

UNIT-3 16 Hours

Digital Signatures: Comparison, Process, Services, Attacks on Digital Signature, Digital Signature Standard.

Key Management: symmetric key distribution, Kerberos, Symmetric Key Agreement, Public Key Distribution. **Security at the Application Layer:** E-Mail, PGP.	
UNIT-4	14 Hours
Security at the Transport Layer: SSL Architecture, Four Protocols, SSL Message Format, Transport Layer Security. **Security at the Network Layer:** Two Modes, Two Security Protocols, Security Association, Security Policy, Internet Key Exchange, ISAKMP.	
Text Books :	Cryptography and network security - Behrouz A. Forouzan
References :	1. William Stallings "Cryptography and Network Security" 4th Edition, (Pearson Education/PHI). 2. Kaufman, Perlman, Speciner, "NETWORK SECURITY", 2nd Edition, (PHI / Eastern Economy Edition) 3. Trappe & Washington, "Introduction to Cryptography with Coding Theory", 2/e, Pearson.

MACHINE LEARNING LAB
III B. Tech. –VI Semester (Code: 20CSL602)

Practicals	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Basic Calculus and Probability

Course Objectives: Students will be able to

- Learn a Regression Model
- Comprehend a Supervised Learning Model
- Apply Ensemble methods for improving the performance of a Learning Model
- Apply an Unsupervised Learning Model

Course Outcomes: Students will be able to

CO-1	Apply the correct regressions models for the given problems and implement it.
CO-2	Analyze the suitable supervised learning model for the given problem and implement it.
CO-3	Identify the suitable probabilistic learning model for the given problem and implement it.
CO-4	Choose the correct clustering algorithm for the given problem and implement it.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	2	3	2	3	-	-	2	-	2	-	1	3	3	3
CO-2	1	2	3	2	3	-	-	2	-	2	-	1	3	3	3
CO-3	1	2	3	2	3	-	-	2	-	2	-	1	3	3	3
CO-4	1	2	3	2	3	-	-	2	-	2	-	1	3	3	3

LIST OF EXPERIMENTS

1. Write sample programs using
   a) NumPy b) Pandas
2. Write sample programs using
   a) Matplotlib b) Scikit Learn
3. Write a program to implement the linear regression using
   a) Stochastic gradient descent approach of training for a sample training data set.
   b) Batch gradient descent approach of training for a sample training data set
4. Write a program to implement the naïve Bayesian classifier for a sample training data set. Compute the performance of the classifier.
5. Write a program to implement the Logistic regression for a sample training data set and test the same using appropriate data sets.
6. Write a program to demonstrate the working of the decision tree based on ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample. Compute the performance of the classifier, considering few test data sets.

7. Write a program to implement the Random Forest classifier for a sample training data set stored as a .CSV file. Compare the performance of the classifier with any weak classifier, considering few test data sets. 8. Write a program to implement the AdaBoost classifier for a sample training data set. Compare the performance of the classifier with Random Forest classifier, considering few test data sets. 9. Apply k-Means algorithm to cluster a dataset. 10. Apply Hierarchical clustering algorithm to cluster a dataset.	
Text Books :	1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Second Edition, Aurelien Geron, O'Reilly publishers, ISBN: 781492032649. 2. Andreas C. Muller and Sarah Guido. Introduction to Machine Learning with Python. Oreilly, 1 edition, 2016. ISBN 9781449369415.
References :	1. Peter Harrington Machine Learning in Action. Manning, I edition, 2012. 2. Andrew Ng. Machine Learning Lecture Notes. Stanford University. URL https://seeedu/course/CS229. 3. Sebastain Raschka and Vahid Mirjalili. Python Machine Learning. Packt Publishing, 2 edition, 2017. ISBN 97893252136278. 4. Tom M. Mitchell. Machine Learning, 1 edition, 1997. ISBN 0070428077. URL http://www.cs.cmu.edu/~ tom/mlbook.html.

CONSTITUTION OF INDIA III B.Tech – VI Semester (Code:20CS606/MC04)			
Lectures :	**2** Periods / Week	Continuous Internal Assessment :	**30** Marks
Final Exam :	---	Semester End Exam :	---

Pre-Requisite: NIL

Course Objectives: Students will be able to

- To understand the importance of the Constitution in a Democratic Society.
- To Understand to Fundamental Rights and make the best use of them and the duties of a citizen and discharge his duties and became a good citizen.
- To know the judicial supremacy and independence of Judiciary and fight for his legitimate Right through Court of Law.
- To participate in Nation building activities and be away from destructive outfits and in the democratic process of governance.

Course Outcomes: Students will be able to

CO-1	Able to understand the importance of the constitution in a Democratic Society.
CO-2	Comprehend the Fundamental Rights and effectively apply them, while also acknowledging the responsibilities of a citizen, fulfilling those duties, and aspiring to become a responsible citizen
CO-3	Know about Judicial supremacy and Independence of judiciary and fight for his legitimate Rights through court of law.
CO-4	Participate in nation building activities and be away from destructive outfits and in the democratic process of governance.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-3	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
CO-4	-	-	-	-	-	-	2	-	-	-	-	3	-	-	-

UNIT-I	8 Periods
Meaning of the Constitutional Law and Constitutionalism, Historical perspective of the Constitution of India, Salient features and Characteristics of the Constitution of India, scheme of Fundamental Rights	
UNIT-II	8 Periods
The Scheme of the Fundamental Duties and its legal status, The Directive Principles of State Policy- its implementation, Federal structure and distribution of Legislative and Financial powers between the Union and States, Parliamentary form of Government of India – The constitutional Powers and Status of the President of India.	
UNIT-III	8 Periods
Amendment of Constitutional powers and procedure, the Historical Perspective of the Constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India	
UNIT-IV	8 Periods
Scheme of the Fundamental Rights to Equality, Scheme of the Fundamental Right to certain Freedoms under Article 19, Scope of the Right to Life and Personal Liberty under Article 21.	
Text Book(s) :	1. Introduction to constitution of India, D.D.Basu, Lexisnexis 2. The constitution of India, P. M. Bhakshi, Universal law publishing

INDUSTRIAL MANAGEMENT & ENTREPRENEURSHIP DEVELOPMENT
IV B. Tech. – VII Semester (Code: 20CS705/ME05)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite:

Course Objectives: Students will be able to

- To provide students an insight into the concepts of general, scientific management and various forms of business organizations along with awareness about various organization structures
- It aims to provide the students with an understanding of basics of human resource management, marketing management.
- To make the students to understand inventory control concepts, fundamentals of TQM, and supply chain management.
- To provide an understanding of financial management and realize the importance of Entrepreneurship.

Course Outcomes: Students will be able to

CO-1	Describe the various functions of the management. Learn various forms and structures of business organizations.
CO-2	Understand how resources to be planned and also understand various motivation theories, leadership styles and marketing management.
CO-3	Develop knowledge about inventory control. Gain the knowledge on Total quality management and understand supply chain management.
CO-4	Grasp complete knowledge on importance of entrepreneurship and ability to understand capital and various types of capital.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	-	-	-	-	-	-	-	-	1	2	3	-	-	-	1
CO-2	-	-	-	-	-	2	-	-	3	-	1	-	-	-	1
CO-3	-	-	-	-	-	-	-	-	3	2	1	2	-	-	1
CO-4	2	3	2	3	-	-	2	-	-	-	-	-	-	-	-

UNIT-1 13 Hours

General Management: Management definition, Functions of Management and Principles of Management.

Scientific Management: Definition, Principles of Scientific Management.

Forms of Business Organization: Choice of form of organization, Salient features of Sole Proprietorship, Partnership, Joint Stock Company: Private Limited and Public Limited companies; Merits and demerits.

Organization: Definition, Line, line and staff, functional and matrix organization, Introduction to Strategic Management: Definition and scope

UNIT-2 13 Hours

Human Resource Management: Functions of HR management, human resource planning, recruitment, selection, placement, training & development and performance appraisal, Motivation theories, leadership styles. **Marketing Management:** Concepts of Selling and Marketing, Functions of Marketing, Marketing mix (4 Ps); Advertising and sales promotion; Product life cycle; distribution channels	
UNIT-3	13 Hours
Materials Management: Inventory Control, objectives of inventory control, Inventory costs, Basic EOQ model, Model with Price breaks, ABC analysis, FSN Analysis, VED Analysis. **Total Quality Management:** Definition of, Importance of quality, Phases of quality management, quality control, Difference between Inspection and Quality control, Components of total quality, Quality Function Deployment **Introduction to Supply Chain Management:** Definition, scope of SCM, Drivers of SCM, Advantages, limitations	
UNIT-4	13 Hours
Financial Management: Functions of finance, Types of Capital-Fixed and Working Capital, Break Even Analysis. **Entrepreneurship Development:** Introduction, Entrepreneurial characteristics, Functions of an Entrepreneur; Factors affecting entrepreneurship; Role of communication in entrepreneurship; Entrepreneurial Development-Objectives, Need of Training for enterprises; Finance for the enterprises.	
Text Books :	1. Essentials of Management /Koontz and Heinz Weihrich/ Tata-McGraw-Hill 10th Ed. 2. Manufacturing Organization and Management / Amrine / Pearson Education
References :	1. Management Science, A. R. Aryasri. 2. Industrial Engineering and production management by M Mahajan, Dhanapatrai Publications 3. Marketing Management, Philip Kotler

Professional Electives

Subject Code	Subject Name
PE01	Wireless Networks
PE02	Data Warehousing & Data Mining
PE03	Distributed Systems
PE04	Artificial Intelligence
PE05	Block chain Technologies
PE06	Protocols for Secure Electronic Commerce
PE07	Artificial Neural Networks and Deep Learning
PE08	Natural Language Processing

WIRELESS NETWORKS
Professional Elective (Code: PE01)

Lectures	:	4 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Computer Networks (20CS502)

Course Objectives: Students will be able to

- Understand the fundamentals of the wireless communications systems, the wireless network architectures, protocols, and applications.
- Understand architecture of different telecommunication systems and satellitesystems.
- Understand architecture and layers of wireless local area networks and network layer for wireless environment.
- Understand network architectures of 4G and 5G Technology Advancements.

Course Outcomes: Students will be able to

CO-1	Develop the foundation for mobile and wireless networks.
CO-2	Learns about 2G mobile communication system, DECT, UMTS and LTE Technology. Learns about basics, routing, and localization of satellite systems.
CO-3	Learn about Wireless LAN architecture and protocols used. Learns about Mobile Network Layer.
CO-4	Learn the fundamentals of network architecture and evolution of 4G and 5G technology.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	1	2	-	1	-	1	1	-	2	2	-	1	2	2
CO-2	3	-	3	-	1	2	1	-	1	-	-	1	2	1	1
CO-3	-	-	1	1	1	-	-	-	-	1	1	1	1	2	2
CO-4	1	2	3	3	2	2	-	-	-	1	1	-	2	1	1

UNIT-1 — 15 Hours

Introduction: Applications, Short History of Wireless Communications, Simplified Reference Model.
Wireless Transmission: Frequencies, Signals, Signal Propagation, Multiplexing, Modulation, Spread Spectrum, and Cellular Systems.
Medium Access Control: Motivation for a Specialized MAC, SDMA, FDMA, TDMA, CDMA, and Comparison.

UNIT-2 — 15 Hours

Telecommunication Systems: GSM, DECT, TETRA, UMTS and IMT-2000: System Architecture and Radio Interface.
Satellite Systems: History, Applications, Basics, Routing, Localization, and Handover.

UNIT-3 — 15 Hours

Wireless LAN: Infrared Vs. Radio Transmission, Infrastructure and Ad Hoc Networks, IEEE 802.11: System Architecture, Protocol Architecture, Physical Layer, MAC Layer, and MAC Management.

Mobile Network Layer: Mobile IP: Entities and Terminology, IP packet delivery, Agent discovery, Registration, and Tunneling and Encapsulation, Dynamic Host Configuration Protocol. Ad Hoc Networks.	
UNIT-4	15 Hours
4G and 5G Technology Advancements **Part1:** 4G – LTE: Network Architecture, QoS and Bearer Service Architecture. **Part2:** 5G: Evolution of LTE Technology to beyond 4G, 5G roadmap, 10 pillars of 5G.	
Text Books :	1. Jochen.Schiller, "Mobile communications", second edition, Addison-Wesley, 2003. 2. Farooq Khan, "LTE for 4G Mobile Broadband" Line-Air Interface Technologies and Performance, CAMBRIDGE, 2009. 3. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", WILEY, 2015.
References :	1. William Stallings, "Wireless Communication Networks". 2. UWE Hansmann, Lother Merk, Martin S.Nicklous, Thomas Stober, "Principles of Mobile Computing", 2nd Edition.

DATAWAREHOUSING AND DATA MINING
Professional Elective (Code: PE02)

Lectures	:	3 Hours /week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: Database Management Systems (20CS403) and basic mathematics

Course Objectives: Students will be able to

- Identify the scope and necessity of Data Warehousing & Mining for the society.
- Understand importance of data, data preprocessing techniques to solve the real time problems.
- Understand and implement classical models and algorithms in data warehouses and data mining.
- Develop skill in selecting the appropriate data mining algorithm for solving practical problems.

Course Outcomes: Students will be able to

CO-1	Understand scope and necessity of Data Warehousing & Mining for the society.
CO-2	Understand, implement preprocessing techniques and classification models and develop skills in selecting appropriate preprocessing and classification algorithms.
CO-3	Understand, implement classical models and develop skills in selecting appropriate association rule mining algorithms.
CO-4	Understand, implement clustering models and develop skills in analyzing appropriate clustering algorithms to solve real time problems.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	3	3	2	3	1	1	-	-	-	-	2	-	-	-
CO-2	3	3	3	2	3	1	1	-	-	-	-	2	-	-	-
CO-3	3	3	3	2	3	1	1	-	-	-	-	2	-	-	-
CO-4	3	3	3	2	3	1	1	-	-	-	-	2	-	-	-

UNIT-1 — 15 Hours

Data Warehouse and OLAP Technology: Introduction, A Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation from Data Warehousing to Data Mining.
Data Mining: Introduction, Kinds of Data, Data Mining Functionalities, Classification of Data Mining Systems, Major Issues in Data Mining.

UNIT-2 — 15 Hours

Data Pre-processing: Importance of Data Process, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation. **Classification and Prediction:** Introduction to Classification and Prediction, Issues Regarding Classification and Prediction, Classification by Decision Tree Induction - Decision Tree Induction, Attribute Selection Measures, Bayesian Classification.	
UNIT-3	15 Hours
Mining Frequent Patterns, Associations, and Correlations: Basic Concepts and a Road Map, Efficient and Scalable Frequent Item-set Mining Methods, Mining Various Kinds of Association Rules, From Association Mining to Correlation Analysis, Constraint-Based Association Mining.	
UNIT-4	15 Hours
Cluster Analysis: Introduction, Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods- k-Means and k-Medoids, Hierarchical Methods- Agglomerative and Divisive Hierarchical Clustering, Density-Based Methods- DBSCAN, Grid- Based Methods- STING, Outlier Analysis.	
Text Books :	Jiawei Han Micheline Kamber – "Data Mining Concepts & Techniques", 2nd ed., Morgan Kaufmann Publishers.
References :	1. "Data Warehousing in the real world – A Practical guide for Building decision support systems", Sam Anahory, Dennis Murray, Pearson Education. 2. "Data Mining (Introductory and Advances Topics)", Margaret H. Dunham, Pearson Education.

DISTRIBUTED SYSTEMS
Professional Elective (Code: PE03)

Lectures :	4 Periods / Week	Continuous Internal Assessment :	30 Marks
Final Exam :	3 hours	Semester End Exam :	70 Marks

Pre-Requisite:

Course Objectives: Students will be able to

- To understand and comprehend the architecture of distributed systems
- To understand and comprehend process in distributed systems
- To understand and apply naming and coordination of systems
- To understand consistency and fault tolerance in distributed systems

Course Outcomes: Students will be able to

CO-1	Understand the basic structure of distributed systems.
CO-2	Understand the implementation of process, thread, file systems and processors in Distributed system.
CO-3	Analyze Clock Synchronization protocols in Distributed system as well as Deadlock handling mechanism.
CO-4	Compare Shared memory Multiprocessors used in Distributed System.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO-1	2	-	3	-	-	-	-	-	-	-	-	3	2	1	1
CO-2	2	-	2	-	-	-	-	-	-	-	-	2	3	1	1
CO-3	2	3	1	-	-	-	-	-	-	-	-	3	2	1	1
CO-4	2	-	3	1	-	-	-	-	-	-	-	3	3	1	1

UNIT-I	12 Periods

Introduction: What is a distributed system? Design goals, Types of distributed systems. Architectures: Architectural styles, Middleware organization, System architecture, Example architectures.

UNIT-II	13 Periods

Processes: Threads, Virtualization, Clients, Servers, Code migration. Communication: Types of Communication, Remote procedure call, Message-oriented communication, Multicast communication.

UNIT-III	12 Periods

Naming: Names, identifiers, and addresses, Flat naming, Structured naming, Attribute-based naming. Coordination: Clock synchronization, Logical clocks, Mutual exclusion, Electionalgorithms, Location systems.	
UNIT-IV	13 Periods
Consistency and replication: Introduction, Data-centric consistency models, Client-centric consistency models, Replica management, Consistency protocols. Fault tolerance: Introduction to fault tolerance, Process resilience, Reliable client-server communication, Reliable group communication, Distributed commit, Recovery.	
Text Book(s) :	1. Andrew S.Tanenbaum, Maarten Van Steen, "Distributed Systems", Third Edition (2017), Pearson Education/PHI.
References :	1. Coulouris, Dollimore, Kindberg, "Distributed Systems-Conceptsand Design", 3rd edition, Pearson Education. 2. Mukesh, Singhal & Niranjan G.Shivarathri, "Advanced Conceptsin Operating Systems", TMH. 3. Sinha, "Distributed Operating System – Concepts and Design", PHI.

ARTIFICIAL INTELLIGENCE
Professional Elective (Code: PE04)

Lectures	:	3 Hours /week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: Data Structures(20CS302), Design and Analysis of Algorithms (20CS404), Discrete Mathematics (20CS206)

Course Objectives: Students will be able to

- understand the fundamental concepts of artificial intelligence, and their environment, various Search techniques
- understand knowledge representation using predicate logic and rules
- understand the planning techniques.
- understand how to design and solve Learning techniques and Expert systems.

Course Outcomes: Students will be able to

CO-1	Understand the fundamental concepts of artificial intelligence, search techniques for solving simple AI problems and their environments.
CO-2	Apply knowledge representation using predicate logic and rules.
CO-3	Utilize the planning techniques.
CO-4	Possess the knowledge of the concepts of Learning and Expert Systems.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	-	-	2	-	1	-	1	2	1	-	-	-	1	1	1
CO-2	-	-	2	-	2	-	2	3	-	2	1	-	1	2	2
CO-3	-	2	-	-	-	2	-	-	1	-	2	-	2	1	1
CO-4	-	1	-	1	-	-	1	-	1	-	-	1	2	2	1

UNIT-1 — 14 Hours

Introduction to AI: What is AI? , Foundations of AI, History of AI, State of the Art. **Intelligent Agents**: Agents and Environments, Good Behavior: Concept of Rationality, The Nature of Environments And The Structure of Agents. **Solving Problems by Searching:** Problem Solving Agents, Searching for Solutions, **Uninformed Search Strategies:** Breadth First Search, Uniform Cost Search, Depth First Search, Iterative Deepening DFS and Bi-directional Search. **Informed (Heuristics) Search Strategies:** Greedy BFS, A* Algorithm, AND-OR Search trees, **Constraint Satisfaction Problems:** Defining Constraint Satisfaction Problems, Local Search in CSP.

UNIT-2 — 14 Hours

Logical Agents: Knowledge Based Agents, The Wumpus World, Logic and Propositional Logic**, Propositional Theorem Proving:** Inference and proofs, Proof by resolution, Horn clauses and definite clauses, Forward and Backward chaining. **First Order Logic:** Representation, Revisited Syntax and Semantics of First Order Logic, Using First Order Logic, Knowledge Engineering in First Order Logic. **Inferences in First Order Logic:** Propositional vs. First Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution.

UNIT-3 — 14 Hours

Knowledge Representation: Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information. **Slot and Filler Structures:** Semantic Nets, Conceptual Dependency, Scripts. **Planning:** Overview - An Example Domain, The Blocks World, Component of Planning Systems, Goal Stack Planning, Hierarchical planning, Reactive systems.	
UNIT-4	14 Hours
Learning: Introduction to learning, Rote learning, Learning by taking advice, Learning in problem solving, Learning from examples, Induction Learning, Explanation Based Learning. **Expert Systems:** Representing and using domain knowledge, Expert system shells, Explanation, Knowledge Acquisition.	
Text Books :	1. Stuart Russel and Peter Norvig, Artificial Intelligence – A Modern Approach, 3rd Edition, Pearson Education/ PHI.. 2. Elaine Rich & Kevin Knight, Artificial Intelligence, 3rd Edition, (TMH).
References :	1. Patrick Henry Winston. Artificial Intelligence. Pearson Education, 3 edition, 2007. ISBN 81317 15051 2. Saroj Kaushik. Artificial Intelligence. CENGAGE Learning, 1 edition, 2020. ISBN 9788131510995.

BLOCKCHAIN TECHNOLOGIES Professional Elective (Code: PE05)			
Lectures :	**4** Periods / Week	Continuous Internal Assessment :	**30** Marks
Final Exam :	**3** hours	Semester End Exam :	**70** Marks

Prerequisites:	Cryptography & Network Security (20CS603)

Course Objectives: Students will be able to

- Understand the introduction concepts of Blockchain and the importance of decentralization in Blockchain.
- Acquire the knowledge of several cryptographic algorithms and bitcoin transactions.
- Understand the concepts of Smart Contracts and Ethereum blockchain.
- Understand Hyperledger, alternative Blockchains.

Course Outcomes: Students will be able to

CO-1	Understand the blockchain technology in decentralized paradigm.
CO-2	Apply cryptographic algorithms and understand the concepts of bitcoin.
CO-3	Understand the concepts of smart contracts.
CO-4	Explain the importance and applications of Hyperledger. Understand the other blockchains.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	-	-	1	-	-	-	1	-	1	1	-	1	2	1	1
CO-2	2	2	2	-	-	2	2	3	1	2	-	1	1	2	2
CO-3	-	1	-	1	-	1	1	-	1	1	-	1	2	1	1
CO-4	-	1	-	1	-	-	1	-	1	1	-	1	2	1	1

UNIT-I	16 Periods

Block Chain 101 - Distributed Systems, The History of blockchain, Introduction to blockchain, Types of block chain, CAP theorem and blockchain, Benefits and limitations of blockchain,

Decentralization - Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Blockchain and full eco system decentralization, Smart contract, Decentralized Organizations, decentralized autonomous organizations, Decentralized autonomous corporations, Decentralized autonomous societies, Decentralized applications, Platforms for Decentralization.

