

VELALAR COLLEGE OF ENGINEERING AND TECHNOLOGY

[AUTONOMOUS]

[Approved by AICTE, Affiliated to Anna University, Chennai]

(Accredited by NAAC with 'A+' Grade)



DEPARTMENT OF INFORMATION TECHNOLOGY


Accredited by NBA

REGULATIONS 2018 Ver. 4


BATCH 2021-2025

CHOICE BASED CREDIT SYSTEM

CURRICULUM AND SYLLABUS

	VELALAR COLLEGE OF ENGINEERING AND TECHNOLOGY (Autonomous)									CREDIT SUMMARY	
										UG	
										R – 2018 Ver 4 Incorporating Relative Grading System	
Department		Information Technology (IT)									
Programme		B.Tech - IT									

Semester/ Category	I	II	III	IV	V	VI	VII	VIII	Total	%	AICTE Norms (%)
HS	3	3					6		12	7.41	5% to 10%
BS	11	8	4	4					27	16.67	15% to 20%
ES	8	8	4	4		4			28	17.28	15% to 20%
PC			11	15	12	8	7		53	32.72	30% to 40%
PE					6	6	6		18	11.11	10% to 15%
OE					3	3	3		9	5.56	5% to 10%
PSI						3		12	15	9.26	10% to 15%
MC	✓	✓	✓	✓	✓	✓	✓				
TOTAL	22	19	19	23	21	24	22	12	<u>162</u>		

							VELALAR COLLEGE OF ENGINEERING AND TECHNOLOGY (Autonomous)							CURRICULUM		
														UG		
														R - 2018		
Department							Information Technology (IT)									
Programme							B.Tech (IT)									
Semester				1												
Sl. No.	Category	Course Code					Course Title	Hours / Week			Credit	Max. Marks				
								L	T	P		CA	SE	Tot.		
THEORY																
1	HS	21	EN	T	1	1	Communicative English - I	3	0	0	3	40	60	100		
2	BS	21	MA	T	1	1	Engineering Mathematics - I	3	1	0	4	40	60	100		
3	BS	21	PH	T	1	1	Engineering Physics	3	0	0	3	40	60	100		
4	BS	21	CY	T	1	1	Engineering Chemistry	3	0	0	3	40	60	100		
5	ES	21	CS	T	1	3	Python Programming	3	0	0	3	40	60	100		
6	ES	21	ME	C	1	1	Engineering Graphics	2	0	4	4	40	60	100		
PRACTICALS																
7	BS	21	PH	L	1	1	Physics and Chemistry Laboratory – I	0	0	3	1	60	40	100		
8	ES	21	CS	L	1	3	Python Programming Laboratory	0	0	3	1	60	40	100		
MANDATORY																
9	MC	21	MC	L	1	1	Universal Human Values - 1	1	0	1	0	100	0	100		
Total Credits for Sem								1			22					
Semester				2												
Sl. No.	Category	Course Code					Course Title	Hours / Week			Credit	Max. Marks				
								L	T	P		CA	SE	Tot.		
THEORY																
1	HS	21	EN	T	2	1	Communicative English - II	3	0	0	3	40	60	100		
2	BS	21	MA	T	2	1	Engineering Mathematics - II	3	1	0	4	40	60	100		
3	BS	21	PH	T	2	2	Physics for Information Sciences	3	0	0	3	40	60	100		
4	ES	21	EE	T	1	1	Basics of Electrical and Electronics Engineering	3	0	0	3	40	60	100		
5	ES	21	IT	T	2	1	Programming in C	3	0	0	3	40	60	100		
PRACTICALS																
6	BS	21	PH	L	2	1	Physics and Chemistry Laboratory – II	0	0	3	1	60	40	100		
7	ES	21	IT	L	2	1	C Programming Laboratory	0	0	3	1	60	40	100		
8	ES	21	EE	L	2	2	Engineering Practices Laboratory	0	0	3	1	100	0	100		
MANDATORY																
9	MC	21	MC	T	0	2	Environmental Science and Engineering	2	0	0	0	100	0	100		
Total Credits for Sem								2			19					

Semester				3											
Sl. No.	Category	Course Code					Course Title	Hours / Week			Credit	Max. Marks			
								L	T	P		CA	SE	Tot.	
THEORY															
1	BS	21	MA	T	3	1	Transforms and Partial Differential Equations	3	1	0	4	40	60	100	
2	PC	21	IT	T	3	1	Object Oriented Programming	3	0	0	3	40	60	100	
3	PC	21	CS	T	3	2	Data Structures	3	0	0	3	40	60	100	
4	ES	21	CS	C	3	1	Digital Principles and System Design	3	0	2	4	50	50	100	
5	PC	21	IT	T	3	2	Computer Architecture	3	0	0	3	40	60	100	
PRACTICALS															
6	PC	21	IT	L	3	1	Object Oriented Programming Laboratory	0	0	3	1	60	40	100	
7	PC	21	CS	L	3	2	Data Structures Laboratory	0	0	3	1	60	40	100	
MANDATORY															
8	MC	21	MC	L	0	3	Essential English for Professionals	0	0	2	0	100	0	100	
Total Credits for Sem								3			19				
Semester				4											
Sl. No.	Category	Course Code					Course Title	Hours / Week			Credit	Max. Marks			
								L	T	P		CA	SE	Tot.	
THEORY															
1	BS	21	MA	T	4	2	Probability and Queueing Theory	3	1	0	4	40	60	100	
2	ES	21	EC	T	4	6	Analog and Digital Communication	3	1	0	4	40	60	100	
3	PC	21	CS	T	4	1	Database Management Systems	3	0	0	3	40	60	100	
4	PC	21	CS	T	4	2	Software Engineering	3	0	0	3	40	60	100	
5	PC	21	IT	T	4	1	Operating Systems	3	0	0	3	40	60	100	
6	PC	21	IT	T	4	2	Design and Analysis of Algorithms	3	1	0	4	40	60	100	
PRACTICALS															
7	PC	21	CS	L	4	1	Database Management Systems Laboratory	0	0	3	1	60	40	100	
8	PC	21	IT	L	4	1	Operating Systems Laboratory	0	0	3	1	60	40	100	
MANDATORY															
9	MC	21	MC	L	0	4	Professional Communication	0	0	2	0	100	0	100	
Total Credits for Sem								4			23				

Semester				5													
Sl. No.	Category	Course Code					Course Title	Hours / Week			Credit	Max. Marks					
								L	T	P		CA	SE	Tot.			
THEORY																	
1	PC	21	IT	T	5	1	Java Programming	3	0	0	3	40	60	100			
2	PC	21	CS	T	5	1	Computer Networks	3	0	0	3	40	60	100			
3	PC	21	IT	T	5	2	Formal Language and Automata Theory	3	1	0	4	40	60	100			
4	PE	21					Professional Elective - I	3	0	0	3	40	60	100			
5	PE	21					Professional Elective -I I	3	0	0	3	40	60	100			
6	OE	21					Open Elective-I	3	0	0	3	40	60	100			
PRACTICALS																	
7	PC	21	IT	L	5	1	Java Programming Laboratory	0	0	3	1	60	40	100			
8	PC	21	CS	L	5	1	Computer Networks Laboratory	0	0	3	1	60	40	100			
MANDATORY																	
9	MC	21	MC	T	0	5	Aptitude and Logical Reasoning	2	0	0	0	100	0	100			
Total Credits for Sem								5	21								
Semester																	
Semester				6													
Sl. No.	Category	Course Code					Course Title	Hours / Week			Credit	Max. Marks					
								L	T	P		CA	SE	Tot.			
THEORY																	
1	PC	21	1T	C	6	1	Web Technology	3	0	2	4	50	50	100			
2	PC	21	1T	T	6	1	Mobile Application Development	3	0	0	3	40	60	100			
3	ES	21	EE	C	5	1	Microprocessor and Microcontroller	3	0	2	4	50	50	100			
4	PE	21					Professional Elective - III	3	0	0	3	40	60	100			
5	PE	21					Professional Elective - IV	3	0	0	3	40	60	100			
6	OE	21					Open Elective – II	3	0	0	3	40	60	100			
PRACTICALS																	
7	PC	21	IT	L	6	1	Mobile Application Development Laboratory	0	0	3	1	60	40	100			
8	PSI	21	IT	L	6	2	Mini Project	0	0	6	3	40	60	100			
MANDATORY																	
9	MC	21	MC	T	0	7	Arithmetic and Analytical Ability	2	0	0	0	100	0	100			
10	MC	21	MC	L	0	9	Communication Skills Laboratory	0	0	2	0	100	0	100			
Total Credits for Sem								6	24								

Semester				7										
Sl. No.	Category	Course Code					Course Title	Hours / Week			Credit	Max. Marks		
								L	T	P		CA	SE	Tot.
THEORY														
1	HS	21	IT	T	7	1	Economics and Management for Engineers	3	0	0	3	40	60	100
2	PC	21	CS	T	7	1	Network Security	3	0	0	3	40	60	100
3	PC	21	IT	T	7	2	Distributed Computing	3	0	0	3	40	60	100
4	PE	21					Professional Elective - V	3	0	0	3	40	60	100
5	PE	21					Professional Elective - VI	3	0	0	3	40	60	100
6	OE	21					Open Elective - III	3	0	0	3	40	60	100
7	HS	21	HS	T	7	1	Human Values and Professional Ethics	3	0	0	3	40	60	100
PRACTICALS														
8	PC	21	CS	L	7	1	Network Security Laboratory	0	0	3	1	60	40	100
MANDATORY														
9	MC	21	MC	T	0	9	Indian Constitution and Traditional Knowledge	2	0	0	0	100	0	100
Total Credits for Sem								7			22			
Semester				8										
Sl. No.	Category	Course Code					Course Title	Hours / Week			Credit	Max. Marks		
								L	T	P		CA	SE	Tot.
PRACTICALS														
1	PSI	21	IT	L	8	1	Internship	-	-	-	2	100	0	100
2	PSI	21	IT	L	8	2	Project work	0	0	20	10	40	60	100
Total Credits for Sem								8			12			
Total Credits											162			

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Data Science	Vertical II Full Stack Development for IT	Vertical III Cloud Computing and Data Center Technologies	Vertical IV Cyber Security and Data Privacy	Vertical V Creative Media	Vertical VI Artificial Intelligence and Machine Learning
Exploratory Data Analysis	Cloud Computing	Cloud Computing	Essentials of Ethical Hacking	Augmented Reality/Virtual Reality	Knowledge Engineering
Recommender Systems	Service Oriented Architecture	Virtualization	Digital and Mobile Forensics	Multimedia and Animation	Soft Computing
Neural Networks and Deep Learning	Cloud Services Management	Cloud Services Management	Social Network Security	Video Creation and Editing	Neural Networks and Deep Learning
Text and Speech Analysis	UI and UX Design	Data Warehousing	Cyber Security	UI and UX Design	Text and Speech Analysis
Business Analytics	Software Testing and Automation	Storage Technologies	Engineering Secure Software Systems	Digital Marketing	Natural Language Processing
Image and Video Analytics	Web Application Security	Software Defined Networks	Cryptocurrency and Blockchain Technologies	Visual Effects	Game Theory
Computer Vision	DevOps	Stream Processing	Modern Cryptography	Game Development	Cognitive Science
Big Data Analytics	Principles of Programming Languages	Security and Privacy in Cloud	Security and Privacy in Cloud	Multimedia Data Compression and Storage	Ethics and AI

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V to VII. These courses are listed in groups called verticals that represent a particular area of specialisation / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI & VII.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2018 ver.4.

PROFESSIONAL ELECTIVE COURSES: VERTICALS										
S. No	Course Code	Course Title	Category	Periods / Week			Credits	Max. Marks		
				L	T	P		CA	SE	Tot.
VERTICAL 1: DATA SCIENCE										
1	21ITE11	Exploratory Data Analysis	PE	3	0	0	3	40	60	100
2	21ITE12	Recommender Systems	PE	3	0	0	3	40	60	100
3	21ITE13	Neural Networks and Deep Learning	PE	3	0	0	3	40	60	100
4	21ITE14	Text and Speech Analysis	PE	3	0	0	3	40	60	100
5	21ITE15	Business Analytics	PE	3	0	0	3	40	60	100
6	21ITE16	Image and Video Analytics	PE	3	0	0	3	40	60	100
7	21ITE17	Computer Vision	PE	3	0	0	3	40	60	100
8	21ITE18	Big Data Analytics	PE	3	0	0	3	40	60	100
VERTICAL 2: FULL STACK DEVELOPMENT FOR IT										
1	21ITE21	Cloud Computing	PE	3	0	0	3	40	60	100
2	21ITE22	Service Oriented Architecture	PE	3	0	0	3	40	60	100
3	21ITE23	Cloud Services Management	PE	3	0	0	3	40	60	100
4	21ITE24	UI and UX Design	PE	3	0	0	3	40	60	100
5	21ITE25	Software Testing and Automation	PE	3	0	0	3	40	60	100
6	21ITE26	Web Application Security	PE	3	0	0	3	40	60	100
7	21ITE27	DevOps	PE	3	0	0	3	40	60	100
8	21ITE28	Principles of Programming Languages	PE	3	0	0	3	40	60	100
VERTICAL 3: CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES										
1	21ITE21	Cloud Computing	PE	3	0	0	3	40	60	100
2	21ITE32	Virtualization	PE	3	0	0	3	40	60	100
3	21ITE23	Cloud Services Management	PE	3	0	0	3	40	60	100
4	21ITE34	Data Warehousing	PE	3	0	0	3	40	60	100
5	21ITE35	Storage Technologies	PE	3	0	0	3	40	60	100
6	21ITE36	Software Defined Networks	PE	3	0	0	3	40	60	100
7	21ITE37	Stream Processing	PE	3	0	0	3	40	60	100
8	21ITE38	Security and Privacy in Cloud	PE	3	0	0	3	40	60	100
VERTICAL 4: CYBER SECURITY AND DATA PRIVACY										
1	21ITE41	Essentials of Ethical Hacking	PE	3	0	0	3	40	60	100
2	21ITE42	Digital and Mobile Forensics	PE	3	0	0	3	40	60	100
3	21ITE43	Social Network Security	PE	3	0	0	3	40	60	100
4	21ITE44	Cyber Security	PE	3	0	0	3	40	60	100
5	21ITE45	Engineering Secure Software Systems	PE	3	0	0	3	40	60	100

6	21ITE46	Cryptocurrency and Blockchain Technologies	PE	3	0	0	3	40	60	100
7	21ITE47	Modern Cryptography	PE	3	0	0	3	40	60	100
8	21ITE38	Security and Privacy in Cloud	PE	3	0	0	3	40	60	100
VERTICAL 5: CREATIVE MEDIA										
1	21ITE51	Augmented Reality/Virtual Reality	PE	3	0	0	3	40	60	100
2	21ITE52	Multimedia and Animation	PE	3	0	0	3	40	60	100
3	21ITE53	Video Creation and Editing	PE	3	0	0	3	40	60	100
4	21ITE24	UI and UX Design	PE	3	0	0	3	40	60	100
5	21ITE55	Digital Marketing	PE	3	0	0	3	40	60	100
6	21ITE56	Visual Effects	PE	3	0	0	3	40	60	100
7	21ITE57	Game Development	PE	3	0	0	3	40	60	100
8	21ITE58	Multimedia Data Compression and Storage	PE	3	0	0	3	40	60	100
VERTICAL 6: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING										
1	21ITE61	Knowledge Engineering	PE	3	0	0	3	40	60	100
2	21ITE62	Soft Computing	PE	3	0	0	3	40	60	100
3	21ITE13	Neural Networks and Deep Learning	PE	3	0	0	3	40	60	100
4	21ITE14	Text and Speech Analysis	PE	3	0	0	3	40	60	100
5	21ITE65	Natural Language Processing	PE	3	0	0	3	40	60	100
6	21ITE66	Game Theory	PE	3	0	0	3	40	60	100
7	21ITE67	Cognitive Science	PE	3	0	0	3	40	60	100
8	21ITE68	Ethics and AI	PE	3	0	0	3	40	60	100

LIST OF OPEN ELECTIVES OFFERED BY THE DEPARTMENTS

Sl. No.	Category	Course Code					Course Title	Hours / Week			Credit	Max. Marks		
								L	T	P		CA	SE	Tot.
OFFERED BY DEPARTMENT OF INFORMATION TECHNOLOGY														
1	OE	21	IT	O	0	1	Basics of Java Programming	3	0	0	3	40	60	100
2	OE	21	IT	O	0	2	Ethical Hacking	3	0	0	3	40	60	100
3	OE	21	IT	O	0	3	E-Commerce and Applications	3	0	0	3	40	60	100
4	OE	21	IT	O	0	4	Basics of Android Application Development	3	0	0	3	40	60	100
5	OE	21	IT	O	0	5	Principles of Data Science	3	0	0	3	40	60	100
OFFERED BY DEPARTMENT OF BIO MEDICAL ENGINEERING														
1	OE	21	BM	O	0	1	Biotelemetry	3	0	0	3	40	60	100
2	OE	21	BM	O	0	2	Biometric systems and their applications	3	0	0	3	40	60	100
3	OE	21	BM	O	0	3	Biology for Engineers	3	0	0	3	40	60	100
4	OE	21	BM	O	0	4	Healthcare Management Systems	3	0	0	3	40	60	100
5	OE	21	BM	O	0	5	Medical Robotics	3	0	0	3	40	60	100
6	OE	21	BM	O	0	6	Rapid Prototyping	3	0	0	3	40	60	100
OFFERED BY DEPARTMENT OF CIVIL ENGINEERING														
1	OE	21	CE	O	0	1	Civil and Infrastructure Engineering	3	0	0	3	40	60	100
2	OE	21	CE	O	0	2	Environmental Pollution and waste management	3	0	0	3	40	60	100
3	OE	21	CE	O	0	3	Disaster Management and Mitigation	3	0	0	3	40	60	100
4	OE	21	CE	O	0	4	Building Services	3	0	0	3	40	60	100
OFFERED BY DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING														
1	OE	21	CS	O	0	1	Cyber Security	3	0	0	3	40	60	100
2	OE	21	CS	O	0	2	Web Designing	3	0	0	3	40	60	100
3	OE	21	CS	O	0	3	Knowledge Management	3	0	0	3	40	60	100
4	OE	21	CS	O	0	4	Green Computing	3	0	0	3	40	60	100
5	OE	21	CS	O	0	5	Principles of Artificial Intelligence	3	0	0	3	40	60	100
OFFERED BY DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING														
1	OE	21	EE	O	0	1	PLC and SCADA	3	0	0	3	40	60	100
2	OE	21	EE	O	0	2	Renewable Energy Sources	3	0	0	3	40	60	100
3	OE	21	EE	O	0	3	Embedded Real Time System	3	0	0	3	40	60	100
4	OE	21	EE	O	0	4	Energy Auditing and Conservation	3	0	0	3	40	60	100
5	OE	21	EE	O	0	5	Electric Vehicles	3	0	0	3	40	60	100
OFFERED BY DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING														
1	OE	21	EC	O	0	1	Automotive Electronics	3	0	0	3	40	60	100

Sl. No.	Category	Course Code					Course Title	Hours / Week			Credit	Max. Marks		
								L	T	P		CA	SE	Tot.
2	OE	21	EC	O	0	2	SCILAB for Engineers	3	0	0	3	40	60	100
3	OE	21	EC	O	0	3	Satellite Applications	3	0	0	3	40	60	100
4	OE	21	EC	O	0	4	Consumer Electronics	3	0	0	3	40	60	100
5	OE	21	EC	O	0	5	Principles of Communication Engineering	3	0	0	3	40	60	100
6	OE	21	EC	O	0	6	Microcontroller based System Design	3	0	0	3	40	60	100
7	OE	21	EC	O	0	7	5G Technologies	3	0	0	3	40	60	100
OFFERED BY DEPARTMENT OF MECHANICAL ENGINEERING														
1	OE	21	ME	O	0	1	Industrial Instrumentation	3	0	0	3	40	60	100
2	OE	21	ME	O	0	2	Product Design and Development	3	0	0	3	40	60	100
3	OE	21	ME	O	0	3	Sustainable Manufacturing	3	0	0	3	40	60	100
4	OE	21	ME	O	0	4	Entrepreneurship Development	3	0	0	3	40	60	100
5	OE	21	ME	O	0	5	Fundamentals of Ergonomics	3	0	0	3	40	60	100
6	OE	21	ME	O	0	6	Principles of Management and Industrial Psychology	3	0	0	3	40	60	100
7	OE	21	ME	O	0	7	Safety Measures for Engineers	3	0	0	3	40	60	100
OFFERED BY DEPARTMENT OF MEDICAL ELECTRONICS														
1	OE	21	MD	O	0	1	Introduction to Medical Electronics	3	0	0	3	40	60	100
2	OE	21	MD	O	0	2	Hospital Waste Management	3	0	0	3	40	60	100
3	OE	21	MD	O	0	3	Hospital Information System	3	0	0	3	40	60	100
4	OE	21	MD	O	0	4	IoT Applications in Healthcare	3	0	0	3	40	60	100
OFFERED BY DEPARTMENT OF S&H														
1	OE	21	GE	O	0	1	National Cadet Corps Studies – I	3	0	0	3	40	60	100
2	OE	21	GE	O	0	2	National Cadet Corps Studies – II	3	0	0	3	40	60	100

Sl. No.	Category	Course Code					Course Title	Hours / Week			Credit	Max. Marks		
								L	T	P		CA	SE	Tot.
VALUE ADDED COURSES														
1	VAC	21	IT	V	0	1	R Programming	0	0	2	1	100	0	100
2	VAC	21	IT	V	0	2	ANN and Deep Learning	0	0	2	1	100	0	100
3	VAC	21	IT	V	0	3	Stress Management and Emotional Intelligence	0	0	2	1	100	0	100
4	VAC	21	IT	V	0	4	Kotlin Programming	0	0	2	1	100	0	100

ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree.

For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also. Complete details are available in Regulations 2022.

VERTICALS FOR MINOR DEGREE **(In addition to all the verticals of other programmes)**

Vertical I Fintech and Block Chain	Vertical II Entrepreneurship	Vertical III Public Administration	Vertical IV Business Data Analytics	Vertical V Environmental and Sustainability	Vertical VI Artificial Intelligence
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics for Management	Sustainable infrastructure Development	Introduction to Data Science
Fundamentals of Investment	Team Building & Leadership Management for Business	Constitution of India	Data mining for Business Intelligence	Sustainable Agriculture and Environmental Management	Principles of Artificial Intelligence
Banking, Financial Services and Insurance	Creativity & Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials	Data Warehousing and Data Mining
Introduction to Blockchain and its Applications	Principles of Marketing Management For Business	Administrative Theories	Digital Marketing and Social Network Analytics	Materials for Energy Sustainability	Machine Learning Techniques
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Indian Administrative System	Supply Chain Analytics	Green Technology	Expert Systems
Introduction to Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis	Cognitive Science
-	-	-	-	Integrated Energy Planning for Sustainable Development	Gamification
-	-	-	-	Energy Efficiency for Sustainable Development	

MINOR DEGREE COURSES: VERTICALS									
S. No	Course Code	Course Title	Hours / Week			Credits	Max. Marks		
			L	T	P		CA	SE	Tot.
VERTICAL I- FINTECH AND BLOCK CHAIN									
1	21ITM11	Financial Management	3	0	0	3	40	60	100
2	21ITM12	Fundamentals of Investment	3	0	0	3	40	60	100
3	21ITM13	Banking, Financial Services and Insurance	3	0	0	3	40	60	100
4	21ITM14	Introduction to Blockchain and its Applications	3	0	0	3	40	60	100
5	21ITM15	Fintech Personal Finance and Payments	3	0	0	3	40	60	100
6	21ITM16	Introduction to Fintech	3	0	0	3	40	60	100
VERTICAL II - ENTREPRENEURSHIP									
1	21MEM21	Foundations of Entrepreneurship	3	0	0	3	40	60	100
2	21MEM22	Team Building & Leadership Management for Business	3	0	0	3	40	60	100
3	21MEM23	Creativity & Innovation in Entrepreneurship	3	0	0	3	40	60	100
4	21MEM24	Principles of Marketing Management for Business	3	0	0	3	40	60	100
5	21MEM25	Human Resource Management for Entrepreneurs	3	0	0	3	40	60	100
6	21MEM26	Financing New Business Ventures	3	0	0	3	40	60	100
VERTICAL III – PUBLIC ADMINISTRATION									
1	21ECM31	Principles of Public Administration	3	0	0	3	40	60	100
2	21ECM32	Constitution of India	3	0	0	3	40	60	100
3	21ECM33	Public Personnel Administration	3	0	0	3	40	60	100
4	21ECM34	Administrative Theories	3	0	0	3	40	60	100
5	21ECM35	Indian Administrative System	3	0	0	3	40	60	100
6	21ECM36	Public Policy Administration	3	0	0	3	40	60	100
VERTICAL IV - BUSINESS DATA ANALYTICS									
1	21CSM41	Statistics for Management	3	0	0	3	40	60	100
2	21CSM42	Data mining for Business Intelligence	3	0	0	3	40	60	100
3	21CSM43	Human Resource Analytics	3	0	0	3	40	60	100
4	21CSM44	Digital Marketing and Social Network Analytics	3	0	0	3	40	60	100
5	21CSM45	Supply Chain Analytics	3	0	0	3	40	60	100
6	21CSM46	Financial Analytics	3	0	0	3	40	60	100
VERTICAL V - ENVIRONMENTAL AND SUSTAINABILITY									
1	21CEM51	Sustainable infrastructure Development	3	0	0	3	40	60	100
2	21CEM52	Sustainable Agriculture and Environmental Management	3	0	0	3	40	60	100
3	21CEM53	Sustainable BioMaterials	3	0	0	3	40	60	100
4	21CEM54	Materials for Energy Sustainability	3	0	0	3	40	60	100

5	21CEM55	Green Technology	3	0	0	3	40	60	100
6	21CEM56	Environmental Quality Monitoring and Analysis	3	0	0	3	40	60	100
7	21CEM57	Integrated Energy Planning for Sustainable Development	3	0	0	3	40	60	100
8	21CEM58	Energy Efficiency for Sustainable Development	3	0	0	3	40	60	100
VERTICAL VI - ARTIFICIAL INTELLIGENCE									
1	21CSM61	Introduction to Data Science	3	0	0	3	40	60	100
2	21CSM62	Principles of Artificial Intelligence	3	0	0	3	40	60	100
3	21CSM63	Data Warehousing and Data Mining	3	0	0	3	40	60	100
4	21CSM64	Machine Learning Techniques	3	0	0	3	40	60	100
5	21CSM65	Expert Systems	3	0	0	3	40	60	100
6	21CSM66	Cognitive Science	3	0	0	3	40	60	100
7	21CSM67	Gamification	3	0	0	3	40	60	100

Preamble:

Communicative English is a life skill necessary for all students of Engineering and Technology. The course Communicative English-I aims at developing Communication Skills in English essential for the learner to handle English language for a variety of everyday purposes through acquisition of basic grammar and vocabulary along with necessary listening, speaking, reading and writing skills.

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

1. Converse fluently with Business and British American vocabulary.
2. Write and edit given informal writing tasks without grammatical errors.
3. Write clear, coherent and organized informal passages adhering to the rules of different types of descriptive writing.
4. Identify without mistakes general and specific ideas while listening and reading a given excerpt.
5. Give extemporaneous clear, fluent descriptive and grammatically correct short informal narrations and actively participate in discussions with fellow members.

UNIT 1 VOCABULARY**6**

Synonyms and Antonyms- Single Word Substitutes - Use of Abbreviations and Acronyms-Homonyms and Homophones- Business Vocabulary - Commonly Confused Words- Collocation - British and American Vocabulary- Word formation

UNIT 2 GRAMMAR**9**

Comparative Adjectives- Modals -Phrasal Verbs -Tenses – Connectives-Impersonal Passive Voice -Types of Questions -Mechanics of Writing (Editing) -Direct and Indirect Speech- Numerical Adjectives - Gerunds and Infinitives-Expressions of Purpose- Conditional Sentences- Same Word Used as Different Parts of Speech – Subject Verb Agreement

UNIT 3 INFORMAL WRITING**5**

Letter Writing - Informal Letters - Dialogue Writing -Informal Dialogues – Essay Writing-Informal Essays
Movie/Book Reviews

UNIT 4 LANGUAGE ENHANCEMENT THROUGH LISTENING& READING**9**

Listening Comprehension -Listening for General Ideas- Listening to You Tube Documentaries - Listening for Specific Information- Listening for Details-Listening for Vocabulary-BBC Learn English Videos -Reading Comprehension- Understanding General and Specific Information -Sign Post Words-Jumbled Sentences - Finding Topic Sentences and Supporting Arguments - Reading for Vocabulary-Reading News Papers

UNIT 5 LANGUAGE ENHANCEMENT THROUGH SPEAKING**16**

Introduction to IPA-Syllable, Stress, Intonation, etc., -Conversation Starters- Describing Places, People, Things and Pictures -Self Introduction - Narrating Personal Experiences and Incidents-Informal Group Discussions

TOTAL:45PERIODS**TEXT BOOKS:**

1. Sanjay Kumar and Pushp Lata, "Communication Skills" 2nd Edition, Oxford University Press, New Delhi, 2017.
2. Raman, Meenakshi and Sangeetha Sharma, "Technical Communication: English Skills for Engineers", 1st Edition, Oxford University Press, New Delhi. 2008.

REFERENCES:

1. Department of English, Anna University, "Mindscapes: English for Technologists and Engineers", 1st Edition, Orient Black Swan, Chennai. 2012
2. Dhanavel, S.P, "English and Communication Skills for Students of Science and Engineering", 1st Edition, Orient Black Swan, Chennai. 2011
3. Rizvi, Ashraf. M, "Effective Technical Communication", 2st Edition, Tata McGraw-Hill, New Delhi, 2018.

e-RESOURCES:

1. <https://learnenglish.britishcouncil.org/intermediate-vocabulary>
2. <https://learnenglish.britishcouncil.org/intermediate-grammar>
<http://www.usingenglish.com>
<https://www.khanacademy.org/humanities/grammar>
3. <http://learnenglishteens.britishcouncil.org/skills/writing/advanced-c1-writing/informal-email-or-letter>
4. <http://learnenglishteens.britishcouncil.org/skills/reading>
5. <https://learnenglish.britishcouncil.org/speaking>

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	3	-	-	-	3	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO4	-	-	-	-	3	-	-	-	-	3	-	-	-	-
CO5	-	1	-	-	-	1	-	-	1	3	-	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

The course aims at achieving conceptual understanding of topics such as Matrix Algebra and Calculus. The syllabus is designed to provide the skills for modeling engineering problems and understand the role of single variable and multivariables in the discipline of engineering and computer science.

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

1. Evaluate Eigenvalues, eigenvectors and diagonalization of symmetric matrices.
2. Use limit definition, understand differentiation and integration methods.
3. Compute curvature, centre of curvature, evolute and envelope of curves.
4. Express functions of two variables in Taylor's series and compute Jacobians, maximum and minimum values.
5. Apply multiple integrals to determine area in cartesian and polar coordinates and volume in cartesian coordinates.

UNIT 1 MATRICES**9+3**

Characteristic equation – Eigen values and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors – Statement and application of Cayley Hamilton Theorem – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT 2 CALCULUS**9+3**

Representation of functions – Mathematical Models – New Functions from Old Functions – Graphing Calculators and Computers – The Limit of a Function – Calculating Limits Using the Limit Laws – Continuity – Exponential Growth and Decay – Hyperbolic Functions – Areas and Distances – The Definite Integral – The Fundamental Theorem of Calculus – Improper Integrals.

UNIT 3 GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS**9+3**

Curvature – Radius, Centre and Circle of curvature in Cartesian and Parametric form - Evolute – Envelope of family of curves with one and two parameters – Evolute as the envelope of normals – Properties of Evolute and Envelope.

UNIT 4 FUNCTIONS OF SEVERAL VARIABLES**9+3**

Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian- Properties – Taylor's series expansion for functions of two variables – constrained Maxima and Minima – Lagrange's multipliers with single constraint.

UNIT 5 MULTIPLE INTEGRALS**9+3**

Double integrals in Cartesian and Polar coordinates- Change of order of Integration – Change of variables from Cartesian to Polar coordinates – Area as a double integral in Cartesian and Polar form – Volume as a triple integral in Cartesian coordinates

TOTAL : 60 PERIODS**TEXT BOOKS:**

1. Grewal B.S., "Higher Engineering Mathematics" 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015. [Sections 1.1, 1.2, 1.3, 1.4, 2.2, 2.3, 2.5, 3.8, 3.11, 5.1, 5.2, 5.3 and 7.8].

REFERENCES:

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 26th Reprint, New Delhi, 2016
2. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
3. N.P.Bali, Manish Goyal, "Engineering Mathematics", Lakshmi Publications(PVT) Ltd, 4th edition, 2014

e-RESOURCES:

1. <http://nptel.ac.in/courses/111105035/> "Advanced Engineering Mathematics", Prof. Pratima Panigrahi, Indian Institute of Technology, Kharagpur
2. <http://nptel.ac.in/courses/122104017/> "Mathematics-I", Prof. S.K. Ray, Indian Institute of Technology, Kanpur

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-	-	-	-	-	-	1	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	1	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	1	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	1	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

Ultrasonics forms the basis of Sonar and in the field of medicine for both diagnostics and therapeutic applications. Mechanical properties of Engineering materials are explored for industrial applications such as construction of bridges and railway wagons. Particle and wave nature of quantum particles form the basis of quantum computers. The virtues of lasers are explored in applications such as holography, computers, space satellites and medicines.

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

- 1 Demonstrate the knowledge of wave optics in propagation of light waves in optical fibers in communications system.
- 2 Explain the production of Ultrasonics and its NDT techniques in scanning methods, medical applications.
- 3 Describe the Elastic property of solid materials and thermal conductivity of solids in industrial applications.
- 4 Explore the dual nature of light waves with quantum theory on Black body radiation and Schrodinger's wave equations.
- 5 Demonstrate the knowledge on Nd-YAG, CO₂, Semiconductor lasers in industrial applications of welding, heat treatment, cutting, medical treatment and holography.

UNIT 1 WAVES AND OPTICS

9

Classification of waves-wave equation-(qualitative)-Typical and General wave equation-qualitative analysis of phase and group velocities of waves-Differential equation of simple harmonic motion-Forced oscillations –analysis and classification of damped oscillations through differential equations-coherent sources and incoherent sources. Superposition principle of Waves- Illustrations-Principle and propagation of light in optical fibers-numerical aperture and acceptance angle-Types of optical fibers (material, refractive index, mode-Application of optical fibers.

UNIT 2 ULTRASONICS

9

Introduction – Production techniques– Magnetostriction effect– Piezoelectric effect - Piezoelectric generator- detection of ultrasonic waves - properties – cavitations - velocity measurement – acoustic grating - Industrial applications – drilling, welding, soldering and cleaning – SONAR - non destructive testing – pulse echo system, through transmission and reflection modes - A,B and C scan - medical applications - sonograms.

UNIT 3 MECHANICAL AND THERMAL PROPERTIES

9

Elasticity – Stress-strain diagram and its uses – factors affecting elastic modulus and tensile strength. Torsional stress and deformations – twisting couple – torsion pendulum: theory and experiment – bending of beams. Bending moment – cantilever, Young's Modulus by Uniform and non-uniform bending: theory and experiment – I-shaped girders. Modes of heat transfer -thermal conductivity- Specific heat-Newton's law of cooling - Forbe's and Lee's disc method: theory and experiment– thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters

UNIT 4 MODERN PHYSICS

9

Wave- particle duality, de-Broglie matter waves, Davisson-Germer experiment, Heisenberg uncertainty principle and its applications, Black body radiation – Planck's theory (derivation) – deduction of Wien's displacement law and Rayleigh – Jeans' law from Planck's theory — Matter waves – concept of operator-Eigen value and Eigen function- Physical significance of wave function -Schrodinger's time independent wave equation — Particle in a one dimensional box ,qualitative explanation on wave equation and energy value in three dimensional box.

UNIT 5 LASER

9

Introduction – principle of spontaneous emission and stimulated emission, population inversion, pumping. Einstein's coefficients - derivation. Types of lasers- Nd-YAG-CO₂, Semiconductor lasers (homojunction&heterojunction) – Industrial applications - lasers in welding, heat treatment, cutting- medical applications- holography-construction and reconstruction-Safety classes of laser.

TOTAL : 45 PERIODS**TEXT BOOKS**

1. Gaur R.K. and Gupta S.L., "Engineering Physics", 8th Edition, Dhanpat Rai publishers, 2009.
2. Mani Naidu S., "Engineering Physics", 2nd Edition, Pearson Publishing, 2011.

REFERENCES

1. Serway and Jewett, "Physics for Scientists and Engineers with Modern Physics", 9th Edition, Thomson Brooks Cole, 2013
2. Young H.D., Freedman R.A. and Ford A.L., "Sears and Zemansky's University Physics with Modern Physics", 13th Edition, Pearson India, 2013.
3. Tipler P.A. and Mosca G.P., "Physics for Scientists and Engineers with Modern Physics", 6th Edition, W.H. Freeman, 2007.

e-RESOURCES:

1. <http://nptel.ac.in/courses/115101003> , "Atomic and Molecular Physics" – Dr. T. Kundu, IIT Bombay.
2. <https://www.khanacademy.org/science/physics/quantum-physics>

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2
CO1	3	2	1	1	1	1	1	-	-	1	1	1	-	-
CO2	3	2	1	1	1	1	1	-	-	1	1	1	-	-
CO3	3	2	1	1	1	1	1	-	-	1	1	1	-	-
CO4	3	2	1	1	1	1	1	-	-	1	1	1	-	-
CO5	3	2	1	1	1	1	1	-	-	1	1	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

The study of water technology enables engineers to acquire skills to make the simple design calculation of drinking water as well as industrial water treatment. Electrochemistry and corrosion explain the fundamentals, corrosion prevention, identification and implementation for solving electrochemical and corrosion problems. The study of energy storage devices exposes some of the most commonly used energy storage technologies. Instrumental methods and analysis describe basic concepts and promote to solve real analytical problems. Studies of Nanochemistry span many areas as assemblies significant new structures like nanowire, nanotube and lab-in-chip devices.

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

1. Evaluate the process to purify hardwater using ion-exchange, zeolite and reverse osmosis methods
2. Compare and contrast corrosion control methods and analyze the performance of alkaline, lead acid and fuel cells.
3. Analyze the metal ion concentration for solid and liquid samples with the aid of flame photometry, colorimetry, UV and IR spectroscopy
4. Categorize different types of polymers to select injection or compression fabrication method
5. Analyze the synthesis of nanoparticles using top down and bottom up process

UNIT 1 WATER TECHNOLOGY

9

Hardness – types, estimation by EDTA method, Boiler troubles – scale, sludge, priming, foaming, caustic embrittlement and boiler corrosion, Internal conditioning - carbonate, phosphate and calgon conditioning, External conditioning – zeolite and demineralisation process, Desalination – reverse osmosis method.

UNIT 2 ELECTROCHEMISTRY AND CORROSION

9

Electrochemistry – cell terminology, EMF series. Corrosion – chemical (corrosion by O_2 , H_2 and liquid-metal) and electrochemical corrosion (H_2 evolution and absorption of O_2), Corrosion control – sacrificial anode, Impressed current method and electroless plating. Application of electrochemistry-primary battery (alkaline battery), secondary battery (lead acid battery) and fuel cell (H_2 - O_2 fuel cell)

UNIT 3 INSTRUMENTAL METHODS AND ANALYSIS

9

Basic principles – Beer-Lambert's law, instrumentation with block diagram and applications of calorimetry (estimation of Fe^{2+}), UV-Visible spectroscopy, infrared spectroscopy and flame photometry (estimation of sodium).

UNIT 4 HIGH POLYMERS

9

Polymers – classification (based on molecular forces-thermoplastics and thermosetting plastics), polymerisation – types, mechanism (Free radical only), Compounding and fabrication – compression, injection, Composites-definition, types, polymer matrix composites-FRP only.

Real time applications of thermoplastics (PVC, Teflon), thermosetting plastics (nylon, epoxy resin)

UNIT 5 NANO CHEMISTRY

9

Basics – distinction between molecules, nanoparticles and bulk materials, Nanoparticles – nano cluster, nano rod, nanotube (CNT) and nanowire, Synthesis – top down process (laser ablation and electro-deposition), bottom up process (thermolysis – hydrothermal, solvothermal), Nanoparticles – properties and applications.

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. P.C Jain and Monika Jain, "Engineering Chemistry", 16th edition, Danpat Rai publishing company (P) Ltd, New Delhi, 2015
2. N. Krishnamurthy, P. Vallinayagam and D. Madhavan, "Engineering Chemistry", 3rd edition. PHI Learning PVT., LTD, New Delhi, 2014.

REFERENCES:

1. S.S.Dara, "A Text book of Engineering Chemistry", 12th Edition, S.Chand & Company Ltd., New Delhi, 2010.
2. "Engineering chemistry", 2nd edition, Wiley India private Ltd. New Delhi, 2014.
3. V.R.Gowariker, N.V.Viswanathan and Jayadevsreedhar, "Polymer Science" 2nd edition, New age International publishers, New Delhi, 2015.

e-RESOURCES:

1. <http://nptel.ac.in/courses/113104061/>, "Environmental Degradation of Materials" - Dr.Kallol Mondal, Department of Metallurgy and Material Science, IIT Kanpur
2. <http://nptel.ac.in/courses/113105028/>, "Science and Technology of Polymers"- Prof.B.Adhikari, Department of Metallurgical & Materials Engineering, IIT Kharagpur

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1	1	1	1	2	-	1	1	1	1	-	-
CO2	3	2	2	1	1	1	2	-	1	1	1	1	-	-
CO3	3	2	1	2	1	1	1	-	1	1	1	1	-	-
CO4	3	1	2	1	1	1	2	-	1	1	1	1	-	-
CO5	3	2	1	2	1	1	1	-	1	1	1	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

e-RESOURCES:

1. <https://swayam.gov.in/course/4178-spoken-tutorial-python-english>, “Introduction to Python”, Prof. Prabhu Ramachandran, IIT Bombay.
2. https://onlinecourses.nptel.ac.in/noc18_cs21, “Programming, Data Structures and Algorithms Using Python”, Prof. Madhavan Mukund, IIT-Bombay.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2
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CO2	3	2	2	2	1	-	-	-	-	-	-	1	-	-
CO3	3	2	2	2	1	-	-	-	-	-	-	1	-	-
CO4	3	2	2	2	1	-	-	-	-	-	-	1	-	-
CO5	3	2	2	2	1	-	-	-	-	-	-	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

The knowledge of Engineering graphics is essential for the Engineering graduates in proposing new product designs through drawings and interpreting data from existing drawings. Engineering Design inculcates into an Engineer the creativity and knowledge on various aspects to be considered while designing and realizing the functional products and processes. This course deals with Engineering curves, orthographic and pictorial projections, sectional views and development of surfaces.

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

1. Draw the various conic sections and Engineering curves.
2. Sketch the orthographic views from given pictorial views and projections of lines.
3. Draw the projections of planes and solids kept in various positions.
4. Sketch sectioned views of solids and development of surfaces.
5. Draw the isometric and perspective projections of simple solids.

UNIT 1 INTRODUCTION AND PLANE CURVES**12**

Importance of graphics in Engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lines, lettering and dimensioning-Basic geometrical constructions. (PRACTICE ONLY AND NOT FOR EXAMINATIONS).

Curves used in Engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – Construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

UNIT 2 PROJECTION OF POINTS, LINES AND FREE HAND SKETCHING**12**

Orthographic projection- principles-Principal planes-First angle projection- Projection of points in four quadrants - End point projection of straight lines (only First angle projections) inclined to both the principal planes -Determination of true lengths and true inclinations by rotating line method.

Visualization concepts- Free hand sketching – Conversion of Isometric view to orthographic views.

UNIT 3 PROJECTION OF PLANE SURFACES AND SOLIDS**12**

Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

Projection of simple solids- Cube, prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane and parallel to the other by rotating object method.

UNIT 4 SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES**12**

Sectioning of above solids in simple vertical position when cut by a cutting plane which is inclined to one of the reference planes and perpendicular to the other – Obtaining true shape of section.

Development of lateral surfaces of simple and truncated solids in simple vertical position – Cube, prisms, pyramids, cylinder and cone.

UNIT 5 ISOMETRIC AND PERSPECTIVE PROJECTIONS**12**

Principles of isometric projection – Isometric scale –Isometric projections of simple solids - Prisms, pyramids, cylinder and cone- Combination of two solid objects in simple vertical position.

Perspective projection of simple solids-Cube, prisms, pyramids, cylinder and cone, by visual ray method when axis is either parallel or perpendicular to ground plane.

TOTAL : 60 PERIODS**TEXT BOOKS:**

- 1 Venugopal K and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Ltd, 13th Edition, 2015.
- 2 Jeyapooan T. , “Engineering Graphics with AUTOCAD”, Vikas Publishing House Pvt., Ltd., 7th Edition, 2015.

REFERENCES:

- 1 Bhatt N.D., Panchal, V.M. and Ingle P.R., “Engineering Drawing”, Charotar Publishing House Pvt. Ltd., 53rd Edition, 2014.
- 2 Parthasarathy N.S. and Vela Murali, “Engineering Drawing”, Oxford University Press, 1st Edition, Second Impression 2015.
- 3 LuzzaderW.J. and Duff J.M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production”, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.

e-RESOURCES:

1. <http://nptel.ac.in/courses/105104148>, “Engineering Graphics” - Dr. NiharRanjanPatra , IIT Kanpur
2. <http://cfd.annauniv.edu/webcontent.htm>, “Engineering Graphics” - Dr. Velamurali

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2
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CO 2	3	2	1	-	-	-	-	-	-	2	-	1	-	-
CO 3	3	2	1	-	-	-	-	-	-	2	-	1	-	-
CO 4	3	2	1	-	-	-	-	-	-	3	-	2	-	-
CO 5	3	2	1	-	-	-	-	-	-	3	-	2	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

In the present course related to the lab, understanding of physics concepts applied in optics, thermal and properties of matter has been developed. The necessary practical skills in the determination of water quality parameters and strength of acid has been explored.

Course Outcomes:

1. Experiment and determine the physical characteristics of given solid materials.
2. Experiment and determine the velocity of ultrasonic waves through water medium.
3. Experiment and determine the optical property of light sources.
4. Experiment and estimate hydroxyl, carbonate and bicarbonate alkalinity using HCl in water sample.
5. Experiment and determine the amount of total, temporary, permanent hardness of water using EDTA by complexometric titration.
6. Experiment and determine the amount of iron content present in the given sample using potentiometer, spectrophotometer and strength of acid using conductivity meter.

PHYSICS LABORATORY – I
(Any Five Experiments)**LIST OF EXPERIMENTS**

1. (a) Determination of Wavelength, and particle size using Laser
2. (b) Determination of acceptance angle in an optical fiber.
3. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
4. Determination of wavelength of mercury spectrum – spectrometer grating
5. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
6. Determination of Young's modulus by Non uniform bending method
7. Determination of Planck's constant by photocell method

CHEMISTRY LABORATORY – I**LIST OF EXPERIMENTS**

1. Determination of alkalinity in water sample
2. Determination of total, temporary and permanent hardness of water by EDTA method.
3. Determination of iron content of the water sample using spectrophotometer (1,10-phenanthroline /thiocyanate method).
4. Determination of iron content of the given solution using a potentiometer
5. Determination of strength of acid using conductivity meter.

TOTAL : 30 PERIODS

- **Laboratory classes on alternate weeks for Physics and Chemistry.**

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	-	3	-	1	1	-	1	1	1	1	-	-
CO2	2	2	-	3	-	1	1	-	1	1	1	1	-	-
CO3	2	2	-	3	-	1	1	-	1	1	1	1	-	-
CO4	2	1	-	3	-	1	1	-	1	1	1	1	-	-
CO5	2	1	-	3	-	1	1	-	1	1	1	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

Python is a dynamic and powerful programming language that focuses on code readability. The Python language has diversified application in the software development companies such as in gaming, web frameworks and applications, language development, prototyping, graphic design applications, etc. This provides the language a higher plethora over other programming languages used in the industry.

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

1. Create documents, presentation slides and perform data manipulations using Libre Office packages. Design flowcharts using Raptor.
2. Develop programs using expressions and Control statements in Python.
3. Apply suitable data structure in Python for a real-world problem.
4. Develop programs using functions, OOP concepts, modules and packages for a given problem.
5. Create and manipulate files and database connectivity using Python.

LIST OF EXPERIMENTS

1. Creating document, presentation slides and performing mathematical calculations using Libre Office packages.
2. Design flowchart using Raptor for the following problems:
 - Solving problems using algorithm and flowchart.
 - To find if a given year is a leap year or not. Any year which is divisible by 4 and not by 100 are leap years. Otherwise, any year which is divisible by 400 is also a leap year.
 - To find the sum of numbers divisible by 4. The flowchart must allow the user to accept a number and add it to the sum if it is divisible by 4. It should continue accepting numbers as long as the user wants to provide an input and should display the final sum.
3. Write a python programs for solving the problems:
 - All decision control statements.
 - An organization has decided to provide salary hike to its employees based on their job level. Employees can be in job levels 3, 4 or 5. In case of invalid job level, consider hike percentage to be 0. Given the current salary and job level, write a python program to find and display the new salary for 10 employees in the organization. Hike percentage based on job levels are given below:

Job level	Hike Percentage
3	15
4	7
5	5

4. Write a python program to find the list of 'n' prime numbers using functions.
5. Write a python program to implement list, set, tuple and dictionary.
6. Write a python program by defining a user defined module leap. Import the module and find whether a given year is leap year or not.
7. Write a python program to perform the arithmetic operations using packages.
8. Write a python Program to implement string handling functions.
9. Write a python program to implement object-oriented concepts.
10. Write a python program to implement database connectivity.

TOTAL: 45 PERIODS

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	2	1	-	-	-	-	-	-	1	-	-
CO2	3	2	2	2	1	-	-	-	-	-	-	1	-	-
CO3	3	2	2	2	1	-	-	-	-	-	-	1	-	-
CO4	3	2	2	2	1	-	-	-	-	-	-	1	-	-
CO5	3	2	2	2	1	-	-	-	-	-	-	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

Universal Human Values is a life skill necessary for all to develop physical health and factors for strengthening life force. This course aims to expose the students in the areas of meditation and impart the knowledge on social virtues and morals.

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

1. Demonstrate the knowledge on physical health
2. Discuss the factors for strengthening life force
3. Classify mind waves and explain the benefits of meditation
4. Explain individual and social virtues
5. Identify and explain the importance of morals.

UNIT 1 PHYSICAL HEALTH**6**

SKY – Introduction – Education as a means for youth empowerment – Greatness of Education – Yoga for Youth Empowerment – Simplified Physical Exercises: Explanation – Hand, Leg, Breathing and Eye exercises – Kapalabathi, Makarasanam, Massaging, Acupressure and Relaxation practices –Yogasanas-Explanation – Benefits.

UNIT 2 STRENGTHENING LIFE FORCES**6**

Reasons for Diseases: Natural Reasons (Hereditary, Planetary Position, Natural Calamities and Climatic changes) – Artificial Reasons (Food, Thought, Deed). Philosophy of Kayakalpa: Physical Body –Life Force – Biomagnetism – Mind. Maintaining Youthfulness – Postponing Aging – Transformation of Food into seven Body constituents.

UNIT 3 WELLNESS OF MIND**6**

Classification of Mind Waves – Beta, Alpha, Theeta, Delta – Agna Meditation – Benefits. Shanthi Meditation – Benefits. Thuriya Meditation – Benefits. Blessing and its Benefits: Auto Suggestion – Blessing the family and others – Blessings the World – Divine Protection.