UNIT-II	16 Periods

Cryptography and Technical Foundations - Introduction, Cryptographic primitives, Asymmetric Cryptography, Public and Private-keys – RSA, Discrete logarithm problem, Cryptographic primitives, Hash functions-Merkle trees, Patricia trees.

Bitcoin - Bitcoin, Transactions, Blockchain.

UNIT-III	16 Periods
Alternative Coins – Bitcoin limitations - Privacy and anonymity, Extended protocols on top of bitcoin, Development of altcoins. **Smart Contracts** - History, Definition, Ricardian Contracts.	
UNIT-IV	14 Periods
Hyperledger - Projects, Hyperledger as a Protocol, Fabric, Hyperledger Fabric, Sawtooth lake-PoET, Transaction families, Consensus in Sawtooth. **Alternative Blockchain** - Blockchains.	
Text Book(s) :	Mastering Blockchain, Packt Publishing by Imran Bashir
References :	1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos Blockchain, IBM Limited Edition, Published by John Wiley &Sons, Inc. www.wiley.com 2. Blockchain by Melanie Swa, O'Reilly 3. Hyperledger Fabric -https://www.hyperledger.org/projects/fabric Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

PROTOCOLS FOR SECURE ELECTRONIC COMMERCE
Professional Elective (Code: PE06)

Lectures	:	4 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Cryptography and Network Security (20CS603)

Course Objectives: Students will be able to

- To Comprehend and apply electronic money and payment systems.
- To Plan the architecture for the electronic payments and provide security for the payments.
- To Recognize the concept of security socket layer and the protocols.
- To Comprehend and plan micro payments and support face to face commerce.

Course Outcomes: Students will be able to

CO-1	Analyze the impact of E-commerce on business models and strategies.TO develop E-markrting strategies and digital payment.
CO-2	To comprehend E-marketing tools and E-Business enterpreneurship.To infer insights on business incubators.
CO-3	Analyze SSL,TSL and established protocols.
CO-4	Develop the frame work and anotomy of money and payment systems.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	2	2	2	3	-	-	1	-	1	-	1	1	2	3
CO-2	1	2	2	3	-	-	-	1	-	1	-	3	3	3	3
CO-3	1	2	2	3	-	-	-	1	-	1	-	3	3	3	3
CO-4	1	2	2	2	3	-	-	1	-	1	-	3	3	3	3

UNIT-1 — 16 Hours

Overview of Electronic Commerce:- What Is Electronic Commerce, Categories of Electronic Commerce, The Influence of the Internet, Infrastructure for Electronic Commerce, Network Access, Consequences of E-Commerce, Summary.

Money and Payment Systems:- The Mechanisms of Classical Money, Instruments of Payment, Types of Dematerialized Monies, Purses and Holders, Transactional Properties of Dematerialized Currencies, Overall Comparison of the Means of Payment, The Practice of Dematerialized Money, Banking Clearance and Settlement, Summary.

UNIT-2 — 16 Hours

Algorithms and Architectures for Security:- Security of Commercial Transactions, Security of Open Financial Networks, Security Objectives, OSI Model for Cryptographic Security, Security Services at the Link Layer, Security Services at the Network Layer, Security Services at the Application Layer, Message Confidentiality, Data Integrity, Identification of the Participants, Authentication of the Participants, Access Control, Denial of Service, Nonrepudiation, Secure Management of Cryptographic Keys, Exchange of Secret Keys: Kerberos, Public Key Kerberos, Exchange of Public Keys, ISAKMP (Internet Security Association and Key Management

Protocol), SKIP (Simple Key Management for Internet Protocols), Key Exchange Algorithm, Certificate Management, Encryption Cracks, Summary.

Business-to-Business Commerce:- Overview of Business-to-Business Commerce, Examples of Business-to-Business Electronic Commerce, Business-to-Business Electronic Commerce Platforms, Obstacles Facing Business-to-Business Electronic Commerce, Business-to-Business Electronic Commerce Systems, Structured Alphanumeric Data, Structured Documents or Forms, EDI Messaging, Security of EDI, Relation of EDI with Electronic Funds Transfer, Electronic Billing, EDI Integration with Business Processes, Standardization of the Exchanges of Business-to-Business Electronic Commerce, Summary.

UNIT-3	16 Hours

SSL (Secure Sockets Layer):- General Presentation of the SSL Protocol, SSL Subprotocols, Example of SSL Processing, Performance Acceleration, Implementations, Summary.

TLS (Transport Layer Security) and WTLS (Wireless Transport Layer Security):- From SSL to TLS, WTLS, Summary.

The SET Protocol:- SET Architecture, Security Services of SET, Certification, Purchasing Transaction, Optional Procedures in SET, SET Implementations, Evaluation, Summary.

UNIT-4	16 Hours

Composite Solutions:- C-SET and Cyber-COMM, Hybrid SSL/SET Architecture, 3-D Secure, Payments with CD-ROM, Summary.

Micropayments and Face-to-Face Commerce:- Characteristics of Micropayment Systems, Potential Applications, Chipper, GeldKarte, Mondex, Proton, Harmonization of Electronic Purses, Summary.

Remote Micropayments:- Security without Encryption: First Virtual, NetBill, KLELine, Millicent, PayWord, MicroMint, eCoin, Comparison of the Different First-Generation Remote Micropayment Systems, Second-Generation Systems, Summary.

Text Book :	Protocols for Secure Electronic Commerce Mostafa Hashem Sherif, Ph.D. AT&T Laboratories, New Jersey Series Editor-in-Chief Saba Zamir

ARTIFICIAL NEURAL NETWORKS AND DEEP LEARNING
Professional Elective (Code: PE07)

Lectures	:	3 Hours /week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: Machine Learning (20CS602)

Course Objectives: Students will be able to

- Design an ANN model for identifying complex decision boundaries
- Design a CNN model for Computer Vision applications.
- Apply sequence models to natural language processing tasks.
- Model the structure in the existing data to generate new data samples.

Course Outcomes: Students will be able to

CO-1	Design and implement a Neural Network for classification.
CO-2	Create a Convolutional Neural Network for image classification.
CO-3	Model a Recurrent Neural Network and Long Short Term Memory Network for text processing.
CO-4	Design and implement an Encoder and Decoder model.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	POs												PSOs		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO-1	2	-	3	-	3	-	-	-	-	-	-	1	3	3	3
CO-2	2	-	3	-	3	-	-	-	-	-	-	1	3	3	3
CO-3	2	-	3	-	3	-	-	-	-	-	-	1	3	3	3
CO-4	2	-	3	-	3	-	-	-	-	-	-	1	3	3	3

UNIT-1 12 Hours

Artificial Neural Networks : Sigmoid neuron, Feedforward neural networks, activation functions, backpropagation algorithm, loss functions, Gradient Descent - Stochastic Gradient Descent (SGD), Mini Batch Stochastic Gradient Descent (MB-SGD), Optimization methods - SGD with momentum, Adaptive Gradient (AdaGrad), RMSprop, Adam, Regularization - dropout. Demonstration of ANN using TensorFlow.

UNIT-2 12 Hours

Convolutional Neural Networks : Convolution, filters, stride, padding, feature maps, Architecture of CNNs - input layer, convolutional layers, activation functions, pooling layers, fully connected layers, output layer, training, transfer learning, image classification. TensorFlow demonstration.

UNIT-3 12 Hours

Sequence Models : Introduction to Sequence Modeling, word embeddings, Recurrent Neural Networks (RNNs) - Basic architecture of RNNs, Language model and sequence generation, Sentiment analysis using TensorFlow, Long Short-Term Memory (LSTM).	
UNIT-4	12 Hours
Generative Models : Autoencoders, Architecture and training of autoencoders for unsupervised representation learning, Variational Autoencoders (VAEs), The encoder-decoder framework and the reparameterization for generating new samples.	
Text Books:	1. Francois Chollet, Deep Learning with Python, Manning publishers, O'Reilly publishers, First Edition, ISBN- 9781617294433 2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Third Edition, ISBN- 9355421982
References:	1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, First Edition, ISBN- 978-0262035613. 2. Neural Networks and Deep Learning, Michael Nielsen, online free-book. **Video Lecture Series:** 3. Deep Learning Course-106106184, Part-1, NPTEL, Prof. Mitesh M. Kapra 4. Deep Learning Course- 106106201, Part-2, NPTEL, Prof. Mitesh M. Kapra 5. Deep Learning Course -106105215, NPTEL, Prof. Prabir Kumar Biswas 6. CS230 - Deep Learning - Stanford University. 7. 6.S191 - Introduction to Deep Learning – MIT. 8. CS224N - Natural Language Processing with Deep Learning - Stanford University.

NATURAL LANGUAGE PROCESSING

Professional Elective (Code: PE08)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Compiler Design (20CS601), Machine Learning (20CS602)

Course Objectives: Students will be able to

- Get familiarized with the concepts and techniques of Natural language Processing for analyzing words based on Morphology and CORPUS.
- Make them understand the concepts of morphology, syntax, semantics and pragmatics of the language and that they are able to give the appropriate examples that will illustrate the above mentioned concepts.
- Recognize the significance of pragmatics for natural language understanding.
- Be capable to describe the application based on natural language processing and to

Course Outcomes: Students will be able to

CO-1	Apply the principles and processing of natural language processing using computers and create CORPUS linguistics based on dogestive pproach
CO-2	Analyze the synatx,semantics and pragmatics of a statement written in a natural language and perform POS tagging for a given natural language.
CO-3	Demonstrate the techniques for the text-based processing of natural language with respect to morphology.
CO-4	Elarobate the feature engineering techniques needed for real time omplementation of various natural language applications.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO-1	1	2	1	1	2	-	1	1	1	3	3	1	3	3	3
CO-2	1	3	2	2	3	1	-	-	1	2	1	1	2	3	2
CO-3	1	1	1	2	1	-	-	-	1	2	2	1	3	2	2
CO-4	1	2	1	3	3	1	-	1	1	1	2	1	1	2	3

UNIT-1 — 13 Hours

Basics of NLP: - Evolution of Human Language, Text Mining, Need of Text Mining, Text Mining & Natural Language Processing, Basic Structure of a NLP Application, Understanding basic applications, Advantages of togetherness-NLP and Python.

Corpus Analysis: - What is a corpus? Why do we need a corpus? Understanding corpus analysis, Understanding types of data attributes, Exploring different file formats for corpora.

UNIT-2 — 13 Hours

Understanding the Structure of a Sentence: - Understanding components of NLP, Natural language understanding, Defining context-free grammar, Morphological analysis, Syntactic analysis, Semantic Analysis, Ambiguity, Handling Ambiguity, Discourse integration, Pragmatic analysis.

UNIT-3	12 Hours
Preprocessing: - Handling corpus-raw, Handling corpus-raw sentences, Basic preprocessing, Practical and customized preprocessing.	
UNIT-4	12 Hours
Feature Engineering and NLP Algorithms:- Understanding feature engineering, Basic feature of NLP, Basic statistical feature of NLP, Advantages of features engineering, Challenges of features engineering.	
Text Books	Python Natural Language Processing (Packt Publishers) Author: Jalaj Thanaki
References	Natural Language Processing (Oxford Publishers) Author: Tanvir Siddiqui

Job Oriented Elective

Subject Code	Subject Name
JO01	Enterprise Programming
	Enterprise Programming Lab
JO02	Mobile Application Development
	Mobile Application Development Lab
JO03	Cloud Programming
	Cloud Programming Lab
JO04	Cyber Security
	Cyber Security Lab
JO05	Internet of Things
	Internet of Things Lab
JO06	Big Data Analytics
	Big Data Analytics Lab

ENTERPRISE PROGRAMMING
Job Oriented Elective (Code: JO01)

Lectures	:	3 Hours /week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: Object Oriented Programming(20CS303), Web Technologies(20CS402)

Course Objectives: Students will be able to

- Develop an application using servlets and JDBC.
- Design an application using JSP and JSF.
- Create an application on web services and web sockets.
- Code an enterprise application using EJBs and Persistence API.

Course Outcomes: Students will be able to

CO-1	Comprehend the sequential stages of establishing a database connection utilizing JDBC components, as well as grasp the services offered by J2EE. Additionally, create a web application using cookies and sessions within servlets.
CO-2	Practice standard and custom tags in JSP and use JSF framework in designing rich user interface.
CO-3	Design Web Socket Applications and understand about RESTful webservices.
CO-4	Comprehend middleware services such as multi-threading, Timer Service, Transactions, and Asynchronous services within Enterprise JavaBeans (EJB). Also, grasp the contemporary memory concept through Java Persistence API (JPA).

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	-	2	1	-	2	-	-	-	3	-	2	3	2	3	3
CO-2	-	-	-	-	2	-	-	-	-	-	-	3	-	-	-
CO-3	-	2	-	-	-	-	-	-	3	-	-	-	2	-	-
CO-4	-	-	1	-	-	-	-	-	-	-	2	-	-	3	1

UNIT-1 15 Hours

The Big Picture: Java EE Architecture, The Many Variations of Java EE Applications, Packaging and Deploying the Java EE Application, Java EE Platform and Implementations.

Classic Memories - JDBC: Introduction to JDBC, Structured Query Language, The JDBC APIs.

Java Servlets and Web Applications - Foundations of the Web Tier: The HTTP Protocol, Introducing Java Servlets, Understanding the Java Servlet API, Web Applications, Java Servlets: The Good and the Bad.	
UNIT-2	15 Hours
Dynamic Web Pages - JSP: JSP Runtime Architecture, JSP Syntax, The Java Environment for JSPs, JSP Standard Tags, Custom Tag Libraries, Expression Language. **Assembling Dynamic Web Pages - JavaServer Faces:** Architecture of a JSF Application, JavaServer Faces Tags, Java EE Managed Beans, f: Core Tags, JSTL Core Tags, Extensibility and Modularity.	
UNIT-3	15 Hours
Web Sites for Non-browsers - JAX-RS: What Are RESTful Web Services, The Java API for RESTful Web Services, Deploying JAX-RS Resources, Content Production, Content Consumption, Accessing Web Service Context, Exception Mapping, Number of Instances of Resource Classes, Path Mapping. **JSON Processing : Streaming API :** Consuming JSON Using the Streaming API, Producing JSON Using the Streaming API; **Object Model API :** Consuming JSON Using the Object Model API , Producing JSON Using the Object Model API. **Adding Sparkle - Java WebSockets:** Introduction to the WebSocket Protocol, The WebSocket Lifecycle, Overview of the Java WebSocket API, Java WebSocket Encoders and Decoders, Message Processing Modes, Path Mapping, Deployment of Server Endpoints.	
UNIT-4	15 Hours
The Fundamentals of Enterprise Beans: Introduction to Enterprise Beans, Hello Enterprise Beans, Flavors of Enterprise Beans, Exposing Enterprise Beans, Finding Enterprise Beans, EJB Lifecycle, Packaging Enterprise Beans. **Advanced Thinking with Enterprise Beans:** Multi-threading and Enterprise Beans, Asynchronous Enterprise Beans, Enterprise Bean Contexts, The Timer Service, Transactions and Enterprise Beans, Interceptors. **Modern Memories - The Java Persistence API:** Persistence Entities, The Entity Manager, Java Persistence Query Language, Configuring JPA Applications.	
Text Books :	1. Dr. Danny Coward, "Java EE 7: The Big Picture", oracle press. 2. Arun Gupta "Java EE 7 Essentials" O'Reilly.
References :	Antonio Goncalves "Beginning Java EE 7" apress.

ENTERPRISE PROGRAMMING LAB
Job Oriented Elective (Code: JO01)

Practicals	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Object Oriented Programming(20CS303), Web Technologies(20CS402)

Course Objectives: Students will be able to

- Develop an application using servlets and JDBC.
- Design an application using JSP and JSF.
- Create an application on web services and web sockets.
- Code an enterprise application using EJBs and Persistence API

Course Outcomes: Students will be able to

CO-1	Develop an application using servlets and JDBC.
CO-2	Design an application using JSP and JSF.
CO-3	Create an application on web services and web sockets.
CO-4	Code an enterprise application using EJBs and Persistence API

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	2	1	-	2	-	-	-	3	-	2	3	2	3	3	2
CO-2	2	1	-	2	-	-	-	3	-	2	3	2	3	3	2
CO-3	2	1	-	2	-	-	-	3	-	2	3	2	3	3	2
CO-4	2	1	-	2	-	-	-	3	-	2	3	2	3	3	2

LIST OF EXPERIMENTS

1. Write a JDBC application to implement DDL and DML commands.
2. Write an application to demonstrate HTTP Servlets.
3. Write an application to demonstrate cookie & Sessions.
4. Write an application to integrate JSP & Servlets.
5. Write an application to demonstrate custom tags and standard tags in JSP.
6. Write an application to demonstrate JSF validators, event handlers and convertors.
7. Write an application to demonstrate web service.
8. Write a chat application using Web sockets.
9. Write an application to demonstrate Session Bean and Entity Bean (persistence).
10. Write an application to demonstrate Asynchronous and Timer services of Enterprise Bean.

Text Books :	1. Dr. Danny Coward, "Java EE 7: The Big Picture", oracle press. 2. Arun Gupta "Java EE 7 Essentials" O'Reilly.
References :	Antonio Goncalves "Beginning Java EE 7" apress.

MOBILE APPLICATION DEVELOPMENT
Job Oriented Elective (Code: JO02)

Lectures	:	4 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Object Oriented Programming (20CS303)

Course Objectives: Students will be able to

- Understand the Android Application Architecture and Working.
- Understand how to develop android applications and internal working of applications
- Understand Intents, Broadcast Receivers, Preferences .
- Understand to develop android applications using Databases, Content Providers, Services & Menus.

Course Outcomes: Students will be able to

CO-1	Comprehend the concepts of Android & fundamentals of Android App Development.
CO-2	Design basic User Interfaces using Activities, Layouts & Fragments.
CO-3	Develop Android Apps using Intents, Broadcast Receivers & Shared Preferences.
CO-4	Develop Android apps using SQLLite Database, Content Providers, Services and Menus

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	2	-	1	-	-	-	-	-	-	-	-	2	-	-
CO-2	1	2	3	1	1	-	-	-	-	1	-	-	1	2	1
CO-3	-	-	3	-	2	-	1	-	-	1	-	1	2	2	1
CO-4	1	1	3	-	2	-	1	-	-	1	-	1	2	2	1

UNIT-1 — 15 Hours

Hello, Android:- ANDROID: AN OPEN PLATFORM FOR MOBILE DEVELOPMENT, Android SDK Features, Introducing the Development Framework
Getting Started:- What You Need to Begin, Creating Your First Android Application, Types of Android Applications

UNIT-2 — 16 Hours

Creating Applications and Activities:- What Makes an Android Application?, Introducing the Application Manifest File, Externalizing Resources, The Android Application Lifecycle, A Closer Look at Android Activities, Creating Activities, The Activity Lifecycle, Activity States.
Building User Interfaces:- Fundamental Android UI Design, Android User Interface Fundamentals, Introducing Layouts, Introducing Fragments.

UNIT-3 — 16 Hours

Intents and Broadcast Receivers:- Introducing Intents, Creating Intent Filters and Broadcast Receivers
Saving State and Preferences:- Creating and Saving Shared Preferences , Retrieving Shared Preferences Persisting the Application Instance State.

UNIT-4 — 15 Hours

Databases and Content Providers:- Introducing Android Databases, Introducing SQLite, Content Values and Cursors, Working with SQLite Databases, Creating Content Providers, Using Content Providers **Working in the Background:-** Creating and Controlling Services, Binding Services to Activities **Expanding the User Experience:-** Introducing the Action Bar ,Creating and Using Menus and Action Bar Action Items	
Text Books :	Professional Android 4 Application Development‖, Reto Meier, John Wiley & Sons, Inc.
References :	1. Android Programming The Big Nerd Ranch Guide‖, Brian Hardy & Bill Phillips, Big Nerd Ranch, Inc. 2. Head First: Android Development‖, Dawn Griffiths & David Griffiths, O'Reilly Publications.

MOBILE APPLICATION DEVELOPMENT LAB
Job Oriented Elective (Code: JO02)

Practicals	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Object Oriented Programming (20CS303)

Course Objectives: Students will be able to

- Understand the Android Application Architecture and Working.
- Understand how to develop android applications and internal working of applications
- Understand Intents, Broadcast Receivers, Preferences .
- Understand to develop android applications using Databases, Content Providers, Services & Menus.

Course Outcomes: Students will be able to

CO-1	Create an Environment to develop Android applications.
CO-2	Design user Interfaces using Activities, Layouts & Fragments.
CO-3	Develop Android apps using intents and shared preferences.
CO-4	Develop android apps using SQLite database

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	2	-	1	-	-	-	-	-	-	-	-	2	-	-
CO-2	1	2	3	1	1	-	1	-	-	1	-	-	1	2	1
CO-3	-	-	3	-	2	-	1	-	-	1	-	1	2	2	1
CO-4	1	1	2	-	2	-	1	-	-	1	-	1	2	2	1

LIST OF EXPERIMENTS

- Design an Android application to display hello world?
- Design an Android application to create interactive user interface?
- Design an Android application to create and start activity?
- Design an Android application to demonstrate different types of layouts?
- Design an Android application to demonstrate animation?
- Develop standard calculator application to perform basic calculator operations like addition, subtraction, multiplication and division?
- Design an Android application to demonstrate fragments?
- Design an Android application to demonstrate fragment lifecycle?
- Design an Android application to demonstrate implicit Intent?
- Design an Android application to demonstrate explicit intent?
- Design an Android application to demonstrate shared preferences?
- Design an Android application to demonstrate SQLite database?

Text Books :	Professional Android 4 Application Development‖, Reto Meier, John Wiley & Sons, Inc.
References :	1. Android Programming The Big Nerd Ranch Guide‖, Brian Hardy & Bill Phillips, Big Nerd Ranch, Inc.

	2. Head First: Android Development, Dawn Griffiths & David Griffiths, O'Reilly Publications.

CLOUD PROGRAMMING
Job Oriented Elective (Code: JO03)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Problem Solving using Programming (20CS203), Object Oriented Programming (20CS303), Operating Systems (20CS304), Computer Networks (20CS502), Web Technologies (20CS402)

Course Objectives: Students will be able to

- Understand the Cloud Computing environment, Windows Azure platform, and Azure websites service.
- Configure Visual Studio with Azure SDK, develop applications to demonstrate Azure storage services – Blob, Table, Queue and Files. Learn the concept of Azure storage Security.
- Demonstrate the concepts of Azure Virtual Machines and Azure Virtual Networks, Azure SQL.
- Learn Service Bus, Azure Active Directory, Azure Key Vault.