UNIT 4 VIRTUES**6**

Individual Virtues: Self Control – Self Confidence – Speaking Truth – Contentment – Humility – Mind Control. Tolerance – Adjustment – Sacrifice – Forgiveness. Cleanliness (Body, Dress, Surrounding)- External, Mental, Inner Cleanliness. **Societal Virtues** :Ahimsa – Services, Patriotism – Equality, Respecting the parents and elders – Caring for them – Respecting Teachers. Punctuality – Time Management.

UNIT 5 MORALS**6**

Importance of introspection: I and Mine (Ego, Possessiveness), Six Temperaments: Greed – Anger – Miserliness – Immoral Sexual Passion – Inferior Superior complex – Vengeance. Maneuvering the Six Temperaments: Contentment – Tolerance – Charity – Chastity – Parity – Forgiveness. Five important Benefits of Meditation: Perspicacity – Magnanimity – Adaptability – Receptivity – Creativity. (Enhancing memory) (Effective Examination Preparation)

TOTAL : 30 PERIODS**TEXT BOOKS:**

1. “Yoga for Youth Empowerment” compiled by Vethathiri Maharishi Institute for Spiritual and Institutional Education, Aliyar, Pollachi, 1st Edition 2016.
2. “Yoga for Human Excellence”, compiled by Vethathiri Maharishi Institute for Spiritual and Institutional Education, Aliyar, Pollachi 1st Edition 2009.

e-RESOURCE:

1. www.online.vethathiri.edu.in “online in (Virtual) Programme on Yoga and Human Excellence”.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2
CO1	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	3	-	2	-	-	-	-	-	-
CO3	-	-	-	-	-	3	-	2		-	-	-	-	-
CO4	-	-	-	-	-	3	-	2	2	-	-	-	-	-
CO5	-	-	-	-	-	3	-		2	-	-	-	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

Communicative English is a life skill necessary for all students of Engineering and Technology. The course Communicative English-II aims at developing Communication Skills in English essential for expressing the ideas through speaking and writing in different social, academic and professional contexts.

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

1. Start, maintain and close a conversation in a variety of contexts including formal/informal and telephonic conversation.
2. Use structurally correct expressions and conversations.
3. Speak fluently using phrasal verbs and Idiomatic Expressions by recognizing and rectifying own pronunciation and intonation problems.
4. Speak fluently using a wide range of vocabulary.
5. Communicate effectively by using business correspondence structures.

UNIT 1 EFFECTIVE SPEAKING -BASIC LANGUAGE CHUNKS**10**

Conversational Starters – Closing a Conversation - Greeting and Leave Taking - Introducing Oneself - Introducing Others - Making Request - Offering Help - Expressing Gratitude -Extending Invitation - – Conveying Wishes – Encouraging Words -Seeking Permission – Granting Permission-Making Complaints - Seeking Apology - Making Interruption - Expressing Possibility- Expressing Agreement and Disagreement - Expressing Hesitation -Asking for Directions and Giving Directions - Giving Instructions- Questions and Expressions with Time – Checking for Understanding -Showing Interest -Expressing Likes and Dislikes

UNIT 2 EFFECTIVE SPEAKING –ADVANCED LANGUAGE CHUNKS**10**

Expressing Personal Opinion - Expressing Feelings - Accepting Responsibility - Giving Clarifications - Tag Questions - Giving Comments – Giving Advice – Making Suggestions- –Making Comparisons – Analyzing Problems- Exploring Options – Making Classifications and Elaborations - Speaking Hypothetically-- Discussing Plans-Making Negotiations-Making Presentations-Telephone Etiquette - Telephone Conversation

UNIT 3 EFFECTIVE SPEAKING - PHRASAL VERBS AND IDIOMATIC EXPRESSIONS**3**

Most useful Phrasal Verbs related to Self-Introduction-Idiomatic Expressions related to Person, Time and Action

UNIT 4 EFFECTIVE SPEAKING – VOCABULARY ENRICHMENT**10**

Talking about Abilities – Travel – Shopping – Climate -Commuting – Distance – Food – Occupation – Parties and Festivals – Daily Routine – Clothing – Hobbies – Favorites- Family – Buying and Selling- Schedules and Plans

UNIT 5 BUSINESS WRITING**12**

Writing Instructions - Recommendations - Checklist - Tour Itinerary -Writing Slogans - E- mail Writing - Single Line Definitions - Process Description – SMS - Transcoding Graphics - Bar Chart, Flow Chart, Pie Chart and Tables - Business Letters - Calling for Quotations, Placing Orders, Letter of Complaint, Letter of Clarification - Agenda and Meeting Minutes - Cover Letter with Résumé - Report Writing - Accident Report, Industrial Visit Report, Survey Report and Feasibility Report- Summary Writing.

TOTAL : 45PERIODS**TEXT BOOKS:**

1. Sanjay Kumar and Pushp Lata, “Communication Skills” 2nd Edition, Oxford University Press, New Delhi, 2017.
2. J.K. Gangal, “A Practical Course in Spoken English” 1st Edition PH1 Learning Private Limited, Delhi, 2014.

REFERENCES:

1. Dr K Elango, Dr. Veena Selvam, Dr. Sujatha Priyadarshini, “Resonance English for Engineers and Technologists”. Cambridge University Press, 1st Edition, Foundation Books, New Delhi, 2013.
2. Dr. Mahendra Sarawat, “Speak English Fluently” Upkar Prakashan Publishers, 1st Edition, Agra, 2010.
3. S. Sumant, Joyce Pereira, “Technical English”, Vijay Nicole imprints Private Limited, 1st Edition Chennai, 2017.

e-RESOURCES:

1. <https://www.fluentu.com/Blog/english/english-small-talk/>

Mapping of COs with POs and PSOs

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2
CO1	-	1	-	-	-	1	-	-	-	3	-	-	-	-
CO2	-	1	-	-	-	1	-	-	1	3	-	1	-	-
CO3	-	1	-	-	-	1	-	-	-	3	-	-	-	-
CO4	-	1	-	-	-	1	-	-	-	3	-	-	-	-
CO5	-	-	-	-	-	3	-	-	-	3	-	-	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

Vector calculus is a form of mathematics that is focused on the integration of vector fields. An Engineer should know the Transformations of the Integrals, as Transformation of Line Integral to surface and then to volume integrals. Complex Integration approach is very useful to evaluate many improper integrals of a real variable. The Laplace transform method is a powerful method for solving linear ODEs and corresponding initial value problems as well as systems of ODEs arising in Engineering. The knowledge of transformations is to create a new domain in which it is easier to handle the problem that is being investigated.

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

1. Compute gradient, directional derivative by vector differentiation and determine line integrals, surface integrals and volume integrals by vector integration.
2. Construct analytic functions and transforms the analytic functions from one domain to another using conformal mapping.
3. Classify the singularities, find Laurent's series for analytic functions and compute complex integrals using Cauchy's integral theorem and Cauchy's Residue theorem.
4. Solve linear higher order differential equations with constant and variable coefficients
5. Solve linear second order ordinary differential equations with constant coefficients using the properties of Laplace Transforms.

UNIT 1 VECTOR CALCULUS**9+3**

Vector Differentiation: Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration: Line, Surface and Volume Integrals -Green's theorem in a plane, Gauss Divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving squares, rectangles, cubes and rectangular parallelepipeds.

UNIT 2 ANALYTIC FUNCTIONS**9+3**

Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions by Milne's method – Conformal mapping:
 $w = z+k$, kz , $1/z$ and bilinear transformation.

UNIT 3 COMPLEX INTEGRATION**9+3**

Statement and applications of Cauchy's integral theorem and Cauchy's integral formula (excluding proof) – Taylor's and Laurent's series expansions – Singularities – Residues – Cauchy's residue theorem(excluding proof) – Application of residue theorem to evaluate real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis)

UNIT 4 ORDINARY DIFFERENTIAL EQUATIONS**9+3**

Linear higher order differential equations with constant coefficients – Method of variation of Parameters – Cauchy's and Legendre's linear differential equations – Simultaneous first order linear differential equations with constant coefficients.

UNIT 5 LAPLACE TRANSFORMS**9+3**

Laplace transform: Sufficient conditions – Transform of elementary functions – Basic Properties – Transforms of derivatives and integrals of functions — Transform of periodic functions

Inverse Laplace transform: Standard results – Statement of Convolution theorem and its applications – Initial and final value theorems – Solution of linear second order ODE with constant coefficients using Laplace transformation techniques.

TOTAL : 60PERIODS**TEXT BOOKS:**

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, New Delhi, 2014.
2. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 26th Reprint, New Delhi, 2016

REFERENCES:

1. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Veerarajan T., "Engineering Mathematics (I Year)", 3 rd Edition, Tata McGraw Hill Publishing Company, Delhi, 12.
3. P.Kandasamy, K.Thilagavathy, K.Gunavathy, "Higher Engineering Mathematics", S.Chand& Co Ltd, Chennai,2016.

e-RESOURCES:

1. <http://nptel.ac.in/courses/122107036/> “Mathematics-II”, Prof. TanujaSrivastava, Department of Mathematics, Indian Institute of Technology, Roorkee.
2. <http://nptel.ac.in/courses/122107037/> “Mathematics – III”, Prof. Dr. P. N. Agrawal , Indian Institute of Technology, Roorkee

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2
CO1	3	3	2	2	-	-	-	-	-	-	-	1	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	1	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	1	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	1	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

Knowledge about the electronic structure of metals and semiconductors has manifested as a technology to design materials of desired properties. The knowledge of magnetic materials, superconductors and optical behavior of materials form the basis of solid state devices. Nanomaterials are envisioned in self-replicating robots at the molecular scale, in engines of creation.

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

1. To understand the behaviour of conducting materials based on classical and Quantum theory.
2. Gaining the knowledge on semiconductors with their carrier concentration and hall effect.
3. To understand the types of magnetic material and applications of superconducting materials.
4. Understanding the functioning of optical materials for optical data storage.
5. Familiarize the synthesis of nanomaterials and their various characterization techniques,

UNIT 1 CONDUCTING MATERIALS

9

Conductors – Classical free electron theory of metals – Electrical and thermal conductivity -Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory –Fermi distribution function – Effect of temperature on Fermi function – Density of energy states –Carrier concentration in metals.

UNIT 2 SEMICONDUCTING MATERIALS

9

Intrinsic semiconductor – Carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – Electrical conductivity – Band gap determination –Types of semiconductor- Derivation of carrier concentration in n-type and p-type semiconductor– Variation of Fermi level with temperature and impurity concentration — Hall effect – Determination of Hall coefficient – Applications.

UNIT 3 MAGNETIC AND SUPERCONDUCTING MATERIALS

9

Origin of magnetic moment – Bohr magneton – Comparison of dia, Para and Ferro magnetism –Domain theory – Hysteresis – Soft and hard magnetic materials – Antiferromagnetic materials.

Superconductivity : Properties – Type I and type II superconductors –BCS theory of superconductivity(qualitative) – High T_csuperconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT 4 OPTICAL MATERIALS

9

Classification of optical materials – Absorption in metals, insulators & Semiconductors (concept only)- carrier generation and recombination processes-LED's – Organic LED's – Polymer light emitting materials – Plasma light emitting devices— Laser diodes – Optical data storage techniques

UNIT 5 SYNTHESIS AND CHARACTERIZATION OF NANOMATERIALS

9

Nanomaterials: Introduction-properties –Classification of synthesis routes - Ball milling – Sol gels –Chemical Vapour Deposition (CVD) – Applications of Nanomaterials. Carbon nanotubes: Fabrication – Arc method – Pulsed Laser Deposition (PLD) – Chemical Vapour Deposition (CVD) - Properties and applications – Characterization technique – Powder X-ray diffractometer – Microscopic techniques: Introduction to Electron microscope– Scanning Electron Microscope (SEM)– Transmission Electron Microscope (TEM).

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Palanisamy P.K, “Materials Science”, 2ndEdition, Scitech publications (India) Pvt. Ltd., Chennai, 2007.
2. S.O.Pillai “Solid State Physics”, 6thEdition, New Age International(P) Ltd, Publishers New Delhi, 2010.

REFERENCES:

1. Balasubramaniam R, “Callister’s Materials Science and Engineering”, 2ndEdition, Wiley-India 2014.
2. Charles P. Poole and Frank J.Owens, “Introduction to Nanotechnology”, 1stEdition, Wiley, Delhi, 2007.
3. Donald A.Neamen, “Semiconductor Physics and Devices: Basic Principles”, 3rd Edition, Tata McGraw-Hill, 2012.

e-RESOURCES:

1. <http://nptel.ac.in/courses/122102008> , “Materials Science” – Dr. S. K. Gupta, IIT Delhi
2. <https://www.khanacademy.org/science/physics/magnetic-forces-and-magnetic-fields>

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO2	3	2	-	-	-	1	1	-	-	1	1	1	-	-
CO3	3	2	-	-	-	1	1	-	-	1	1	1	-	-
CO4	3	2	-	-	-	1	1	-	-	1	1	1	-	-
CO5	3	2	-	-	-	1	1	-	-	1	1	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

The course covers the fundamentals of basic electrical circuit parameters of both ac and dc circuits and the characteristics of motors and generators. The basics of semiconductor devices and logic gates provides the necessary initiative for the students to acquire the knowledge in basic electronics.

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

- 1 Analyze the various DC circuits and find the circuit parameters.
- 2 Describe the principles of AC fundamentals.
- 3 Illustrate the construction and working principle of DC machines.
- 4 Explain the basics of semiconductor devices and its applications.
- 5 Explain the basics of Number systems and Logic gates.

UNIT 1 ELECTRICAL CIRCUITS – DC**9**

Definition of Electrical Circuit Parameters - voltage – current - power and energy. Elements of DC Circuits - DC voltage / Current Sources. Calculation of Resistance and Current in series and parallel circuit– Star-Delta transformation of Resistance. Ohm's Law, Kirchhoff's Laws and its applications - Simple Problems in Mesh and Nodal analysis. Construction and working principle of Permanent Magnet Moving Coil Instruments.

UNIT 2 ELECTRICAL CIRCUITS – AC**9**

AC Circuit Terminologies - RMS and Average value of Sinusoidal waveform – Form Factor - Peak Factor - Power Factor - Definition of impedance and admittance – Phasor diagram - Analysis of R, L, C, RL, RC, RLC circuits. Construction and working principle of Moving iron Instruments. Introduction to Three phase system - Star and Delta Connection.

UNIT 3 ELECTRICAL MACHINES**9**

Review of Laws of Electromagnetic Induction – Fleming's Right and Left hand rules – Lenz's law. DC Generator - Construction - Working principle - Characteristics of DC Shunt Generator. DC Motor - Construction - Working principle – Characteristics and applications of DC Shunt Motor - AC transmission and distribution system (Single line diagram).

UNIT 4 SEMICONDUCTOR DEVICES AND APPLICATIONS**9**

PN junction Diode and its Characteristics - Zener Diode and its Characteristics – Half and Full wave Rectifiers – Voltage regulation. Bipolar Junction Transistor - CE configuration and its characteristics – BJT as an amplifier.

UNIT 5 DIGITAL ELECTRONICS**9**

Boolean Algebra - Theorems and Laws - De-Morgan's theorem – Logic Gates – Universal Gates - Implementation of Boolean functions. Binary Arithmetic - Addition – Subtraction – Multiplication - Division – BCD addition - Half adder and Full adder circuits.

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Muthusubramanian R and Salivahanan S, "Basic Electrical and Electronics Engineering", McGraw Hill Education, 1st Edition, 2014.
2. Mittle V N and Aravind Mittal, "Basic Electrical engineering", McGraw Hill Education, 2nd Edition, 2006.

REFERENCES:

1. V.K.Mehta and Rohit Mehta, "Principles of Electrical Engineering and Electronics", S.Chand& Company Ltd, 2015.
2. SedhaR.S., "Applied Electronics", S.Chand& Company Ltd, 2006.
3. Thomas L.Floyd., "Digital Fundamentals", Pearson Education, Prentice Hall, Tenth Edition, 2010.

E-RESOURCES:

1. NPTEL, <http://nptel.ac.in/courses/117106101/> , "Basic Electrical Circuits", Prof. Nagendra Krishnapura, IIT, Madras.
2. NPTEL, <http://nptel.ac.in/downloads/108105053/> , "Basic Electrical Technology", Prof. Dr. L. Umanand, IIS, Bangalore.

3. NPTEL, <http://nptel.ac.in/courses/117103063/>, “Basic Electronics”,
Dr. Chitralekha Mahanta, IIT, Guwahati.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2
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CO2	2	3	2	-	-	-	1	-	-	-	-	1	-	-
CO3	2	3	2	-	-	-	1	-	-	-	-	1	-	-
CO4	2	3	2	-	-	-	1	-	-	-	-	1	-	-
CO5	2	3	2	-	-	-	1	-	-	-	-	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

e-RESOURCES:

1. <http://nptel.ac.in/courses/106104128/>, "Introduction to Programming", Prof. Satyadev Nandakumar, IIT-Kanpur.
2. <http://www.nptel.ac.in/courses/106102066/>, "Introduction to Problem Solving and Programming", Dr. S. Arun Kumar, IIT-Delhi.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO3	3	2	1	2	-	-	-	-	-	-	-	2	2	1
CO4	3	2	1	2	-	-	-	-	-	-	-	2	2	1
CO5	3	2	1	2	-	-	-	-	-	-	-	2	2	1

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble :

The understanding of characteristics of solids and liquids and properties of semiconducting materials has been explored. The practical skills in the instrumental methods for quantitative estimation of metal ions content has been the main focus.

Course Outcomes:

1. Experiment and determine the physical characteristics of given solid material.
2. Experiment and determine the Energy band gap of the given semiconducting materials.
3. Experiment and determine the physical characteristics of given liquid.
4. Experiment and estimate dissolved oxygen content using alkali iodide solution by Winkler's method, amount of copper content using EDTA by complexometric titration.
5. Experiment and test chloride content present in the waste water by titrating against silver nitrate using Mohr's method.
6. Experiment and determine the concentration of metals and ions present in the wastewater with the aid of flame photometer and pH meter

**PHYSICS LABORATORY II
(Any Five Experiments)****LIST OF EXPERIMENTS**

1. Determination of Young's modulus by uniform bending method.
2. Determination of band gap of a semiconductor.
3. Determination of coefficient of viscosity of a liquid – Poiseuille's method.
4. Determination of thickness of a thin wire – Air wedge method.
5. Determination of rigidity modulus – Torsion pendulum.
6. Determination of Hysteresis of a ferromagnetic material – Deflection magnetometer

CHEMISTRY LABORATORY II**LIST OF EXPERIMENTS**

1. Determination of Dissolved Oxygen content of waste water sample by Winkler's method
2. Determination of chloride content of wastewater sample by Argentometric method.
3. Determination of acid strength in waste water using pH meter.
4. Estimation of dissolved metal ions present in wastewater using flame photometer.
5. Estimation of dissolved metal ions(copper) present in wastewater by EDTA method.

TOTAL : 30 PERIODS

- **Laboratory classes on alternate weeks for Physics and Chemistry.**

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO2	2	2	-	3	-	1	1	-	1	1	1	1	-	-
CO3	2	2	-	3	-	1	1	-	1	1	1	1	-	-
CO4	2	1	-	3	-	1	1	-	1	1	1	1	-	-
CO5	2	1	-	3	-	1	1	-	1	1	1	1	-	-
CO6	2	1	-	3	-	1	1	-	1	1	1	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

This laboratory course is intended to provide students with opportunities to get hands on training to solve Engineering problems using C programming language.

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

1. Develop and test the C program to solve a given problem statement using suitable datatypes, decision making and control statements.
2. Develop and test the C program to process the given list or table of data and reproduce the array according to the expected result.
3. Develop and test the C program for the given problem statement using structure, union and functions.
4. Develop and test the C programs using pointers to access arrays , functions and allocate memory using dynamic memory management functions.
5. Develop and test the C programs to store and process the given data using files.

LIST OF EXPERIMENTS

1. C programs that involve basic data types, looping and decision statements.
2. C programs using one dimensional and two dimensional arrays.
3. C programs for String manipulation operations.
4. C programs using Functions
 - Parameter passing
 - Library functions
 - Math functions
 - Recursion
5. C programs using structures and union.
6. C programs using Pointers
 - Pointer arithmetic
 - Arrays and functions using pointers.
7. C programs for basic file operations.
8. C programs using dynamic memory allocation.
9. Developing applications using C
 - Payroll Processing
 - Banking Application
 - Quiz software

TOTAL : 45 PERIODS

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3	2	3	2	-	-	-	1	-	-	-	2	1
CO2	1	3	2	3	2	-	-	-	1	-	-	-	2	1
CO3	1	3	2	3	2	-	-	-	1	-	-	-	2	1
CO4	1	3	2	3	2	-	-	-	1	-	-	-	2	1
CO5	1	3	2	3	2	-	-	-	1	-	-	-	2	1

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

The students are given the introduction upon the basics of computer which comprises of the study of Motherboard and interfacing components and operating system. They were given the practice for assembling a PC, assembling RAM in a motherboard, assembling hard disk drive in a cabinet, assembling CD/DVD ROM in a cabinet, establishing data connection and fixing wires. The basic knowledge of electrical and electronics is mandatory and it is practiced with the wiring experiments and by verification of the basic logic gates.

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

1. Study the basics of personal computer and also its interfacing components.
2. Install and update windows and Linux operating systems.
3. Explain basics of Computer assembly and configuration and also system installation with different software's.
4. Construct various types of domestic wiring and measure the various electrical parameters.
5. Develop and test circuits with active elements and verify truth table of logic gates.

LIST OF EXPERIMENTS**COMPUTER**

- 1) Study and identification of standard desktop personal computer.
- 2) Study of Motherboard and interfacing components.
- 3) Install, upgrade and configure Windows operating systems.
- 4) Install, upgrade and configure Linux operating systems.
- 5) Computer Assembly and Configuration : Steps for assembling a PC, assembling RAM in a motherboard, assembling hard disk drive in a cabinet, assembling CD/DVD ROM in a cabinet, establishing data connection and fixing wires.
- 6) System Installation: Steps for installing different software's (including antivirus software, printer and scanner software).

ELECTRICAL AND ELECTRONICS**ELECTRICAL**

- 7) Residential house wiring using switches, fuse, indicator and lamps.
- 8) Fluorescent lamp wiring.
- 9) Stair case wiring.
- 10) Reading of voltage, current, power, energy and other parameters with 1 phase digital energy meter
- 11) Measurement of earth resistance

ELECTRONICS

- 12) Identification and Study of Electronic components and equipments – Resistors, capacitors, inductors, colour coding and measurement.
- 13) Measurement of AC signal parameters (peak-peak, RMS value, period, frequency) using CRO.
- 14) Verification of the truth tables of logic gates: AND, OR, XOR and NOT.
- 15) Construction of Half Wave and Full Wave Rectifiers and study their output waveforms.
- 16) Soldering practice – Using general purpose PCB.

TOTAL : 45PERIODS

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3	1	1	2	-	1	1	1	-	-	-	-	-
CO2	1	3	1	1	2	-	1	1	1	-	-	-	-	-
CO3	1	3	1	1	2	-	1	1	1	-	-	-	-	-
CO4	1	3	2	1	2	-	1	1	1	-	-	-	-	-
CO5	1	3	2	1	2	-	1	1	1	-	-	-	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

The study of biodiversity reflects the extent of the interest of a nation in its natural resources and heritage, which is considered as a crucial portion of the national wealth. Since India is one of the twelve mega-diversity center of the earth, much emphasis should be put on understanding, preserving and utilizing the biodiversity of our biotic resources. Environmental protection is an important issue for society today as scientific research provides evidence of increasing global warming, ozone depletion and higher levels of pollution. Engineers should learn how to design, develop and evaluate structures, equipment and systems to provide practical solutions to problems caused by pollution, exploitation of natural resources and population explosion.

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

1. Compare and contrast structure and function of forest and marine ecosystem to conserve biodiversity
2. Analyze the sources, effects, control measures of air and water, solid waste management to maintain green environment.
3. Describe overexploitation of forest, overutilization of water and environmental impacts related to food resources to preserve environment.
4. Explain human health, environment and disaster management through information technology.
5. Discuss air and water act to solve environmental issues of climatic change.

UNIT 1 ECOSYSTEM AND BIODIVERSITY MANAGEMENT**6**

Importance of environmental studies-Ecosystem-Definition, Characteristics, structure and functions of Forest and Ocean ecosystem. Biodiversity-Definition, Significance, Values of biodiversity, Threats to biodiversity-Habitat loss and poaching, Biodiversity conservation-In-situ (Biosphere and National park), Ex-situ (Gene bank and Seed bank)

UNIT 2 ENVIRONMENTAL POLLUTION**6**

Pollution- Definition causes and effects of Air and Water. Control strategies-Air pollution- (Catalytic converter, Cyclone separator). Water pollution-waste water treatment (Primary, Secondary and Tertiary Treatment). Solid waste-Source and generation of solid waste, Methods of disposal- Sanitary land fill, Incineration and composting.

UNIT 3 NATURAL RESOURCES**6**

Forest Resources: Functions of forest, deforestation-causes, consequences and steps to prevent deforestation.

Water Resources: over-exploitation of surface and ground water, Benefits and problems of dams on forests and tribal people. Food Resources: Environmental impacts related to food resources –Effects of modern agriculture (fertilizer and pesticide problems), water logging and salinity.

UNIT 4 ROLE OF IT AND DISASTER MANAGEMENT**6**

Role of IT in environment-Remote Sensing and GIS application, Global positioning system, Environmental data base. Role of IT in human health – EHR, Medical Transcription, Endoscopy, Automated dispensing machine (ADM), Teleconference, Picture archiving and Communication System (PACS) method. Disaster management-Cause, effects and mitigation of Flood, Cyclone, Earthquake, Tsunami

UNIT 5 SOCIAL ISSUES AND ENVIRONMENTAL LEGISLATION**6**

Social Issues: Climate change- Global warming, Ozone layer depletion, Water conservation-Rain water harvesting (Roof top method). Legislation- Function of State and Central pollution control Board (Air and Water).

TOTAL : 30 PERIODS**TEXT BOOKS:**

1. Dr. Arun Luiz T, 'Environmental Science and Engineering', 1st edition (2017), VK publications.
2. P. Yuganath & Dr. R. Kumaravelan, 'Environmental Science and Engineering', 2nd edition, reprint (2017), Scitech Publication (India) Pvt. Ltd., Chennai.