Course Outcomes: Students will be able to

CO-1	Configure visual studio with Azure SDK. Understand the basics of cloud computing, design and deploy ASP .NET web forms and MVC web sites to Azure cloud environment using VS.
CO-2	Design cloud service applications to demonstrate Azure storage services-Blob table queue and files.
CO-3	Create and configure Azure virtual machines, Azure virtual networks and Azure SQL.
CO-4	Write c# applications to access service bus.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	-	-	-	-	1	-	-	-	-	1	3	2	3	3	3
CO-2	2	1	-	-	1	-	-	-	-	1	3	2	3	3	3
CO-3	2	1	-	1	1	-	-	3	-	1	3	2	3	3	3
CO-4	2	1	-	1	1	-	-	3	-	1	3	2	3	3	3

UNIT-1 — 14 Hours

Introduction to Cloud Computing & Windows Azure Platform – What is Azure?, Overview of Cloud Computing, Comparison of on-premises versus Azure, Service models, Deployment models, Azure services, Azure Resource Manager, Azure subscriptions, Azure registration, Exploring Management portal.

Windows Azure Websites – Visual Studio – Introduction to .NET Framework, Introduction to ASP.NET, Razor syntax, Forms and validation, Working with data, Creating and publishing simple and database driven ASP.NET web sites.

UNIT-2 — 15 Hours

Cloud Applications - Software Development Kits, Windows Azure Tools for Visual Studio, Cloud Project with a Web Role, Deployment to Windows Azure, Configuration and Upgrading, Service

Definition File, Service Configuration File and Role Properties. Cloud applications using ASP.NET.

Windows Azure Storage - Local Storage Vs Azure Storage, Windows Azure Storage Account, Windows Azure Management Tool, Blobs, Tables, Queues, Files. Worker Roles - Queue Service.

Security and Azure Storage - Securing your storage account, Securing access to your data, Securing your data in transit, Encryption at rest, Using Storage Analytics to audit access, Using Cross-Origin Resource Sharing (CORS).

UNIT-3	15 Hours

Virtual Machines – Introduction to Azure Virtual Machine, Virtual machine models, Virtual machine components, Virtual Machine creation, connecting to a virtual machine, configuring and managing virtual machine, scaling Azure virtual machine, Installing SQL server and J2EE Platform, Connecting to SQL Server on Virtual Machine.

Azure Virtual Networks – Introduction, Network Security Groups, Cross-premises connection options, Point-to-site network.

Azure SQL – Azure SQL Features, Database Server Creation in the Cloud, Azure SQL Relational Engine Features, Azure SQL Access, Existing Database Migration, Applications connecting to SQL Azure.

UNIT-4	15 Hours

Service Bus - Service Bus, Relayed messaging, Brokered Messaging- Queues, Topics.

Azure Active Directory - Overview of Azure Active Directory, Creating a directory, Users and groups, Multi-Factor Authentication, Application gallery.

Azure Key Vault - Basic concepts, Terminology used in Azure Key Vault, Ways to access Keys and Secrets in a Key Vault, Steps to authenticate an application with the Key Vault, Benefits of using Azure Key Vault.

Text Books :	1. Windows Azure Technical Documentation Library-MSDN-Microsoft. (msdn.microsoft.com/en-us/library/windowsazure) 2. Lydford, Steve. Building ASP. NET web pages with Microsoft WebMatrix. Apress, 2012. 3. Collier, Michael, and Robin Shahan. Microsoft Azure Essentials-Fundamentals of Azure. Microsoft Press, 2015. 4. https://www.encryptionconsulting.com/introduction-to-azure-key-vault/
References :	1. C# 4.0 The Complete Reference by Herbert Schildt, Tata McGraw Hill, 2010. 2. Beginning ASP.NET 4.5 in C#‖, Matthew MacDonald, Apress Publishing Company. 3. Moroney, Laurence. Introducing Microsoft® WebMatrixTM. " O'Reilly Media, Inc.", 2011. 4. Brunetti, Roberto. Windows Azure step by step. Microsoft Press, 2011. 5. Krishnan, Sriram. Programming Windows Azure: Programming the Microsoft Cloud. " O'Reilly Media, Inc.", 2010.

CLOUD PROGRAMMING LAB
Job Oriented Elective (Code: JO03)

Practicals	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Problem Solving using Programming Lab (20CSL203), Object Oriented Programming Lab (20CSL303)

Course Objectives: Students will be able to

- Understand the Cloud Computing environment, Windows Azure platform, and Azure websites service.
- Configure Visual Studio with Azure SDK, develop applications to demonstrate Azure storage services – Blob, Table, Queue and Files. Learn the concept of Azure storage Security.
- Demonstrate the concepts of Azure Virtual Machines and Azure Virtual Networks, Azure SQL.
- Learn Service Bus, Azure Active Directory, Azure Key Vault.

Course Outcomes: Students will be able to

CO-1	Configure Visual Studio with Azure SDK. Understand the basics of Cloud computing, design and deploy ASP.NET Razor Pages websites to Azure Cloud Environment using Visual Studio.
CO-2	Design Cloud Service applications to demonstrate Azure storage services – Blob, Table, Queue and Files.
CO-3	Create and configure Azure Virtual Machines, Azure Virtual Networks, and Azure SQL.
CO-4	Write C# applications to access Service Bus.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	-	-	-	-	1	-	-	-	-	1	3	2	3	3	3
CO-2	2	1	-	-	1	-	-	-	-	1	3	2	3	3	3
CO-3	2	1	-	1	1	-	-	3	-	1	3	2	3	3	3
CO-4	2	1	-	1	1	-	-	3	-	1	3	2	3	3	3

LIST OF EXPERIMENTS

1. Create Azure Student subscription and explore the Azure management portal.
2. Design an ASP.NET MVC website to perform CRUD operations on a SQL Server database with search option and validation.
3. Design Cloud Service with WebRole to demonstrate Windows Azure Blob Storage.
4. Design Cloud Service with WebRole to demonstrate Windows Azure Table Storage.
5. Design Cloud Service with WebRole and WorkerRole to demonstrate Windows Azure Queue Storage.
6. Design Cloud Service to demonstrate Windows Azure Files Storage.
7. Create Azure Virtual Machine and configure with Microsoft SQL Server, and J2EE platform to host web applications.

8. Design a Cloud service (or) C# Console Application to access Virtual Machine SQL Server database. 9. Design Cloud Service (or) C# Console Application to access Azure SQL. 10. Write C# Console Application to implement Service Bus Relayed Messaging. 11. Write C# Console Application to implement Service Bus Brokered Messaging using Queues. 12. Write C# Console Application to implement Service Bus Brokered Messaging using Topics.	
Text Books :	1. Windows Azure Technical Documentation Library-MSDN-Microsoft. (msdn.microsoft.com/en-us/library/windowsazure) 2. Lydford, Steve. Building ASP. NET web pages with Microsoft WebMatrix. Apress, 2012. 3. Collier, Michael, and Robin Shahan. Microsoft Azure Essentials-Fundamentals of Azure. Microsoft Press, 2015.
References :	1. C# 4.0 The Complete Reference by Herbert Schildt, Tata McGraw Hill, 2010. 2. Beginning ASP.NET 4.5 in C#‖, Matthew MacDonald, Apress Publishing Company. 3. Moroney, Laurence. Introducing Microsoft® WebMatrixTM. " O'Reilly Media, Inc.", 2011. 4. Brunetti, Roberto. Windows Azure step by step. Microsoft Press, 2011. 5. Krishnan, Sriram. Programming Windows Azure: Programming the Microsoft Cloud. " O'Reilly Media, Inc.", 2010.

CYBER SECURITY
Job Oriented Elective (Code: JO04)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Operating Systems(20CS304), Computer Networks(20CS502), Cryptography & Network Security(20CS603)

Course Objectives: Students will be able to

- To make the students familiar with Security services and Security mechanisms and Hacking phases.
- Understand about Security in the networks how to analyze.
- Understand how to secure computer system with using various techniques.
- Gather the matter about how to secure applications in the computer system

Course Outcomes: Students will be able to

CO-1	Analyze the hacking and types of hacking and their phases
CO-2	Practice different information gathering tools, and different types of attacks and their security for computer networks
CO-3	Apply various techniques to secure the computer system
CO-4	Modify security feature to computer application with using different methodologies to improve security

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	1	-	-	-	-	-	2	-	-	-	2	1	1	2
CO-2	1	2	2	2	2	1	-	2	-	-	-	2	1	1	2
CO-3	1	2	2	2	2	1	-	2	-	-	-	2	1	1	2
CO-4	1	2	2	2	2	1	-	2	-	-	-	2	1	1	2

UNIT-1 — 12 Hours

HACKING Essential Terminology: Information Security, Cyber Security, Threat, Vulnerability, Exploit, Hackers M‹ tives and Objectives, Penetration Testing and Hacker classes.
Hacking Phases: Footprinting Methodology , Network Scanning and Enumeration

UNIT-2 — 12 Hours

SECURITY OF COMPUTER NETWORKS: Information gathering tools, Sniffing and eavesdropping, Spoofing, Session hijacking and Man-in-the-Middle attack, DNS and ARP poisoning, Distributed-Denial-of-Service attacks, Firewall and IDS attacks.

UNIT-3 — 12 Hours

SECURITY OF COMPUTER SYSTEMS: Malware attacks, Password attacks, Denial-of-Service attacks, Unauthorized access, Privilege escalation, Backdoor attacks.

UNIT-4 — 12 Hours

SECURITY OF APPLICATIONS: Improper data / Input validation, Authentication and Authorization attacks, Security misconfiguration, Information disclosure, Buffer overflow issues, Broken session management, SQL injection, Improper error handling and exception management.

References :	1. CISSP All-in-One Exam Guide, Seventh Edition 2016 by Shon Harris and Fernando Maymi McGraw- Hill Education. 2. Gray Hat Hacking: The Ethical Hackers Handbook 3rd Edition by Allen Harper, Shon Harris McGraw- Hill Education.

CYBER SECURITY LAB

Job Oriented Elective (Code: JO04)

Practicals	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Operating Systems(20CS304), Computer Networks(20CS502), Cryptography & Network Security(20CS603)

Course Objectives: Students will be able to

- Learn the Installations of different Tools (VMWare, Kali Linux, Windows OS, Metasploitable2, Veil frame work and DVWA).
- Understand the usage of Information Gathering and MITMF tools. Learn how to detect/prevent intrusions in system by using snort and configuring firewall Settings using IPtables,
- Learn how to hack a system and gathering information of a system using metasploit frame work and meterpreter shell commands, mechanisms for cracking passwords and wireless network attacks.
- Understand the usage of the Web application hijacking tools, DOS, Sql-injection, XSS and Phishing attacks.

Course Outcomes: Students will be able to

CO-1	Install the different Tools (VMWare, Kali Linux, Windows OS, Metasploitable2, Veil framework and DVWA).
CO-2	Test the Information Gathering and MITMF tools, Detect/prevent intrusions in system by using snort and configure firewall Settings using IPtables.
CO-3	Practice the hacking and gathering information of a system using metasploit frame work and meterpreter shell commands, password cracking & wireless network attacks.
CO-4	Test the Web application hijacking tools, DOS, Sql-injection, XSS and Phishing attacks.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	1	2	-	2	-	-	2	-	-	-	2	2	1	2
CO-2	1	2	2	2	2	1	-	2	-	-	-	2	1	1	2
CO-3	1	2	2	2	2	1	-	2	-	-	-	2	1	1	2
CO-4	1	2	2	2	2	1	-	2	-	-	-	2	1	1	2

LIST OF EXPERIMENTS

Experiments

1. Installations: - VM-ware, kali, windows OS, metaspotiable-2, DVWA.
2. Information Gathering Tools:- a) Recon-ng b) Nmap c) Dmitry d) Netdiscover
3. Session hijacking, Man in The Middle (MTM) Attack.
4. Linux Firewall rules configuration by Iptables.
5. Snort installation and usage in
   a) Packet Sniffer mode
   b) Packet Logger mode
   c) IDS mode
   d) IPS mode

	6. Hacking any windows OS by using Malware. 7. Password Attacks:- a) Online Password cracking with hydra, xhydra. b) Offline Password Cracking with John the ripper. 8. Wireless Network attacks:- a) Aircrack-NG. b) Fern Wi-Fi cracker 9. Burpsuit , OWASP ZAP tools 10. DOS attack, Sql-injection, XSS attack. 11. Phishing attacks with Setoolkit.
References :	1. Basic Security Testing with Kali Linux -Daniel W. Dieterle 2. Hacking exposed web applications - JOEL SCAMBRAY MIKE SHEMA

INTERNET OF THINGS
Job Oriented Elective (Code: JO05)

Lectures	:	4 Hours/Week	Continuous Assessment	:	50
Final Exam	:	3 hours	Final Exam Marks	:	50

Pre-Requisite: Basic Knowledge of Hardware and Programming

Course Objectives: Students will be able to

- Make the students to know the IoT challenges and architectures.
- Provide an understanding of the technologies and the standards relating to the Internet of Things.
- Understanding the concept of M2M (machine to machine) with necessary protocols.
- Design and develop skills on IoT applications.

Course Outcomes: Students will be able to

CO-1	Identify the importance of IOT in real world.
CO-2	Acquire skill of various sensors and its working.
CO-3	Design of the IOT applications based on M2M and IOT design methodology.
CO-4	Create the IOT applications for real time problems.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	2	1	-	-	-	-	-	-	-	-	-	1	2	-
CO-2	3	1	1	-	-	1	-	-	-	-	-	-	1	2	-
CO-3	3	3	2	-	-	1	-	-	1	-	-	-	1	2	-
CO-4	3	3	2	-	-	1	-	-	1	-	-	-	1	2	-

UNIT-1 | 12 Hours

Introduction to IoT:
The flavour of the IoT, the technology of the IoT, characteristics of IoT, physical design of IoT,logical design of IoT, IoT enabling technologies, IoT levels & deployment templates

UNIT-2 | 10 Hours

Elements of IoT:
Hardware Components-Computing (Arduino, Raspberry Pi), Sensors, Actuators, I/O interfaces,Communication Protocols (ZigBee, Bluetooth, 6LoPAN, and MQTT), Software Components- Programming API‟s (using Python/Arduino).

UNIT-3 | 10 Hours

M2M and IoT Design Methodology:
M2M, Differences and Similarities between M2M and IoT, IoT Design Methodology.

UNIT-4 | 14 Hours

Cloud for IoT and Case Studies: Introduction, IoT with Cloud – Challenges, Selection of Cloud Service Provider for IoT Applications, Introduction to Fog Computing, Cloud Computing: Security Aspects,
Case Studies: Smart Lighting, Home Intrusion Detection, Smart Parking, Weather Monitoring
System, Smart Irrigation, and Adafruit Cloud

Text Books:	1. Internet of Things: A Hands-on-Approach‖, Arsh deep Bahga, Vijay Madisetti, VPT, 1st Edition, 2014. 2. Internet of Things, Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, John Wiley & Sons. 1st edition, 2019. 3. Designing the Internet of Things, Adrian McEwen, Hakim Cassimally, John Wiley and Sons, 1st Edition, 2014.

INTERNET OF THINGS LAB Job Oriented Elective (Code: JO05)					
Practicals	:	3 Hours/Week	Continuous Assessment	:	50
Final Exam	:	3 hours	Final Exam Marks	:	50

Pre-Requisite:

Course Objectives: Students will be able to

- Hands on practice on IoT hardware and software platforms, microcontrollers and single board computers.
- Detailed study and interfacing of sensors, actuators and communication modulesto microcontrollers and single board computers.
- Analyze the Application areas of IoT.
- Development of different IoT applications.

Course Outcomes: Students will be able to

CO-1	Comprehend the programming environment specific to the Internet of Things (IoT).
CO-2	Develop IOT applications using sensors.
CO-3	Develop IOT applications using web/mobile services
CO-4	Improve individual / team work skills, communication & report writing skills with ethical values.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	1	2	-	2	-	-	2	-	-	-	2	2	1	2
CO-2	1	2	2	2	2	1	-	2	-	-	-	2	1	1	2
CO-3	1	2	2	2	2	1	-	2	-	-	-	2	1	1	2
CO-4	1	2	2	2	2	1	-	2	-	-	-	2	1	1	2

LIST OF EXPERIMENTS

Week #	Name of the Experiment	Specific Requirements
1.	Arduino Uno Development Kit: Familiarization with Arduino Uno hardware, software, and perform necessary software installation.	Arduino Uno hardwareand software platforms
2.	Outputting Digital Signal: a) Interface LED/Buzzer with Arduino Uno and writea program to turn ON LED for 1 sec after every 2 seconds. b) Interface Buzzer with Arduino Uno and write a program to turn ON sound by Buzzer for 2 seconds.	Arduino Uno (1), LED(2), and Buzzer (1)
3.	Inputting Digital Signal: a) Interface push button and LED with Arduino Uno and write a program to turn ON LED when push button is pressed. b) Interface digital sensor (IR-infrared sensor) with Arduino Uno and write a program to turn ON Sound by Buzzer when object detects.	Arduino Uno (1), Push buttons(2), LED (2), Buzzer (1), and IR sensor module (1)

4.	Inputting Analog Signal: a) Interface Potentiometer with Arduino Uno and write a program to increase and decrease light intensity of LED. b) Interface LDR light sensor with Arduino and writea program to control LED.	Arduino Uno (1), Potentiometer (1), LED (2), and LDR sensor module (1)

BIG DATA ANALYTICS
Job Oriented Elective (Code: JO06)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Problem Solving using Programming (20CS203), Object Oriented Programming (20CS303), Database Management System(20CS403)

Course Objectives: Students will be able to

- Understanding Big data, Hadoop and Hadoop Distributed File System.
- Understanding YARN(Yet Another Resource Node), Map Reduce mechanism.
- Understanding PIG, HIVE.
- Understanding SQOOP, SPARK.

Course Outcomes: Students will be able to

CO-1	Hadoop and HDFS.
CO-2	MR with YARN.
CO-3	PIG and HIVt.
CO-4	SQOOP and Spark.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	2	3	2	-	3		2	-	1	3	2	-	1	3	3
CO-2	1	3	-	2	-	2	2	-	2	-	3	3	-	-	-
CO-3	-	2	-	1	-	3	-	2	-	3	-	-	2	2	-
CO-4	-	2	-	3	-	-	1	-	-	2	-	-	1	-	1

UNIT-1 — 15 Hours

Big Data Analytics: Introduction to Big Data Analytics, Characteristics of Big Data, Sources of Big Data, Applications of Big Data.
HADOOP: Introduction to Hadoop, Hadoop components, Configuration of Hadoop.
The Hadoop Distributed File System: The design of HDFS,HDFS concepts, The command line interpreter, Basic File system operations, Hadoop File System, Interfaces Data flow, parallel copying with distcp.

UNIT-2 — 15 Hours

YARN: Anatomy of YARN application run, YARN compared to Map Reduce 1, Scheduling in YARN.
How Map Reduce Works: Anatomy of Map Reduce job run, Failures, Shuffle and sort, Task execution.
Map Reduce Features-Counters, sorting, joins side data distribution, Writing map reduce programs, deploying map reduce programs on Hadoop Cluster.

UNIT-3 — 15 Hours

Installing and Running Pig-Execution Types, Running Pig Programs, Grunt, Pig Latin Editors, An Example, Comparison with Databases, Pig Latin-Structure, Statements, Expressions, Types, Schemas, Functions, Macros, User-Defined Functions-A Filter UDF, An Eval UDF, Data Processing Operators- Loading and Storing Data, Filtering Data, Grouping and Joining Data,

Sorting Data, Combining and Splitting Data, Pig in Practice-Parallelism, Anonymous Relations, Parameter Substitution.

Installing Hive, The Hive Shell, An example, Running Hive, Configuring Hive, Hive Services, The Metastore, Comparison with traditional databases, Schema on Read versus Schema on Write, Update, transactions and Indexes, SQL on Hadoop alternatives, HiveQL, Data types, Operators and functions, Tables, Querying Data-sorting and aggregating, MapReduce Script, joins, Sub queries, Views.

UNIT-4	12 Hours

Spark: Installing spark, an example spark application, jobs, stages, tasks, a scalastand alone application, anatomy of spark job run, job submission, DAG construction, task scheduling, task execution, execution cluster managers, spark on YARN.

Sqoop: Getting Sqoop, Sqoop Connectors, A Sample Import, Text and Binary File Formats, Generated Code, Additional Serialization Systems, Imports: A Deeper Look, Controlling the Import, Imports and Consistency.

Text Books :	HADOOP "The Definitive Guide", Tom White, O'Reilly Publications, 4th Edition. Black Book on Big Data, Dreamtech Publications.
References :	Hadoop in Action, Hadoop Beginner's Guide,Optimizing Hadoop for MapReduce, Scaling Big Data with Hadoop and Solr

BIG DATA ANALYTICS LAB
Job Oriented Elective (Code: JO06)

Practicals :	**3** Periods / Week	Continuous Internal Assessment :	**30**
Final Exam :	**3** hours	Semester End Exam :	**70**

Course Outcomes: Students will be able to

- Understand the concepts of Data mining and Big Data Analytics
- Apply machine learning algorithms for data analytics
- Analyze various text categorization algorithms
- Use Technology and tools to solve the Big Data Analytics problems

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	3
CO-2	-	3	1	-	-	-	-	-	-	1	-	1	1	2	-
CO-3	-	2	1	-	-	-	-	-	-	1	-	1	1	-	3
CO-4	-	2	2	-	-	-	-	-	-	3	-	1	1	3	2

LIST OF EXPERIMENTS

1. Write the steps for installation of Hadoop.
2. Write commands to interact with HDFS interface.
3. Write a Map Reduce program for Word Count Example.
4. Write a Map Reduce program for Card Count data set.
5. Write the steps for installation of Pig.
6. Write the word count script using Pig Latin.
7. Illustrate the basic Pig Latin concepts with help of any dataset.
8. Write the steps for installing Hive.
9. Illustrate the creation, loading & complete select statements in Hive.
10. Write the script how data will be transfer using Sqoop.

Text Book(s):	1. HADOOP "The Definitive Guide", Tom White, O'Reilly Publications, 4th Edition.
References :	

Advanced Skill Oriented Elective

Subject Code	Subject Name
SO04	Full Stack Development
SO05	DevOps
SO06	Robotic Process Automation

FULL STACK DEVELOPMENT
Advanced Skill Oriented Elective (Code: SO04)

Lectures	:	5 hours/Week (2T+3P)	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Web Technologies (20CS402)

Course Objectives: Students will be able to

- Develop a WEB-API using Node.JS.
- Work with NOSQL databases like MongoDB
- Develop a front-end in Angular that consumes web-services
- Develop a responsive front-end in Angular

Course Outcomes: Students will be able to

CO-1	Work with Timer Events, Listeners and Callbacks.
CO-2	Access the File System from Node.js.
CO-3	Use Express middleware and implement routes and templating for web application development.
CO-4	Understand Cookies, Sessions and Authentication.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	2	-	3	-	3	-	-	-	-	-	-	1	3	3	3
CO-2	2	-	3	-	3	-	-	-	-	-	-	1	3	3	3
CO-3	2	-	3	-	3	-	-	-	-	-	-	1	3	3	3
CO-4	2	-	3	-	3	-	-	-	-	-	-	1	3	3	3

UNIT-1 (14 Hours)

Node.js, Using Events, Timers, and Callbacks in Node.js, buffers and File system, Express with Node.js, Routes, Request and Response objects, Template engine.