REFERENCES:

1. Benny Joseph, 'Environmental Science and Engineering', 3rd reprint (2015), McGraw Hill Education (India) Pvt. Ltd. Delhi.
2. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd edition (2004), Prentice Hall of India Pvt. Ltd.

e-RESOURCES:

1. <https://nptel.ac.in/courses/105104099/4> "Types and forms of Air Pollutants" – Prof. Mukesh Sharma, Department of Civil Engineering, IIT Kanpur.
2. <https://nptel.ac.in/courses/105104183/8> - "Introduction to natural hazards (Flood and Tsunami)" – Prof. Javed Malik, Department of Civil Engineering, IIT Kanpur

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	1	1	1	2	3	1	1	1	1	2	-	-
CO2	3	2	1	1	1	3	3	1	1	1	1	2	-	-
CO3	3	2	1	1	1	3	3	2	1	1	1	2	-	-
CO4	3	2	1	1	1	3	3	2	1	1	1	2	-	-
CO5	2	2	1	1	1	3	3	1	1	1	1	2	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

The phenomena of heat conduction, wave and signal propagation in media are described by Partial Differential equations (PDE) or Difference equations. For analyzing such phenomena, knowledge of mathematical techniques for solving PDE and Difference equations are needed for engineering students. This course aims to provide sufficient knowledge to engineering students in the specific mathematical techniques such as Fourier series, Fourier transform, Z-transform and PDE.

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

1. Compute the trigonometric form of the Fourier series for periodic waveforms satisfying the Dirichlet's conditions and using them to evaluate infinite series.
2. Compute the solution for the standard forms of linear partial differential equations of first order and solve homogeneous partial differential equations of first and second order with constant coefficients.
3. Compute the analytical solution for the given physical model for the specified initial and boundary conditions in one dimensional and two dimensional distributions.
4. Compute the Fourier transform of elementary non-periodic waveforms using Fourier Transform properties.
5. Solve the difference equations of first and second order using Z-transform techniques.

UNIT 1 FOURIER SERIES**9+3**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic Analysis.

UNIT 2 PARTIAL DIFFERENTIAL EQUATIONS**9+3**

Formation of partial differential equations – Singular Integrals – Solutions of standard types of first order partial differential equations: $F(p, q) = 0$, $F(z, p, q) = 0$, $F(x, p) = G(y, q)$ and $z = px + qy + F(p, q)$ – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of homogeneous type.

UNIT 3 APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**9+3**

One dimensional wave equation – Transverse vibrations of a string – One dimensional equation of heat conduction – Steady state temperature distribution in a rod – Two dimensional steady state temperature distributions in a plate.

UNIT 4 FOURIER TRANSFORMS**9+3**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Convolution theorem – Parseval's identity.

UNIT 5 Z TRANSFORMS AND DIFFERENCE EQUATIONS**9+3**

Z-transforms - Elementary properties – Inverse Z-transform (using Partial Fraction and Residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z-transform.

TOTAL :60 PERIODS**TEXT BOOKS:**

1. Bali.N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, University Press India (P) Ltd, Hyderabad (2015).
2. Grewal. B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna publishers, Delhi (2016).

REFERENCES:

1. Ramana.B.V., "Higher Engineering Mathematics", 1st Edition, Tata Mc-GrawHill Publishing Company Ltd, New Delhi, 2016
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley Dream Tech India(P) Ltd. 2016

e-RESOURCES:

1. <http://nptel.ac.in/courses/111105035/27> , "Advanced Engineering Mathematics", Prof. Jitendra Kumar, Department of Mathematics, IIT- Kharagpur

2. <http://nptel.ac.in/courses/111106046>, “Fourier Series”, Prof.R.Radha, and Prof S. Thangavelu, Department of Mathematics, IIT -Madras.
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Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO2	3	3	2	2	-	-	-	-	-	1	-	1	-	-
CO3	3	3	2	2	-	-	-	-	-	1	-	1	-	-
CO4	3	3	2	2	-	-	-	-	-	1	-	1	-	-
CO5	3	3	2	2	-	-	-	-	-	1	-	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

Object oriented programming aims to implement real world entities like inheritance, hiding, and polymorphism in programming.

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

1. Identify the object-oriented language features and constructs and apply them to write C++ programs for simple problems.
2. Develop solution for a given problem using constructors, destructors.
3. Apply inheritance and polymorphism for a given problem to achieve reusability and exception handling mechanism.
4. Apply templates for the given problem to achieve generic programming and efficient anomaly handling.
5. Develop C++ programs that uses string, and file for input and output and for the given problem.

UNIT 1 OBJECT ORIENTED CONCEPTS**9**

Concepts of Object-oriented programming — Classes and Objects – Methods and messages – Abstraction and Encapsulation – Inheritance – Polymorphism-Overview of C++ – Classes and objects– Access specifiers – Function and data members – Objects – Pointers and objects – Constant objects – Nested classes – Local Classes - Functions: Default arguments – Function overloading – Friend functions.

UNIT 2 CONSTRUCTOR, DESTRUCTORS, OPERATOR OVERLOADING**9**

Constructors – Default constructor – Parameterized constructors – Constructor with dynamic allocation – Copy constructor – Destructors – Operator Overloading: unary, binary operator overloading–Overloading through friend functions – Type conversion.

UNIT 3 INHERITANCE, POLYMORPHISM**9**

Inheritance –Public, private, and protected derivations – Multiple inheritance - Virtual base class – Abstract class – Polymorphism: Compile time and Runtime polymorphism – Virtual functions – Pure virtual functions.

UNIT 4 TEMPLATES AND EXCEPTIONS**9**

Function Templates – Simple Function Template – Function Templates with Multiple Arguments – Class Templates- Introduction to STL-Algorithms-Containers-Functions-Iterators. Exception handling: Need-Components of exception handling–Throwing within and outside the function–Rethrowing exception.

UNIT 5 STREAMS - FORMATTED I/O AND STRINGS**9**

Streams and formatted I/O: Formatted and Unformatted I/O –Using files for input/output: Opening and closing files – Text files– String objects: Creating strings, Substring operations.

TOTAL:45 PERIODS**TEXT BOOKS:**

1. Robert Lafore, “Object-Oriented Programming in C++”, Fourth Edition, Sams publishing, Twenty Sixth Impression, 2019.
2. Bhushan Trivedi , “Programming with ANSI C++”, Second Edition, Oxford press, 2013.

REFERENCES:

1. Bjarne Stroustrup, “The C++ Programming Language”, Fourth Edition, Addison Wesley, 2013.
2. Stanley B. Lippman and Josee Lajoie, “C++ Primer”, Fifth Edition, Addison Wesley, 2012.
3. E Balagurusamy, “Object-Oriented Programming with C++”, Seventh edition, McGraw Hill Education, 2017.

e-RESOURCES:

1. <http://nptel.ac.in/courses/106105151/>, “Programming in C++”, Prof. ParthaPratim Das, IIT, Kharagpur.
2. <https://www.khanacademy.org/computing/computer-programming/programming/object-oriented/pt/>.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3	2	1	-	1	-	-	-	-	-	1	3	2
CO2	1	3	2	2	-	1	-	-	-	-	-	1	3	2
CO3	1	2	3	2	-	1	-	-	-	-	-	1	3	2
CO4	1	2	3	2	-	1	-	-	-	-	-	1	3	2
CO5	1	2	3	3	-	1	-	-	-	-	-	1	3	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

A data structure is an arrangement of data in computer's memory in such a way that it could make the data quickly available to the processor for required calculations. A data structure should be seen as a logical concept that must address two fundamental concerns. Lists, arrays, stacks, queues, heaps, trees, and graphs are the more commonly used data structures.

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

1. Develop list ADT for a given list or table using array and linked list implementation by ensuring the ordering of data elements.
2. Create stack and queue ADT for a given list using array and linked list implementation and apply specific ADT for a given application.
3. Construct a tree for a given list of data by ensuring tree properties and analyze inorder, preorder, postorder traversal for a constructed tree.
4. Implement a suitable shortest path algorithm for a given graph such that the sum of the edges weights is minimum.
5. Apply a suitable searching and hashing algorithms for a given list of data considering the size and ordering of data.

UNIT 1 LISTS 9

Abstract Data Types (ADT) – List ADT – Array-Based Implementation – Linked List Implementation– Singly Linked Lists- Circularly Linked Lists -Doubly-Linked Lists – Applications of Lists.

UNIT 2 STACKS AND QUEUES 9

Stack ADT – Queue ADT – Circular Queue – Applications of Stacks and Queues.

UNIT 3 TREES 11

Preliminaries - Binary Trees - Binary Tree Traversal - Binary Search Trees- Expression Trees – AVL. Trees- Binary Heap - Heap Sort.

UNIT 4 GRAPHS 9

Definitions - Graph Traversal - Topological Sort - Shortest-Path Algorithms: Unweighted Shortest Paths - Dijkstra's Algorithm - Minimum Spanning Tree - Prim's and Kruskal's Algorithms - Undirected Graphs.

UNIT 5 SEARCHING AND HASHING 7

Searching: Linear Search - Binary Search. Hashing - General idea - Hash Function - Separate Chaining - Open Addressing: Linear Probing - Quadratic Probing - Double Hashing.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. M. A. Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 2015.
2. Richard F. Gilberg, and Behrouz A. Forouzan, "Data Structures - A Pseudocode Approach with C", Second Edition, Thomson Brooks/cole, 2011.

REFERENCES:

1. Reema Thareja, “Data Structures Using C”, First Edition, Oxford University Press, 2011.
2. ISRD Group, “Data Structures Using C”, First Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2007.
3. Data Structures through C, Yashwant Kanetkar, BPB Publications.

e-RESOURCES:

1. <http://www.nptel.ac.in/courses/106102064>, Introduction to data structure, Mr. Varma, IIT Bombay.
2. <http://nptel.ac.in/courses/106102064>, Video Lectures, Data Structures and Algorithms, IIT Delhi.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	1	-	-	-	-	-	1	-	1	3	-
CO2	3	2	2	1	-	-	-	-	-	1	-	1	3	-
CO3	3	2	2	1	-	-	-	-	-	1	-	1	3	-
CO4	3	2	2	1	-	-	-	-	-	1	-	1	3	-
CO5	3	2	2	1	-	-	-	-	-	1	-	1	3	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble :

This course aims at giving adequate exposure to students on the design and analysis of logic circuits. The course is intended to understand different kinds of number representation and its conversion. It helps the student to acquire knowledge on the concepts of combinational and sequential logic circuits and simulate digital logic circuits using Verilog HDL.

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

1. Represent a number in bases like Binary, Decimal, Octal and Hexadecimal and convert a numeral from one base to another base.
2. Design logic circuits by reducing the Boolean expression using K-map and Tabulation minimization techniques and implement them using Universal logic gates.
3. Design Adders, Subtractor, Code Converters, Encoder, Decoder, Multiplexer and Demultiplexer by deriving logical expressions using K-Map.
4. Design sequential logic circuits to implement shift registers and counters using Flipflops.
5. Design combinational and sequential circuits using PROM, PLA and PAL and simulate digital circuits using Verilog HDL.

UNIT 1 NUMBER SYSTEMS AND LOGIC GATES**9**

Number Systems – binary, decimal, octal and hexadecimal number systems. Number Base conversions- Binary Arithmetic – Binary Codes – Classification of binary codes – Logic Gates.

UNIT 2 BOOLEAN ALGEBRA**9**

Boolean Algebra -Basic Theorems and properties – De-Morgan's Theorem – Principle of Duality – Truth tables and Boolean expression - Minimization of Boolean expressions using Boolean Theorems – Minterm – Maxterm – Sum of Products (SOP) – Product of Sums (POS) – Simplification of Boolean Functions using Karnaugh Map and Tabulation Methods (Two, Three, Four and Five variables) – Don't care conditions - NAND and NOR Implementations.

UNIT 3 COMBINATIONAL LOGIC CIRCUITS**9**

Combinational circuits - Design procedure –Half Adder and Full Adder- Half Subtractor and Full Subtractor – Parallel adder/ Subtractor- Code converters-Binary to gray code convertor- Gray to binary code convertor-BCD to Excess-3 code convertor- Encoder – Decoder- Multiplexer- Demultiplexer.

UNIT 4 SEQUENTIAL LOGIC CIRCUITS**9**

Sequential circuits – Latches - Flip flops – Realization of one flip flop using other flip flop - Analysis and design of clocked sequential circuits - State reduction and State assignment - Shift registers – Counters-Design of Counters.

UNIT 5 MEMORIES AND HDL**9**

RAM and ROM - Programmable logic devices (PLDs) – PROM – PLA - PAL - Introduction to Verilog Hardware Description Language (HDL) – Verilog HDL for combinational circuits, Verilog HDL for Sequential Circuits.

List of Experiments

1. Verification of De-Morgan's theorems using digital logic gates.
2. Design and implementation of Half Adder, Full Adder and binary to gray code converter.
3. Design and implementation of multiplexers/ Demultiplexers.
4. Design and implementation of Synchronous counters.
5. Simulation of combinational and sequential circuits using Verilog HDL.

TOTAL : (L:45+P:15) 60 PERIODS**TEXT BOOKS:**

1. Morris Mano M. and Michael D. Ciletti, "Digital Design", 5th Edition, Pearson Education, NewDelhi, 2013.
2. Charles H. Roth Jr, "Fundamentals of Logic Design", 7th Edition, Jaico Publishing House, Mumbai, 2014.

REFERENCES:

1. Thomas. C. Bartee, "Digital Computer Fundamentals", 6th Edition, Tata McGraw- Hill, New Delhi, 2011.
2. Anil K. Maini, "Digital Electronics: Principles and Integrated Circuits", 1st Edition, Wiley-India, New Delhi, 2008.
3. Kharate G. K., "Digital Electronics", Oxford University Press, 2010
4. Donald D. Givone, "Digital Principles and Design", First Edition, Tata McGraw Hill, New Delhi, 2011.

e-RESOURCES:

1. <http://nptel.iitm.ac.in/courses/117106086>, “Digital Circuits and Systems-video”, Prof.S.Srinivasan, IIT -Madras.
2. <http://www.satishkashyap.com/2012/02/digital-electronic-circuits-by-shouri.html>, “Digital Electronics”, Dr.Shouri Chatterjee, IIT- Delhi.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2
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CO2	2	3	2	2	-	-	-	-	-	-	-	1	3	-
CO3	2	3	2	2	-	-	-	-	-	-	-	1	3	-
CO4	2	3	2	2	-	-	-	-	-	-	-	1	3	-
CO5	2	3	2	2	-	-	-	-	-	-	-	1	3	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

Computer Architecture equips students' knowledge on principles of computer design, instruction set design concepts, performance enhancements, performance comparisons and design and implementation of high performance computing systems. It imparts the concept of parallelism and different memory technologies in hierarchical memory systems.

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

1. Analyze the performance and describe the instruction set using different addressing modes for a given computer architecture and organization.
2. Describe the arithmetic operations involving addition, subtraction, division, multiplication and floating point number operations for a given computer organization.
3. Construct the datapath and describe the effect of data hazard, control hazard for a given pipeline processor.
4. Describe the memory hierarchy and analyze the operation of cache memory for a given computer organization.
5. Compare the standard I/O interfaces and data transfer techniques to access I/O devices for the given computer system.

UNIT 1 BASIC STRUCTURE OF COMPUTERS 9

Functional Units – Basic Operational Concepts– Bus Structures - Instruction Set Architecture–RISC – CISC – Instructions and Instruction Sequencing– Addressing modes– Performance and Metrics.

UNIT 2 ARITHMETIC OPERATIONS 9

Addition and Subtraction – Design of Fast Adders – Signed operand Multiplication – Fast Multiplication - Integer Division – Floating Point Numbers and Operations.

UNIT 3 PROCESSOR AND CONTROL UNIT 9

Basic concepts –Role of Cache Memory – Pipelining Performance – Types of Hazards- Data hazards – Instruction Hazards (prediction) – Data path and Control Considerations.

UNIT 4 MEMORY SYSTEMS 9

Memory hierarchy – Speed , Size and Cost – Semiconductor RAM – ROM–Cache Memory – Mapping FUNCTIONS – Replacement Algorithms – Measuring Cache Performance.

UNIT 5 I/O ORGANIZATION 9

Accessing I/O devices – Programmed Input / Output – Interrupts – Direct Memory Access –Buses – Interface circuits – Standard I/O Interfaces (PCI, SCSI, USB).

TOTAL : 45 PERIODS

TEXT BOOKS:

1. V.CarlHamacher, ZvonkoVaranesic and SafwatZaky, “Computer Organization“, 5thEdition, McGraw-Hill Inc, 2012.

REFERENCES:

1. David A. Patterson and John L. Hennessey, “Computer organization and design’, Morgan Kauffman/ Elsevier, 5th Edition, 2014.
2. M. Morris Mano, “Computer System Architecture”, 3rd Edition Pearson Education, 2017
3. William Stallings “Computer Organization and Architecture”, 10th Edition, Pearson Education, 2015.

e-RESOURCES:

1. <http://nptel.ac.in/courses/106102062/1>, “Computer Architecture”, Prof. Anshul Kumar, IIT- Delhi.
2. <http://nptel.ac.in/courses/106105033/6>, “High Performance Computer Architecture”, Prof. Ajit Pal, IIT-Kharagpur.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO3	3	3	2	2	-	1	-	-	-	-	-	1	2	2
CO4	2	3	-	2	-	-	-	-	-	-	-	1	1	2
CO5	2	3	-	2	-	1	-	-	-	-	-	-	1	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

This laboratory course will enable students to implement real world objects and object-oriented concepts like information hiding, inheritance and polymorphism using C++ programming language.

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

1. Develop a C++ program using objects and array of object concept for the given applications.
2. Develop a C++ program using operator overloading and inheritance for the given applications
3. Create a C++ program to calculate area of a rectangle and add two length units using dynamic polymorphism.
4. Develop a C++ program using templates and exception for the given applications
5. Develop a C++ program use string object with file concept for the given applications

LIST OF EXPERIMENTS

1. Develop a C++ application to generate Electricity bill. Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection (i.e domestic or commercial). Compute the bill amount using the following tariff.
If the type of the EB connection is domestic, calculate the amount to be paid as follows:
 - a. First 100 units – Rs. 1.00 per unit
 - b. 101-200 units – Rs. 2.50 per unit
 - c. 201 -500 units – Rs. 4.00 per unit
 - d. 501 units – Rs. 6.00 per unit
 If the type of the EB connection is commercial, calculate the amount to be paid as follows:
 - e. First 100 units – Rs. 2.00 per unit
 - f. 101-200 units – Rs. 4.50 per unit
 - g. 201 -500 units – Rs. 6.00 per unit
 - h. 501 units – Rs. 7.00 per unit
2. Write a C++ program to calculate interest for recurring deposit, fixed deposit, housing loan, vehicle loan for hundred customers. (use method overload and array of object)
3. Write a program to store the detail of the following rectangles.

Rectangle No.	Color	Length	Breadth
1.	Red	10 cm	25 cm
2.	Blue	34 cm	Unknown. Get from user
3.	Unknown. Get from user	Unknown. Get from user	Unknown. Get from user
4.	Similar to second one	Similar to second one	Similar to second one

Store the value using constructors and calculate the area.

4. Write a C++ program to get two length from the user and add them using operator overload and print the result.
5. Develop a C++ application with Employee class with Emp_name, Emp_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.
6. Develop with suitable hierarchy, classes for Point, Shape, Rectangle, Square, Circle. Design a simple test application to calculate area to using dynamic polymorphism.
7. Create a C++ program to store integers and floating-point numbers and display the numbers in increasing order using template.
8. Create a C++ program to avoid the division of a number by zero using exception handling mechanisms.
9. Write a C++ program store the input numbers in one file and arrange it in ascending order and store the result in another file.
10. Write a C++ program to demonstrate the String object and substring function.

SOFTWARE

- Code:Blocks IDE

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	2	3	1	-	-	-	1	-	-	-	3	2
CO2	2	3	2	3	1	-	-	-	1	-	-	-	3	2
CO3	2	3	2	3	1	-	-	-	1	-	-	-	3	2
CO4	2	3	2	3	1	-	-	-	1	-	-	-	3	2
CO5	2	3	2	3	1	-	-	-	1	-	-	-	3	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

This laboratory course is intended to provide students with opportunities to get hands on training to implement various data structures like lists, arrays, stacks, queues, heaps, trees, and graphs using C programming language.

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

1. Implement and test array and linked list to perform insertion, deletion and searching operations using list ADT.
2. Demonstrate the programming skills in design and implementation of non linear data structures.
3. Design an algorithm to search an element for the given data using linear data structure.
4. Develop a solution to the arrange values for a given problem using heap.
5. Design a solution using non-linear data structures for a given real world problems.

LIST OF EXPERIMENTS

1. There are lists where insertion should ensure the ordering of data elements. Since the elements are in ascending order the search can terminate once equal or greater element is found. Implement a singly linked list of ordered integers (ascending/descending) with insert, search and display operations.
2. Program to simulate Stack using array and linked list.
3. Program to simulate Queue using array and linked list.
4. Write a recursive C program, for traversing a binary tree in preorder, in-order and post-order.
5. Write a C program to insert, delete and search for a node in a binary search tree.
6. Write a C program for graph traversals by applying: (a) Breadth First Search. (b) Depth First Search.
7. Consider the motor racing game in which there are n participants. Get the points scored by each participant. Write a program to sort the positions of players in ascending order based on points scored using heap sort and print the highest score.
8. Use linear search technique to search for a character in a given message.
9. A person has registered for voter id, he received a voter number and he need to check whether it exist in the voter list or not. Use binary search in a recursive way to find whether the voter number exist in the list or not.
10. For the given route map with cost of transportation between different cities, find the shortest route from a source to all the other cities using Dijkstra's Algorithm.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2
CO1	-	2	2	3	-	-	-	-	1	-	-	1	2	-
CO2	-	1	2	3	-	-	-	-	1	-	-	1	2	-
CO3	-	2	2	3	-	-	-	-	1	-	-	1	2	-
CO4	-	2	2	3	-	-	-	-	1	-	-	1	2	-
CO5	-	2	2	3	-	-	-	-	1	-	-	1	2	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

Communicative English is a life skill necessary for all students of Engineering and Technology. The course Essential English for Professionals aims at enabling the learners to communicate effectively and appropriately in professional contexts by exposing them to LSRW tasks.

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

1. Analyze the given listening material and answer the questions correctly employing listening techniques.
2. Analyze the given reading material and answer the questions correctly employing reading techniques.
3. Write within the stipulated time syntactically and semantically correct sentences to present ideas in the form of paragraphs and letters.
4. Give well-structured effective time sensitive presentations extemporaneously or after careful preparation.
5. Identify within the stipulated time syntactically and semantically correct sentences for a variety of language exercises.

UNIT 1 LISTENING **6**

Listening to Casual Conversation and TED Talks

UNIT 2 READING **8**

Poem – Robert Frost – Road not Taken Essays - Bacon's Essays

UNIT 3 WRITING **6**

Letter Writing – Letters Seeking Permission and Letters Seeking Apology and Letters Requesting Certificates and Paragraph Writing

UNIT 4 PRESENTATION **7**

Watching Presentations - Presentation Techniques - JAM and Three Minute Presentation

UNIT 5 VERBAL ABILITY **3**

Verbal Analogy - Cloze Test- Idioms and Phrases- Sentence Completion – Concord – Common Errors

TOTAL: 30 PERIODS

REFERENCES:

1. Rizvi, Ashraf. M, "Effective Technical Communication", 2st Edition, Tata McGraw-Hill, New Delhi, 2018.
2. Raman, Meenakshi and Sangeetha Sharma, "Technical Communication: English Skills for Engineers", 1st Edition, Oxford University Press, New Delhi. 2008.

e-RESOURCES:

1. <https://agendaweb.org/listening/audio-books-mp3.html>
2. <https://www.ndtv.com/world-news>
3. <https://www.naukri.com/blog/self-introduction-for-interview/>
4. <http://learnenglishteens.britishcouncil.org/skills/reading>
5. <https://www.bbc.com/bitesize/guides/zphc9j6/revision/1>

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO3	-	-	-	-	-	3	-	-	3	3	-	1	-	-
CO4	-	1	-	-	-	3	-	-	-	3	-	1	-	-
CO5	-	-	-	-	-	3	-	-	-	3	-	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

Probability theory is an important foundation for computer science and information technology fields such as machine learning, artificial intelligence, computer graphics and randomized algorithms. Queuing theory provides a rich and useful set of mathematical models for the analysis and design of service process for which there is contention for shared resources.

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

1. Compute moments and moment generating functions of one dimensional random variables and solve the problems involving discrete and continuous random variables.
2. Measure the degree of relationship between the two dimensional random variables using correlation and regression.
3. Classify the first and second order stationary processes and solve the problems involving Markov and Poisson processes.
4. Identify and solve the queueing systems with finite and infinite population using Markovian queueing models
5. Identify and solve the Non Markovian queueing system, series queues and Open Jackson Networks using Markovian queueing models.

UNIT 1 ONE DIMENSIONAL RANDOM VARIABLES**9+3**

Discrete and continuous random variables – Moments – Moment generating functions – Distributions: Discrete distributions – Binomial, Poisson – Continuous distributions – Uniform, Exponential and Normal distributions.

UNIT 2 TWO DIMENSIONAL RANDOM VARIABLES**9+3**

Joint distributions – Two dimensional discrete and continuous random variables – Marginal and conditional distributions – Covariance – Correlation and Linear regression.

UNIT 3 RANDOM PROCESSES**9+3**

Classification – Stationary process – First order, Second order Stationary Process , SSS Process , WSS Process – Markov Process – Poisson Process.

UNIT 4 QUEUEING THEORY**9+3**

Markovian queues – Single server with infinite capacity–Multiple server with infinite capacity – Single server with finite capacity – Multiple server with finite capacity –Little's formula.

UNIT 5 ADVANCED QUEUEING MODELS**9+3**

M/G/1 queue – PollaczekKhinchin formula - M/D/1 and M/EK/1 as special cases – Series queues without blocking – Open Jackson networks.