UNIT-2 (15 Hours)

Understanding NoSQL and MongoDB, MongoDB CRUD operations Accessing MongoDB from Node.js.

UNIT-3 (16 Hours)

Typescript- types, interfaces, classes, modules, functions, Angular- Components, Expressions.

UNIT-4 (16 Hours)

Angular data binding, Built-in directives, Browser events, , Observables, Angular services.

Lab Exercises

1. Write programs
   a. to implement timers.
   b. to demonstrate different ways of performing read/write operations in local file system.
2. Code a basic Node.JS user registration application.
3. Create a CRUD application using data from local file system.
4. Create a CRUD web application using data from MongoDB server.
5. Refactor the above program to separate
   a. Model operations
   b. Controller operations

6. Code Angular applications to demonstrate a. Data binding. b. Directives c. Data sharing between parent/child components. 7. Create an Angular CRUD application that interacts with a REST API.	
Text Books :	**Node.js, MongoDB and Angular Web Development** (Second Edition), Brad Dayley, Brendan Dayley Caleb Dayley, by Pearson Education, Inc.
References :	1. Getting MEAN with Mongo, Express, Angular, and Node, Manning Publications, ISBN-10 : 1617294756, 2. Beginning Node.js, Express & MongoDB Development, ISBN-10 : 9811480281, 3. Beginning Node.js, Basarat Syed, APress, ISBN-10: 9781484201886

DEVOPS Advanced Skill Oriented Elective (Code: SO05)			
Lectures :	**2** Periods / Week, Practical: **3**	Continuous Internal Assessment :	**30** Marks
Final Exam :	**3** hours	Semester End Exam :	**70** Marks

Pre-Requisite:

Course Objectives: Students will be able to

- Understand the concepts of DevOps and version control.
- Apply Continuous Integration process.
- Apply Continuous delivery process.
- Apply Continuous Monitoring Tools.

Course Outcomes: Students will be able to

CO-1	Understand Version Control using git and github.
CO-2	Use tools like Jenkins for Continuous Integration.
CO-3	Use tools like Ansible, Docker & Kubernetes for Continuous Delivery.
CO-4	Use tools like Nagios for monitoring.

	PO's												**PSO's**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	2	1	2	3	-	-	-	3	3	3	2	2	2	3
CO-2	1	3	3	2	3	-	-	-	3	2	3	2	3	3	2
CO-3	1	3	3	2	3	-	-	-	3	2	3	2	3	3	2
CO-4	2	2	1	1	3	-	-	-	3	2	2	2	2	1	1

UNIT-I	12 Periods

DevOps Basics & Version Control : Definition of DevOps, DevOps Stakeholders, DevOps goals, DevOps life cycle.
Version Control, Continuous Integration, Continuous Delivery, Continuous Deployment, Continuous Monitoring.
Git basics, Git features, installing Git, Git essentials, common commands in Git, working with remote repositories using GitHub.

List of Experiments
1. Demonstrate Deploying an Application to GitHub.
2. Demonstrate working with Git Shell commands.
3. Demonstrate working with remote repositories.

UNIT-II	12 Periods

Continuous Integration using Jenkins: Introduction-Understanding Continuous Integration, introduction about Jenkins, Build Cycle, Jenkins Architecture, installation, Jenkin management. Adding a slave node to Jenkins, Building Delivery Pipeline, Pipeline as a Code.
List of Experiments
1. Demonstrate creation of maven application.
2. Demonstrate Building Delivery Pipeline (Continuous Integration) using Jenkins.

UNIT-III	12 Periods

Continuous Delivery: Configuration management, and application deployment functionality using Ansible, Containerization with Docker, Containerization using Kubernetes.
List of Experiments
1. Demonstrate CI/CD job to build code on ansible and deploy it on container.
2. Demonstrate Containerization with Docker.
3. Demonstrate Containerization with Kubernetes.

UNIT-IV	12 Periods

Continuous Monitoring: Continuous Monitoring with Nagios.
List of Experiments
1. Demonstrate Continuous Monitoring with Nagios.

Text Book(s) :	1. Patrick Debois Gene Kim, Jez Humble and John willis. The DevOps Handbook. IT Revolution Press,LLC, 1 edition, 2016. ISBN 978-1942788003
References :	1. Jennifer Davis & Ryn Daniels. Effective DevOps. Oreilly publications, 1 edition, 2018. ISBN 978- 1-492-07309-3 2. George Spafford Gene Kim, Kevin Bher. CThe Phonex Project. IT Revolution, 1 edition, 2018. ISBN 978-194278294.

ROBOTIC PROCESS AUTOMATION
Advanced Skill Oriented Elective (Code: SO06)

Lectures	:	5 hours/Week (2T+3P)	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite:

Course Outcomes: Students will be able to

- Understand types, components, equipment and various automated material handling systems of robots.
- Able to know components, motions, classification by using control methods and specifications of robots.
- Understand about effectors, various types of grippers and able to know about considerations in gripper selection and design.
- Able to understand about robotic programming in terms of languages, language structures, types of commands and VAL II programming language.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	-	-	-	-	2	1	-	-	-	-	-	-	-	-
CO-2	-	2	2	-	-	2		-	-	-	-	-	-	-	-
CO-3	1	2		-	-	-	-	-	-	-	-	-	-	-	-
CO-4	2	1	2	-	-	1	1	-	-	-	-	-	-	-	-

UNIT-1 (14 Hours)

INTRODUCTION TO ROBOTIC PROCESS AUTOMATION: Scope and techniques of automation, Robotic process automation What can RPA do? Benefits of RPA, Components of RPA, RPA platforms, The future of automation. RPA BASICS: History of Automation What is RPA RPA vs Automation Processes & Flowcharts Programming Constructs in RPA What Processes can be Automated Types of Bots Workloads which can be automated RPA Advanced Concepts Standardization of processes RPA Development methodologies Difference from SDLC Robotic control flow architecture RPA business case RPA Team Process Design Document/Solution Design Document Industries best suited for RPA Risks & Challenges with RPA RPA and emerging ecosystem.

UNIT-2 (15 Hours)

RPA TOOL INTRODUCTION AND BASICS : Introduction to RPA Tool - The User Interface - Variables - Managing Variables - Naming Best Practices - The Variables Panel - Generic Value Variables - Text Variables - True or False Variables - Number Variables - Array Variables - Date and Time Variables - Data Table Variables - Managing Arguments - Naming Best Practices - The Arguments Panel - Using Arguments - About Imported Namespaces - Importing New Namespaces- Control Flow - Control Flow Introduction - If Else Statements - Loops - Advanced Control Flow - Sequences - Flowcharts - About Control Flow - Control Flow Activities - The Assign Activity - The Delay Activity - The Do While Activity - The If Activity - The Switch Activity - The While Activity - The For Each Activity - The Break Activity - Data Manipulation - Data Manipulation Introduction - Scalar variables, collections and Tables - Text Manipulation - Data Manipulation - Gathering and Assembling Data

UNIT-3 (16 Hours)

ADVANCED AUTOMATION CONCEPTS & TECHNIQUES: Recording Introduction - Basic and Desktop Recording - Web Recording - Input/Output Methods - Screen Scraping - Data Scraping - Scraping advanced techniques - Selectors - Defining and Assessing Selectors - Customization - Debugging - Dynamic Selectors - Partial Selectors - RPA Challenge - Image, Text & Advanced Citrix Automation - Introduction to Image & Text Automation - Image based automation - Keyboard based automation - Information Retrieval - Advanced Citrix Automation challenges - Best Practices - Using tab for Images - Starting Apps - Excel Data Tables & PDF - Data Tables in RPA - Excel and Data Table basics - Data Manipulation in excel - Extracting Data from PDF - Extracting a single piece of data - Anchors - Using anchors in PDF	
UNIT-4	(16 Hours)
HANDLING USER EVENTS & ASSISTANT BOTS, EXCEPTION HANDLING: What are assistant bots? - Monitoring system event triggers - Hotkey trigger - Mouse trigger - System trigger - Monitoring image and element triggers - An example of monitoring email - Example of monitoring a copying event and blocking it - Launching an assistant bot on a keyboard event. EXCEPTION HANDLING: Debugging and Exception Handling - Debugging Tools - Strategies for solving issues - Catching errors.	
Text Books :	Alok Mani Tripathi. Learning Robotic Process Automation. Packt, 2018
References :	1. Heidi Jaynes Lauren Livingston Frank Casale, Rebecca Dilla. Introduction to Robotic Process Automation: a Primer. Institute of Robotic Process Automation, 1 edition, 2015 2. Richard Murdoch. Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks and Become An RPA Consultant. Independently Published, 1 edition, 2018 3. Srikanth Merianda. Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation. Consulting Opportunity Holdings LLC, 1 edition, 2018

Open Electives

List of Subjects offered under Open Elective	
20CEOE01	Air Pollution and Control
20CEOE02	Remote Sensing and GIS
20CSOE01	Database Management System
20CSOE02	Java Programming
20ECOE01	Digital Image Processing
20EEOE01	Non-Conventional Energy Sources
20EEOE02	Electrical Energy Conservation and Auditing
20EIOE01	Sensors And Signal Conditioning
20ELOE01	Professional Communication
20ITOE01	Web Technologies
20ITOE02	Cyber Security
20MEOE01	Automobile Engineering
20MEOE02	Renewable Energy Sources
20PHOE01	Nano Materials
20PHOE02	Opto Electronic Devices and Applications
20PHOE03	Fiber Optic Communications

AIR POLLUTION & CONTROL
Open Elective (Code: 20CEOE01)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Objectives: Students will be able to

- To take up the basic concepts of sources and effects of Air Pollution
- The contents involved the knowledge of the effect of metrological parameters on air pollution
- The contents involved the knowledge of the control of air pollution from particulates
- To develop skills relevant to control of gaseous pollution and also introduce about Air Quality Management

Course Outcomes: Students will be able to

CO-1	The concepts of sources of air pollution and effects of air pollutants on man, materials and plants
CO-2	Be able to understand the effect of air pollution with meteorological parameters
CO-3	The knowledge about particulate control by different devices
CO-4	Be able to develop gaseous pollution control technologies and estimate the quality monitoring of air pollutants

UNIT-1 (12 Hours)

Air Pollution –Definitions, Air Pollutants–Classifications –Natural and Artificial– Primary and Secondary, point and Non-Point, Line and Areal Sources of air pollution-stationary and mobile sources.
Effects of Air pollutants on man, material land vegetation: Global effects of air pollution – Green House effect, Heat Islands, Acid Rains and Ozone Holes etc.

UNIT-2 (12 Hours)

Meteorology and plume Dispersion; properties of atmosphere; Heat, Pressure, Wind forces, Moisture and relative Humidity, Influence of Meteorological phenomenon Air Quality-wind rose diagrams.

UNIT-3 (12 Hours)

Lapse Rates, Pressure Systems, Winds and moisture plume behavior and plume Rise Models; Theory and problem related to Gaussian dispersion model.
Control of particulates –Control at Sources, Process Changes, Equipment modifications, Design and operation of control. Equipment's–Settling Chambers, Centrifugal separators, filters Dry and Wet scrubbers, Electrostatic precipitators.

UNIT-4 (12 Hours)

General Methods of Control of NOx and Sox emissions–In-plant Control Measures, process changes, dry and wet methods of removal and recycling. Air Quality Management–Monitoring of SPM, SO;NO and CO Emission Standards.

Text Books :
1. Airpollution By M.N.Raoand H.V.N.Rao –Tata Mc.GrawHillCompany.
2. Airpollution by Warkand Warner. –Harper & Row, NewYork.

References : An introduction to Air pollution by R.K.Trivedy and P.K.Goel, B.S.Publications

REMOTE SENSING &GIS
Open Elective (Code: 20CEOE02)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Objectives: Students will be able to

- Learn basic concepts of Aerial Photographs.
- Learn basic concepts of remote sensing and its characteristics, satellite sensors and platforms.
- Know about satellite digital image processing and classification techniques. Understand the basic concepts GIS, spatial data and analysis
- Applications of GPS in surveying. Know various remote sensing and GIS applications in civil engineering

Course Outcomes: Students will be able to

CO-1	Interpret Information from Aerial Photographs.
CO-2	Exposure on Basics of Remote Sensing, Satellite Sensors and Platforms, Practical Knowledge on Satellite Image Classification.
CO-3	Know Basics of GIS And Map Making. Exposure about Spatial Analysis Using Overlay Tools.
CO-4	Geo-Tag Assets Using GPS And Add Attribute & Meta-Data. Get the Knowledge on Various Remote Sensing and GIS Applications in Civil Engineering.

UNIT-1 (12 Hours)

PHOTOGRAMMETRY: Fundamentals of Photogrammetry and Photo interpretation – types of photographs; Vertical photographs – principal point; scale; Stereoscopy; Overlap, side lap and flight planning.

UNIT-2 (12 Hours)

REMOTE SENSING:
Introduction to Remote Sensing: Basic concepts of remote sensing, electromagnetic radiation, electromagnetic spectrum, interaction with atmosphere and target.
Sensors and platforms: Introduction, types of sensors, airborne remote sensing, Space-borne remote sensing. Visual Interpretation Techniques. Overview of Indian Remote sensing satellites and sensors, satellite definition and types, characteristics of satellite, characteristics of satellite orbit

UNIT-3 (12 Hours)

GEOGRAPHIC INFORMATION SYSTEM (GIS)
Introduction, key components, data entry &preparation – Spatial data input, Raster Data Model, Vector Data Model, Raster Vs Vector, advantages and disadvantages of Raster & Vector network analysis - concept and types, Data storage-vector data storage, attribute data storage.

UNIT-4 (12 Hours)

GLOBAL POSITIONING SYSTEM (GPS)&RS AND GISAPPLICATIONS:
GPS definition, components of GPS, GPS receivers. Space, Control and User segments of GPS. Advantages and disadvantages of GPS, Limitations and applications of GPS Indian Systems (IRNSS, GAGAN)Development of GPS surveying techniques, Navigation with GPS, Applications of GPS. Applications: Photogrammetry, Remote Sensing and Geographical information Systems

Text Books :
1. Bhatta B (2008), 'Remote sensing and GIS', Oxford University Press

	2. Chang, K. T. (2006). Introduction to Geographic Information Systems. The McGraw-Hill. 3. Lillesand, T.M, R.W. Kiefer and J.W. Chipman (2013) 'Remote Sensing and Image Interpretation', Wiley India Pvt. Ltd., New Delhi 4. Schowenger, R. A (2006) 'Remote Sensing' Elsevier publishers. 5. Parkinson, B. W., Spilker, J. J. (Jr.) (1996). Global Positioning System: Theory & Applications (Volume-I). AIAA, USA
References :	1. 'Fundamentals of Remote Sensing' by George Joseph, Universities Press, 2013. 2. 'Fundamentals of Geographic Information Systems' by Demers, M.N, Wiley India Pvt.Ltd, 2013. 3. Jensen John R. Introduction to Digital Image Processing: A Remote Sensing Perspective Prentice hall, New Jersey 4. Paul Wolf, Elements of Photogrammetry, McGraw Hill. 5. Leick Alfred, 1995: GPS Satellite Surveying, Wiley Inter science 6. Burrough, P. P. & McDonnel, R. A. (1998). Principles of GIS. Oxford University Press.

DATABASE MANAGEMENT SYSTEMS
Open Elective (Code: 20CSOE01)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Objectives: Students will be able to

- Familiarize with fundamental concepts of database and various database architectures and Design relations for Relational databases using conceptual data modeling.
- Implement formal relational operations in relational algebra and SQL.
- Identify the Indexing types and normalization process for relational databases
- Use mechanisms for the development of multi user database applications.

Course Outcomes: Students will be able to

CO-1	Ability to apply knowledge of database design methodology which give a good formal foundation in relational data model and Understand and apply the principles of data modeling using ER Model.
CO-2	Familiar with relational DB theory and will able to write relational algebra expressions, Relational Calculus and SQL.for query
CO-3	Design database schema and Identify and solve the redundancy problem in database tables using normalization.
CO-4	Understand transaction processing, concurrency control and recovery techniques.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	2	2	-	-	-	-	-	-	-	-	-	-	1	-
CO-2	2	2	3	1	-	-	-	-	-	-	-	-	-	2	-
CO-3	1	2	3	1	-	-	-	-	-	-	-	-	-	1	-
CO-4	1	3	3	1	-	-	-	-	-	-	-	-	-	3	-

UNIT-1 (12 Hours)

Databases and Database Users: Introduction - An Example - Characteristics of the Database Approach - Actors on the Scene - Workers behind the Scene - Advantages of Using the DBMS Approach - A Brief History of Database Applications - When Not to Use a DBMS.

Database System Concepts and Architecture: Data Models, Schemas, and Instances - Three-Schema Architecture and Data Independence - Database Languages and Interfaces - The Database System Environment - Centralized and Client/Server Architectures for DBMSs - Classification of Database Management Systems.

Data Modeling Using the Entity-Relationship (ER) Model: Using High-Level Conceptual Data Models for Database Design - An Example Database Application - Entity Types, Entity Sets, Attributes, and Keys - Relationship Types, Relationship Sets, Roles, and Structural Constraints - Weak Entity Types - Refining the ER Design for the COMPANY Database - ER Diagrams, Naming Conventions, and Design Issues.

UNIT-2 (12 Hours)

The Relational Data Model and Relational Database Constraints: Relational Model Concepts - Relational Model Constraints and Relational Database Schemas - Update Operations,

Transactions, and Dealing with Constraint Violations - Relational Database Design Using ER-to-Relational Mapping. **Basics of SQL**: DDL, DML and DCL Commands.	
UNIT-3	(12 Hours)
Functional Dependencies and Normalization for Relational Databases: Informal Design Guidelines for Relation Schemas - Functional Dependencies - Normal Forms Based on Primary Keys - General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form. **Relational Database Design Algorithms and Further Dependencies**: Properties of Relational Decompositions - Algorithms for Relational Database Schema Design – Multivalued Dependencies and Fourth Normal Form - Join Dependencies and Fifth Normal Form.	
UNIT-4	(12 Hours)
Introduction to Transaction Processing Concepts and Theory: Introduction to Transaction Processing - Transaction and System Concepts - Desirable Properties of Transactions - Characterizing Schedules Based on Recoverability - Characterizing Schedules Based on serializability. **Concurrency Control Techniques**: Two-Phase Locking Techniques for Concurrency Control - Concurrency Control Based on Timestamp Ordering – Multiversion Concurrency Control Techniques - Validation (Optimistic) Concurrency Control Techniques - Granularity of Data Items and Multiple Granularity Locking.	
Text Books :	"Fundamentals of Database Systems", RamezElmasri and Navate Pearson Education, 5th edition.
References :	1. "Introduction to Database Systems", C.J.Date Pearson Education. 2. "Data Base Management Systems", Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill, 3rdEdition. 3. "Data base System Concepts", Silberschatz, Korth, McGraw hill, 5th edition.

JAVA PROGRAMMING
Open Elective (Code: 20CSOE02)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Programming for Problem Solving

Course Objectives: Students will be able to

- Understand advantages of OO programming over procedural oriented programming, learn the basics of variables, operators, control statements, arrays, classes and objects.
- Understand, write and implement the following concepts: Inheritance, Interfaces, Packages, Strings and Collections.
- Understand and write programs on Exception Handling, I/O, and Multithreading.
- Understand and implement applications using Applets, AWT, Swings and Events.

Course Outcomes: Students will be able to

CO-1	Demonstrate OOP concepts, its advantages over structured programming.
CO-2	Develop and implement Inheritance, polymorphism.
CO-3	Analyze Exception Handling, Multithreading, I/O.
CO-4	Create code for Event Handling, Applets, AWT and Swings.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	2	3	-	-	-	-	-	-	-	-	-	3	3	2
CO-2	3	2	3	-	-	-	-	-	-	-	-	-	3	3	2
CO-3	3	2	3	-	-	-	-	-	-	-	-	-	3	3	2
CO-4	3	2	3	-	2	-	-	-	-	-	-	-	3	3	2

UNIT-1 (12 Hours)

Introduction: Introduction to java, data types, dynamic initialization, scope and life time, operators, control statements, arrays, type conversion and casting, finals & blank finals.

Classes and Objects : Concepts, methods, constructors, usage of static, access control, this key word, garbage collection, overloading, parameter passing mechanisms, nested classes and inner classes.

Inheritance: Basic concepts, access specifires, usage of super key word, method overriding, final methods and classes, abstract classes, dynamic method dispatch, Object class.

Interfaces: Differences between classes and interfaces, defining an interface, implementing interface, variables in interface and extending interfaces.

Packages: Creating a Package, setting CLASSPATH, Access control protection, importing packages.

Strings: Exploring the String class, String buffer class, Command-line arguments.

UNIT-2 (12 Hours)

Exception Handling: Concepts of Exception handling, types of exceptions, usage of try, catch, throw, throws and finally keywords, Built-in exceptions, creating own exception sub classes.

Multithreading: Concepts of Multithreading, differences between process and thread, thread life cycle, Thread class, Runnable interface, creating multiple threads, Synchronization, thread priorities.

Applets: Concepts of Applets, life cycle of an applet, creating applets, passing parameters to applets, accessing remote applet, Color class and Graphics	
UNIT-3	(12 Hours)
Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, handling events. AWT: AWT Components, windows, canvas, panel, File Dialog boxes, Layout Managers, Event handling model of AWT, Adapter classes, Menu, Menu bar.	
UNIT-4	(12 Hours)
Swing-I – swings introduction, JApplet, JFrame and JComponent, Icons and Labels, text fields, buttons – The JButton class, Check boxes, Radio buttons. JDBC Connectivity: Jdbc connectivity, types of Jdbc Drivers, connecting to the database, Jdbc Statements, Jdbc Exceptions, Manipulations on the database, Metadata.	
Text Books :	1. "The Complete Reference Java J2SE", 7th Edition, Herbert Schildt, TMH Publishing Company Ltd, New Delhi. 2. "Big Java", 2nd Edition, Cay Horstmann, John Wiley and Sons, Pearson Education.
References :	1. "Java How to Program", Sixth Edition, H.M.Dietel and P.J.Dietel, Pearson Education/PHI. 2. "Core Java 2", Vol 1, Fundamentals, Cay.S.Horstmann and Gary Cornell, Seventh Edition, Pearson Education. 3. "Core Java 2", Vol 2, Advanced Features, Cay.S.Horstmann and Gary Cornell, Seventh Edition, Pearson Education. 4. "Beginning in Java 2", Iver Horton, Wrox Publications. 5. "Java", Somasundaram, Jaico. 6. "Introduction to Java programming", By Y.DanielLiang, Pearson Publication.

DIGITAL IMAGE PROCESSING
Open Elective (Code: 20ECOE01)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Objectives: Students will be able to

- Recall and summarize the digital image fundamentals and to be exposed to basic image processing techniques.
- Be familiar with image restoration, segmentation and compression techniques.
- Illustrate the representation of monochrome and color images in the form of features and descriptors
- Give the students a taste of the applications of the theories taught in the subject. This will be achieved through the project and some selected lab sessions. Develop a theoretical foundation of fundamental Digital Image Processing concepts.

Course Outcomes: Students will be able to

CO-1	Explain the digital image fundamentals and basic image processing techniques
CO-2	Apply appropriate technique for image enhancement both in spatial and frequency domains
CO-3	Analyze the need for image restoration and color image processing and illustrate various restoration and color image processing techniques.
CO-4	Evaluate various segmentation, representation and description techniques on digital images

UNIT-1 (12 Hours)

INTRODUCTION: What Is Digital Image Processing? The Origins of Digital Image Processing, Examples of Fields that Use Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System.
DIGITAL IMAGE FUNDAMENTALS: Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships between Pixels.

UNIT-2 (12 Hours)

SPATIAL AND FREQUENCY DOMAIN FILTERING: Background. Some Basic Intensity Transformation functions, Histogram Processing, Fundamentals of Spatial Filters, Smoothing Spatial Filters, Sharpening Spatial Filter. The basics of filtering in the Frequency Domain, Image smoothing using frequency domain filters, Image sharpening using frequency domain filters.
IMAGE COMPRESSION: Fundamentals – Image Compression models – Error Free Compression, Lossy Compression

UNIT-3 (12 Hours)

IMAGE RESTORATION: A Model of the Image Degradation/Restoration Process, Noise Models, Restoration in the Presence of Noise Only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering.
COLOR IMAGE PROCESSING: Color Fundamentals, Color Models, Pseudo color Image Processing, Basics of Full-Color Image Processing, Color Transformations, Smoothing and Sharpening, Image Segmentation based on Color.

UNIT-4 (12 Hours)

IMAGE SEGMENTATION: Detection of discontinuities, Thresholding, Edge based Segmentation and Region based Segmentation IMAGE REPRESENTATION AND DESCRIPTION: Representation schemes, Boundary Descriptors, Regional Descriptors.	
Text Books :	R. C. Gonzalez, R. E. Woods, Digital Image Processing 4thEdition, Pearson Education Publishers, 2019.
References :	1. S Jayaraman, S Esakkirajan, T Veerakumar, Digital Image Processing, Mc-Grah Hill Publications, 2010. 2. Milan Sonka, Vaclav Hlavac and Roger Boyle, Image Processing Analysis and Machine Vision, Thomson learning, Second Edition, 2001. 3. S.Sridhar, Digital Image Processing, Oxford University Press, 2016.

NON-CONVENTIONAL ENERGY SOURCES
Open Elective (Code: 20EEOE01)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Objectives: Students will be able to

- To enable students to identify different sources of non conventional energy and innovative Technologies in harnessing energy from these sources.
- Understand the energy conversion from wind energy, geothermal energy, Biomass, biogas, fuel cells.
- Understand the advantages and limitations of different non conventional energy sources
- identify a wide variety of applications for non conventional energy.

Course Outcomes: Students will be able to

CO-1	Understand different methods of exploiting solar energy.
CO-2	Understand the principles and energy conversion from wind and geo thermal sources
CO-3	Gain knowledge in exploring the energy from ocean, tidal and bio-mass
CO-4	understand the techniques in power generation using Fuel cells, bio gas and MHD

UNIT-1 (12 Hours)

Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits Solar Energy: Extra terrestrial solar radiation - terrestrial solar radiation –solar radiations on earth-measurement of solar radiations-solar constant-solar collectors-flat plate collectors-concentrating collectors-solar thermal conversion-solar thermal central receiver systems - photovoltaic energy conversion - solar cells- energy storage methods-applications of solar energy

UNIT-2 (12 Hours)

Wind energy: Availability of wind energy in India, site selection-Components of wind energy conversion systems-Classification of wind energy conversion systems-vertical axis and horizontal axis wind turbines- Performance characteristics-Betz criteria coefficient-applications of WECS-environmental aspects

Geo thermal Energy: Structure of earth's interior-geothermal sites-geothermal resources-Site selection for geothermal power plants-Principle of working-various types of geothermal power plants- applications

UNIT-3 (12 Hours)

Ocean thermal energy conversion (OTEC): Principle of ocean thermal energy conversion-Open cycle and closed cycle OTEC plants-Merits and demerits

Tidal Power: Tides and waves as sources of energy-fundamentals and use of tidal energy-limitations of tidal energy conversion system

Bio mass: Availability of biomass and its conversion techniques-bio mass gasification-bio mass resource development in India

UNIT-4 (12 Hours)

Bio Gas: Bio gas production, aerobic and anaerobic bio conversion process-Properties of bio gas-classification of biogas plants-advantages and disadvantages-bio gas applications

Fuel Cells: Classification, Principle of working of various types of fuel cells, merits and demerits, future potential of fuel cells.

Magneto-Hydrodynamics (MHD): Principle of working of MHD Power plant, Classification, advantages and disadvantages.

Text Books :	1. H.P. Garg& Jai Prakash, Solar Energy: Fundamentals and Applications, Tata McGraw Hill, New Delhi 2. Non-Conventional Energy Sources by G.D.Rai, Khanna Publisher 3. B H Khan, "Non-Conventional Energy Resources", 2nd Edition, Tata McGraw Hill Education Pvt Ltd, 2011
References :	1. Power plant technology by EL-Wakil, McGraw-Hill. 2. Renewable Energy Sources by John Twidell& Toney Weir: E&F.N. Spon

ELECTRICAL ENERGY CONSERVATION & AUDITING
Open Elective (Code: 20EEOE02)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Objectives: Students will be able to

- Understand the concept of energy conservation, energy management.
- Explain the energy efficient motors and its characteristics.
- Understand the power factor improvement, lighting and different measuring instruments.
- Explain the economic aspects of energy management.

Course Outcomes: Students will be able to

CO-1	Examine the principles of Energy audit and its process in thermal power station & analyze the different aspects of energy management.
CO-2	Describe the characteristics of energy efficient motors.
CO-3	Illustrate the power factor improvement, good lighting system practice and the typesof energy instruments.
CO-4	Analyze the economic aspects of Energy Management.

UNIT-1 (12 Hours)

Basic Principles of Energy Audit: Energy audit - definitions, concept , types of audit, energy index, cost index , pie charts, Sankey diagrams, load profiles, Energy conservation schemes - Energy saving potential, energy audit of thermal power station, building energy audit.
Energy Management: Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting, Energy manger, Qualities and functions, language, Questionnaire - check list for top management.

UNIT-2 (12 Hours)

Energy Efficient Motors: Energy efficient motors, factors affecting efficiency, loss distribution, constructional details. Characteristics - Variable speed, variable duty cycle systems, Voltage variation -Voltage unbalance - Over motoring - Motor energy audit.

UNIT-3 (12 Hours)

Power Factor Improvement, Lighting & Energy Instruments: Power Factor Improvement, Lighting: Power factor – Methods of improvement, location of capacitors, Pf with non-linearloads, effect of harmonics on power factor. Power factor motor controllers - Good lighting system design and practice, lighting control, lighting energy audit. Energy Instruments: Watt meter, data loggers, thermocouples, pyrometers, lux meters, tong testers, application of PLC's.

UNIT-4 (12 Hours)

Economic Aspects and Analysis:Economics Analysis - Depreciation Methods, time value of money, rate of return, present worth method , replacement analysis, life cycle costing analysis - Energy efficient motors, Calculation of simple payback method, net present worth method - Power factor correction, lighting - Applications of life cycle costing analysis, return on investment.

Text Books :

1. Desai, Sonal, "Handbook of Energy Audit", McGraw-Hill Education, 2015.
2. W.R. Murphy and G. Mckay. Energy Management. Butter worth Publications.2001.
3. John. C. Andreas, Energy Efficient Electric Motors, Marcel Dekker Inc Ltd, 2nd Edition, 1995.

References :	1. Bureau of Energy Efficiency India. General Aspects of Energy Management and Energy Audit. Bureau of Energy Efficiency India, 4 th edition, 2015. 2. Bureau of Energy Efficiency India. Energy Efficiency in Electrical Utilities. Bureau of Energy Efficiency India, 4 th edition, 2015. 3. Doty, Steve, and Wayne C. Turner. Energy management handbook. Crc Press, 2004. 4. Paul O' Callaghan, "Energy Management", Mc-Graw Hill Book Company, 1st Edition, 1998. 5. S. C. Tripathy, "Utilization of Electrical Energy", Tata McGraw Hill, 1993.

SENSORS AND SIGNAL CONDITIONING
Open Elective (Code: 20EIOE01)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Objectives: Students will be able to

- Describe the basics of sensors, their static and dynamic characteristics, primary sensors for common quantities, working principles of resistive sensors and various methods of signal condition of resistive sensors.
- Study various reactive variation sensors and design of signal condition circuits for these sensors
- Know various self generating sensors and design of signal condition circuits for these sensors
- Understand the working principles of various digital and Intelligent sensors

Course Outcomes: Students will be able to

CO-1	List the characteristics of sensors and their significance
CO-2	State applications of resistive sensors and design a signal conditioning circuit for a given resistive sensor.
CO-3	State the working principles of self generating sensors, their applications design a signal conditioning circuit for a given self generating sensor
CO-4	List various digital sensors and their applications

UNIT-1 (12 Hours)

Introduction to sensor-based measurement systems: General concepts and terminology, sensor classification, general input-output configuration, static and dynamic characteristics of measurement systems, primary sensors.
Resistive sensors : potentiometers, strain gauges, resistive temperature detectors, thermistors.
Signal conditioning for resistive sensors: Measurement of resistance, voltage dividers, Wheatstone bridge-balance measurements, Wheatstone bridge- deflection measurements, differential and instrumentation amplifiers, interference.

UNIT-2 (12 Hours)

Reactance variation and electromagnetic sensors: capacitive sensors, inductive sensors-variable reluctance sensors, eddy current sensors, linear variable differential transformer, electromagnetic sensors.
Signal conditioning for reactance variation sensors: problems and alternatives, ac bridges, carrier amplifiers and coherent detection, specific signal conditioning for capacitive sensors.

UNIT-3 (12 Hours)

Self generating Sensors: thermocouples, piezoelectric sensors, photovoltaic sensors, electrochemical sensors.
Signal conditioning for self-generating sensors: Chopper and low-drift amplifiers, electrometer and transimpedance amplifiers, charge amplifiers, noise in amplifiers, noise and drift in resistors.

UNIT-4 (12 Hours)

Digital and Intelligent sensors: Position encoders, resonant sensors, variable oscillators, conversion to frequency, period or time duration, direct sensor- microcontroller interfacing, communication systems for sensors, intelligent sensors.

Text Books :	Raman Pallas – Areny, John G. Webster :Sensors and signal conditioning, second edition, John Wiley and sons.
References :	Walt Kester : Practical design techniques for sensor signal conditioning, Analog devices and Prentice Hall.

PROFESSIONAL COMMUNICATION
Open Elective (Code: 20ELOE01)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Objectives: Students will be able to

- improve grammar, mechanics and writing style for clarity, concision, coherence and emphasis and increase knowledge of technical communication
- identify and understand the facets and functions of the primary genres of technical writing, reports, proposals and project reports
- define and identify different life skills required in professional life
- Explain the basic mechanics of effective communication and demonstrate these through presentations.

Course Outcomes: Students will be able to

CO-1	use and apply writing skills in writing Technical reports, Project Proposals and make oral presentations of their findings
CO-2	Develop strategies for addressing multiple audiences, expert and lay audiences.
CO-3	apply principles of cross cultural etiquette and build professional network
CO-4	demonstrate improved competency of Soft Skills required for the workplace

UNIT-1	(12 Hours)

Preparing project reports
Research methods- Abstract writing- background knowledge of the research topic-Literature review— Plagiarism- methodology- sampling- data collection and analysis- Integrate tables, figures, and other images into documents -presenting the findings- conclusion- preparing references- Appendices

UNIT-2	(12 Hours)

Oral presentation of the Projects (Viva voce)
Presentation and oral communication skills- presenting the findings of research- Maintaining audience orientation- body language- voice modulation- delivery of ideas

UNIT-3	(12 Hours)

Life skills for professionals
Understanding career management- Networking professionally- Mastering Cross Cultural Etiquette -Respecting social protocols- Developing a long termcareer plan- Making career choices

UNIT-4	(12 Hours)

Corporate Etiquette
Power Dressing – Greeting – Introduction - Polishing Business Manners (Hand Shakes, Gifts, Humour, Office Behaviour) – The art of Small talk & Conversations - Dining Etiquette

References :

1. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India; 6 edition, 2015.
2. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1 edition, 2013.
3. Butterfield Jeff, “Soft Skills for Everyone”, Cengage Learning India Pvt Ltd; 1 edition, 2011.

	4. Markel, Mike, Technical Communication (9th Edition) Boston: Bedford/St. Martin's, 2009.

WEB TECHNOLOGIES
Open Elective (Code: 20ITOE01)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Objectives: Students will be able to

- Analyze a web page and identify HTML elements and their attributes.
- Build dynamic web pages using JavaScript (client side programming).
- Write a well formed / valid XML documents.
- Understand Web server and its working also working with Ajax for asynchronous communication.

Course Outcomes: Students will be able to

CO-1	Design web pages with different elements and attributes.
CO-2	Build websites with dynamic functionality using java script.
CO-3	Identify the functionality of XML and create an XML document and display data from XML document.
CO-4	Recognize the use of web servers and know the functionality of web servers.

UNIT-1	(12 Hours)
Introduction to HTML5 Part I, Introduction to HTML5 Part II, Cascading Style Sheets I, Cascading Style Sheets II, JavaScript: Introduction to Scripting, Control Statements I, Control Statements II, Functions, Arrays.	
UNIT-2	(12 Hours)
JavaScript: Objects, Dynamic HTML: Document Object Model and Collections, Event Model, HTML5 Introduction to Canvas	
UNIT-3	(12 Hours)
XML: Introduction, XML Basics, Structuring data, XML Namespaces, DTD, XSD, XSL Transformations.	
UNIT-4	(12 Hours)
Building Ajax-Enabled Web Applications, Web Servers (IIS and Apache), Working with JQuery.	

Text Books :

1. Harvey M. Deitel and Paul J. Deitel, "Internet & World Wide Web How to Program", 5/e, PHI.
2. Kogent Learning Solutions Inc.,HTML5 Black Book: "Covers CSS3, Javascript, XML, XHTML, Ajax, PHP and Jquery".

References :

1. Jason Cranford Teague, “Visual Quick Start Guide CSS, DHTML & AJAX”, 4e, Pearson Education.
2. Tom NerinoDoli smith, “JavaScript & AJAX for the web”, Pearson Education 2007.
3. Joshua Elchorn, “Understanding AJAX”, Prentice Hall 2006.

CYBER SECURITY
Open Elective (Code: 20ITOE02)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Objectives: Students will be able to

- understand about Security basics and Cryptographic algorithms.
- understand how to secure computer system with Cryptographic algorithms and data integrity.
- identify hacking basics information and privacy concepts.
- gather the matter about Security in the networks & analyze, and various types of attacks in the computer system.

Course Outcomes: Students will be able to

CO-1	Use basic security information and cryptographic algorithms.
CO-2	Explain principles of operation of Asymmetric Encryption techniques and integrity algorithms.
CO-3	analyze hacking techniques and privacy concepts.
CO-4	Add security feature to computer networks and improve computer security.

UNIT-1 (12 Hours)

Int. to Computer Security: Definition of Computer Security, the OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms and A Model for Network Security.
Symmetric Ciphers: Classical Encryption Techniques, Block Ciphers and the DES, AES Techniques.

UNIT-2 (12 Hours)

Public Key Cryptography: Principles of Public-Key Cryptosystems, The RSA algorithm and Diffie Hellman Key Exchange Algorithm.
Digital Signatures: Properties, Attacks and Forgeries, Digital Signature Requirements, Direct Digital Signature and Elgamal Digital Signature Scheme.

UNIT-3 (12 Hours)

Hacking: Basic Terminology, Hacker's Motives and Objectives, Hacker Classes, Hacking Phases and Role of an Ethical Hacker.
Privacy in Cyberspace: Privacy Concepts, -Privacy Principles and Policies, Privacy on the Web, Email Security, Privacy Impacts of Emerging Technologies.

UNIT-4 (12 Hours)

Information gathering tools: Recon-ng, Dmitry, Net discover and Nmap.
Network Scanning: Objectives of Network Scanning, TCP/IP protocol stack, Types of Network Scanning.
Security of Computer Systems: Malware attacks, Password attacks.

Text Books : Cryptography and Network Security - Principles & Practice by William Stallings, 7th edition, Prentice Hall

References :

1. Cryptography and Network Security by Behrouz A. Forouzan and DebdeepMukhopadhyay 3rded, Mcgraw-Hill Education, 2016.
2. CISSP All-in-One Exam Guide, Seventh Edition 2016 by Shon Harris and Fernando Maymi McGraw-Hill Education.

	3. Gray Hat Hacking: The Ethical Hackers Handbook 4th Edition by Allen Harper, Shon Harris McGraw-Hill Education. 4. Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, Security in Computing,5th Edition , Pearson Education , 2015.

AUTOMOBILE ENGINEERING
Open Elective (Code: 20MEOE01)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Objectives: Students will be able to

- Familiarize the fundamentals of Engine Components, Chassis and suspension system, braking and transmission system, and cooling and lubrication system.
- Develop a strong base for understanding future developments like hybrid and electric vehicles in the automobile industry.

Course Outcomes: Students will be able to

CO-1	List different types of Vehicles and their applications
CO-2	Define working of Automobile Engine cooling and lubrication system.
CO-3	Describe functioning of Ignition system and its accessories.
CO-4	Describe functioning of Transmission, Steering, Braking and Suspension system. Understand the working and layout of Hybrid and electric vehicles and their components

UNIT-1 (12 Hours)

INTRODUCTION: Classification of vehicles – applications, valves, valve arrangements and operating Mechanisms, Piston - design basis, types, piston rings, firing order; Crankshafts, Flywheel, Air and Fuel Filters, Mufflers.
FUEL SUPPLY SYSTEMS: Fuel supply pumps, Mechanical and Electrical type Diaphragm pumps.
COOLING SYSTEMS: Need for cooling system, Air and water cooling, Thermal syphon cooling systems

UNIT-2 (12 Hours)

LUBRICATING SYSTEMS: Various lubricating systems for I.C. Engines.
ELECTRICAL SYSTEM: Ignition system, Spark plugs, Distributor, Electronic Ignition, Alternator, cut out, Current and voltage regulators, charging circuit, starting motors, lighting, instruments and accessories.
CHASSIS: Introduction, Construction, Requirements of Chassis.

UNIT-3 (12 Hours)

TRANSMISSION: Gear Box - Theory, Four speed and Five Speed Sliding Mesh, Constant mesh & synchromesh type, selector mechanism, automatic transmission, overdrive, propeller shaft, differential - principle of working.
SUSPENSION SYSTEMS: Need for suspension systems, springs, shock absorbers, axles – front and rear, different methods of floating rear axle, front axle and wheel alignment.

UNIT-4 (12 Hours)

VEHICLE CONTROL: Steering mechanisms and power steering, types of brakes and brake actuation mechanisms (air and hydraulic).
ELECTRIC, HYBRID AND FUEL CELL VEHICLES: Layout of electric and hybrid vehicles – Advantages and drawbacks, System Components, Electronic control system, Different configurations of electric and hybrid vehicles hybrid vehicles, Power split device, High energy and power density batteries – Basics of fuel cell vehicles.

Text Books :
1. Automobile Engineering - G.B.S.Narang.
2. Automobile Engineering -R.B.Gupta

	3. Automobile Engineering - Vol I & II - Kirpal Singh
References :	1. Automotive Mechanics - Joseph Heitner 2. Automobile Engineering -S.Srinivasan

NANO MATERIALS Open Elective (Code: 20PHOE01)					
Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Outcomes: Students will be able to

CO-1	Scale up synthesis of nanomaterials and understand quantum confinement
CO-2	Understand properties of nanomaterials and nano tubes
CO-3	Know the characterisation techniques of nano materials
CO-4	Know the usage of nano particles in nano biology and nano medicine.

UNIT-1 (12 Hours)

INTRODUCTION TO NANO TECHNOLOGY: history of Nano materials nano scale, conventional and Nano materials differences, quantum confinement, quantum wells, quantum wires, quantum dots, surface to volumeratio, nanoceramics, nanocomposites and nanoclusters .
SYNTHESIS OF NANOMATERIAL:Bottom up and top down approaches, cryo rolling, high energy ball milling, chemical vapour deposition, solgel method, laser ablation, rapid solidification processing, equal channel angular extrusion, molecular beam epitaxy, sputtering ,hydrothermal method, physical vapour deposition and electro deposition.

UNIT-2 (12 Hours)

PROPERTIESOFNANOMATERIALS: Electrical, magnetic, optical, physical, chemical, mechanical, thermal and electro-chemical properties.
CARBON NANOMATERIALS: Nanotubes, graphene, bucky balls, nano horns, properties of carbon nanotubes, synthesis of carbon nano materials, application of carbon nano tubes.

UNIT-3 (12 Hours)

CHARACTERIZATION OF NANO MATERIALS: X-ray diffraction, scanning electron microscopy, uv- visible spectroscopy, scanning tunnelling microscopy, differential thermal analysis and differential scanning calorimetry , FTIR.

UNIT-4 (12 Hours)

APPLICATION OF NANOMATERIALS: Electronics, computers, biomedical, mechanical, chemical, coatings, optoelectronic, environmental, sensors, aerospace, textiles, cosmetics and medical applications.

Text Books :

1. Kulkarni SulabhaK, Nanotechnology: Principles and Practices, capital publishing company , 2007.
2. Stuart M.Lindsay, Introduction to nano science , Oxford University Press,2009.
3. Robert Kelsall, IamHamley, Mark Geoghegan, Nanoscale, Scince and Technology, John Wiley&Sons,2005.

OPTO ELECTRONIC DEVICES AND APPLICATIONS Open Elective (Code: 20PEOE02)					
Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Objectives: Students will be able to

- Understand the concepts of different lasers and mode locking systems.
- Gain the knowledge about light generating devices, solar cells and display devices.
- To know the operating mechanism and applications of various light detecting devices.
- To familiarize electro optic modulators relating to communication

Course Outcomes: Students will be able to

CO-1	Develop the knowledge of laser operating principles and structures to produce giant optical pulses.
CO-2	To Acquire the detailed knowledge about functionality and applications of solar cells ,light generating and display devices
CO-3	To posses the skills of design ,develop and adoption of photo detectors in real time electronic applications.
CO-4	To have the knowledge on the usage of optical modulators in communication process.