TOTAL (L:45+T:15): 60 PERIODS**TEXT BOOKS:**

1. Ibe.O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier, 2nd edition 2014.
2. D.Gross, John F. Shortle, James M. Thompson and C.M. Harris, "Fundamentals of Queueing Theory", Wiley India Pvt Ltd, 4th Reprint, 2013.

REFERENCES:

1. Veerarajan T., "Probability Statistics and Random Processes With Queueing theory and Queueing networks", 4th Edition, Tata McGraw Hill Edition, New Delhi, 2015.
2. Trivedi.K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, Wiley Dream Tech. India (P) Ltd, New Delhi, 2013.
3. Hwei Hsu, "Probability, Random Variables and Random Processes", Tata Mc Graw Hill Edition, New Delhi, 3rd Edition 2014.

e-RESOURCES:

1. <http://nptel.ac.in/courses/117105085/>, "Introduction to the Theory of Probability and Random Process", Prof. M. Chakraborty, IIT- Kharagpur
2. <http://nptel.ac.in/courses/112106131/30>, "Queueing Models", Prof. G. Srinivasan, IIT- Chennai.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO2	3	3	2	2	-	-	-	-	-	-	-	1	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	1	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	1	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble :

This course aims at designing Analog and Digital communication systems that are used for the transmission of information. A detailed quantitative framework for analog and digital transmission techniques is addressed.

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

1. Evaluate the AM, FM and PM systems with respect to performance and signal to noise ratio.
2. Compare the performance of various shift keying techniques used in digital communication systems
3. Analyze the characteristics of PAM, PTM and PCM modulation techniques and evaluate natural and flat top sampling techniques in digital pulse modulation
4. Compare and contrast of Huffman and Shannon-Fano coding techniques for coding efficiency of lossless data compression
5. Summarize the basic physical and technical settings of mobile communication systems and illustrate the orbital parameters of a satellite.

UNIT 1 ANALOG COMMUNICATION**9**

Introduction to Communication Systems: Modulation – Types – Need for Modulation. Theory of Amplitude Modulation – Evolution and Description of SSB Techniques – Theory of Frequency and Phase Modulation – Comparison of various Analog Communication System (AM – FM – PM).

UNIT 2 DIGITAL COMMUNICATION**9**

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) – Phase Shift Keying (PSK) – BPSK – QPSK – 8 PSK – Quadrature Amplitude Modulation (QAM) – 8 QAM – Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

UNIT 3 DATA AND PULSE COMMUNICATION**9**

Data Communication: Standards Organizations for Data Communication – Data Communication Circuits – Error Detection and Correction Techniques – Data communication Hardware.

Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) – Comparison of various Pulse Communication System (PAM – PTM – PCM).

UNIT 4 SOURCE AND ERROR CONTROL CODING**9**

Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, channel coding theorem, Error Control Coding, linear block codes, cyclic codes.

UNIT 5 MULTI-USER RADIO COMMUNICATION**9**

Global System for Mobile Communications (GSM) – Cellular Concept and Frequency Reuse – Channel Assignment and Hand off – Satellite Communication: Kepler's Law – satellite orbit – Geostationary Satellite – Satellite link modes – Bluetooth – Wi Fi.

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Wayne Tomasi, "Electronic Communication Systems", 5th Edition, Pearson Education, 2008.
2. Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2009.

REFERENCES:

1. Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, 2004
2. Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2007
3. H.Taub, D L Schilling and G Saha, "Principles of Communication", 3rd Edition, Pearson Education, 2007.

e-RESOURCES :

1. Nptel video <http://nptel.ac.in/courses/117101051/> , "Quantization, PCM and Delta Modulation", Prof. Bikash Kumar Dey, IIT, Bombay.
2. Nptel video <http://nptel.ac.in/courses/117101051/> , "Source Coding (Part - 1)", Prof. Bikash Kumar Dey, IIT, Bombay.
3. Nptel video <http://nptel.ac.in/courses/117101051/> , "Introduction to Digital Communication)", Prof. Bikash Kumar Dey, IIT, Bombay.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2
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CO2	2	2	3	-	1	2	2	-	-	-	2	-	-	-
CO3	2	-	3	-	1	2	-	-	-	1	-	-	-	-
CO4	2	2	3	2	-	-	2	-	-	-	2	1	-	-
CO5	2	-	3	-	-	2	2	-	-	-	2	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

The course aims to provide an understanding about the fundamentals of database, database system architecture and various database design technique. It also helps to familiarize SQL standards and various SQL operations. An overview of normalization, query optimization and transaction management is also provided.

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

1. Compare File processing system with Database systems in terms of performance, scalability and data storage for efficient access of data.
2. Design a database schema using E-R model, Relational model and apply relational algebra operations like selection, projection, join and Cartesian product to solve the given problem.
3. Develop SQL queries using aggregate functions, nested sub queries, joins and views for the given problem.
4. Apply suitable normalization and query optimization techniques to normalize the give relation and to optimize the query for efficient access of data.
5. Discuss serialization and concurrency control mechanisms to avoid deadlock problem in transaction processing.

UNIT 1 DATABASE SYSTEMS**8**

Overview of File processing system- Purpose of Database System-Views of data–Data Models–Database Languages—Database System Architecture–Database users and Administrator.

UNIT 2 DATABASE DESIGN**9**

Database design & E-R Model: Entity–Relationship model (E-R model)–E-R Diagrams-Constraints-Extended E-R features. Introduction to Relational Model: Database schema–Keys- Schema Diagrams – Relational Query languages – Relational Operations.

UNIT 3 SQL**10**

SQL Standards-Data types–structure of SQL queries–additional basic operations-set operations-null values-aggregate functions-nested sub queries-modification of the database. Intermediate SQL: Joins-Views-Transactions-Integrity constraints–Authorization. Advanced SQL.

UNIT 4 NORMALIZATION AND QUERY OPTIMIZATION**9**

Relational database design: Functional Dependencies -Normalization and its normal forms- Denormalization-Data Storage: RAID – Tertiary Storage – File organization – Organization of records in files. Query Processing - Query optimization.

UNIT 5 TRANSACTION MANAGEMENT**9**

Transaction concepts- Transaction recovery-Properties of Transaction-Serializability-Concurrency Control – Locking Mechanisms-Two Phase Commit Protocol-Dead lock. Case study: Database connectivity using SQL.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Sixth Edition, Tata McGraw Hill, 2011.

REFERENCES:

1. C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
1. RamezElmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Fourth Edition, Pearson / Addisonwesley, 2007.
2. Atul Kahate, “Introduction to Database Management Systems”, Pearson Education, New Delhi, 2006.

3-RESOURCES:

1. <http://www.nptelvideos.in/2012/11/database-management-system.html>, Database Management Systems, Dr.S.Srinath, IIT Madras.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3	2	-	-	1	-	-	-	-	-	1	2	1
CO2	1	3	2	2	-	1	-	-	-	-	-	1	2	2
CO3	1	3	2	3	-	1	-	-	-	-	-	1	2	2
CO4	1	3	2	3	-	1	-	-	-	-	-	1	2	2
CO5	1	3	2	2	-	1	-	-	-	-	-	1	2	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

Software Engineering is the application of engineering to the development of software in a systematic method. Starting with basic life cycle model concepts, it would discuss requirements specification, design, and testing issues. Large scale software development poses special challenges. This course targets to expose the students to the challenges of large scale software development and would expose the students as to how to overcome those.

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

1. Develop software product using suitable software process models for the given specification.
2. Analyze the requirements for real-time problem specification and devise a SRS pertaining to industry standards.
3. Design a system model using the appropriate design engineering procedure for a given SRS.
4. Test the software model using black box testing, white box testing, unit testing and integration testing to produce error free product.
5. Estimate the development cost, schedule a risk free work plan for a given project model using appropriate tool.

UNIT 1 SOFTWARE PROCESS AND AGILE DEVELOPMENT 9

Software Process -Software Process models- Waterfall Model-Incremental Process Models -Evolutionary Process Models- Prototyping-Spiral Model- Introduction to Agility-Agile process.

UNIT 2 REQUIREMENTS ANALYSIS AND SPECIFICATION 9

Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management-Classical analysis: Structured system Analysis - Data Dictionary.

UNIT 3 SOFTWARE DESIGN 9

Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design -Architectural styles, Architectural Design - User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.

UNIT 4 SOFTWARE TESTING 9

Software testing fundamentals-Internal and external views of Testing-white box testing - basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing and Debugging.

UNIT 5 PROJECT MANAGEMENT 9

Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO Model – Project Scheduling – Scheduling, Earned Value Analysis Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection - Risk Management-Risk Identification-RMMM Plan-CASE TOOLS.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Roger S. Pressman, Software Engineering – A Practitioners Approach, Seventh Edition, Mc Graw-Hill International Edition, 2010.
2. Ian Sommerville, Software Engineering, 9th Edition, Pearson Education Asia, 2011.

REFERENCES:

1. Rajib Mall, Fundamentals of Software Engineering, Third Edition, PHI Learning Private Limited, 2009.
2. Pankaj Jalote, Software Engineering, A Precise Approach, Wiley India, 2010.
3. Kelkar S.A., Software Engineering, Prentice Hall of India Pvt Ltd, 2007.

e-RESOURCES:

1. <https://nptel.ac.in/courses/106101061/>,
2. <https://nptel.ac.in/downloads/106105087/>,

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	2	3	-	-	1	-	-	-	-	-	1	2	3
CO2	1	2	2	2	-	1	-	-	-	-	-	1	2	3
CO3	1	3	2	3	-	1	-	-	-	-	-	1	2	3
CO4	1	2	2	3	-	1	-	-	-	-	-	1	2	3
CO5	1	3	2	2	-	1	-	-	-	-	-	1	2	3

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble

The main aim of this course is to introduce the concepts of operating system abstractions, mechanisms and implementations. The course makes the students to develop the optimal solution for CPU scheduling, synchronization problems and deadlocks. This course will enable the students to apply the appropriate memory, file and disk management technique for effective resource utilization.

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

1. Outline the structure and functions of Operating Systems for multiuser environment considering Linux process and thread management as a case study.
2. Evaluate the FIFO, SJF, Priority scheduling, Round Robin process scheduling algorithms for a given set of process considering the arrival time, burst time and resources.
3. Analyze the memory allocation techniques and page replacement algorithms for a given reference strings with minimum page fault.
4. Analyze file allocation methods for efficient file organization considering Linux virtual file system as a case study.
5. Evaluate the FIFO, SSTF, SCAN, CSCAN, LOOK, CLOOK disk scheduling algorithms with minimum seek time for a given disk request and analyze the architecture of iOS and Android Mobile Operating Systems.

UNIT 1 OPERATING SYSTEMS AND PROCESS MANAGEMENT**9**

Operating System Overview: Objectives and Functions – Evolution of Operating Systems – Computer Organization – Operating System Operations – Services – System Calls – System Programs – Operating System Structure – OS Generation – System Boot. Processes: Process concept – Process scheduling – Operations on processes – Inter process communication – Threads: Overview – Multicore Programming – Multithreading Models. Case Study: Linux Process and Thread Management.

UNIT 2 PROCESS SCHEDULING AND SYNCHRONIZATION**9**

CPU Scheduling: Concepts – Scheduling criteria – Scheduling algorithms. Process Synchronization: The critical-section problem – Synchronization hardware – Semaphores – Classic problems of synchronization – Monitors. Deadlocks: System model – Deadlock characterization – Methods for handling deadlocks – Deadlock prevention – Deadlock avoidance – Deadlock detection – Recovery from deadlock. Case Study: Linux Scheduling.

UNIT 3 MEMORY MANAGEMENT**9**

Main Memory: Background – Swapping – Contiguous memory allocation – Paging – Segmentation. Virtual Memory: Background – Demand paging – Page replacement – Allocation of frames – Thrashing. Case Study: Linux Memory Management.

UNIT 4 FILE SYSTEMS**9**

File-System Interface: File concept – Access methods – Directory and disk structure – File-system mounting – Sharing and Protection. File-System Implementation: Structure and Implementation – Directory implementation – Allocation methods – Free-space management. Case Study: Linux Virtual File System.

UNIT 5 I/O SYSTEMS**9**

I/O Systems: I/O Hardware - Mass Storage Structure: Overview, Disk Structure and Attachment - Disk Scheduling and Management – Swap-space management – RAID. Mobile OS: iOS and Android – Architecture and SDK Framework, Media Layer, Services Layer, Core OS Layer, File System.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne, “Operating System Concepts”, 9th Edition, John Wiley and Sons Inc., 2013.
2. William Stallings, “Operating Systems – Internals and Design Principles”, 7th Edition, Prentice Hall, 2011.

REFERENCES:

1. Andrew S. Tanenbaum, “Modern Operating Systems”, Third Edition, Pearson Education, 2009.
2. Harvey M. Deital, “Operating Systems”, Third Edition, Pearson Education, 2004.
3. D M Dhamdhare, “Operating Systems: A Concept-Based Approach”, 3rd Edition, Tata McGraw-Hill Education, 2007.

e-RESOURCES:

1. <http://nptel.ac.in/courses/106108101/> “Introduction to operating system”, Prof P.C.P. Bhatt , IISc-Bangalore.
2. <https://nptel.ac.in/courses/106106144/2/> “Introduction to operating system”, Prof Chester Rebeiro,IIT-Madras.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO2	2	3	2	2	-	2	-	-	-	-	-	1	3	2
CO3	2	3	2	2	-	2	-	-	-	-	-	1	3	2
CO4	2	3	2	2	-	2	-	-	-	-	-	1	3	2
CO5	2	3	2	2	-	2	-	-	-	-	-	1	3	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

This course enables the student to understand various algorithm design techniques, and know how to apply those techniques to various problems. The analysis of various algorithms can be performed and select the best algorithm for solving a problem.

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

1. Differentiate recursive and non-recursive algorithms using asymptotic notations.
2. Evaluate the performance of Selection sort, Bubble sort, Merge sort, Quick sort, Insertion sort, Heap sort considering input data set properties, running time and code size.
3. Analyze the efficiency of Prim's algorithm, Kruskal's algorithm, Dijkstra's algorithm, Huffman trees, Fractional knapsack problem for a given problem using greedy technique.
4. Categorize Warshall's and Floyd's algorithms, optimal binary search trees, Knapsack problem for a given problem using dynamic programming technique.
5. Illustrate the design strategies for n-Queens problem, Hamiltonian circuit problem, subset sum problem, Knapsack problem, Traveling salesman problem using Backtracking and Branch & Bound technique.

UNIT 1 ALGORITHM ANALYSIS**9+3**

Introduction – Notion of Algorithm – Fundamentals of Algorithmic problem Solving – Important Problem types – Fundamentals of the Analysis of Algorithm Efficiency - Analysis Framework – Asymptotic notations and Basic Efficiency Classes - Mathematical Analysis of Recursive and Non-recursive algorithms-Empirical analysis of Algorithms-Algorithm Visualization.

UNIT 2 ANALYSIS OF SORTING AND SEARCHING ALGORITHMS**9+3**

Brute Force – Selection Sort and Bubble Sort - Divide and conquer – Merge sort – Quick Sort-Strassen's Matrix Multiplication -Decrease and Conquer – Insertion Sort-Transform and Conquer-Heaps and Heap sort- Analysis of Linear Search and Binary search techniques.

UNIT 3 GREEDY TECHNIQUE**9+3**

Introduction to greedy technique - Prim's algorithm - Kruskal's algorithm - Dijkstra's algorithm- Huffman Trees – Fractional Knapsack Problem- Job Sequencing with Deadlines.

UNIT 4 DYNAMIC PROGRAMMING**9+3**

Introduction to Dynamic Programming-Computing a Binomial Coefficient-Warshall's and Floyd's Algorithms - Optimal Binary search trees – 0/1 Knapsack Problem and Memory functions-Matrix-chain multiplication.

UNIT 5 BACKTRACKING & BRANCH AND BOUND**9+3**

Backtracking- n-Queens problem - Hamiltonian Circuit Problem - Subset Sum problem - Branch and Bound – 0/1 Knapsack problem - Traveling Salesman Problem-Introduction to P, NP and NP-complete Problems.

TOTAL :45+15=60 PERIODS**TEXT BOOKS:**

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.
2. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.

REFERENCES:

1. Ellis Horowitz, Sartaj Sahni, SanguthevarRajasekaran, "Fundamentals of Computer Algorithms", Second edition, Galgotia Publications, New Delhi, 2010.
2. Donald E. Knuth, "The Art of Computer Programming", Pearson Education, 2009.
3. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.

e. RESOURCES :

1. <https://nptel.ac.in/courses/106101060/> "Design and analysis of algorithms", Prof. Abhiram Ranade, IIT-Bombay.
2. <http://nptel.ac.in/courses/106106131/>, "Design and analysis of algorithms", Prof.Madhavan Mukund, IIT-Madras.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	2	2	-	-	-	-	-	-	-	1	3	1
CO2	2	3	2	2	-	-	-	-	-	-	-	1	3	1
CO3	2	3	2	2	-	-	-	-	-	-	-	1	3	1
CO4	2	3	2	2	-	-	-	-	-	-	-	1	3	1
CO5	2	3	2	2	-	-	-	-	-	-	-	1	3	1

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

This laboratory course is intended to provide students with opportunities to get hands on training to create database with SQL queries, Joins, Aggregate functions, Triggers and Exception Handling using Oracle /MySQL.

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

1. Work with DDL and DML commands to store and manipulate information in the database.
2. Apply the concept of views, indexes, sequences, joins and aggregate functions to perform analysis on data in the database.
3. Develop simple programs using PL/SQL for the given problem.
4. Work with procedure, trigger, exception handling and function to provide solutions for the given problem.
5. Develop real time applications (Banking system, Payroll processing and Library Information system) using SQL.

LIST OF EXPERIMENTS

1. Create a database and work with SQL queries to retrieve information from the database.
2. Create an Employee database to set various constraints.
3. Work with Joins, aggregate functions
4. Creation of database objects: Synonyms, Sequences, Views, Indexes and save point.
5. Study of PL/SQL block.
6. Develop simple programs using PL/SQL.
7. Creation of Procedures.
8. Creation of Functions.
9. Work with Triggers and Exception handling
10. Mini project (Application Development using Oracle / MySQL)
 - Payroll processing.
 - Banking System.
 - Library Information System

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	3	2	-	-	-	1	-	-	-	2	-
CO2	3	3	2	3	2	-	-	-	1	-	-	-	2	2
CO3	3	3	2	3	2	-	-	-	1	-	-	-	2	-
CO4	3	3	2	3	2	-	-	-	1	-	-	-	2	-
CO5	3	3	2	3	2	-	-	-	1	-	-	-	2	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

The main aim of this course is to implement the concepts of operating system mechanisms and policies. The course makes the students to implement the program that provide the optimal solution for CPU scheduling, synchronization problems and deadlocks. This course will also enable the students to apply the designed module to appropriate memory, file and disk management technique for effective resource utilization.

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

1. Develop the suitable shell commands to establish user interface with UNIX kernel.
2. Develop C Program to implement CPU scheduling algorithms, deadlock avoidance algorithms and page replacement algorithms for a given set of processes considering arrival time, burst time and resources.
3. Develop C program to implement thread, process synchronization and Inter Process Communication for a given set of processes by using semaphore and shared memory mechanisms
4. Construct a C program to implement file allocation and organization techniques for a given set of files by using sequential, indexed and linked file allocation methods.
5. Develop C Program for memory management by using paging technique.

LIST OF EXPERIMENTS

1. Study and execute the basic commands of UNIX operating system for resource management.
2. Write a C program to implement FCFS, SJF and Round Robin (time quantum=2) CPU scheduling algorithms for process Scheduling.
3. Write a C program to implement the file allocation strategies such as a) Sequential b) Indexed c) Linked for 'n' number of files.
4. Write a C program to implement the process synchronization for producer – consumer problem using semaphore.
5. Write a C program to implement single and two-level directory structure for effective file organization.
6. Write a C program to implement the Bankers Algorithm for deadlock avoidance and detection.
7. Write a C program to implement the FIFO and LRU page replacement algorithm for the following reference string: 1,2,3,4,2,1,5,6,2,1,2,3,7,6,3,2,1,2,3,6.
8. Write a C program to implement shared memory between the two-process using Inter Process communication (IPC) primitives.
9. OS uses a paging system with 2Kbytes pages. A given processes uses a virtual address space of 8Kbytes and it is assigned 8Kbytes of physical memory. Write a C program to create page table and implement Paging Technique to find out physical address for the above scenario.
10. Write a C program to create 2 threads named Th1 and Th2 and establish synchronization between two threads using mutex lock.

SOFTWARE

- Linux :Ubuntu / OpenSUSE / Fedora / Red Hat / Debian / Mint OS
- GCC compiler

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	2	-	-	2	-	-	1	-	-	1	3	2
CO2	2	3	2	2	-	2	-	-	1	-	-	1	3	2
CO3	2	3	2	2	-	2	-	-	1	-	-	1	3	2
CO4	2	3	2	2	-	2	-	-	1	-	-	1	3	2
CO5	2	3	2	2	-	2	-	-	1	-	-	1	3	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

Communicative English is a life skill necessary for all students of Engineering and Technology. The course Professional Communication aims at enabling the learners to communicate effectively and appropriately in professional contexts by exposing them to LSRW tasks.

COURSE OUTCOMES – After the completion of this course, students will be able to

1. Analyze the given listening material and answer the questions correctly, employing listening techniques.
2. Take part effectively in group discussions, conforming to professional norms
3. Analyze the given reading material and answer the questions correctly, employing reading techniques
4. Write within the stipulated time, syntactically and semantically correct sentences to present ideas in the form of an essay.
5. Identify within the stipulated time syntactically and semantically correct sentences for a variety of language exercises

UNIT 1 LISTENING 6

Listening to News Bulletins and Documentaries

UNIT 2 GROUP DISCUSSION 8

Watching Group Discussion videos – Do's and Don'ts of GD – Mock GD

UNIT 3 READING 6

Letters to Editor Column - Reading News Articles - Biographies of Famous Personalities

UNIT 4 WRITING 6

IELTS Essay Writing

UNIT 5 VERBAL ABILITY 4

Verbal analogy - Cloze Test- Idioms and Phrases- Sentence Completion -Error Spotting

TOTAL: 30 PERIODS

REFERENCES:

1. Raman, Meenakshi and Sangeetha Sharma, "Technical Communication: English Skills for Engineers", 1st Edition, Oxford University Press, New Delhi. 2008.
2. Rizvi, Ashraf. M, "Effective Technical Communication", 2st Edition, Tata McGraw-Hill, New Delhi, 2018

e-RESOURCES:

1. <http://www.slideshare.net/rohitjsh/presentation-on-group-discussion>
2. <https://www.bbc.com/bitesize/guides/zphc9j6/revision/1>
3. <https://www.fresherslive.com/online-test/verbal-ability-test/questions-and-answers>

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO2	-	1	-	-	-	3	-	-	3	3	-	1	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	1	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

This course is aimed at enabling the students to create any type of Desktop Applications like Database Applications, Client/server Applications, and Standalone Applications using OOP concepts. It grooms the students to enable them to work on current technology scenarios as well as prepare them to keep pace with the changing face of technology and the requirements of the growing IT industry. It imparts knowledge on the concepts like classes, inheritance, packages, GUI development and database management.

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

1. Develop a program in Java for the given problem statement by applying object oriented programming features abstraction, inheritance, polymorphism and encapsulation.
2. Write Java program for the given problem statement to solve it using the concepts of packages and exception handling.
3. Implement concurrency in a Java program using Thread classes and interfaces to maximize the utilization of CPU time.
4. Develop Java program for the given problem statement using Wrapper classes and Collection APIs.
5. Develop Java application using JDBC for a given problem statement.

UNIT 1 OBJECT ORIENTED PROGRAMMING USING JAVA**9**

Overview of Java- Installing Java (Windows and Linux) - JVM, JRE and JDK- Eclipse- Data types, Variables – Type conversion– Arrays - Operators- Control Statements - Class fundamentals, Objects and Constructors - Method Overloading – static- this – garbage collection - Inheritance - Method Overriding - Dynamic Method Dispatch - Final with Inheritance - Abstract Class - Interfaces and extending Interfaces.

UNIT 2 STRINGS, PACKAGES AND EXCEPTIONS**9**

String Handling – String, String Buffer and String Builder Classes - Packages - Access Protection – Importing Packages - Exception Fundamentals and Types - try, catch, and throw - throws and finally.

UNIT 3 I/O STREAMS AND MULTITHREADING**9**

Java I/O Classes and Interfaces – FileInputStream, FileOutputStream, BufferedInputStream, BufferedOutputStream, FileReader, FileWriter, BufferedReader and BufferedWriter -Multithreading - Thread Model, Creating Threads and Thread Priorities - Synchronization- Inter-thread Communication.

UNIT 4 COLLECTIONS**9**

Collections: List - ArrayList – Set – HashSet - TreeSet- Queue – PriorityQueue - Map - HashMap – Iterator – Enumerator- Wrapper Classes- Autoboxing and Unboxing- Regular Expressions.

UNIT 5 DATABASE CONNECTIVITY**9**

JDBC architecture -Establishing connectivity and working with connection interface - Working with statements - Creating and executing SQL statements- Working with Result Set

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Herbert Schildt, “Java the Complete Reference”, McGraw Hill Education, Ninth Edition, 2014.
2. Paul Deitel, Harvey Deitel, “Java How to Program”, Prentice Hall, Tenth Edition, 2014.

REFERENCES:

1. Cay S.Horstmann and Gary Cornell, “Core Java- Volume I Fundamentals”, Pearson Education, Ninth Edition, 2012.
2. Daniel Liang, “Introduction to Java Programming, Comprehensive Version”, Pearson Education, Ninth Edition, 2014.
3. E. Balagurusamy, “Programming with Java A Primer”, Tata McGrawHill, Fifth Edition, 2014.

e-RESOURCES:

1. <http://nptel.ac.in/courses/106106147/>, “Java Basics”, Prof. Pushpendra Singh, IIT – Madras.
2. https://swayam.gov.in/nd1_noc20_cs08/, “Programming in Java”, Prof. DebasisSamanta, IIT – Kharagpur.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	2	3	2	-	1	-	-	-	-	-	1	3	2
CO2	2	2	3	2	-	1	-	-	-	-	-	1	3	2
CO3	2	2	3	2	-	1	-	-	-	-	-	1	3	2
CO4	2	2	3	2	-	1	-	-	-	-	-	1	3	2
CO5	1	3	3	3	-	1	-	-	-	-	-	1	3	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

The course aims to provide an understanding of computer networks architecture, various technologies available to build a network and protocols in use at different levels of network layers stack. An overview of global Internet, Internet applications and types of protocols used for mail transfer is also provided.