UNIT-1	(12 Hours)

Optical process in semiconductors /optical media: Interaction of photons with matter , radiative non radiative processes , rates of absorption and emission –laser principle optical feedback-threshold condition-semiconductor laser –heterojunction lasers quantum well lasers, tunneling based lasers, mode locking: active mode locking and passive mode locking Q-switching

UNIT-2	(12 Hours)

Display devices: photo luminescence, cathode luminescence, electro luminescence, injection luminescence, LED principle of operation- LED structure –frequency response –defects and reliability, plasma display liquid crystal display, numerical display-photovoltaic effect- I-V characteristics and spectral response of solar cells – heterojunction and cascaded solar cells-Schottky barrier and thin film solar cells –design of solar cell.

UNIT-3	(12 Hours)

Detection devices: photo detection principle ,photo detector –thermal detector – photo conductor – noise in photo conductors –PIN photo diode –APD detector performance parameters –detectors for long wave length operation
–wave length selective detection charge coupled device (CCD), application of infrared detector used for TV and remote controllers

UNIT-4	(12 Hours)

Communication –types of communication –examples –modulation-types of modulation – limitations of direct modulation – modulation by carrier injection in semiconductors – electro optic modulators – Kerr modulators Acousto- optic modulators (Bragg cell) , interferometric modulators semiconductor optical amplifiers .

Text Books :
1. Pallab Bhattacharya “Semiconductor opto electronic devices” , Prentice Hall of India Pvt. LTD, New Delhi 2009
2. Jasptit Singh, “Opto Electronics-An introduction to Materials and Devices” ,McGraw-Hill International Edition,2014.

	3. S.C.Gupta,"Opto Electronic Devices and Systems", Prentice Hall of India,2015 4. J.Wilson and J.F.B.Hawes,"Optoelectronics-An Introduction", PearsonEducatiob, Taiwan Ltd,2010.

FIBER OPTICS COMMUNICATIONS Open Elective (Code: 20PHOE03)					
Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Outcomes: Students will be able to

CO-1	identify signal degradation and losses in optical fibers.
CO-2	understand power launching and coupling in optical fibers .
CO-3	compute optical fiber link design parameters .
CO-4	measure optical parameters and optical signal losses.

UNIT-1	(12 Hours)

Fiber optical wave guides : Introduction ,total internal reflection ,types of fibers, planar dielectric wave guide, optical fiber wave guides-inter-modal dispersion ,single mode fibers, low dispersion fibers.

Signal degradation in optical fibers: Attenuation, Absorption, Scattering losses, Radioactive losses signal distortion in optical wave guides, information capacity determination, intra model dispersion (material dispersion, wave guide dispersion)

UNIT-2	(12 Hours)

Power launching and coupling: Source to fiber power launching, source output pattern power-coupling calculation, power launched verss wave length, equilibrium numerical. Aperture lensing schemes for coupling improvement nanimaging micro sphere. Laser diode-to-fiber-coupling, fiber-to-fiber joints, mechanical misalignment, fiber-related losses, fiber end face preparation, fiber splicing optical fiber connectors.

UNIT-3	(12 Hours)

Transmission link analysis: point –to-point links, system consideration, link power budget, rise time budget, transmission distance for single model links ,wave length division multiplexing (WDM) passive components, the 2x2 fiber coupler ,the 2x2 wave guide coupler ,star coupler ,local area network .

UNIT-4	(12 Hours)

Measurement attenuation Measurement ,the cut back technique,insertion loss method optical time domain reflectometer. dipersion measurement – inter modal diaspersion,time domainter modal diaspersion measurement, Frequency domain inter modal diaspersion measurement, OTDR fiber application ,OTDR Trace ,attenuation measurments fiberfault location.

Text Books :
1. WillamJ & Hawkes F.B opto electronics: An introduction.(PHI)
2. Gerd Keiser optical fiber communication (3 rd edition McGraw Hill)

Reference Books:
1. A .Selvarajan, S .Kar, and T.SRINIVAS , fiber optic communications, Tata Mc GrawHill,2002.
2. D.C Agarwal “fiber optics in communications “Wheeler publishing,1993.

Honors

Code	List of HONOR Courses	Mode
A	Advanced Data Structures	Class Room
B	Advanced Computer Architecture	Class Room
C	Graph Theory	Class Room
D	Prompt Engineering & AI Tools	Class Room
E	Advanced Database Systems	Class Room
F	Real Time Operating Systems	Class Room
G	Parallel Processing	Class Room
H	Embedded Systems	Class Room
I	Web Mining	Class Room
J	High speed Networks	Class Room
K	Software Project Management	Class Room
L	Numerical Optimization	Class Room
M	Web Semantics	Class Room
N	Spatial Informatics	MOOC
O	Perception & Computer Vision	MOOC
P	Virtual Reality	MOOC
Q	Cloud Computing	MOOC
R	Computational Complexity	MOOC
S	Competitive Programming	MOOC
T	Realtime Systems	MOOC
U	Computer Vision and Image Processing fundamentals and applications	MOOC
V	Social Networks	MOOC
W	Ethical Hacking	MOOC

ADVANCED DATA STRUCTURES Honer Course (Code: A)					
Lectures	:	4 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Data Structures

UNIT-1	(12 Hours)
Efficient Binary Search Trees: - Red-Black Trees, Splay Trees, 2-3 Trees – Properties, Rotations, Insertion, Deletion.	
UNIT-2	(12 Hours)
Advanced Hashing: - Double Hashing, Rehashing, Extendible Hashing. Priority Queues: - Binomial heaps, Symmetric Min-Max Heaps, Fibonacci Heaps – Structure of Fibonacci heaps, Mergeable-heap operations, decreasing a key and deleting a node, Bounding the maximum degree.	
UNIT-3	(12 Hours)
Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. Data Structures for Disjoint Set: - Disjoint-set operations, Linked-list representation of disjoint sets, Disjoint-set forests, Analysis of union by rank with path compression.	
UNIT-4	(12 Hours)
String Matching- The naive string-matching algorithm, The Rabin-Karp algorithm, The Knuth-Morris-Pratt algorithm.	

Text Books :	1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education. 2. Cormen, Leiserson, Rivest and Stein, "Introduction of Computer Algorithm", PHI.
References :	1. Langsam, Augeustein and Tenenbaum, "Data Structures Using C", Pearson Education Asia. 2. Horowitz, Sahniand, Rajasekaran,"Fundamentals of Computer Algorithms", Galgotia Publication.

ADVANCED COMPUTER ARCHITECTURE
Honer Course (Code: B)

Lectures	:	4 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite:

UNIT-1 (15 Hours)

Parallel Computer Models: The state of computing, Classification of parallel computers, Multiprocessors and Multi computers, Multi-vector and SIMD computers.
Program and network properties: Conditions of parallelism, Data and resource Dependencies, 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.
System Interconnect Architectures: Network properties and routing, Static interconnection Networks, Dynamic interconnection Networks, Hierarchical bus systems, Crossbar switch and multiport memory, Multistage and combining network.

UNIT-2 (15 Hours)

Principles of Scalable Performance: Performance Metrics and Measures: Parallelism Profile in Programs, Efficiency, Utilization and Quality, Standard Performance Measures, Speedup Performance Laws: Amdahl's law for fixed load, Gustafson's law for scaled problems, Memory Bounded Speedup Model.
Pipelining: Linear pipeline processor, nonlinear pipeline processor, Instruction pipeline Design-Instruction Execution Phases, Mechanisms for instruction pipelining, Dynamic instruction scheduling, Branch Handling techniques, Arithmetic Pipeline Design: Computer Arithmetic principles, Static Arithmetic pipeline, Multifunctional arithmetic pipelines.

UNIT-3 (15 Hours)

MULTI Processors: Multiprocessor System Interconnect: Hierarchical Bus Systems, Crossbar Switch and Multiport Memory, Multistage and Combining Networks, Cache Coherence and Synchronization Mechanisms: The Cache Coherence problem, Snoopy Bus Protocols, Directory Based Protocols, Hardware Synchronization Mechanisms, Message-passing Mechanism: Message Routing Schemes, Deadlock and Virtual Channels, Flow Control Strategies, Multicast Routing Algorithms.
Scalable, Multithreaded and Dataflow Architectures: Latency-Hiding Techniques, Principles of Multithreading, Scalable and Multithreaded Architectures.

UNIT-4 (15 Hours)

Thread Based Parallelism: Introduction, Using the python threading model, How to define a Thread, How to determine a current Thread, How to use a thread in subclass, Thread Synchronization with Lock and RLock, Thread Synchronization with RLock, Thread Synchronization with Semaphores, Thread Synchronization with a Condition, Thread Synchronization with an Event, Using a with Statement, Thread Communication with a Queue, Evaluating the performance of Multithreaded applications.
Process Based Parallelism: Introduction, How to spawn a process, How to name a Process, How to run a Process in the background, How to kill a process, How to use a process in subclass, how to exchange objects between processes, How to synchronize the Processes, How to manage a state between Processes, How to use a Process pool, Using the mpi4py python module, Point-to-Point to Communications, Avoiding Dedalock problems, Collective communication using Broadcast, Collective Communication using a Scatter, Collective Communication using Gather, Collective Communication using Alltoall, The reduce operation, How to Optimize an Operation.

Text Books :	1. Kai Hwang, "Advanced Computer Architecture", TMH. 2. "Python Parallel Programming cookbook", Giancarlo Zaccone, Packt Publishing.
References :	1. D.A. Patterson and J.L.Hennessy, "Computer organization and Design", Morgan Kaufmann, 2nd Edition. 2. V.Rajaram & C.S.R.Murthy, "Parallel Computer", PHI. 3. Barry Wilkinson and Michael Allen, "Parallel Programming", Pearson Education. 4. Parallel Programming with Python, Jan Palach, Packt Publishing

GRAPH THEORY Honer Course (Code: C)					
Lectures	:	4 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite:

UNIT-1	(13 Hours)
Graphs, Sub graphs, some basic properties, various example of graphs & their sub graphs, walks, path & circuits, connected graphs, disconnected graphs and component, euler graphs, various operation on graphs, Hamiltonian paths and circuits, the traveling sales man problem.	
UNIT-2	(13 Hours)
Trees and fundamental circuits, distance diameters, radius and pendent vertices, rooted and binary trees, on counting trees, spanning trees, fundamental circuits, finding all spanning trees of a graph and a weighted graph, algorithms of primes, Kruskal and Dijkstra Algorithms.	
UNIT-3	(13 Hours)
Cuts sets and cut vertices, some properties, all cut sets in a graph, fundamental circuits and cut sets, connectivity and separability, network flows, Planer graphs, combinatorial and geometric dual: Kuratowski graphs, detection of planarity, geometric dual, Discussion on criterion of planarity, thickness and crossings.	
UNIT-4	(13 Hours)
Vector space of a graph and vectors, basis vector, cut set vector, circuit vector, circuit and cut set subspaces, Matrix representation of graph – Basic concepts; Incidence matrix, Circuit matrix, Path matrix, Cut-set matrix and Adjacency matrix. Coloring, covering and partitioning of a graph, chromatic number, chromatic partitioning, chromatic polynomials, matching, covering, four color problem Discussion of Graph theoretic algorithm wherever required.	

Text Books :	DeoNarsingh, Graph theory with applications to Engineering and Computer Science, PHI
References :	1. Gary Chartrand and Ping Zhang, Introduction to Graph Theory, TMH 2. Robin J. Wilson, Introduction to Graph Theory, Pearson Education 3. Harary, F, Graph Theory, Narosa 4. Bondy and Murthy: Graph theory and application. Addison Wesley. 5. V. Balakrishnan, Schaum's Outline of Graph Theory, TMH 6. GeirAgnarsson, Graph Theory: Modeling, Applications and Algorithms, Pearson Education

PROMPT ENGINEERING & AI TOOLS Honer Course (Code: D)					
Lectures	:	4 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

UNIT-1	(13 Hours)

Introduction - Conversational Interfaces, Getting Set Up ChatGPT, How Does ChatGPT Sound Human.

Tools & Techniques - Conversational Approach to ChatGPT, Time for Roleplay with ChatGPT, Training ChatGPT, Chunking in ChatGPT

UNIT-2	(13 Hours)

Advanced Prompt Engineering - Co-Creation with ChatGPT, [Format] Your Output in ChatGPT, Building Personas, Chain Prompting, The Rise of Autonomous Agents, Using ChatGPT without using ChatGPT.

GPT-4 - Getting Access to GPT-4, The Hype Was Wrong, More Context = More Power, Multimodal - Image Input, More Accurate, But Still Probabilistic, Web Browsing, ChatGPT Plugins

UNIT-3	(13 Hours)

Use Cases - Brainstorming Ideas, Translations, Summarizing, Writing Articles, Blogs, and Books, Academic Writing, Emails, Learning to Codes, Finding Recipes, Having Fun.

UNIT-4	(13 Hours)

ChatGPT with Excel - Formula Writing, Formula Explanation, Formula Examples With Data, Formula Debugging, Complex Excel Formula Help, Formula Help – Using Data, Power Query – How to consolidate two sheets in Excel, ChatGPT & Sample Excel Data, ChatGPT & Excel Pivot Tables, AI Excel Formula Bot, ChatGPT & VBA Macros, ChatGPT & Excel Shortcuts.

ChatGPT for Microsoft Word - Benefits of using ChatGPT in MS Word, How to Use ChatGPT in Microsoft Word, VBA Code to Integrate ChatGPT with MS Word, How to fine tune ChatGPT Output, Steps for troubleshooting errors.

Text Books :

1. The Art of Prompt Engineering with ChatGPT by Nathan Hunter.
2. AI Prompt Engineering: The Engineer's Handbook, by Timothy Krimmel.
3. https://www.promptingguide.ai/
4. https://www.myexcelonline.com/blog/how-to-use-chatgpt-with-microsoft-excel-the-ultimate-guide/https://www.listendata.com/2023/05/integrate-chatgpt-into-word.html

ADVANCED DATABASE SYSTEMS Honer Course (Code: E)					
Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite:

UNIT-1	(15 Hours)
Introduction to NoSQL: Difference between RDBMS and NoSQLDatabase, Definition of NoSQL, History of NoSQL, NoSQL Storage Architecture, Types of NoSQL databases-Document Databases, Key-value databases, Column Oriented databases, Graph databases, When to use NoSQL and when not, Interfacing and Interacting with NoSQL.	
UNIT-2	(15 Hours)
Introduction MongoDB: MongoDB installation, Basics of MongoDB, MongoDB shell, MongoDB datatypes, MongoDB CRUD operations: adding new documents to a collection, selecting documents, updating existing documents, removing documents from a collection.	
UNIT-3	(15 Hours)
MongoDb Aggregation frameworks and MongoDb Aggregation operations: $group, $limit, $project, $sort, $match, $add fields, $count, $lookup, $out operators. MongoDb sorting, MongoDb indexing: single field indexes, sorting with indexed, compound indexed, partial indexes.	
UNIT-4	(15 Hours)
MongoDb import and export, sharding in MongoDb, MongoDb python drivers, python and MongoDb, creating application with python and MongoDb.	

Text Books :	1. MongoDB – The Definitive Guide, 2nd edition, Oreilly. 2. Pramod J.Sadalage, Martin Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", 1st edition, Pearson Education, 2012.
References :	1. MongoDB Cook Book, 2nd edition, Cyrus Dasadia & Amol Nayak, PACKT Publishing. 2. Dan Sullivan, "NoSQL for Mere Mortals", 1st edition, Pearson Education, 2015.

REAL TIME OPERATING SYSTEMS Honer Course (Code: F)					
Lectures	:	4 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite:

UNIT-1	(13 Hours)
Introduction: Typical Real-Time applications, Hard versus Soft Real-Time systems, A reference model of Real-Time Systems.	
UNIT-2	(13 Hours)
Commonly used approaches to Real-Time scheduling: Clock-Driven scheduling, Pros and Cons of Clock-driven scheduling.	
UNIT-3	(13 Hours)
Priority-Driven scheduling of Periodic tasks: static assumption, Fixed-Priority versus Dynamic-Priority algorithms, Optimality of the RM and DM algorithms, A schedulability test for Fixed-Priority tasks with short response times and arbitrary response times, sufficient schedulability conditions for the RM and DM algorithms; Scheduling Aperiodic and Sporadic jobs in priority-Driven systems: Deferrable Servers, Sporadic Servers, Constant Utilization, Total Bandwidth and weighted Fair-Queuing Servers, Scheduling of sporadic Jobs.	
UNIT-4	(13 Hours)
Resources and Resources Access Control: Scheduling Flexible computations and tasks with temporal distance constraints.	

Text Books :	Jane W.S.Liu, “Real-Time Systems”, Pearson Education Asia.
References :	C.M.Krishna and G.Shin, “Real-Time Systems”, Tata McGraw Hill Co. Inc., 1997.

PARALLEL PROCESSING Honer Course (Code: G)					
Lectures	:	4 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

UNIT-1	(13 Hours)

Introduction: Parallel Processing Architecture: Parallelism in sequential machines, Abstract model of parallel computer, Multiprocessor Architecture, Pipelining, Array Processors.
Programmability Issues: An overview, Operating System Support, Types of operating Systems, Parallel Programming Model, Software Tools.
Data Dependency Analysis: Types of Dependencies, Loop and Array Dependencies, Loop Dependency Analysis, Solving Diophantine equations, Program Transformations.

UNIT-2	(13 Hours)

Shared Memory Programming: General model of shared memory programming, Process model under UNIX.
Algorithms for Parallel Machines: Speed-up, Complexity and Cost, Histogram Computation, Parallel Reduction, Quadrature Problem, Matrix Multiplication, Parallel Sorting Algorithms, Solving Linear Systems, Probabilistic Algorithms.
Message Passing Programming: Introduction, Model, Interface, Circuit Satisifiability, Introducing Collective, Benchmarking Parallel Performance.

UNIT-3	(13 Hours)

Parallel Programming Languages: Fortran90, nCUBE C, Occam, n-Linda.
Debugging Parallel Programs: Debugging Techniques, Debugging Message Passing Parallel Programs, Debugging Shared Memory Parallel Programs.
Memory and I/O Subsystems: Hierarchical Memory Structure, Virtual Memory System, Memory Allocation and Management, Cache Allocation and Management, Cache Memories and Management, Input Output Systems.

UNIT-4	(13 Hours)

Other Parallelism Paradigms: Dataflow Computing, Systolic Architectures, Functional and Logic Paradigms, Distributed Shared Memory.
Performance of Parallel Processors: Speed-up and Efficiency, Amdahl's Law, GustafsonBarsis.s Law, Karf-Flatt Matrix, Isoefficiency Matrix.

Text Books :

1. Hawang Kai and Briggs F.A, "Computer Architecture and Parallel Processing", McGraw Hill.
2. Jordon H.F. and Alaghaband G., "Fundamentals of Parallel Processing".
3. M.J. Quinn, "Parallel Processing", TMH.

References :

1. Shasikumar M., "Introduction to Parallel Processing", PHI.
2. Wilson G.V., "Practical Parallel Programming", PHI.
3. Singh, A.Gupta, "Parallel Computer Architecture", Morgan Kaufman.

EMBEDDED SYSTEMS Honer Course (Code: H)					
Lectures	:	4 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite:

UNIT-1	(13 Hours)

Introduction: Typical Real-Time applications, Hard versus Soft Real-Time systems, A reference model of Real-Time Systems.

UNIT-2	(13 Hours)

Commonly used approaches to Real-Time scheduling: Clock-Driven scheduling, Pros and Cons of Clock-driven scheduling.

UNIT-3	(13 Hours)

Priority-Driven scheduling of Periodic tasks: static assumption, Fixed-Priority versus Dynamic-Priority algorithms, Optimality of the RM and DM algorithms, A schedulability test for Fixed-Priority tasks with short response times and arbitrary response times, sufficient schedulability conditions for the RM and DM algorithms;
Scheduling Aperiodic and Sporadic jobs in priority-Driven systems: Deferrable Servers, Sporadic Servers, Constant Utilization, Total Bandwidth and weighted Fair-Queuing Servers, Scheduling of sporadic Jobs.

UNIT-4	(13 Hours)

Resources and Resources Access Control: Scheduling Flexible computations and tasks with temporal distance constraints.

Text Books :	Jane W.S.Liu, “Real-Time Systems”, Pearson Education Asia.
References :	C.M.Krishna and G.Shin, “Real-Time Systems”, Tata McGraw Hill Co. Inc., 1997.

WEB MINING
Honer Course (Code: I)

Lectures	:	4 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

UNIT-1 (13 Hours)

INTRODUCTION:
Introduction – Web Mining – Theoretical background –Algorithms and techniques – Association rule mining – Sequential Pattern Mining -Information retrieval and Web search – Information retrieval Models-Relevance Feedback- Text and Web page Pre-processing – Inverted Index – Latent Semantic Indexing – Web Search – Meta-Search – Web Spamming.

UNIT-2 (13 Hours)

WEB CONTENT MINING:
Web Content Mining – Supervised Learning – Decision tree - Naïve Bayesian Text Classification -Support Vector Machines - Ensemble of Classifiers. Unsupervised Learning - Kmeans Clustering -Hierarchical Clustering –Partially Supervised Learning – Markov Models - Probability-Based Clustering - Evaluating Classification and Clustering – Vector Space Model – Latent semantic Indexing – Automatic Topic Extraction - Opinion Mining and Sentiment Analysis – Document Sentiment Classification.

UNIT-3 (13 Hours)

WEB LINK MINING:
Web Link Mining – Hyperlink based Ranking – Introduction -Social Networks Analysis-CoCitation and Bibliographic Coupling - Page Rank -Authorities and Hubs -Link-Based Similarity Search -Enhanced Techniques for Page Ranking - Community Discovery – Web Crawling -A Basic Crawler Algorithm- Implementation Issues- Universal Crawlers- Focused CrawlersTopical Crawlers-Evaluation - Crawler Ethics and Conflicts - New Developments.

UNIT-4 (13 Hours)

STRUCTURED DATA EXTRACTION:
Structured Data Extraction: Wrapper Generation – Preliminaries- Wrapper InductionInstance-Based Wrapper Learning ·- Automatic Wrapper Generation: Problems - String Matching and Tree Matching -.Multiple Alignment - Building DOM Trees - Extraction Based on a Single List Page and Multiple pages- Introduction to Schema Matching - Schema-Level Match -Domain and Instance-Level Matching – Extracting and Analyzing Web Social Networks.