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

1. Interpret the importance of layering, addressing and annotate the protocol stack of OSI and TCP/IP model.
2. Annotate MAC protocols (Ethernet, Token Ring and Wi-Fi) supported by Data Link layer to ensure hop-to-hop reliable communication.
3. Use IP addressing and routing protocols to find shortest route to achieve reliable network-layer data transmission.
4. Classify the transport layer protocols and explain the congestion control or congestion avoidance techniques to ensure quality of service.
5. Analyze the functions and services provided by the application layer protocols (HTTP, SMTP and DNS).

UNIT 1 DATA COMMUNICATIONS**9**

Data Communication– Networks–The OSI Model– Layers in the OSI Model – TCP/IP Protocol Suite – Addressing – Transmission Media

UNIT 2 DATA LINK LAYER**9**

Framing – Error Detection and Correction– IEEE Standards (802.3,802.5,802.11)– MAC protocols and types

UNIT 3 NETWORK LAYER**9**

Internetworking: Switching and Bridging – Basic Internetworking-IPv4 - IPv6 – Routing Techniques: Distance vector (RIP) – Link state (OSPF) — Interdomain Routing (BGP).

UNIT 4 TRANSPORT LAYER**9**

Congestion Control and Resource Allocation: TCP Congestion Control – Congestion Avoidance Mechanisms – Quality of Service: Integrated Services – Differentiated Services.

UNIT 5 APPLICATION LAYER**9**

Domain Name System - File Transfer – Web Services and SNMP - HTTP - Electronic Mail (SMTP, POP3, IMAP, MIME).

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers, 2011.
2. Behrouz A. Forouzan, “Data Communications and Networking”, Fourth Edition, Tata McGraw - Hill, Reprint 2012.

REFERENCES:

1. William Stallings, “Data Communication and Networks”, Pearson Education, Tenth edition, 2014.
2. James.F. Kurose& W. Rouse, “Computer Networking: A Topdown Approach Featuring”,Sixth edition, Pearson Education, 2013.
3. William Stallings, “Data Communication and Networks”, Pearson Education, Tenth edition, 2014.

e-RESOURCES:

1. <http://www.nptel.ac.in/downloads/106105080>, “Computer Networks”, Prof.Sujoy Ghosh, IIT Kharagpur.
2. <https://www.elsevier.com/journals/subjects/computer-science>

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	-	2	-	-	1	-	-	-	-	1	1	2
CO2	1	3	-	2	-	-	1	-	-	-	-	1	1	2
CO3	1	3	-	2	-	-	1	-	-	-	-	1	2	2
CO4	1	3	-	2	-	-	1	-	-	-	-	1	2	2
CO5	1	3	-	2	-	-	1	-	-	-	-	1	1	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

This course enables the student to know the models of computation, along with their variants in the context of formal languages and their recognizers. This can be applied in designing compilers and pattern recognition system.

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

1. Design a Finite Automata for a given regular language and translate a given automata into deterministic and non-deterministic finite automata using minimization techniques.
2. Examine the equivalence of Finite Automata and Regular Expression and identify whether the given language is regular or not using pumping lemma.
3. Formulate the Chomsky normal form and Greiback normal form for given CFG using simplification techniques.
4. Design a PDA for a given CFG/CFL and identify whether the given language is CFG or not using pumping lemma.
5. Apply programming techniques involved in Turing Machine to solve decidable and undecidable problems to achieve efficiency.

UNIT 1 FINITE AUTOMATA**9+3**

Introduction to formal proof – Additional forms of proof – Inductive proofs – Basic Definitions – Finite Automaton – DFA & NDFA – Finite Automaton with epsilon moves – Equivalence of NFA and DFA – Equivalence of NDFA's with and without epsilon moves – Minimization of DFA.

UNIT 2 REGULAR EXPRESSIONS AND LANGUAGES**9+3**

Regular Languages – Regular Expression – FA and Regular Expressions – Closure properties of regular languages – Equivalence of finite Automaton and regular expression – Proving languages not to be regular – Pumping Lemma for Regular sets – Problems on Pumping Lemma.

UNIT 3 CONTEXT-FREE GRAMMARS AND LANGUAGES**9+3**

Grammar Introduction– Types of Grammar – Context Free Grammars and Languages– Derivations and Languages – Ambiguity- Relationship between derivation and derivation trees – Simplification of CFG – Elimination of Useless symbols – Unit productions – Null productions – Greiback Normal form – Chomsky normal form – Problems on CNF and GNF – Closure properties of CFL.

UNIT 4 PUSHDOWN AUTOMATA**9+3**

Pushdown Automata- Definitions – Moves – Instantaneous descriptions – Deterministic pushdown automata – Equivalence of Pushdown automata and CFL – pumping lemma for CFL – problems based on pumping Lemma.

UNIT 5 TURING MACHINE AND UNDECIDABILITY**9+3**

Definitions of Turing machines – Models – Computable languages and functions – Techniques for Turing machine construction -Multihead and Multitape TM – The Halting problem -Partial Solvability – Problems about TM –A language that is not Recursively Enumerable (RE) – An undecidable problem that is RE – Ladner's Theorem –Undecidable problems about Turing Machine.

TOTAL: L:45+T:15=60 PERIODS**TEXT BOOKS:**

1. J.E. Hopcroft, R. Motwani Tuand J.D. Ullman, "Introduction to Automata Theory, Languages and Computations", Third Edition, Pearson Education, 2014.
2. John C Martin, "Introduction to Languages and the Theory of Computation", Fourth Edition, Tata McGraw Hill Publishing Company, New Delhi, 2011.

REFERENCES:

1. Micheal Sipser, "Introduction of the Theory and Computation", Third Edition, Thomson Brokecole, 2013.
2. Linz Peter, "An Introduction to Formal Languages and Automata", Sixth Edition, Jones & Bartlett Learning, 2016.
3. Mishra and Chandrashekar, "Theory of Computer Science–Automata Languages and Computation", Third Edition, PHI, 2008.

e. RESOURCES:

1. <http://nptel.ac.in/courses/>, "Theory of computation", Prof. Raghunath Tewar, IIT- Kannpur.
2. <http://nptel.iitm.ac.in>, "Theory of computation", Prof. Kamala Krithivasan, IIT Madras.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO3	1	3	3	2	-	-	-	-	-	-	-	1	3	-
CO4	1	3	3	2	-	2	-	-	-	-	-	1	3	-
CO5	1	3	3	2	-	2	-	-	-	-	-	1	3	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

This course provides knowledge and skill on java object oriented concepts such as inheritance, polymorphism and also the concepts such as threading, packages, exceptions. It also provides knowledge at analyze level on selecting java libraries like collections, jar, jdbc, logging for an application.

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

1. Write and test the java program for the given problem using object oriented features.
2. Develop and test the java programs to solve the given problems using advanced concepts of packages, exception handling and multithreading.
3. Develop and test the event driven java applications for the given problem statements using applet and listener classes.
4. Write and test the java programs to store and process the given list of data using collection frameworks.
5. Develop and test java applications for the given scenario using java database connectivity to manipulate data in the database.

LIST OF EXPERIMENTS

1. The retail store management wants to automate the process of generating the bill amount for its customers. Assume that there is only one customer and one item purchased by the customer.
The business rules/constraints are given below:
 1. The item ids of the items sold by the retail store are 5001, 5002, 5003, 5004 and 5005.
 2. Quantity purchased by the customer must be greater than 0 and less than 5.
 3. Item price must be minimum Rs. 5.If the constraints mentioned in 1, 2 and 3 are satisfied, bill amount must be calculated based on the quantity purchased and item price. Otherwise appropriated error message(s) must be displayed.
2. In the happy shopping retail application, there are many customers who visit the retail store to purchase various items. The shop wants to maintain the details of the customers. Let us assume as of now there are 3 customers (John, Ally and Roy) and the details include customer name, customer id, telephone number and address. Customer ID must be generated automatically by the application itself. Write java program for the scenario using classes and objects.
3. Programs to demonstrate the concept of reusability in java with inheritance and interfaces.
4. Happy shopping retail store wants to display the customer information. The information depends on the type of customer (Regular and Privileged Customer). Generate the customerId for the customers in the constructor of customer class. In Regular Customer class, initialize the discount value using constructor. In Privileged Customer class, initialize the membership card type (Gold or Silver) in the constructor. The developer wants to write a single method that would display all the customer information. Assume customerId, discount and cardType are private members in the respective classes.
5. The happy learning school maintains the details of the students in the Student management Application. The details such as email Id and telephone number must be validated before it is updated in the database using the criteria that the email Id should have exactly one '@' sign and only one '.' after '@'. Also check the total number of digits in mobile number must be 10.
6. Programs for packages and exceptions.
7. IBB bank wants to maintain the account of customers. Transactions such as deposit some amount to an account and withdraw some amount from an account are possible. Now, for a given account, if two or more transactions occur simultaneously, then only one transaction should be allowed at a time instead of simultaneous transaction processing in order to avoid data inconsistency. Write a java program to synchronize the transaction.
8. Program to store and manipulate data using ArrayList.
9. Develop a java class with an instance variable 'CountryMap' HashMap(M1) and add a method saveCountryCapital(String CountryName, String capital). This method should insert the passed country and capital as key/value in the map M1 and return the Map (M1). Develop a method getCapital (String CountryName) which returns the capital for the country passed from the Map M1.
10. Implement the following using Java Database Connectivity
 - a) Library Management System
 - b) Course Registration System
 - c) Online Reservation System

TOTAL: 45 PERIODS

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2
CO1	1	2	3	3	1	1	-	-	1	-	-	1	3	1
CO2	1	2	3	3	1	1	-	-	1	-	-	1	3	1
CO3	1	2	3	3	1	1	-	-	1	-	-	1	3	2
CO4	1	2	3	3	1	1	-	-	1	-	-	1	3	2
CO5	1	3	3	2	1	1	-	-	1	-	-	1	3	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

The course aims to provide a development of socket programming, simulation of Stop & Wait, Go back-N, Selective Repeat protocols and Distance Vector Routing algorithm along with the simulation of point-to-point and local area network using Cisco packet tracer.

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

1. Simulate the network topologies using NS2 for data communication.
2. Experiment Automatic Repeat Request protocols (Stop and Wait, Go back-N and Selective Repeat) using the appropriate elements and packages in Socket programming.
3. Develop a java program to find shortest path using Distance Vector for a given scenario.
4. Write a java socket program for simulating TCP communication and UDP communication.
5. Create a Point-to-Point Network and Local Area Network using CISCO Packet Tracer.

LIST OF EXPERIMENTS

1. Study of Network simulator 2 (NS2).
2. Implementation of Various Topologies using NS2 Simulator.
3. Bit Stuffing and CRC computation.
4. Program to simulate Stop & Wait protocol.
5. Implementation of Sliding Window Protocol.
6. Program to simulate Distance Vector Routing algorithm.
7. Socket program to implement echoclientandechoserver using TCP
8. Socket program to contact a given DNS server to resolve a given host name using UDP
9. Case Study using Cisco Packet Tracer.

Establishing a Local Area Network (LAN):The main objective is to set up a Local AreaNetwork, concepts involved in this network are IP addressing and the Address ResolutionProtocol (ARP). The required equipment's are 192.168.1.1,192.168.1.2, 192.168.1.3,Host AHost B Host C, Switch/HUB, three PC's equipped with at least one NIC, one HUB or Switchand the necessary cables. Once the physical LAN is set up the hosts need to be configured using the ipconfig command. To verify communication among the machines the ping command isused. Next, to manipulate the routing tables at the hosts to understand how machines know where to send packets. Since the ipconfig command places a default route into the routing tablethis route must be deleted to 'blindfold' the machine. The ping command is used again to showthat communication is no longer available. To re-establish communication the routes are putback into the routing table one host at a time. Communication is once again verified using theping command.

10. Establish a LAN in Cisco Packet Tracer and perform traffic analysis for FTP using TrafficGenerator.

TOTAL:45 PERIODS

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO2	3	-	2	3	1	-	-	-	1	-	-	-	3	2
CO3	3	-	2	3	1	-	-	-	1	-	-	-	3	2
CO4	3	-	2	3	1	-	-	-	1	-	-	-	3	2
CO5	3	-	2	3	1	-	-	-	1	-	-	-	3	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

Aptitude tests are used to determine an individual's ability/potential to succeed in a certain task, with no prior knowledge or training and are frequently used as part of a pre-employment assessment. Aptitude tests are a proven tool used to identify those who are best equipped to carry out any given role.

A logical reasoning test is a form of testing that is widely used by corporate employers to help assess candidates during their recruitment process.

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

1. Solve the given equation using appropriate simplification methods.
2. Apply aptitude method of ratio and proportion to solve the given scenario.
3. Calculate time, speed, distance by applying suitable aptitude method for the given problem statement.
4. Calculate percentage and profit & loss for the given problem statement.
5. Compute simple interest, compound interest and predict relationship for the given problem/scenario.

UNIT 1**6**

Number System, Simple Equation, Sequence and Series

UNIT 2**6**

Ratio and Proportion, Problems on Ages, Partnership

UNIT 3**6**

Time and Distance, Problems on Trains, Boats and Streams

UNIT 4**6**

Percentage, Profit and Loss, Directions Sense

UNIT 5**6**

Simple Interest and Compound Interest, Blood Relations

TOTAL : 30 PERIODS

REFERENCES:

1. Dr.R.S.Aggarwal, "Quantitative Aptitude for Competitive Examination", S.Chand Publications, 2017
2. Dr.R.S.Aggarwal, "A Modern Approach to Verbal & Non-Verbal Reasoning", S.Chand Publications, 2018

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	2	2	-	-	-	-	-	-	-	1	-	-
CO2	2	3	2	2	-	-	-	-	-	-	-	1	-	-
CO3	2	3	2	2	-	-	-	-	-	-	-	1	-	-
CO4	2	3	2	2	-	-	-	-	-	-	-	1	-	-
CO5	2	3	2	2	-	-	-	-	-	-	-	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

This course focuses on the fundamentals of World Wide Web, scripting languages and web application. The students showcase their skills in developing a web application by using client side and server-side programming.

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

1. Select latest standards like HTML5 for designing attractive static web pages and separate design from content using CSS3.
2. Apply the client-side scripting techniques required to develop dynamic websites and validate a web page using JavaScript code with appropriate user interface.
3. Choose appropriate server-side technologies for creating interactive data driven websites to transfer synchronous and a synchronous data between client and server using server-side programming techniques like Servlet and JSP.
4. Design and develop web applications for business processing integrated with database using PHP, AJAX and MySQL.
5. Develop a web page for commercial application using AngularJS and choose data formats like XML for the delivery of electronic information.

UNIT 1 WEB SITE FUNDAMENTALS, HTML 5, CSS 3**9**

Web Essentials: Basic Internet Protocols – World Wide Web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers. HTML5 – Tables – Lists – Image – HTML5 elements – Audio – Video controls – Forms – CSS3 – Inline, Embedded and External style sheets – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations.

UNIT 2 CLIENT-SIDE PROGRAMMING**9**

JavaScript: Introduction to scripting – Variables and Data types – Operators – Control statements – Functions – Arrays – Objects. Document Object Model – Objects and collections – DOM Event handling – JavaScript Events.

UNIT 3 SERVER-SIDE PROGRAMMING**9**

Java Servlets – Servlet Architecture – Servlet Life cycle – Parameter Data – Sessions – Cookies – URL Rewriting. Introduction to Java Server Pages – JSP Life cycle – Scripting elements – Form Processing – MVC Paradigm

UNIT 4 WEB APPLICATIONS AND DATABASE**9**

PHP – Introduction – String processing – Regular expressions – Form processing & Business logic – Creating a database in MySQL. AJAX: Introduction – Traditional web applications versus AJAX applications – Rich internet applications with AJAX, Raw AJAX example using XMLHttpRequest.

UNIT 5 WEB DATA REPRESENTATION AND DEVELOPMENT FRAMEWORK**9**

XML Introduction – Structuring data – XML namespaces – DTDs – XML Schema. Introduction to AngularJS – Expression- Directives – Model – Forms - Validation.

BUILT IN LAB:**15**

1. Create a web site for our college with HTML5 and CSS3 (Include Media elements & all types of style sheets).
2. Write a JavaScript code to validate the following fields in an email registration form.
 - Name should contain alphabets.
 - Password should not be less than 8 characters and include check box to toggle between password visibility (Show password)
 - Email-Id should not contain any invalid characters and must follow the standard pattern (user@domain.com)
 - Phone number should contain 10 digits only and all the fields must be filled for successful form submission.
3. a. Write a Java Servlet program to print current date and time of the web server.
b. Write a JSP program to validate the username and password and display the welcome message if login successfully or display an error message.
4. Create a webpage to dynamically load the student information from the database using AJAX with PHP.
5. Develop a simple webpage for calculator using AngularJS.

TOTAL: L:45+P:15=60 PERIODS**TEXT BOOKS :**

1. Jeffrey C. Jackson, "Web Technologies - A Computer Science Perspective ", 11th Impression, Pearson Education, 2012
2. DT Editorial Services, "HTML 5 Black Book: Covers CSS3, JavaScript, XML, XHTML, Ajax, PHP and jQuery", Dreamtech Press, 2nd Edition, 2015.

REFERENCES:

1. P. J. Deitel, H. M. Deitel, "Internet & World Wide Web How to Program", Fourth Edition, Eleventh Impression, Pearson Education, 2016.
2. Luke Welling, Laura Thomson, "PHP and MySQL Web Development", Fifth Edition, Pearson Education, 2017.
3. Stephen Radford, "Learning Web Development with Bootstrap and AngularJS", Packt Publishing Ltd., 2015.

E-RESOURCES:

1. <http://www.nptel.ac.in/courses/106105084/>, "Internet Technology", Prof. Indranil Sengupta, IIT-Kharagpur.
2. <https://nptel.ac.in/courses/106101163/45/>, "Testing of Web Applications and Web Services", Prof. Meenakshi D'Souza, IIT- Bombay.

Mapping of COs with POs and PSOs

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2
CO1	1	3	2	3	1	-	-	-	-	-	1	-	3	2
CO2	1	2	3	3	2	-	-	-	-	-	1	-	3	2
CO3	1	3	3	2	2	-	-	-	-	-	1	-	3	2
CO4	1	2	3	2	2	-	-	-	-	-	1	-	3	2
CO5	1	2	3	2	2	-	-	-	-	-	1	-	3	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

Mobile Application Development is designed to impart the knowledge on application development framework and tools for creating android applications. It also equips the students to design, implement and deploy applications in mobile devices.

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

1. Develop mobile application for the given user requirement using android development framework and tools.
2. Create android applications using views, layouts, intents and SMS Manager API to send SMS and E-mails.
3. Create menu, notifications and multimedia features for the applications using android Notification Manager and Multimedia APIs.
4. Create databases for the applications to store and retrieve data using SQLite and Firebase.
5. Create mobile applications using standard web technologies such as HTML5, CSS3 and JavaScript for android and iOS platforms.

UNIT 1 GETTING STARTED WITH ANDROID**9**

Android – Evolution of Android - Android architecture – Features- Core building blocks – Anatomy of android application – Android activity life cycle. Android Toast. Android Widgets: Button – TextView – EditText – RadioGroup -ToggleButton – CheckBox – Spinner –DatePicker - Progress Bar –DialogBox.

UNIT 2 INTENTS, LAYOUTS AND TELEPHONY**9**

Intent – Types of Intent - Launching Activities using Intents. Layout: Relative Layout -Table Layout – Linear Layout – ListView – GridView – CardView. Android Telephony: Phone call –send Mail- Send SMS.

UNIT 3 MENUS, NOTIFICATION AND MULTIMEDIA**9**

Menus –Option Menu – Adding and Updating menu items – Handling menu items. Android Notification. Multimedia in Android: Android camera – Android Audio player – Android Video player.

UNIT 4 DATABASE AND CONTENT PROVIDERS**9**

Storage types in Android - Android SQLite Database - Firebase Login – Firebase authentication. Parsing in android – Android JSON parser – Connecting Android with MySQL using API - Android Google Map – Finding Current location.

UNIT 5 HYBRID APP DEVELOPMENT**9**

Apache Cordova– Architecture of Apache Cordova – Building simple App using Apache Cordova- Publish the app on app store: Monetizing, promoting and distributing applications. React Native: Overview and its features.

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Reto Meier, “Professional Android 4 Application Development”, Wiley India Pvt. Ltd, New Delhi - 2014.
2. John M. Wargo, “Apache Cordova API Cookbook”, Pearson Education – 2015.

REFERENCES:

1. ZiguardMedneiks, Laird Dornin G, Blake Meike and Masumi Nakamura, “Programming Android”, O’Reily,2013.
2. Anubhav Pradhan and Anil V Deshpande, “Composing Mobile Apps”, First Edition, Wiley India Pvt. Ltd, 2014.
3. Charlie Collins, Michael Galpin and Matthias Kappler, “Android in Practice”, Manning Publications, 2012.

e-RESOURCES:

1. <https://nptel.ac.in/courses/106/106/106106147/>, “Mobile Computing – Starting Android Programming”, Professor Pushpendra Singh, IIT- Madras.
2. <https://nptel.ac.in/courses/106/106/106106222/>, “Introduction to Modern Application Development”, Prof. Madhavan Mukund, Prof. AbhijatVichare and Prof. Aamod Sane, IIT- Madras.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO3	1	2	3	2	1	-	1	-	-	-	-	2	3	-
CO4	1	2	3	2	1	-	1	-	-	-	-	2	3	-
CO5	1	2	3	2	1	-	1	-	-	-	-	2	3	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

This course provides the fundamental concepts of microprocessor and microcontroller architectures. It describes the interfacing of memory and peripheral devices with microprocessor and microcontroller. It serves as a prerequisite for future courses. The students showcase their skills in simple applications development with Arduino platform.

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

1. Identify and explain the architecture, memory interfacing and instruction set of 8086 Microprocessor.
2. Illustrate the architecture and interfacing of 8051 microcontroller.
3. Develop programs on Arduino platform for simple applications.
4. Develop and test assembly language programs using instruction set of 8086 microprocessor.
5. Develop and test interface circuits with 8051 microcontroller.

UNIT 1 8086 MICROPROCESSOR ARCHITECTURE

9

Architecture of 8086–Bus interface unit, Execution unit –Memory interfacing–Interrupts–Timing diagrams.

UNIT 2 8086 MICROPROCESSOR INSTRUCTION SET AND PROGRAMMING

9

Addressing modes – Assembler directives – Instruction set of 8086: Data transfer instructions – Branch Instructions – Logical instructions – Arithmetic instructions – Shift and rotate instructions – 8086 programming.

UNIT 3 8051 MICROCONTROLLER

9

8051 Hardware Architecture – Memory organization – I/O ports – Interrupts – Instruction set: Data Transfer, manipulation, Control & I/O instructions.

UNIT 4 PERIPHERAL INTERFACING WITH 8051

9

8255 programmable peripheral interface – A/D and D/A converters – Key board and display interface – DC motor interface – Stepper motor control.

UNIT 5 ARDUINO PROGRAMMING

9

Arduino platform– Arduino IDE – Arduino UNO– structures of Arduino C – variables – making decisions – functions – digital I/O – analog I/O – Hardware libraries – LCD – servo motor – stepper motor.

BUILT IN LAB:

15

1. Block move and comparison of two arrays using 8086 microprocessor.
2. Code conversion using 8086 microprocessor.
3. A/D and D/A interface with 8051 microcontroller.
4. Stepper motor interface with 8051 microcontroller.
5. DC motor control, Servomotor control and LCD interface using Arduino.

TOTAL : 60 PERIODS**TEXT BOOKS:**

1. Krishna Kant, “Microprocessor and Microcontrollers”, Eastern Company Edition, Prentice Hall of India, New Delhi, 2012.
2. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D. Kinley ‘The 8051 Micro Controller and Embedded Systems’, PHI Pearson Education, 2014.
3. Brain Evans “Beginning Arduino programming”, Technology in Action, 2011.

REFERENCES:

1. R.S. Gaonkar, “Microprocessor Architecture Programming and Application with 8085”, Wiley Eastern Ltd., New Delhi, 2013.
2. N. Senthil Kumar, M. Saravanan, S. Jeevananthan, “Microprocessors and Microcontrollers”, Oxford, 2013.
3. Soumitra Kumar Mandal, “Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085, 8086, 8051”, McGraw Hill Education, 2013.

e. RESOURCES :

1. <http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/microcontrollers/micro/ui/TOC.htm>, “Microprocessor and applications”, Prof.S.P.Das, IIT Kharagpur.
2. https://playground.arduino.cc/uploads/Main/arduino_notebook_V1-1.pdf.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	1	-	1	-	-	-	-	1	-	-	-	-
CO2	2	3	2	2	1	-	-	-	1	1	-	-	-	-
CO3	2	3	1	-	1	-	-	-	-	1	-	-	-	-
CO4	2	3	2	2	1	-	-	-	1	1	-	-	-	-
CO5	2	3	2	2	1	-	-	-	1	1	-	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

Mobile Application Development equips the students to design, implement and deploy various applications in mobile devices. Students can design and develop useful applications for android platforms with interactive user interfaces using application frameworks and inbuilt APIs.

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

1. Develop mobile applications using android widgets, layout managers, event listeners, listview, menus, activities and intents for the given problem statements.
2. Implement an android application to track the current location of a mobile user using GPS.
3. Develop an android application for storing and updating data using SQLite and Firebase database.
4. Create an application to extract information from the given JSON message using JSON objects.
5. Develop an application to send and receive messages using SMS Manager.

LIST OF EXPERIMENTS

1. Setting up Android Platform, Android Virtual Device and create application to display Welcome message.
2. Build a score keeper app that gives a user the ability to keep track of the score of two different teams playing a game of choice. Include different Buttons which can be clicked for different events in the game to add points.
3. Create a Musical Structure App to store and present the user with the library of songs available in different categories of classical and Melodies. Write code to play the song chosen by the user from the library of music.
4. Create an application to calculate the electricity bill and create an appropriate alert message as well as send the value to the given mobile number using SMS.
5. Write an android program to demonstrate a Menu 'File' with New and Open as menu items. Give toast messages on click of each menu item.
6. Create an application to fetch the current Location information (Latitude and longitude) and display it in the alert message.
7. Write an android program to implement the following operations using SQLite Database.
 - Create the SQLite Database Object.
 - Execute the CRUD Operations required for the application
 - Close the database.
8. Develop an application to implement phone number Verification by OTP using Firebase in Android
9. Create an application to extract employee information from the JSON message and load it in UI.
10. Develop the following mobile application using android
 - Education Quiz App
 - Tour Guide App
 - News Feed App

TOTAL: 45 PERIODS

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	3	3	1	-	1	-	1	-	-	-	3	2
CO2	2	2	3	3	1	-	1	-	1	-	-	-	3	2
CO3	2	2	3	3	1	-	1	-	1	-	-	-	3	2
CO4	2	2	3	3	1	-	1	-	1	-	-	-	3	2
CO5	2	2	3	3	1	-	1	-	1	-	-	-	3	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

This course enhances the knowledge acquired in information technology to do a mini project, which allows the students to come up with new innovative techniques or algorithms and programs expressing their ideas in a novel way. It helps the students in preparing mini project reports and to face reviews and viva voce examination.

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

1. Apply engineering fundamentals to analyze domain specific Issues to identify problem statement with objective and scope.
2. Investigate the identified problem and review state of the art literature survey to synthesis system requirements
3. Identify the risk/impact/technique and interpret the suitable standards related to the problem statement and design appropriate procedures/methods.
4. Develop modules using discipline specific tools and implement the modules to achieve valid conclusion.
5. Prepare documents related to their findings for detailed presentation, Defend the findings and conclude with oral / written presentation.

Note:

To identify a topic of interest in consultation with Faculty/Supervisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design and develop computer code. Demonstrate the novelty of the project through the results and outputs.

TOTAL : 60 PERIODS

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	2	2	2	2	3	3	3	3	3	3
CO2	2	3	3	3	2	2	2	2	3	3	3	3	3	3
CO3	2	3	3	3	3	2	2	2	3	3	2	3	3	3
CO4	2	3	3	3	3	3	2	2	3	3	3	3	3	3
CO5	2	3	3	3	2	3	2	3	3	3	2	3	3	3

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

Arithmetic And Analytical Ability evaluates the talent and potential to perform a certain task, with no prior knowledge and/or training. This course deals with sort of problems on dynamic thinking, numeric capacity and spatial question. This course is further used for prediction of future success both in educational and vocational careers and aptitude skills help the students in the proper choice of courses and careers.

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

1. Compute time, work, capacity and identify the pattern by analyzing the given problem/scenario
2. Analyze the given problem involving mixture, averages, seating arrangement and apply the suitable method to get the appropriate result.
3. Interpret the given chart and determine the solution.
4. Identify and apply the appropriate permutation, Combination, probability technique to determine the solution.
5. Infer the solution for the given scenario involving syllogisms, clocks, calendar using suitable techniques.

UNIT 1**6**

Time and Work, Pipes and Cisterns, Symbol Series

UNIT 2**6**

Alligation or Mixture, Averages, Seating Arrangements

UNIT 3**6**

Data Interpretation-Table Charts, Bar Charts, Pie Charts, Line Charts

UNIT 4**6**

Permutation and Combination, Probability

UNIT 5**6**

Syllogisms, Clocks, Calendar

TOTAL : 30 PERIODS**REFERENCES:**

1. Dr.R.S.Aggarwal, "Quantitative Aptitude for Competitive Examination", S.Chand Publications, 2017.
2. Dr.R.S.Aggarwal, "A Modern Approach to Verbal & Non-Verbal Reasoning", S.Chand Publications, 2018.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO3	2	3	2	2	-	-	-	-	-	-	-	1	-	-
CO4	2	3	2	2	-	-	-	-	-	-	-	1	-	-
CO5	2	3	2	2	-	-	-	-	-	-	-	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

Communication Skill is a life skill necessary for all students of Engineering and Technology. The course Communicative Skills Laboratory aims at developing effective oral and written communication to facilitate their success in competitive examinations, and recruitment screening thereby ensuring professional success and progress.

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

1. Respond quickly and correctly to questions from different types of scripts, exhibiting good comprehension and analyzing skills
2. Participate effectively in formal group discussions and prepare professional e-mails, persuasive and expository paragraphs to establish and meet organizational needs and goals.
3. Fare well in IELTS and other English language assessment segments of competitive examinations within the stipulated time.
4. Write effective resumes and face interviews with communicative competence and confidence, with a good knowledge of career skills.
5. Select appropriate vocabulary and idiomatic expressions, identify errors in syntax, arrange sentences to make meaningful paragraphs, without any aid.

UNIT 1 RECEPTIVE SKILLS**6**

LISTENING & READING – Developing Listening & Reading Skills - Comprehension and Analysis – Listening & Reading for Main Idea - Specific Information - Sequence-Vocabulary - Cultural Interest- Attitude and Opinion- Functional language.

UNIT 2 PRODUCTIVE SKILLS**8**

SPEAKING - Group Discussion skills – Structure- Types- Techniques - Keywords -Vital qualities -Tips to improve performance. **WRITING** - Emails and Paragraph Writing - Expository and Persuasive

UNIT 3 ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS**4**

Orientation to International English Language Testing System (IELTS), Public Service Commission Exams (TNPSC, UPSC)

UNIT 4 CAREER SKILLS**6**

Different types of Interview formats - Answering Questions – FAQ's - Mock Interviews - Body Language - Preparation of Résumé and Job Application Letter - Team Work - Managing Time - Managing Stress - Negotiation Skills - Networking Professionally - Social Protocols – Upskilling

UNIT 5 VERBAL ABILITY**6**

Synonyms and Antonyms - Verbal Analogy - Cloze Test- Idioms and Phrases - Sentence Completion - Jumbled Sentences - Error Spotting - Theme Detection - Sentence Arrangement

TOTAL : 30 PERIODS

RECOMMENDED SOFTWARE: Globerena

REFERENCES:

1. Rizvi M. Ashraf, "Effective Technical Communication", MC Graw Hill Education, New Delhi, 2005.
2. Koneru Aruna, "Professional Communication", MC Graw Hill Education, Chennai, 2008.
3. Upadhyay Meenakshi & Arun Sharma, "Comprehension Interpersonal & Communication Skills for General Studies Civil Services Preliminary Examination", MC Graw Hill Education, New Delhi, 2012.

WEB SOURCES:

1. <http://www.slideshare.net/rohitjsh/presentation-on-group-discussion>
2. <https://www.teachingenglish.org.uk/article/email-writing>
3. <https://www.naukri.com/blog/frequently-asked-hr-interview-questions-and-answers/>
4. <http://www.oxforddictionaries.com/words/writing-job-applications>
5. <https://www.fresherslive.com/online-test/verbal-ability-test/questions-and-answers>

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO4	-	-	-	-	-	3	-	-	-	3	-	-	-	-
CO5	-	-	-	-	-	3	-	-	-	3	-	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

The main aim of this course is to understand the concepts of Economics with respect to the demand and supply analysis. This course makes the students to analyze the theory of production and the analysis of the cost parameter by using the Elasticity. This course will enable the students to manage and plan the situation with the help of the available strategies to support the decision making process.

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

1. Summarize how to solve economics principles to solve economic problems in engineering discipline by satisfying the economic laws.
2. Discuss the demand and supply process for a market analysis using Price elasticity, Cross elasticity and Income elasticity.
3. Interpret short run and long run costs in the process of production for carrying out a business.
4. Apply managerial skills to make decisions and solve problems for achieving organizational objectives.
5. Express the principles of effective planning for survival and success of all organizations using standing and single use planning methods.

UNIT 1 INTRODUCTION TO ECONOMICS**9**

Introduction to Economics – Scope of Economics – Positive and Normative Science – Methodology of Economics – Economic Laws - Economy and its basic problems: Economy and its working – Kinds of economy systems – Basic problems of economy.

UNIT 2 DEMAND AND SUPPLY ANALYSIS**9**

The Law of Demand – The Law of Supply – Elasticities of Demand and Supply: Price Elasticity of Demand - Price Elasticity and Consumption Expenditure- Cross Elasticity of Demand – Income Elasticity of Demand – The Elasticity of Price Expectations – The uses of Elasticity– Price Elasticity of Supply.

UNIT 3 THEORY OF PRODUCTION AND ANALYSIS OF COST**9**

Meaning of Production – Production concepts – Production Function – Laws of Production – Cost Concepts - Short-Run Cost/Output Relations – Long Run Cost output relations – Economics of Scale.

UNIT 4 INTRODUCTION TO MANAGEMENT**9**

Management: An Overview – Management Defined – Managerial skills – Managerial roles – Management responsibilities – Management functions. Evolution of Management: Classical approaches to Management – Contemporary Management Perspectives.

UNIT 5 PLANNING**9**

Planning and Forecasting: Importance of Planning – Principles of effective Planning – Planning process – Types of Plans. Strategic Planning: Strategic Planning process – Rational decision making.

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. D.N.Dwivedi, “Principles of Economics”, Second Edition, Vikas Publishing House (P) Limited, New Delhi, 2012.
2. J.S.Chandan, “Management Concepts and Strategies”, Vikas Publishing House (P) Limited, New Delhi, 2003.

REFERENCES:

1. Ranbir Singh, “Principles of Engineering Economics and Management”, S.K.Kataria & Sons, New Delhi, 2013.
2. Manish Varshney and Vidhan Banerjee, “Engineering and Managerial Economics”, First Edition, CBS Publishers and Distributors Pvt. Ltd., 2015.

e-RESOURCES:

1. <http://nptel.ac.in/courses/110101005/>, Prof. Trupti Mishra, S.J.M. School of Management, IIT Mumbai, Managerial Economics.
2. https://nptel.ac.in/courses/122106031/slides/3_1s.pdf, Dr.M.Thenmozhi, Professor, IIT Madras.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO4	2	3	-	2	-	2	1	-	-	-	-	-	-	2
CO5	2	3	-	2	-	2	1	-	-	-	-	-	-	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

This course on network security aims at exploring the various cryptographic algorithms deployed in offering confidentiality, integrity, authentication and non repudiation. It also focuses on basic concepts of networks, authentication methods, Protocols, standards, Intrusion Detection and Prevention Mechanisms and Firewalls.

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

1. Identify the major types of threats and develop strategies to protect organization information assets from common attacks using classical cryptographic techniques.
2. Encrypt and decrypt information for a given message using symmetric and asymmetric algorithms.
3. Analyze existing authentication and key agreement protocols and choose appropriate protocols for a given message based on the needed functionality
4. Classify firewall-based solutions against security threats and employ access control techniques for the existing computer platforms UNIX and Windows using network security applications.
5. Solve security problems related to e-mail, IP and Web in practical systems using security techniques.

UNIT 1 FOUNDATION & NUMBER THEORY**10**

Services, Mechanisms and attacks-the OSI security architecture-Network security model- Classical Encryption techniques-.FINITE FIELDS AND NUMBER THEORY: Groups, Rings, Fields-Modular arithmetic- Euclid's algorithm-Finite fields- Polynomial Arithmetic –Prime numbers-Fermat's and Euler's theorem-Testing for primality -The Chinese remainder theorem- Discrete logarithms.

UNIT 2 BLOCK CIPHERS & PUBLIC KEY CRYPTOGRAPHY**10**

Data Encryption Standard-Block cipher Design principles- block cipher modes of operation-Advanced Encryption Standard (AES) - Triple DES-Blowfish. Public key cryptography: Principles of public key cryptosystems-The RSA algorithm-Key management - Diffie Hellman Key exchange- Elliptic curve arithmetic-Elliptic curve cryptography.

Case Study: Encrypt and decrypt the message transfer between two users using RSA algorithm.

UNIT 3 HASH FUNCTIONS AND DIGITAL SIGNATURES**8**

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC –MD5 – SHA512 - Digital signature and authentication protocols –DSS – El Gamal – Schnorr. Case Study: Authenticate the sensitive file transfer between two users using DSS.

UNIT 4 SECURITY PRACTICE & SYSTEM SECURITY**8**

Authentication applications – Kerberos – X.509 Authentication services - Internet Firewalls for Trusted System: Roles of Firewalls – Firewall related terminology- Types of Firewalls - Firewall designs – SET for E-Commerce Transactions. Intruder – Intrusion detection system – Virus and related threats –Countermeasures – Firewalls design principles – Trusted systems. Case Study: Create your own Virus.

UNIT 5 E-MAIL, IP & WEB SECURITY**9**

E-mail Security: Security Services for E-mail-attacks possible through E-mail - establishing keys privacy-authentication of the source-Message Integrity-Non-repudiation-Pretty Good Privacy-S/MIME. IP-Security: Overview of IPSec - IP and IPv6-Authentication Header-Encapsulation Security Payload (ESP)-Internet Key Exchange (Phases of IKE, ISAKMP/IKE Encoding). Web Security: SSL/TLS Basic Protocol-computing the keys- client authentication-PKI as deployed by SSL Attacks fixed in v3-Exportability-Encoding-Secure Electronic Transaction (SET).Case Study: Detection of Phishing Email.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. William Stallings, Cryptography and Network Security, 6th Edition, Pearson Education, March 2013. (UNIT I,II,III,IV).
2. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security", Prentice Hall of India, 2002. (UNIT V).

REFERENCES:

1. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata Mc Graw Hill, 2007.
2. Man Young Rhee, "Internet Security: Cryptographic Principles", "Algorithms and Protocols", Wiley Publications, 2003.

e-RESOURCES:

1. williamstallings.com/Extras/Security-Notes/
2. <https://www.slideshare.net/gangadhar9989166446/network-security-cryptography-full-notes>
3. <https://nptel.ac.in/courses/106/105/106105031/>

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	-	-	-	1	-	1	-	-	-	1	2	-
CO2	2	3	2	3	-	1	-	1	-	-	-	1	2	-
CO3	2	3	-	3	-	1	-	1	-	-	-	1	1	-
CO4	2	3	-	2	-	2	-	1	-	-	-	1	1	-
CO5	2	3	2	-	-	2	-	1	-	-	-	1	2	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : -**Preamble**

The principles of computation and communication models in distributed systems are the main topics of this course. Additionally, students will be able to comprehend the problems associated with synchronization and data collecting in distributed systems. The students will learn about distributed mutual exclusion, distributed deadlock detection methods, agreement protocols, and fault tolerance strategies in distributed systems. Students will also be able to comprehend the fundamental ideas behind cloud computing models.

UNIT 1 INTRODUCTION**8**

Introduction: Definition-Relation to Computer System Components – Motivation – Message - Passing Systems versus Shared Memory Systems – Primitives for Distributed Communication – Synchronous versus Asynchronous Executions – Design Issues and Challenges; A Model of Distributed Computations: A Distributed Program – A Model of Distributed Executions – Models of Communication Networks – Global State of a Distributed System.

UNIT 2 LOGICAL TIME AND GLOBAL STATE**10**

Logical Time: Physical Clock Synchronization: NTP – A Framework for a System of Logical Clocks – Scalar Time – Vector Time; Message Ordering and Group Communication: Message Ordering Paradigms – Asynchronous Execution with Synchronous Communication – Synchronous Program Order on Asynchronous System – Group Communication – Causal Order – Total Order; Global State and Snapshot Recording Algorithms: Introduction – System Model and Definitions – Snapshot Algorithms for FIFO Channels.

UNIT 3 DISTRIBUTED MUTEX AND DEADLOCK**10**

Distributed Mutual exclusion Algorithms: Introduction – Preliminaries – Lamport's algorithm – Ricart-Agrawala's Algorithm – Token-Based Algorithms – Suzuki-Kasami's Broadcast Algorithm; Deadlock Detection in Distributed Systems: Introduction – System Model – Preliminaries – Models of Deadlocks – Chandy-Misra-Haas Algorithm for the AND model and OR Model.

UNIT 4 CONSENSUS AND RECOVERY**10**

Consensus and Agreement Algorithms: Problem Definition – Overview of Results – Agreement in a Failure-Free System(Synchronous and Asynchronous) – Agreement in Synchronous Systems with Failures; Checkpointing and Rollback Recovery: Introduction – Background and Definitions – Issues in Failure Recovery – Checkpoint-based Recovery – Coordinated Checkpointing Algorithm -- Algorithm for Asynchronous Checkpointing and Recovery

UNIT 5 CLOUD COMPUTING**7**

Definition of Cloud Computing – Characteristics of Cloud – Cloud Deployment Models – Cloud Service Models – Driving Factors and Challenges of Cloud – Virtualization – Load Balancing – Scalability and Elasticity – Replication – Monitoring – Cloud Services and Platforms: Compute Services – Storage Services – Application Services

Total : 45 Periods**TEXT BOOKS:**

1. Kshemkalyani Ajay D, Mukesh Singhal, "Distributed Computing: Principles, Algorithms and Systems", Cambridge Press, 2011.
2. Mukesh Singhal, Niranjana G Shivaratri, "Advanced Concepts in Operating systems", McGraw Hill Publishers, 1994

REFERENCES:

1. George Coulouris, Jean Dollimore, Time Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012.
2. Pradeep L Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
3. Tanenbaum A S, Van Steen M, "Distributed Systems: Principles and Paradigms", Pearson Education, 2007.

e-RESOURCES:

1. <https://library.iitbbs.ac.in/e-resources-a2z.php?page=21>
2. https://onlinecourses.nptel.ac.in/noc21_cs87/preview

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

- CO1 Explain the foundations of distributed systems
 CO2 Solve synchronization and state consistency problems
 CO3 Use resource sharing techniques in distributed systems
 CO4 Apply working model of consensus and reliability of distributed systems
 CO5 Explain the fundamentals of cloud computing

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	3	3	1	-	-	-	2	1	3	3	2	2
CO2	1	3	2	1	2	-	-	-	2	2	2	2	2	2
CO3	2	2	1	3	3	-	-	-	3	2	1	1	2	2
CO4	1	2	2	3	1	-	-	-	3	3	2	1	2	2
CO5	3	3	1	2	3	-	-	-	3	3	3	1	2	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

Universal Human Values is a life skill necessary for all students of Engineering and Technology. The course aims to identify the values and skills, and to realize the need, basic guidelines, content and process of value education. Professional Ethics For Engineers deals with the human values, integrity and work ethics in the common world. This course is mainly concerned about the theories of ethics, which form the basis for the understanding and responsibility of the various groups encountered in Engineering.

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

1. Relate the significance of value inputs in a classroom and start applying them in their life and profession.
2. Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual.
3. Interpret the value of harmonious relationships based on the trust and respect in their life and profession.
4. Discuss the ethical issues related to Engineering.
5. Discuss Engineer's work in the context of its impact on society.

UNIT 1 INTRODUCTION TO UNIVERSAL HUMAN VALUES**9**

Understanding the need, basic guidelines, content and process for Value Education. Self Exploration– Mechanism for self exploration. Continuous Happiness and Prosperity- Basic Human Aspirations and its requirements for fulfillment of Human Aspirations understanding and living in harmony at various levels.

UNIT 2 HARMONY IN ONESELF, FAMILY AND SOCIETY**9**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding harmony in the Family- the basic unit of human interaction. Understanding values in human-human relationships. Trust and Respect- values of relationship. Difference between intention and competence. Difference between respect and differentiation

UNIT 3 HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS**9**

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in Professional Ethics. Ability to utilize the professional competence for augmenting universal human order, Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models.

UNIT 4 ENGINEERING ETHICS**9**

Senses of Engineering Ethics– Variety of moral issues – Types of inquiry – Moral dilemmas – Moral autonomy – Kohlberg's theory – Gilligan's theory – Consensus and controversy – Models of professional roles –Professional responsibility - Moral reasoning - Theories about right action – Self interest – Self respect – Duty ethics – Customs and religion.

UNIT 5 ENGINEERING AS SOCIAL EXPERIMENTATION**9**

Engineering as experimentation – Engineers as responsible experimenters – Role of codes- Codes of Ethics – Sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of Electronics and Telecommunication Engineers (IETE) – A balanced outlook on law - Safe exits -The Bhopal gas tragedy and Challenger case study.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Gaur R R, Sangal R, Bagaria G P, “A Foundation Course in Human Values and Professional Ethics”. 2009
2. Govindarajan M, Natarajan S and Senthil Kumar V. S, “Engineering Ethics”, PHI Learning Pvt. Ltd, New Delhi, 2017.

REFERENCES:

1. Banerjee B P, “Foundations of Ethics and Management”, Excel Books. 2005.
2. Bajpai B L, “Indian Ethos and Modern Management”, New Royal Book Co., Lucknow. Reprinted 2008.
3. Subramanian R, “Professional Ethics”, Oxford university press, 2017.

e-RESOURCES:

1. <https://www.uhv.org.in/>
2. <https://nptel.ac.in/courses/109/106/109106117/>

Preamble:

This laboratory course is intended to expose the students to different cipher techniques and to implement algorithms like DES, RSA, MD5, SHA-1 using Java programming language/Python programming language.

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

1. Implement and test symmetric and asymmetric cipher techniques using Java/Python.
2. Implement digital signature standard and verify the authentication process using Java/Python.
3. Implement and test digital signature standard using GnuPG
4. Implement and test honey pot using KF Sensor.
5. Implement and test IDS and WEP, WPA using snort and Net stumbler respectively

LIST OF EXPERIMENTS:

1. Implement the following Substitution & Transposition Techniques
 - a) Caesar Cipher
 - b) Playfair Cipher
 - c) Hill Cipher
2. Implement the following algorithms
 - a) DES
 - b) RSA Algorithm
 - c) Diffie-Hellman
 - d) MD5
 - e) SHA-1
2. Implement the Signature Scheme - Digital Signature Standard
3. Demonstrate how to provide secure data storage, secure data transmission and for creating digital signatures (GnuPG).
4. Setup a honey pot and monitor the honeypot on network (KF Sensor)
5. Installation of rootkits and study about the variety of options
6. Perform wireless audit on an access point or a router and decrypt WEP and WPA.(Net Stumbler)
7. Demonstrate intrusion detection system (ids) using any tool (snort or any other s/w)

TOTAL : 45 PERIODS

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	2	3	1	-	-	-	1	1	-	-	1	-
CO2	-	-	2	3	1	-	-	-	1	1	-	-	1	-
CO3	-	-	2	3	3	-	-	-	1	1	-	-	2	-
CO4	-	-	2	3	3	-	-	-	1	1	-	-	2	-
CO5	-	-	2	3	3	-	-	-	1	1	-	-	2	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

The course provides basic information on Indian Constitution and Indian Traditional knowledge. This is essential for all citizens and especially for engineers so that they become aware of Indian polity and governance. This also reminds the citizen about their obligation, adherence and up keeping of Constitutional rights.

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

1. Outline the evolution of Indian constitution and Federal structure
2. List and explain the functions of Centre, States and District Administrations
3. Elaborate the roles of Panchayat raj
4. Explain the powers and roles of Election Commission
5. Illustrate the Indian traditional knowledge and elucidate their recovery

UNIT 1**6**

‘Constitution’ meaning of the term, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy - Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha

UNIT 2**6**

Governor: Role and Position, CM and Council of ministers, State Secretariat: organisation, Structure and Functions District’s Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation,

UNIT 3**6**

Panchayatraj: Introduction, PRI: Zila Panchayat, Elected officials and their roles, CEO Zila Panchayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT 4**6**

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women

UNIT 5**6**

Basics tructure of IndianKnowledgeSystem-Modern Science and Indian Knowledge -Philosophical Tradition - Indian Linguistic Tradition (Phonology, morphology, syntax and semantics) – Indian Artistic Tradition

TOTAL: 30 PERIODS**TEXT BOOKS:**

1. M.Rajaram, Indian Constitution, New Age International, 2009.
2. V.Sivaramakrishnan(Ed.) Cultural Heritage of India (Course Material),Bharatiya Vidya Bhavan, Mumbai, 5thEdition,2014.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	3	1	2	1	1	-	1	-	-
CO2	-	-	-	-	-	3	1	2	1	1	-	1	-	-
CO3	-	-	-	-	-	3	1	2	1	1	-	1	-	-
CO4	-	-	-	-	-	3	1	2	1	1	-	1	-	-
CO5	-	-	-	-	-	3	1	2	1	1	-	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

This course develops the ability to solve a specific problems in-depth insight into the concepts, principles, formulation of the projects and network technique right from its identification and literature review till the successful solution of the same. It also trains the students in preparing project reports and to face reviews and viva voce examination.

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

1. Apply engineering fundamentals to analyze domain specific Issues to identify problem statement with objective and scope.
2. Investigate the identified problem and review state of the art literature survey to synthesis system requirements.
3. Identify the risk/impact/technique and interpret the suitable standards related to the problem statement and design appropriate procedures/methods.
4. Develop modules using discipline specific tools and implement the modules to achieve valid conclusion.
5. Prepare documents related to their findings for detailed presentation, Defend the findings and conclude with oral / written presentation.

Note:

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 180 PERIODS

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	2	2	2	2	3	3	3	3	3	3
CO2	2	3	3	3	2	2	2	2	3	3	3	3	3	3
CO3	2	3	3	3	3	2	2	2	3	3	2	3	3	3
CO4	2	3	3	3	3	3	2	2	3	3	3	3	3	3
CO5	2	3	3	3	2	3	2	3	3	3	2	3	3	3

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

PROFESSIONAL ELECTIVES

Pre-requisites : Python Programming

Preamble

The main aim of this course to outline an overview of exploratory data analysis. To implement data visualization using Matplotlib. To perform univariate data exploration and analysis. To apply bivariate data exploration and analysis. To use Data exploration and visualization techniques for multivariate and time series data.