References :

1. Bing Liu, “Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data-Centric Systems and Applications)”, Springer; 2nd Edition 2009.
2. GuandongXu, Yanchun Zhang, Lin Li, “Web Mining and Social Networking: Techniques and Applications”, Springer; 1st Edition.2010.
3. Zdravko Markov, Daniel T. Larose, “Data Mining the Web: Uncovering Patterns in Web Content, Structure, and Usage”, John Wiley & Sons, Inc., 2007.
4. Soumen Chakrabarti, “Mining the Web: Discovering Knowledge from Hypertext Data”, Morgan Kaufmann; edition 2002.

HIGH SPEED NETWORKS Honer Course (Code: J)					
Lectures	:	4 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

UNIT-1	(13 Hours)
HIGH SPEED NETWORKS: Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture, TM logical Connection, ATM Cell – ATM Service Categories – AAL. High Speed LAN's: Fast Ethernet, Gigabit Ethernet, Fibre Channel – Wireless LAN's.	
UNIT-2	(13 Hours)
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.	
UNIT-3	(13 Hours)
TCP AND ATM CONGESTION CONTROL: TCP Flow control – TCP Congestion Control – Retransmission – Timer Management –Exponential RTO back off – 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.	
UNIT-4	(13 Hours)
INTEGRATED AND DIFFERENTIATED SERVICES: Integrated Services Architecture – Approach, Components, Services- Queuing Discipline, FQ, PS, BRFQ, GPS, WFQ – Random Early Detection, Differentiated Services. 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.	

Text Books :	1. William Stallings, "HIGH SPEED NETWORKS AND INTERNET", Pearson Education, Second Edition, 2002.
References :	1. Warland & Pravin Varaiya, "HIGH PERFORMANCE COMMUNICATION NETWORKS", Jean Harcourt Asia Pvt. Ltd., II Edition, 2001. 2. Irvan Pepelnjk, Jim Guichard and Jeff Apcar, "MPLS and VPN architecture", Cisco Press, Volume 1 and 2, 2003.

SOFTWARE PROJECT MANAGEMENT Honer Course (Code: K)					
Lectures	:	4 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

UNIT-1	(13 Hours)

Conventional Software Management: The waterfall model, conventional software Management performance.
Evolution of Software Economics: Software Economics, pragmatic software cost estimation. **Improving Software Economics:** Reducing Software product size, improving software processes, improving team effectiveness, improving automation, Achieving required quality, peer inspections. **The old way and the new:** The principles of conventional software Engineering, principles of modern software management, transitioning to an iterative process.

UNIT-2	(13 Hours)

Life cycle phases: Engineering and production stages, inception, Elaboration, construction, transition phases.
Artifacts of the process: The artifact sets, Management artifacts, Engineering artifacts, programmatic artifacts.
Model based software architectures: A Management perspective and technical perspective. **Work Flows of the process:** Software process workflows, Iteration workflows.

UNIT-3	(13 Hours)

Checkpoints of the process: Major mile stones, Minor Milestones, Periodic status assessments. Iterative Process Planning: Work breakdown structures, planning guidelines, cost and schedule estimating, Iteration planning process, Pragmatic planning. Project **Organizations and Responsibilities:** Line-of-Business Organizations, Project Organizations, evolution of Organizations.
Process Automation: Automation Building blocks, The Project Environment.

UNIT-4	(13 Hours)

Project Control and Process instrumentation : The seven core Metrics, Management indicators, quality indicators, life cycle expectations, pragmatic Software Metrics, Metrics automation.
Tailoring the Process : Process discriminants.
Future Software Project Management : Modern Project Profiles, Next generation Software economics, modern process transitions.
Case Study: The command Center Processing and Display system- Replacement (CCPDS-R)

Text Books :	Software Project Management, Walker Royce: Pearson Education, 2005.
References :	1. Software Project Management, Bob Hughes and Mike Cotterell: Tata McGraw-Hill Edition. 2. Software Project Management, Joel Henry, Pearson Education. 3. Software Project Management in practice, Pankaj Jalote, Pearson Education.

NUMERICAL OPTIMIZATION Honor Course (Code: L)					
Lectures	:	3 Hours /week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Objectives: Students will be able to

- Identify and develop operational research models from the verbal description of the real system.
- Understand the mathematical tools that are needed to solve optimization problems.
- Use mathematical software to solve the proposed models.
- Develop a report that describes the model and the solving technique, analyze the results and propose recommendations in language understandable to the decision- making processes in Management Engineering.

Course Outcomes: Students will be able to

CO-1	To derive the best and most economical solution to the given LPP within all of it's limitations in the fields of Engineering, Agricultural and manufacturing etc.
CO-2	To apply these techniques constructively to make effective decisions in various competitive game fields.
CO-3	To impart the knowledge of Operations Research in the concepts of Integer Programming and Dynamic Programming Problems.
CO-4	To understand various mathematical models of Queuing systems used in Operations Research.

UNIT-1	12 Hours

LINEAR PROGRAMMING PROBLEM:

Introduction; Graphical Solution Method; Some exception cases; General Linear Programming Problem; Canonical and Standard Forms of L.P.P; The Simplex Method: Introduction, Fundamental Properties of Solutions(without Proofs); the Computations Procedure, Artificial Variable Techniques(Big-M method), Problem of Degeneracy.

[Sections:2.1;2.3;2.4;2.5;2.6;3.1;3.2;3.3;3.5;3.6]

UNIT-2	12 Hours

GAMES AND STRATEGIES: Introduction; Two-person Zero–Sum Games; The Maximin-Minimax Principle; Games Without Saddle Points-Mixed Strategies; Solution of 2x2 Rectangular Games; Graphical Method; Dominance Property; Algebraic Method for mxn Games; Limitations and Extensions.

[Sections:9.1;9.2;9.3;9.4;9.5;9.6;9.7;9.8;9.12]

UNIT-3	12 Hours

INTEGER PROGRMMING PROBBLEM: Introduction, Gomory's All-Integer Programming

Problem Method; Branch and Bound Method.

DYNAMIC PROGRAMMING: Introduction, the Recursive Equation Approach, Characteristics of Dynamic Programming, Dynamic Programming Algorithm, Solution of Discrete Dynamic Programming Problem. [Sections:11.1;11.2;11.4;12.1;12.2;12.3;12.4;12.5]	
UNIT-4	12 Hours
QUEUING THEORY: Introduction, Queuing System, Characteristic of Queuing System, Symbols and Notations, Poisson Process and Exponential Distribution, Classification of Queues, Definition of Transient and Steady States, Poisson Queues; The M/M/I Queuing System: Model-I (M/M/I): (∞/FIFO) , Model-II (M/M/I): (∞/ SIFO) , Model-III (M/M/I):(N/FIFO), Model-IV(Birth-Death Process). [Sections:17.1;17.2;17.3;17.4;17.5;17.6;17.7;17.8;17.8.1]	
Text Books :	Kanthi Swarup, P.K Gupta &Man Mohan, 'Operations Research'
References :	1. SD.Sharma, "Operations Research", Kedarnath, Ramnath &Co., 2. Hamdy A.Taha, Operations Research: An introduction, Pearson Prentice Hall, New Jersey.

WEB SEMANTICS
Honer Course (Code: M)

Lectures	:	3 Hours/Week, Tutorial:1	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: Web Technology

Course Objectives: The student will be able to

CO-1	Understand the advantages of Semantic web and schemas of the semantic web
CO-2	Understand and implement the ideas of sematic web and querying in semantic web.
CO-3	Develop and apply logic for inferences in semantic web.
CO-4	Develop ontologies for various objects.

Course Outcomes: Students will be able to

CO-1	Comprehend the advantages of Semantic web and schemas of the semantic web.
CO-2	Develop and implement the ideas of sematic web and querying in semantic web.
CO-3	Analyze and apply logic for inferences in semantic web.
CO-4	Construct ontologies for various objects.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	2	2	2	1	2	1	1	1	2	1	1	3	1	1
CO-2	1	2	3	3	2	1	1	1	2	1	1	1	3	1	1
CO-3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO-4	1	2	3	3	3	3	2	1	1	2	1	1	3	1	1

UNIT-I — 15 Periods

The Semantic Web Vision, Today's Web, Semantic Web Technologies, A Layered Approach Structured Web Documents in XML, Motivation and Overview, the XML Language Structuring, DTDs, XML Schema, Namespaces, Addressing and Querying XML Documents Processing.

UNIT-2 — 15 Periods

Describing Web Resources in RDF, Motivation and Overview, RDF: Basic Ideas, RDF: XML-Based Syntax RDF Schema: Basic Ideas, RDF Schema: The Language, RDF and RDF Schema in RDF Schema, An Axiomatic Semantics for RDF and RDF Schema, RDF,RDF Schema A direct inference system for RDF(S) Querying in RQL.
Web Ontology Language: OWL, Motivation and Overview, the OWL Language, Examples An African Wildlife Ontology, printer ontology, OWL in OWL, Future extensions.

UNIT-3 — 15 Periods

Logic and Inference: Rules , Motivation and Overview , An Example of Monotonic Rules: Family Relations , Monotonic Rules: Syntax , Monotonic Rules: Semantics , Nonmonotonic Rules: Motivation and Syntax , An Example of Nonmonotonic Rules: Brokered Trade , Rule Mark-up in XML: Monotonic Rules Rule Mark-up in XML: Nonmonotonic Rule
Applications: Introduction, Horizontal information products from Elsevier, Data integration at Boeing (and elsewhere), Skill-finding at Swiss Life , Think-tank portal at Ener Search, eLearning, Web Services ,Other applications scenarios.

UNIT-4	15 Periods
Ontology Engineering: Introduction, Manually constructing ontologies, Re-using existing ontologies Using semi-automatic methods, On-To-Knowledge Semantic Web architecture.	
Text Books :	"A Semantic Web Primer", Grigoris Antoniou,Frank van Harmelen, The MIT Press,Cambridge, Massachusetts ,London, England.
References :	"Foundations of Semantic Web Technologies"by Markus Krotzsch , Pascal Hitzler , Sebastian Rudolph

Minors

MINOR Courses	
A	Computer System Architecture
B	Operating Systems
C	Data Structures using C
D	Object Oriented Programming using Java
E	Discrete Mathematics
F	Statistics with R
G	Design & Analysis of Algorithms
H	Database Management Systems
I	Software Engineering
J	Computer Networks
K	Web Application Programming
L	Artificial Intelligence

OPERATING SYSTEMS
Minor Course (Code: B)

Lectures	:	3 Hours /week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Objectives: Students will be able to

- To learn the mechanism of OS to handle processes & Threads and their communication.
- To learn the algorithms involved in CPU scheduling.
- To gain knowledge on concepts that includes Dead locks, Main Memory and Virtual Memory.
- To know the concepts related to File Access Methods & Mass Storage structure.

Course Outcomes: Students will be able to

CO-1	Understand different structures, services of the operating system, the use of scheduling and operations on process & threads.
CO-2	Develop various process scheduling algorithms for a given specification of CPU utilization, throughput, TAT, WT & RT.
CO-3	Develop various Memory Organization Techniques for optimally allocate memory to process by increasing Memory Utilization & Access time.
CO-4	Design & implement various file allocation methods & Disk Scheduling Algorithms.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	-	-	-	1	-	1	-	1	1	1	-	1	1	-	1
CO-2	1	2	2	1	-	-	-	1	-	-	-	-	1	2	-
CO-3	1	2	2	1	-	-	-	1	-	-	-	-	1	2	-
CO-4	1	2	2	1	-	-	-	1	-	-	1	1	1	2	-

UNIT-1 12 Hours

Introduction: What OSs Do, Computer System Operation, Storage structure, OS Structure, OS Operations.

Operating-System Structures: OS Services, User and operating system Interface, System Calls, Types of System Calls, System Programs, OS Design and Implementation, OS Structure.

Processes: Process Concept, Process Scheduling, Operations on Processes, Inter- process Communication.

Threads: Overview, Multicore Programming, Multithreading Models.

[Sections:1.1, 1.2.1, 1.2.2,1.4,1.5, 1.5.1,2.1, 2.2,2.3,2.4, 2.5, 2.6, 2.7,2.7.1,2.7.2,2.7.3,2.7.4 3.1, 3.2,3.3,3.4, 4.1,4.2,4.3]	
UNIT-2	12 Hours
CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms. **Process Synchronization:** Background, The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic problems of Synchronization, Monitors. [Sections : 6.1,6.2,6.3, 5.1,5.2,,5.3,5.4,5.5,5.6,5.7,5.8]	
UNIT-3	12 Hours
Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Avoidance, Detection and Recovery. **Main Memory:** Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of Page Table. **Virtual-Memory: Background**, Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing, Other Considerations. [Sections; 7.1,7.2,7.3,7.4,7.5,7.6,7.7,8.1,8.2,8.3,8.4,8.5,8.6,9.1, 9.2,9.3,9.4,9.5,9.6,9.9]	
UNIT-4	12 Hours
File System Interface: File concept, Access Methods, Directory and Disk Structure, **File System Implementation**: File System Structures, Directory Implementation, Allocation Methods **Protection**: Goals of Protection, Principles of Protection, Domain of Protection- Domain Structure, Access Matrix, Implementation of Access Matrix. **Mass Storage Structure**: Over View, Disk Structure, Disk Scheduling, Disk Management, RAID levels [Sections:10.1,10.2,10.4,10.5,10.7,11.1,11.2,11.3,11.5,12.1,12.3,12.4,14.1,14.2,14.3,14.3.1,14.4,14.5]	
Text Books :	Silberschatz & Galvin, "Operating System Concepts", 10th edition, John Wiley & Sons (Asia) Pvt.Ltd. **ISBN 9781118063330**.
References :	3. William Stallings, "Operating Systems –Internals and Design Principles", 9/e, Pearson**. ISBN 9789352866717** 4. Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill Co., 2019 edition. **ISBN-9780074635513** 5. Andrew S.Tanenbaum, "Modern Operating Systems", 4nd edition,2017 PHI.**ISBN-9781292061429**

DATA STRUCTURES USING C
Minor Course (Code: C)

Lectures	:	2 Hours /Week, 1 Hour Tutorial	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: Problem Solving using Programming (20CS204)

Course Objectives: Students will be able to

- Understand the role of Data structures in structuring and analysis procedure of an algorithm.
- Learn the concept of Stack, Queue and various Sorting techniques.
- Understand the concept of Binary Tree, Binary Search Tree and AVL tree.
- Learn the concept of Hashing and Heap Data Structures.

Course Outcomes: Students will be able to

CO-1	Analyse the algorithms to determine the time & space complexity and manipulating data using array or list representation.
CO-2	Implement the applications of Stack & Queue and analyze the various sorting techniques.
CO-3	Construct and implement different tree algorithms like binary tree, BST and AVL tree.
CO-4	Implement and analyze various hashing techniques and priority queues.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	2	2	-	-	-	-	-	-	-	-	-	-	3	2
CO-2	2	3	2	-	-	-	-	-	-	-	-	-	-	2	1
CO-3	2	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO-4	2	1	2	-	-	-	-	-	-	-	-	-	-	2	1

UNIT-1 — 12 Hours

Algorithm Analysis: Mathematical Background, Model, what to Analyze, Running Time Calculations.
Lists: Abstract Data Types, The List ADT, Singly Linked List ADT, Doubly Linked List ADT, Circular Linked List ADT, Polynomial ADT: addition, multiplication operations.

UNIT-2 — 12 Hours

Stacks and Queues: The Stack ADT and its applications such as Infix to Postfix expression conversions, Evaluation of Postfix expressions. The Queue ADT, Queue Application-Radix sort.
Basic Sorting Techniques: Bubble sort, Selection sort, Insertion sort, Shell sort

UNIT-3 — 12 Hours

Trees: Preliminaries, Binary Trees, Expression trees, The Search Tree ADT, Binary Search Trees, Implementations, AVL Trees-Single Rotations, Double rotations, Implementations.

UNIT-4	12 Hours
Hashing: General Idea, Hash Function, Separate Chaining, Open Addressing. **Priority Queues (Heaps)**: Model, Simple implementations, Binary Heap, Heap Sort.	
Text Books :	Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education , 2013, Second Edition, ISBN- 978-81-7758-358-8.
References :	1. Y.Langsam, M.J.Augeustein and A.M.Tenenbaum, "Data Structures Using C", Pearson Education Asia, 2006, Second Edition, ISBN- 81-203-1177-9. 2. Richard F.Gilberg, Behrouz A. Forouzan, "Data Structures – A Pseudocode Approach with C", Thomson Brooks / COLE, 1998, Second Edition, ISBN-978-0-534-39080-8 3. Aho, J.E. Hopcroft and J.D. Ullman, "Data Structures andAlgorithms", Pearson Education Asia, 1983, 1st edition, ISBN- 978-0201000238.

OBJECT ORIENTED PROGRAMMING USING JAVA
Minor Course (Code: D)

Lectures	:	2 Hours /Week, 1 Hour Tutorial	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- Understand advantages of OO programming over procedural oriented programming, learn the basics of variables, operators, control statements, arrays, classes and objects.
- Understand, write and implement the following concepts: Inheritance, Interfaces, Packages, Strings and Collections.
- Understand and write programs on Exception Handling, I/O, and Multithreading.
- Understand and implement applications using Applets, AWT, Swings and Events.

Course Outcomes: Students will be able to

CO-1	Demonstrate OOP concepts, its advantages over structured programming.
CO-2	Develop and implement Inheritance, polymorphism.
CO-3	Analyze Exception Handling, Multithreading, I/O.
CO-4	Create code for Event Handling, Applets, AWT and Swings.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	2	3	-	-	-	-	-	-	-	-	-	3	3	2
CO-2	3	2	3	-	-	-	-	-	-	-	-	-	3	3	2
CO-3	3	2	3	-	-	-	-	-	-	-	-	-	3	3	2
CO-4	3	2	3	-	2	-	-	-	-	-	-	-	3	3	2

UNIT-1 — 12 Hours

The History and Evolution of Java
An Overview of Java
Data Types, Variables and Arrays
Operators
Control Statements
Introducing Classes
A Closer Look at Methods and Classes

UNIT-2 — 12 Hours

Inheritance
Packages and Interfaces
Strings: String Constructors, Any 10 String class methods, StringBuffer class, Any 10 StringBuffer class methods, Introducing StringBuilder class.
Type Wrappers: Auto boxing/unboxing.
Collections: Collections Overview, Names of Collection Interfaces,
Collection Classes: LinkedList<String>, Array List<String>

UNIT-3 — 12 Hours

Exception Handling **Multithreaded Programming** **I/O:** I/O Basics, Reading Console Input, Writing Console Output, The Print Writer class, Reading and Writing Files, Automatically Closing a File.	
UNIT-4	12 Hours
The Applet Class: Applet Architecture, An Applet Skeleton, Applet program to draw shapes, setting Color, Font using Graphics class **Event Handling:** **Introducing the AWT:** Window Fundamentals, **AWT components:** Label, Text Field, Text Area, Checkbox, Checkbox Group, Button, **Layout Managers:** Flow Layout, Grid Layout, and Border Layout. **GUI Programming with Swing:** The Origins of Swing, Advantages of Swing over AWT, The MVC Connection, **Swing Components:** JLabel, JText Field, JText Area, JCheck box, JButton, JTabbed Pane, JTable, JTree, JCombo Box	
Text Books :	"Java The Complete Reference", 9th Edition, Herbert Schildt, TMH Publishing Company Ltd, New Delhi, 2014.
References :	3. "Big Java ", 4th Edition, Cay Horstman, John Wiley & Sons, 2009. 4. "Java How to Program (Early Objects)", H. M. Dietel and P. J. Dietel, 11th edition Pearson Education, 2018.

DISCRETE MATHEMATICS
Minor Course (Code: E)

Lectures	:	3 Hours /week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- Understand operations on discrete structures such as sets, functions, and relations. Formulate short proofs using methods of proof of an implication. Verify the correctness of an argument using propositional logic and truth tables. Construct mathematical arguments using logical connectives and quantifiers.
- Verify the correctness of an argument using rules of inference for quantified propositions. Apply algorithms and use definitions to solve problems to prove statements in elementary number theory. Understand counting and indirect counting techniques and combinatory in the context of discrete probability.
- Understand sequences, generating functions, and recurrence relations. Understand and compute coefficients for generating functions. Understand and solve homogeneous recurrence relations.
  Understand and solve Inhomogeneous recurrence relations.
- Understand the properties of binary relations, partial orderings and lattices. Construct graphs and adjacency matrices for binary relations.

Course Outcomes: Students will be able to

CO-1	Understand the basic principles of sets, relations and functions. Illustrate inference rules for validating arguments.
CO-2	Prove that the given statement is valid by using mathematical induction. Solve computational problems by using various counting techniques.
CO-3	Build generating functions for sequences. Compute coefficients for generating functions. Solve homogeneous recurrence relations using various methods.
CO-4	Solve Inhomogeneous recurrence relations. Construct hasse diagrams for posets. Find out the transitive closure of a given relation.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	POs												PSOs		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	3	-	-	-	-	-	1	-	-	-	2	3	3	1
CO-2	3	2	-	-	-	-	-	1	-	-	-	2	3	3	1
CO-3	3	2	-	-	-	-	-	1	-	-	-	1	2	3	1
CO-4	3	2	-	-	-	-	-	1	-	-	-	3	2	3	1

UNIT-1 — 15 Hours

Foundations: Sets, Relations and Functions, Fundamentals of Logic, Logical Inferences, Methods of Proof of an implication, First order Logic & Other methods of proof.

UNIT-2 — 15 Hours

Rules of Inference for Quantified propositions, Mathematical Induction.
Elementary Combinatorics: Basics of Counting, Combinations and Permutations, Enumeration of Combinations and Permutations, Enumerating Combinations and Permutations with repetitions,

Enumerating Permutation with Constrained repetitions..	
UNIT-3	15 Hours
Recurrence relations: Generating functions of sequences, Calculating Coefficients of Generating Functions **Recurrence Relations:** Solving recurrence relations by Substitution and generating functions, The methods of characteristic roots.	
UNIT-4	15 Hours
Recurrence Relations: solutions of Inhomogeneous recurrence relations. **Relations:** Special properties of binary relations, Operations on relation. Ordering relations, Lattice, Paths and Closures, Directed Graphs and Adjacency Matrices.	
Text Books :	Toe L.Mott, Abraham Kandel &TheodoreP.Baker, "Discrete Mathematics Computer Scientists & Mathematicians", PHI 2nd edition, 2012.
References :	1. C.L. Liu, "Elements of Discrete Mathematics", McGraw-Hill Education, 2nd edition. 2. Rosen, "Discrete Mathematics". ", McGraw-Hill Education, 8th edition.

STATISTICS WITH R Minor Course (Code: F)					
Lectures	:	3 Hours /week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None.

UNIT-1	15 Hours

Introduction, How to run R, R Sessions and Functions, Basic Math, Variables, Data Types, Vectors, Conclusion, Advanced Data Structures, Data Frames, Lists, Matrices, Arrays, Classes.
R Programming Structures, Control Statements, Loops, - Looping Over Nonvector Sets,- If-Else, Arithmetic and Boolean Operators and values, Default Values for Argument, Return Values, Deciding Whether to explicitly call return- Returning Complex Objects, Functions are Objective, No Pointers in R, Recursion, A Quicksort Implementation- Extended Extended Example: A Binary Search Tree.

UNIT-2	15 Hours

Doing Math and Simulation in R, Math Function, Extended Example Calculating Probability- Cumulative Sums and Products-Minima and Maxima- Calculus, Functions Fir Statistical Distribution, Sorting, Linear Algebra Operation on Vectors and Matrices, Extended Example: Vector cross Product- Extended Example: Finding Stationary Distribution of Markov Chains, Set Operation, Input /output, Accessing the Keyboard and Monitor, Reading and writer Files,
Graphics, Creating Graphs, The Workhorse of R Base Graphics, the plot() Function ; Customizing Graphs, Saving Graphs to Files.

UNIT-3	15 Hours

Probability Distributions, Normal Distribution- Binomial Distribution- Poisson Distributions Other Distribution, Basic Statistics, Correlation and Covariance,Testing of Hypothesis(T-Test,F-Test, ANOVA Test).

UNIT-4	15 Hours

Linear Models, Simple Linear Regression, -Multiple Regression Generalized Linear Models, Logistic Regression, - Poisson Regression- other Generalized Linear Models- Survival Analysis, Nonlinear Models, Splines- Decision- Random Forests

Text Books :	1. The Art of R Programming, Norman Matloff, Cengage Learning 2. R for Everyone, Lander, Pearson
References :	1. R Cookbook, Paul Teetor, O'reilly. 2. R in Action,Robert Kabacoff, Manning

DESIGN AND ANALYSIS OF ALGORITHMS
Minor Course (Code: G)

Lectures	:	2 Hours/Week, 1 Hour Tutorial	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: Data Structures

Course Objectives: Students will be able to

- Understand about designing and effectiveness of an algorithm, and applying of Master Theorem to find the complexity.
- Strengthen divide and conquer paradigms andknow the optimal solution finding with the greedy method.
- Acquaintance of algorithm design strategies of Dynamic programming and easy know the major graph algorithms and their analyses.
- Get the ability to backtracking,branch with bound values and NP problems.

Course Outcomes: Students will be able to

CO-1	Analyze the performance of algorithms through various strategies and apply the Master theorem to estimate the complexity of divide-and-conquer algorithms.
CO-2	Apply the divide-and-conquer and greedy techniques to solve problems and perform complexity analysis.
CO-3	Articulate on graph problems and identify the applicability of the dynamic-programming paradigm for designing solutions to problems.
CO-4	Find all possible solutions for combinatorial and optimixation problems using Backtracking and Branch and Bound algorithms and also categorize the P and NP complex problems.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	3	2	3	2	3	-	2	-	-	2	2	3	3	3	1
CO-2	2	2	2	2	2	-	2	-	-	2	2	2	2	3	1
CO-3	3	3	3	3	3	-	2	-	-	2	2	3	2	3	2
CO-4	2	2	1	2	2	-	2	-	-	2	2	2	2	3	2

UNIT-1 — 12 hours

Introduction: Algorithm, Pseudo code for expressing algorithms, Performance Analysis-Space complexity, Time complexity, Asymptotic Notation-Bigoh-notation, Omega notation, Theta notation and Little oh notation, Probabilistic analysis, Amortized analysis.
Master Theorem: Introduction, Generic Form- Case1, Case2, Case3, Inadmissible equations, Application to common algorithms.

UNIT-2 — 12 hours

Divide and conquer: General method, applications-Quicksort, Merge sort, Stassen's matrix multiplication.
Greedy method: General method, applications-Job sequencing with deadlines, Fractional knapsack problem, Minimum cost spanning trees-Prims, Kruskal, Single source shortest path problem-Dijkstra.

UNIT-3 — 12 hours

Dynamic Programming: General method, applications-0/1 knapsack problem, Travelling salesperson problem, Longest common sequence algorithm, Multi stage graphs using Forward& Backward approach, Reliability design. **Graph Applications**: Graph traversals – Depth first, Breadth first, Bio Connected Components, Strongly Connected Components.	
UNIT-4	12 hours
Backtracking: General method, applications-n-queen problem, sum of subsets problem. Branch and Bound: General method, applications- 0/1 knapsack problem-LC Branch and Bound solution. **NP-Hard and NP-Complete problems:** Basic concepts, non-deterministic algorithms, NP-Hardand NP Complete classes, Cook's theorem.	
Text Books :	E. Horowitz, S.Sahniand S. Rajasekaran, "Fundamentals of Computer Algorithms" ,GalgotiaPublication.
References :	1. T. H. Cormen, Leiserson, Rivestand Stein, "Introduction of Computer Algorithm", PHI. 2. SaraBasse, A.V.Gelder, "Computer Algorithms", Addison Wesley.

DATABASE MANAGEMENT SYSTEMS
Minor Course (Code: H)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None

Course Objectives: Students will be able to

- Familiarize with fundamental concepts of database and various database architectures and Design relations for Relational databases using conceptual data modeling.
- Implement formal relational operations in relational algebra and SQL.
- Identify the Indexing types and normalization process for relational databases
- Use mechanisms for the development of multi user database applications.

Course Outcomes: Students will be able to

CO-1	Ability to apply knowledge of database design methodology which give a good formal foundation in relational data model and Understand and apply the principles of data modeling using ER Model.
CO-2	Familiar with relational DB theory and will able to write relational algebra expressions, Relational Calculus and SQL.for query
CO-3	Design database schema and Identify and solve the redundancy problem in database tables using normalization.
CO-4	Understand transaction processing, concurrency control and recovery techniques.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	2	2	-	-	-	-	-	-	-	-	-	-	1	-
CO-2	2	2	3	1	-	-	-	-	-	-	-	-	-	2	-
CO-3	1	2	3	1	-	-	-	-	-	-	-	-	-	1	-
CO-4	1	3	3	1	-	-	-	-	-	-	-	-	-	3	-

UNIT-1 (12 Hours)

Databases and Database Users: Introduction - An Example - Characteristics of the Database Approach - Actors on the Scene - Workers behind the Scene - Advantages of Using the DBMS Approach - A Brief History of Database Applications - When Not to Use a DBMS.

Database System Concepts and Architecture: Data Models, Schemas, and Instances - Three-Schema Architecture and Data Independence - Database Languages and Interfaces - The Database System Environment - Centralized and Client/Server Architectures for DBMSs - Classification of Database Management Systems.

Data Modeling Using the Entity-Relationship (ER) Model: Using High-Level Conceptual Data Models for Database Design - An Example Database Application - Entity Types, Entity Sets, Attributes, and Keys - Relationship Types, Relationship Sets, Roles, and Structural Constraints - Weak Entity Types - Refining the ER Design for the COMPANY Database - ER Diagrams, Naming Conventions, and Design Issues.

UNIT-2 (12 Hours)

The Relational Data Model and Relational Database Constraints: Relational Model Concepts - Relational Model Constraints and Relational Database Schemas - Update Operations,

Transactions, and Dealing with Constraint Violations - Relational Database Design Using ER-to-Relational Mapping. **Basics of SQL**: DDL, DML and DCL Commands.	
UNIT-3	(12 Hours)
Functional Dependencies and Normalization for Relational Databases: Informal Design Guidelines for Relation Schemas - Functional Dependencies - Normal Forms Based on Primary Keys - General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form. **Relational Database Design Algorithms and Further Dependencies**: Properties of Relational Decompositions - Algorithms for Relational Database Schema Design – Multivalued Dependencies and Fourth Normal Form - Join Dependencies and Fifth Normal Form.	
UNIT-4	(12 Hours)
Introduction to Transaction Processing Concepts and Theory: Introduction to Transaction Processing - Transaction and System Concepts - Desirable Properties of Transactions - Characterizing Schedules Based on Recoverability - Characterizing Schedules Based on serializability. **Concurrency Control Techniques**: Two-Phase Locking Techniques for Concurrency Control - Concurrency Control Based on Timestamp Ordering – Multiversion Concurrency Control Techniques - Validation (Optimistic) Concurrency Control Techniques - Granularity of Data Items and Multiple Granularity Locking.	
Text Books :	"Fundamentals of Database Systems", RamezElmasri and Navate Pearson Education, 5th edition.
References :	1. "Introduction to Database Systems", C.J.Date Pearson Education. 2. "Data Base Management Systems", Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill, 3rdEdition. 3. "Data base System Concepts", Silberschatz, Korth, McGraw hill, 5th edition.

SOFTWARE ENGINEERING
Minor Course (Code: I)

Lectures	:	3 Hours/Week,	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- Understand different process models of Software Engineering and
- Understand Agile Software Development. How to collect requirements from client and how to analyze the collected requirements.
- Understand how to design and implement the Software Product or Project.
- Understand the concepts of Testing and Measuring the software project or Product.

Course Outcomes: Students will be able to

CO-1	Understand different generic process models.
CO-2	Understand agile process models. Develop different analysis models for the software project.
CO-3	Develop different design models for the software project.
CO-4	Understand different testing strategies, software metrics and measures.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	2		-	1	-	-	-	-	-	2	-	2	1	-
CO-2	-	3	1	-	-	-	1	1	2	1	2	-	1	1	-
CO-3	-	3	1	-	-	-	1	1	2	1	2	-	2	1	-
CO-4	-	3	1	2	-	-	-	-	-	-	2	-	2	1	-

UNIT-1 — 15 Periods

INTRODUCTION TO SOFTWARE ENGINEERING: The Evolving Role of Software, Software, the Changing Nature of Software, Legacy Software, Software Myths.

A GENERIC VIEW OF PROCESS: Software Engineering - A Layered Technology, a Process Framework, the CMMI, Process Patterns, Process Assessment, Personal and Team Process Models, Product and Process.

PROCESS MODELS: Prescriptive Models, the Waterfall Model, Incremental Process Models, Evolutionary Models, the Unified Process.

UNIT-2 — 15 Periods

AN AGILE VIEW OF PROCESS: What Is Agility? , What Is an Agile Process? , Agile Process Models.

REQUIREMENTS ENGINEERING: A Bridge To Design and Construction, Requirements Engineering Tasks, Initiating the Requirements Engineering Process, Eliciting Requirements,

Developing Use-cases, Building the Analysis Model, Negotiating Requirements, Validating Requirements.

BUILDING THE ANALYSIS MODEL: Requirements Analysis, Analysis Modeling Approaches, Data Modeling Concepts, Flow-Oriented Modeling, Class Based Modeling Creating a Behavioral Model.

UNIT-3	15 Periods

DESIGN ENGINEERING: Design within the Context of Software Engineering, Design Process and Design Quality, Design Concepts The Design Model, Pattern Based Software Design.

CREATING AN ARCHITECTURAL DESIGN: Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design, Assessing Alternative Architectural Designs.

MODELING COMPONENT-LEVEL DESIGN: What Is a Component? , Designing Class-Based Components, Conducting Component-Level Design, Designing Conventional Components.

PERFORMING USER INTERFACE DESIGN: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

UNIT-4	15 Periods

SOFTWARE PROCESS AND PROJECT METRICS: Introduction: Metrics Process and Project Domains, Software Measurement, Metrics for Software Quality, Integrating Metrics with Process.

SOFTWARE QUALITY ASSURANCE: Quality Concepts, Quality Movement, SQA, Software Reviews, Formal Technical Reviews, Formal Approaches to SQA, Software Reliability, ISO 9000 Quality Standards, SQA Plan.

SOFTWARE TESTING STRATEGIES: Strategic Approach, Strategic Issues, Test strategies for Conventional Software, Test strategies for Object Oriented Software, Validation Testing, System Testing, The Art of Debugging. White box testing. Black box testing.

Text Books :	Roger S.Pressman, "Software Engineering- A Practitioner's Approach", **McGraw Hill** , 2014, 8th. **McGraw Hill** ISBN- **978-0078022128**
References :	1. K.K. Aggarwal & Yogesh Singh, "Software Engineering", New Age International, 2008, Third Edition,. ISBN- **978-8122423600** 2. Pankaj Jalote, "An Integrated Approach to Software Engineering", Springer, 2005, Second Edition. ISBN- 978-0-387-20881-7 3. Ian Sommerville, "Software Engineering", Pearson Education, 2017, 10th Edition. ISBN-13: 978-9332582699 4. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, "Fundamentals of Software Engineering", PHI, 2002, Second Edition. ISBN - 978-8120322424 5. RajibMall, "Fundamentals of Software Engineering", PHI, 2018, 5thEdition, PHI. ISBN- 978-9388028028

COMPUTER NETWORKS
Minor Course (Code: J)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite:

Course Objectives: Students will be able to

- Understand the basic concepts of data communication, layered model, protocols and OSI&TCP layers
- Understand the basic concepts of Data Link control, Network Layer Design Issues, Routing Algorithms & Congestion.
- Understand the basic concepts of Quality of service, Network Layer & Transport Layer
- Understand the basic concepts of TCP, UDP & Application Layer

Course Outcomes: Students will be able to

CO-1	Able to learn types of communications, topologies, OSI, TCP/IP protocol architectures along with error detection and correction mechanisms and also the working of data link layer
CO-2	Able to learn types of communications, topologies, OSI, TCP/IP protocol architectures along with error detection and correction mechanisms and also the working of data link layer
CO-3	Able to know the transport layer issues, establishment of remote procedure calls and TCP segment header.
CO-4	Able to learn the working of TCP and UDP and differennt application layer issues.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	2	2	-	1	-	2	1	-	2	3	-	1	2	1
CO-2	1	-	2	-	1	1	1	-	1	-	-	1	1	1	2
CO-3	-	-	2	1	1	-	-	-	-	1	1	1	1	2	1
CO-4	1	2	2	2	1	-	-	-	-	1	1		1	2	1

UNIT-1 14 Hours

Data Communications & Networking Overview: A Communications Model, Data Communications, Data Communication Networking.

Protocol Architecture: The Need for a Protocol Architecture, A Simple Protocol Architecture, OSI, The TCP/IP Protocol Architecture.

Digital Data Communication Techniques: Asynchronous & Synchronous Transmission, Types of Errors, Error Detection, Error Correction.

UNIT-2 16 Hours

DATA Link Control: Flow Control, Error Control.

Network Layer: Network Layer Design Issues: Store-and-Forward Packet Switching, Services Provided to the Transport Layer, Implementation of Connectionless Service,

Implementation of Connection-Oriented Service, Comparison of Virtual-Circuit & Datagram Subnets.

Routing Algorithms: The Optimality Principle, Shortest Path Routing, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing.

Congestion Control Algorithms: General Principles of Congestion Control, Congestion Prevention Policies, Congestion Control in Virtual-Circuit Subnets, Congestion Control in Datagram Subnets, Load Shedding, Jitter Control.

UNIT-3	16 Hours

Quality of Service: Requirements, Techniques for Achieving Good Quality of Service The Network Layer in the Internet: The IP Protocol, IP Addresses, Internet Control Protocols. The **Transport Layer, The Transport Service:** Services Provided to the Upper Layers, Transport Service Primitives, Berkeley sockets

Elements of Transport Protocols: Addressing, Connection Establishment, Connection Release, Flow Control and Buffering, Multiplexing, Crash Recovery.

UNIT-4	14 Hours

The Internet Transport Protocol (UDP): Introduction to UDP, Remote Procedure Call, The Real-Time Transport Protocol.

The Internet Transport Protocols (TCP): Introduction to TCP, The TCP Service Model, The TCP Protocol, The TCP Segment Header, TCP Connection Establishment, TCP Connection Release, Modeling TCP Connection Management, TCP Transmission Policy, TCP Congestion Control, TCP Timer Management.

Application Layer: The Domain Name System (DNS): The DNS Name Space, Resource Records, Name Servers.

Text Books :	3. Behrouz A.Forouzan, "Data Communications and Networking", 4th edition, TMH. 4. Tanenbaum,"Computer Networks",5th Edition, Pearson Education, 2011
References :	7. Wayne Tomasi, "Introduction to Data Communications and Networking", PHI. 8. Behrouz A.Forouzan, "Data Communications and Networking", Fourth edition, TMH 9. God Bole, "Data Communications & Networking", TMH. 10. Kurose & Ross, "COMPUTER NETWORKS– A Top-down approach featuring the Internet", Pearson Education, AlbertoLeon, Garciak. 11. Leon Gartia, Indra Widjaja, "Communication Networks Fundamental Concepts and Key Architectures", TMH. 12. Nader F.Mir, "Computer and Communication Networks", PHI.

WEB APPLICATION PROGRAMMING
Minor Course (Code: K)

Lectures	:	3 Hours/Week	Continuous Assessment	:	30
Final Exam	:	3 hours	Final Exam Marks	:	70

Pre-Requisite: None.

Course Objectives: Students will be able to

- Know elements and tags of HTML and apply Styles using Cascading Style Sheets.
- Know the basics of Java Script, Functions, Events, Objects and Working with browser objects.
- Know the basics of server side programming using Servlets.
- Know the elements of JSP and database connectivity.

Course Outcomes: Students will be able to

CO-1	Analyze a web page and identify its elements and attributes.
CO-2	To build dynamic web pages with validation using Java Script objects. Students will be able to create web pages using XHTML and Cascading Styles sheets.
CO-3	Understanding of server side programming using Java Servlets.
CO-4	Able to use web server and data base servers. Create applications by using the concepts like JSP and Servlet.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	1	2	3	-	-	-	-	-	-	-	-	-	-	1	-
CO-2	1	2	3	1	-	-	-	-	-	-	-	-	-	2	-
CO-3	1	2	3	1	-	-	-	-	-	-	-	-	-	1	-
CO-4	1	3	3	1	-	-	-	-	-	-	-	-	-	3	1

UNIT-1 (12 hours)

HTML5: Fundamentals of HTML, Working with Text, Organizing Text in HTML, Working with Links and URLs, Creating Tables, Working with Images, Colors, and Canvas, Working with Forms.

UNIT-2 (12 hours)

CSS: Overview of CSS, Backgrounds and Color Gradients in CSS, Fonts and Text Styles, Creating Boxes and Columns Using CSS, Displaying, Positioning, and Floating an Element, List Styles, Table Layouts.

Dynamic HTML: Overview of JavaScript, JavaScript Functions, statements, operators, arrays and functions.

UNIT-3 (12 hours)

Servlets: Introduction to Servlets, Lifecycle of a Servlet, JSDK, Deploying Servlet, The Servlet API, The javax. Servlet Package, Reading Servlet parameters, Reading Initialization parameters. The javax.servlet HTTP package, Handling Http Request & Responses, Cookies and SessionTracking.

UNIT-4 (12 hours)

JSP: The anatomy of a JSP page, JSP processing, declarations, directives, expressions, code snippets, implicit objects, using beans in JSP pages, connecting to database in JSP.

Text Books : Jeffrey C K Jackson, Web Technologies", Pearson Education, 1st Edition,2006.

	KogentLearningSolutionsInc.,HTML5BlackBook:CoversCSS3,Javascript, XML, XHTML, Ajax, PHP and Jquery.
References :	1. 1. Harvey M.Deitel and Paul J. Deitel, "Internet &World Wide Web How to Program", 4/e, Pearson Education. 2. Tom Nerino Doli smith, "Java Script & AJAX for the web", Pearson Education2007. 3. Herbert Schildt, "Java the Complete Reference", Hill - Osborne, 8thEdition, 2011. 4. Jon Duckett, "Beginning Web Programming", WROX, 2ndEdition, 2008.

ARTIFICIAL INTELLIGENCE
Minor Course (Code: L)

Lectures	:	3 Hours /week	Continuous Assessment	:	30
Final Exam	:	3 Hours	Final Exam Marks	:	70

Pre-Requisite: Data Structures, Discrete Mathematics

Course Objectives: Students will be able to

- understand the fundamental concepts of artificial intelligence, and their environment, various Search techniques
- understand knowledge representation using predicate logic and rules
- understand the planning techniques.
- understand how to design and solve Learning techniques and Expert systems.

Course Outcomes: Students will be able to

CO-1	Understand the fundamental concepts of artificial intelligence, search techniques for solving simple AI problems and their environments.
CO-2	Apply knowledge representation using predicate logic and rules.
CO-3	Utilize the planning techniques.
CO-4	Possess the knowledge of the concepts of Learning and Expert Systems.

Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes

	PO's												PSO's		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	-	-	2	-	1	-	1	2	1	-	-	-	1	1	1
CO-2	-	-	2	-	2	-	2	3	-	2	1	-	1	2	2
CO-3	-	2	-	-	-	2	-	-	1	-	2	-	2	1	1
CO-4	-	1	-	1	-	-	1	-	1	-	-	1	2	2	1

UNIT-1 — 14 Hours

Introduction to AI: What is AI? , Foundations of AI, History of AI, State of the Art. **Intelligent Agents**: Agents and Environments, Good Behavior: Concept of Rationality, The Nature of Environments And The Structure of Agents. **Solving Problems by Searching:** Problem Solving Agents, Searching for Solutions, **Uninformed Search Strategies:** Breadth First Search, Uniform Cost Search, Depth First Search, Iterative Deepening DFS and Bi-directional Search. **Informed (Heuristics) Search Strategies:** Greedy BFS, A* Algorithm, AND-OR Search trees, **Constraint Satisfaction Problems:** Defining Constraint Satisfaction Problems, Local Search in CSP.

UNIT-2 — 14 Hours

Logical Agents: Knowledge Based Agents, The Wumpus World, Logic and Propositional Logic**, Propositional Theorem Proving:** Inference and proofs, Proof by resolution, Horn clauses and definite clauses, Forward and Backward chaining. **First Order Logic:** Representation, Revisited Syntax and Semantics of First Order Logic, Using First Order Logic, Knowledge Engineering in First Order Logic. **Inferences in First Order Logic:** Propositional vs. First Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution.

UNIT-3 — 14 Hours

Knowledge Representation: Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information. **Slot and Filler Structures:** Semantic Nets, Conceptual Dependency, Scripts. **Planning:** Overview - An Example Domain, The Blocks World, Component of Planning Systems, Goal Stack Planning, Hierarchical planning, Reactive systems.	
UNIT-4	14 Hours
Learning: Introduction to learning, Rote learning, Learning by taking advice, Learning in problem solving, Learning from examples, Induction Learning, Explanation Based Learning. **Expert Systems:** Representing and using domain knowledge, Expert system shells, Explanation, Knowledge Acquisition.	
Text Books :	1. Stuart Russel and Peter Norvig, Artificial Intelligence – A Modern Approach, 3rd Edition, Pearson Education/ PHI.. 2. Elaine Rich & Kevin Knight, Artificial Intelligence, 3rd Edition, (TMH).
References :	1. Patrick Henry Winston. Artificial Intelligence. Pearson Education, 3 edition, 2007. ISBN 81317 15051 2. Saroj Kaushik. Artificial Intelligence. CENGAGE Learning, 1 edition, 2020. ISBN 9788131510995.