UNIT 1 EXPLORATORY DATA ANALYSIS

9

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques.

UNIT 2 EDA USING PYTHON

9

Data Manipulation using Pandas – Pandas Objects – Data Indexing and Selection – Operating on Data – Handling Missing Data – Hierarchical Indexing – Combining datasets – Concat, Append, Merge and Join – Aggregation and grouping – Pivot Tables – Vectorized String Operations. Case study: Perform EDA on wine Quality Data set.

UNIT 3 UNIVARIATE ANALYSIS

9

Introduction to Single variable: Distribution Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality.

UNIT 4 BIVARIATE ANALYSIS

9

Relationships between Two Variables - Percentage Tables - Analysing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines.

UNIT 5 MULTIVARIATE AND TIME SERIES ANALYSIS

9

Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Timebased indexing – Visualizing – Grouping – Resampling. Case study: Perform Time Series Analysis and apply the various Visualization techniques.

Total : 45 Periods

TEXT BOOKS:

1. Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”, Packt Publishing, 2020.
2. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", First Edition, O Reilly, 2017.
3. Catherine Marsh, Jane Elliott, “Exploring Data: An Introduction to Data Analysis for Social Scientists”, Wiley Publications, 2nd Edition, 2008.

REFERENCES:

1. Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 2017.
2. Claus O. Wilke, “Fundamentals of Data Visualization”, O’reilly publications, 2019.

e-RESOURCES:

1. <https://analyticsindiamag.com/>

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

- CO1 Explain the concepts of exploratory data analysis and data transformation techniques for merging, reshaping and pivoting using software tools of EDA.
- CO2 Implement the data manipulation, indexing and selection using Panda's Matplotlib for wine quality data set.
- CO3 Perform univariate data exploration and analysis.
- CO4 Apply bivariate data exploration and analysis.
- CO5 Apply Data exploration and visualization techniques for multivariate and time series data using Pandas.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	3	3	-	-	-	2	2	3	2	2	-
CO2	2	2	2	3	3	-	-	-	3	2	2	2	2	-
CO3	2	3	2	2	3	-	-	-	2	2	2	1	2	-
CO4	2	2	2	2	3	-	-	-	3	2	2	1	2	-
CO5	2	2	3	2	1	-	-	-	1	2	2	1	2	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites :-**Preamble**

To understand the foundations of the recommender system, To learn the significance of machine learning and data mining algorithms for Recommender systems, To learn about collaborative filtering, To make students design and implement a recommender system. To learn collaborative filtering.

UNIT 1 INTRODUCTION**9**

Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems- similarity measures- Dimensionality reduction – Singular Value Decomposition (SVD). Case Study : Data similarity measures using Python.

UNIT 2 CONTENT-BASED RECOMMENDATION SYSTEMS**9**

High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms.

UNIT 3 COLLABORATIVE FILTERING**9**

A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection. Case Study : collaborative filter techniques.

UNIT 4 ATTACK-RESISTANT RECOMMENDER SYSTEMS**9**

Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack – Group attack – Strategies for robust recommender design - Robust recommendation algorithms. Case Study : Attack for tampering with recommender systems.

UNIT 5 EVALUATING RECOMMENDER SYSTEMS**9**

Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design – Design Issues – Accuracy metrics – Limitations of Evaluation measures. Case Study : Accuracy metrics like Receiver Operated Characteristic curves.

Total : 45 Periods**TEXT BOOKS:**

1. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
2. Dietmar Jannach , Markus Zanker , Alexander Felfernig and Gerhard Friedrich , Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed
3. Francesco Ricci , Lior Rokach , Bracha Shapira , Recommender Sytems Handbook, 1st ed, Springer (2011),
4. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020.

REFERENCES:

1. M. Chiang, Networking Life, Cambridge, 2010. (Chapter 4).
2. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1st ed

e-RESOURCES:

1. <https://www.witpress.com/Secure/elibrary/papers/1845641523/1845641523005FU1.pdf>
2. <https://freevidelectures.com/course/4694/nptel-e-business/54>

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

- CO1 Explain the concepts of recommender systems.
- CO2 Demonstrate machine-learning and data-mining algorithms in recommender systems data sets.
- CO3 Identify Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics
- CO4 Summarize simple recommender system.
- CO5 Organize about advanced topics of recommender systems.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	1	2	1	-	-	-	1	-	-	1	2	2
CO2	1	2	-	-	1	-	-	-	-	-	-	1	2	2
CO3	2	3	1	-	1	-	-	-	2	-	-	-	2	2
CO4	3	2	2	2	1	-	-	-	2	-	-	2	2	2
CO5	1	1	-	2	1	-	-	-	-	-	-	1	2	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : Transforms and Partial Differential Equations, Probability and Queueing Theory

Preamble

Artificial Neural Networks are the computational models inspired by the human brain. Many of the recent advancements have been made in the field of Artificial Intelligence, including Voice Recognition, Image Recognition, and Robotics using Artificial Neural Networks. These biological methods of computing are considered to be the next major advancement in the Computing Industry. ANN are the biologically inspired simulations performed on the computer to perform certain specific tasks like clustering, classification, pattern recognition, etc. The ANN is the very useful model and the ANN could be applied in problem-solving and machine learning. Thus, their ability to learn by example makes them very flexible and powerful.

UNIT 1 INTRODUCTION TO NEURAL NETWORKS

9

Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction-Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network- Case Study: regression model in Keras.

UNIT 2 ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS

9

Training Algorithms for Pattern Association-Auto associative Memory Network-Hetero associative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Auto associative Memory Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Counter propagation Networks-Adaptive Resonance Theory Network.

UNIT 3 THIRD-GENERATION NEURAL NETWORKS

9

Spiking Neural Networks-Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Neuroscientific Basis – Applications: Computer Vision, Image Generation, Image Compression- Case Study: Image Classifier using CNN in TensorFlow/Keras.

UNIT 4 DEEP FEEDFORWARD NETWORKS

9

History of Deep Learning- A Probabilistic Theory of Deep Learning- Gradient Learning – Chain Rule and Backpropagation - Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout - batch normalization- VC Dimension and Neural Nets-Case Study: Feed Forward Network in TensorFlow/Keras.

UNIT 5 RECURRENT NEURAL NETWORKS

9

Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Autoencoder, Stochastic Encoders and Decoders, Contractive Encoders-Case Study: Sentiment Analysis using RNN.

Total : 45 Periods

TEXT BOOKS:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
2. Francois Chollet, “Deep Learning with Python”, Second Edition, Manning Publications, 2021.

REFERENCES:

1. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, Oreilly, 2018.
2. Josh Patterson, Adam Gibson, “Deep Learning: A Practitioner’s Approach”, O’Reilly Media, 2017.
3. Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook”, Springer International Publishing, 1st Edition, 2018.

e-RESOURCES:

1. http://videlectures.net/deeplearning2015_montreal/
2. https://www.youtube.com/channel/UC9OeZkIwhzfv-_Cb7fCikLQ/videos

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

- CO1 Apply Convolution Neural Network for image processing.
- CO2 Explain associative memory and unsupervised learning networks.
- CO3 Apply CNN and its variants for suitable applications.
- CO4 Apply the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.
- CO5 Apply auto encoders and generative models for suitable applications.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	2	3	1	-	-	2	1	-	-	2	3
CO2	3	1	2	1	-	-	1	-	-	1	2	2	3	3
CO3	3	3	3	3	3	1	-	-	2	1	-	-	3	2
CO4	3	3	3	3	3	-	-	-	2	-	2	3	3	3
CO5	1	1	3	2	3	-	-	-	2	-	-	-	2	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : Neural Networks and Deep Learning**Preamble**

Text analysis is a machine learning technique used to automatically extract valuable insights from unstructured text data. Companies use text analysis tools to quickly digest online data and documents, and transform them into actionable insights. Speech analysis is the process of analyzing voice recordings or live customer calls to contact centers with speech recognition software to find useful information and provide quality assurance.

UNIT 1 NATURAL LANGUAGE BASICS**9**

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop-words – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model.

UNIT 2 TEXT CLASSIFICATION**9**

Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model –FastText model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models. Case study: Use a transformer for implementing classification.

UNIT 3 QUESTION ANSWERING AND DIALOGUE SYSTEMS**9**

Information retrieval – IR-based question answering – knowledge-based question answering – language models for QA – classic QA models – chatbots – Design of dialogue systems -- evaluating dialogue systems. Case study: Design a chatbot with a simple dialog system.

UNIT 4 TEXT-TO-SPEECH SYNTHESIS**9**

Overview. Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems. Case study: Convert text to speech and find accuracy.

UNIT 5 AUTOMATIC SPEECH RECOGNITION**9**

Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems. Case study: Design a speech recognition system and find the error rate.

Total : 45 Periods**TEXT BOOKS:**

- Daniel Jurafsky and James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Third Edition, 2022.
- Dipanjan Sarkar, “Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data”, APress,2018

REFERENCES:

- Tanveer Siddiqui, Tiwary U S, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.
- Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, “Fundamentals of Speech Recognition” 1st Edition, Pearson, 2009.

e-RESOURCES:

- <https://nptel.ac.in/courses/106101007>,”Natural Language Processing”, Prof. Pushpak Bhattacharyya, IIT Bombay.
- <https://nptel.ac.in/courses/106105158>,” Natural Language Processing”,Prof. Pawan Goyal, IIT Kharagpur.

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

- CO1 Explain existing and emerging deep learning architectures for text and speech processing
- CO2 Classify the features of text documents using text classification algorithms
- CO3 Develop question-answering systems, chatbots and dialogue systems for a given application.
- CO4 Apply deep learning based text to speech systems to develop a speech synthesizer for a given application.
- CO5 Develop a speech recognition system for a given application using deep learning models.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	1	3	-	-	-	1	2	1	2	1	1
CO2	3	1	2	1	3	-	-	-	2	2	1	3	3	2
CO3	2	2	1	3	1	-	-	-	3	3	1	2	3	3
CO4	2	1	1	1	2	-	-	-	2	1	2	2	3	1
CO5	1	3	2	2	1	-	-	-	3	2	1	1	2	3

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : Exploratory Data Analysis**Preamble:**

This course aims to inform the changes in business through utilization of predictive models that provide insight into the outcome of proposed changes.

UNIT 1 INTRODUCTION TO BUSINESS ANALYTICS 9

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration.

UNIT 2 BUSINESS INTELLIGENCE 9

Data Warehouses and Data Mart - Knowledge Management –Types of Decisions – Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions.

Case Study: Perform data pre-processing operations i) Handling Missing data ii) Normalization

UNIT 3 BUSINESS FORECASTING 9

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models – Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics.

Case Study: Perform bivariate and multivariate analysis on the dataset.

UNIT 4 HR & SUPPLY CHAIN ANALYTICS 9

Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain - Applying HR Analytics to make a prediction of the demand for hourly employees for a year.

UNIT 5 MARKETING & SALES ANALYTICS 9

Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales - predictive analytics for customers' behaviour in marketing and sales.

Total : 45 Periods

TEXT BOOKS:

1. R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017
2. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016
3. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
4. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
5. Mahadevan B, "Operations Management -Theory and Practice",3rd Edition, Pearson Education,2018.

REFERENCES:

1. R N Prasad, Seema Acharya, Fundamentals Of Business Analytics, 2016, Wiley Publications
2. Foster Provost, Tom Fawcett, Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, O'Reilly Media, Inc. 2013

e-RESOURCES:

1. Business Analytics For Management Decision, IIT Kharagpur <https://nptel.ac.in/courses/110105089>
2. Business Analysis for Engineers, IIT Madras. <https://nptel.ac.in/courses/110106050>

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

CO1 Infer the real world business problems with models and validate the solutions.

CO2 Identify the business processes for extracting Business Intelligence.

CO3 Develop predictive analytics model for business fore-casting using machine learning techniques.

CO4 Apply HR and supply chain analytics to make a prediction of the demand.

CO5 Use analytics for marketing and sales to predict the customers behavior.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	3	1	1	-	-	-	1	2	1	1	3	2
CO2	3	2	3	2	3	2	-	-	-	3	3	1	3	3
CO3	2	2	3	1	1	-	-	-	1	2	1	1	3	2
CO4	5	2	3	2	3	2	-	-	-	3	3	1	3	3
CO5	2	2	3	1	1	-	-	-	1	2	1	1	3	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites: Exploratory Data Analysis, Neural Networks and Deep Learning

Preamble

The main aim of this course is to make understand the basics of image processing techniques for computer vision, to learn the techniques used for image pre-processing, to discuss the various object detection techniques and to understand the various Object recognition mechanisms.

UNIT 1 INTRODUCTION

9

Computer Vision – Image representation and image analysis tasks - Image representations – digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation - Traditional and Hierarchical image data structures- Case Study: T-pyramid of an image

UNIT 2 IMAGE PRE-PROCESSING

9

Local pre-processing - Image smoothing - Edge detectors - Zero-crossings of the second derivative - Scale in image processing - Canny edge detection - Parametric edge models – Edges in multi-spectral images - Local pre-processing in the frequency domain - Line detection by local pre-processing operators - Image restoration – Case Study: Deriving the quad tree representation of an image using the homogeneity criterion of equal intensity

UNIT 3 OBJECT DETECTION USING MACHINE LEARNING

9

Object detection– Object detection methods – Deep Learning framework for Object detection– bounding box approach-Intersection over Union (IoU) –Deep Learning Architectures-R-CNN-Faster R-CNN-You Only Look Once(YOLO)-Salient features-Loss Functions-YOLO architectures-Case Study: Geometric transforms such as Rotation, Change of scale, Skewing, Affine transform calculated from three pairs of corresponding points and Bilinear transform calculated from four pairs of corresponding points.

UNIT 4 FACE RECOGNITION AND GESTURE RECOGNITION

9

Face Recognition-Introduction-Applications of Face Recognition-Process of Face Recognition- Deep Face solution by Facebook - FaceNet for Face Recognition- Implementation using FaceNet- Gesture Recognition-Case Study: motion analysis using moving edges, and apply it to your image sequences and Facial Detection and Recognition.

UNIT 5 VIDEO ANALYTICS

9

Video Processing – use cases of video analytics-Vanishing Gradient and exploding gradient problem-ResNet architecture-ResNet and skip connections-Inception Network-GoogleNet architecture-Improvement in Inception v2-Video analytics-ResNet and Inception v3 –Case Study: Event detection in video surveillance system

Total : 45 Periods

TEXT BOOKS:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and Machine Vision”, 4th edition, Thomson Learning, 2013.
2. Vaibhav Verdhhan,(2021, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras,Apress 2021(UNIT-III,IV and V)

REFERENCES:

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer Verlag London Limited, 2011.
2. Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, “Video Analytics for Business Intelligence”, Springer, 2012.
3. D. A. Forsyth, J. Ponce, “Computer Vision: A Modern Approach”, Pearson Education, 2003.
4. E. R. Davies, (2012), “Computer & Machine Vision”, Fourth Edition, Academic Press.

e-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_cs93/preview
2. <https://appsilon.com/object-detection-yolo-algorithm/>

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

- CO1 Explain image processing techniques in computer vision and video analysis for the T-pyramid of an image .
- CO2 Discuss pre-processing techniques for image smoothing, edge detection, line detection and restoration using the homogeneity criterion of equal intensity.
- CO3 Perform geometric transformation on objects from three and four pairs of corresponding points using IoU, R-CNN and YOLO..
- CO4 Explain the process involved in face recognition and gesture recognition and apply motion analysis for an image.
- CO5 Elaborate on deep learning-based video analytics using ResNet and GoogleNet architectures for video surveillance systems .

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	2	2	2	-	-	-	3	3	2	1	3	3
CO2	2	2	3	3	3	-	-	-	3	2	1	1	3	3
CO3	1	2	2	2	3	-	-	-	1	2	1	2	3	3
CO4	1	2	3	2	3	-	-	-	2	2	2	3	3	3
CO5	3	2	1	3	2	-	-	-	2	1	1	3	3	3

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : -**Preamble**

The main aim of this course is to expose the concepts of Computer Vision seeks to generate intelligent and useful descriptions of visual scenes and sequences and of the objects that populate them, by performing operations on the signals received from video cameras.

UNIT 1 INTRODUCTION TO IMAGE FORMATION AND PROCESSING 9

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization- Case study: Contour analysis, Blob detection

UNIT 2 FEATURE DETECTION, MATCHING AND SEGMENTATION 9

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods- Case study: Image segmentation using Graphcut / Grabcut

UNIT 3 FEATURE-BASED ALIGNMENT & MOTION ESTIMATION 9

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion- Case study: Fourier, Hough, Extract ORB Image features, Feature matching, cloning

UNIT 4 3D RECONSTRUCTION 9

Shape from X - Active rangefinding - Surface representations - Point-based representations Volumetric representations - Model-based reconstruction - Recovering texture maps and albedos- Case study: Creating Depth map from stereo images

UNIT 5 IMAGE-BASED RENDERING AND RECOGNITION 9

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets- Case Study: Object Detection and Tracking using Kalman Filter, Camshift

Total : 45 Periods**TEXT BOOKS:**

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015

REFERENCES:

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012

e-RESOURCES:

1. <https://opencv.org/opencv-free-course>
2. <https://docs.opencv.org>

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

- CO1 Explain the concepts, theories and methods in image processing and computer vision
- CO2 Interpret basic and some advanced image processing techniques in Open CV
- CO3 Apply 2D feature-based based image alignment, segmentation and motion estimations.
- CO4 Apply 3D image reconstruction techniques
- CO5 Develop innovative image processing and computer vision applications

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	1	1	1	-	-	-	2	1	3	2	2	3
CO2	3	3	3	2	3	-	1	-	2	1	2	2	3	3
CO3	3	3	2	2	3	-	-	-	1	1	2	2	3	2
CO4	2	3	3	2	3	-	-	-	2	1	2	3	2	2
CO5	2	3	3	2	2	2	-	-	3	1	2	3	3	3

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : -**Preamble**

The course covers foundational techniques and tools required for big data analytics. It focuses on concepts, principles and techniques applicable to any technology environment and industry and establishes a baseline for additional real-world experience. It provides an in-depth knowledge on managing big data applications, giving insight on real-world big data management.

UNIT 1 FUNDAMENTALS OF BIG DATA**9**

Understanding Big Data: Concepts and Terminology, Big Data Characteristics, Different Types of Data – Big Data Analytics Lifecycle - Enterprise Technologies and Big Data Business Intelligence. Case Study: Identifying data characteristics and types of data.

UNIT 2 STORING AND PROCESSING BIG DATA**9**

Big Data Storage Concepts: Clusters, File Systems and Distributed File Systems, NoSQL, Sharding, Replication, CAP Theorem, ACID, BASE - Big Data Processing Concepts: Parallel Data Processing, Distributed Data Processing, Hadoop, Processing Workloads, Cluster, Processing in Batch Mode, Processing in Realtime Mode - Big Data Storage Technology: On-Disk Storage Devices, In-Memory Storage Devices.

UNIT 3 BIG DATA ANALYSIS**9**

Quantitative Analysis – Qualitative Analysis – Data Mining – Statistical Analysis – Machine Learning – Semantic Analysis – Visual Analysis – Case Study : Correlation – Regression – Time Series Plot – Clustering – Classification.

UNIT 4 ANALYTICS MODELS – PREDICTIVE MODELING**9**

Introduction – Data Models – Computing Models. Predictive Modeling for Unstructured Data: Introduction – Applications of Predictive Modeling – Featured Engineering – Pattern Mining.

UNIT 5 APPLICATIONS FOR BIG DATA ANALYTICS**9**

Big Data Analytics for Financial Services and Banking: Introduction – Customer insights and marketing analysis – Sentiment Analysis – Predictive Analytics – Model Building – Fraud detection and Risk Management – Integration of Big Data Analytics into operations. Big Data Analytics and Recommender Systems: Introduction – Background – Overview – Evaluations of Recommenders – Issues.

Total : 45 Periods**TEXT BOOKS:**

1. C.S.R. Prabhu, Aneesh Sreevallabh Chivukula, Aditya Mogadala, Rohit Ghosh, L.M. Jenila, "Big Data Analytics: Systems, Algorithms, Applications", First edition, Springer, 2019.
2. Paul Buhler, Wajid Khattak, Thomas Erl, "Big Data Fundamentals: Concepts, Drivers & Techniques", Second Edition, Prentice Hall, 2016.

REFERENCES:

1. Anil Maheshwari, "Data Analytics", First Edition, Tata Mcgraw Hill, 2017.
2. Venkat Ankam, "Big Data Analytics", First Edition, Packt Publishing Limited, 2016.
3. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", First Edition, Wiley, 2015

e-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc16_mg06, "Introduction to Data Analytics", Dr. Nandan Sudarsanam, Dr. Balaraman Ravindran, IIT- Madras.
2. <https://nptel.ac.in/courses/106104135/48>, "Big Data", Prof. Arnab Bhattacharya, IIT-Kanpur

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

- CO1 Identify the type of data based on the characteristics of datasets, compare trivial data with big data and explain the lifecycle of data analytics for real world applications.
- CO2 Discuss the storage and processing techniques for big data and apply them for a given scenario using Hadoop.
- CO3 Analyze big data using quantitative, qualitative and machine learning approaches and implement regression, clustering and classification algorithm for a given big data application.
- CO4 Compare data models and computing models used for data analytics and apply predictive modeling for processing unstructured data.
- CO5 Develop analytical models for financial services, banking and recommender systems using marketing analysis, sentiment analysis and predictive analysis.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	-	-	-	1	-	-	-	-	-	1	1	-
CO2	2	3	-	2	-	1	-	-	-	-	-	1	1	-
CO3	1	3	1	2	-	1	-	-	-	-	-	1	2	-
CO4	1	3	2	-	-	1	-	-	-	-	-	1	3	-
CO5	1	3	2	3	-	1	-	-	-	-	-	1	2	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites :- Database Management Systems

Preamble

Cloud computing involves delivering different types of services over the Internet. From software and analytics to secure and safe data storage and networking resources, everything can be delivered via the cloud. It became a hot issue for its advantages such as “reduce costs”, “increase business flexibility” and/or “provide business continuity”. Nowadays, all of the legacy systems are being moved to the cloud platform and its demand is increasing day by day. In future, all web or mobile applications will be available on the cloud.

UNIT 1 CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE 9

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges

UNIT 2 VIRTUALIZATION BASICS 9

Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory and I/O devices-Case study:Open source cloud workstations.

UNIT 3 VIRTUALIZATION INFRASTRUCTURE AND DOCKER 9

Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating Virtualization – Application Virtualization – Virtual clusters and Resource Management – Containers vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories-Case study:Creating a container using Docker.

UNIT 4 CLOUD DEPLOYMENT ENVIRONMENT 9

Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack-Case study: GAE launcher to launch the web applications.

UNIT 5 CLOUD SECURITY 9

Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyperjacking. Data Security and Storage; Identity and Access Management (IAM) - IAM Challenges - IAM Architecture and Practice.

Total : 45 Periods

TEXT BOOKS:

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
2. James Turnbull, “The Docker Book”, O’Reilly Publishers, 2014.
3. Krutz, R. L., Vines, R. D, “Cloud security. A Comprehensive Guide to Secure Cloud Computing”, Wiley Publishing, 2010.

REFERENCES:

1. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
2. Tim Mather, Subra Kumaraswamy, and Shahed Latif, “Cloud Security and Privacy: an enterprise perspective on risks and compliance”, O’Reilly Media, Inc., 2009.

e-RESOURCES:

1. [https://nptel.ac.in/courses/106105167,](https://nptel.ac.in/courses/106105167)” Cloud computing”, Prof. Soumya Kanti Ghosh, IIT Kharagpur

2. <https://nptel.ac.in/courses/106104182>, "Cloud Computing and Distributed Systems", Dr.Rajiv Misra, IIT Patna.

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

- CO1 Explain the principles of cloud architecture, models, infrastructure and design challenges in the cloud.
- CO2 Discuss the concept of virtualization and its types in cloud environment.
- CO3 Explain the virtualization infrastructure and create a container using Docker.
- CO4 Develop and deploy services on the cloud and set up a cloud environment using Google App Engine, Amazon AWS and Microsoft Azure.
- CO5 Explain security challenges in the cloud environment and secured data storage using Identity and Access Management.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1	1	1	-	-	-	-	-	-	3	2	2
CO2	3	1	2	2	1	-	-	-	-	-	-	3	2	2
CO3	2	3	2	3	1	-	-	-	-	-	-	3	2	2
CO4	1	2	3	3	3	-	-	-	-	-	-	2	2	2
CO5	2	3	3	1	3	-	-	-	-	-	-	2	2	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : Web Technology & Computer Networks**Preamble:**

This course enables the student to understand the XML fundamental concepts, definition of XML document structure, web service that offer functionality over the web and set of architectural concepts used for the development and integration of services as SOA. This course makes the students to define "service" and "architecture" and establishes a strong understanding of the concepts needed to have an effective working knowledge of SOA methodologies, modeling, design, SOA technologies, orchestration and architectural frameworks.

UNIT 1 INTRODUCTION TO XML & WEB SERVICES**9**

XML document structure – URIs and XML namespace–Defining structure in XML documents using DTD and schemas–XML schemas reuse–Document navigation and transform –Introduction to Web services–Software as a Service–Definition of Web Services–Characteristics of Web Services – Service interface and implementation–Service Orientation Architecture – Web service technology stack –Quality of Service– Web service interoperability–Web service vs. Components – Impact and shortcoming of Web service

UNIT 2 EVOLUTION, EMERGENCE OF WEB SERVICES & SOA FUNDAMENTALS**9**

Evolution of distributed computing – Core distributed computing technologies – client/server, CORBA, JAVA RMI, Microsoft DCOM, MOM – Challenges in Distributed Computing, role of J2EE and XML in distributed computing – Characteristics of SOA – Anatomy of SOA – Principles of Service orientation.

UNIT 3 WEB SERVICE ARCHITECTURE & SERVICE DESCRIPTION**9**

Web Services Architecture – Web services Architecture and its characteristics – core building blocks of web services – standards and technologies available for implementing web services – web services communication – basic steps of implementing web services –Describing Web Services – WSDL introduction – nonfunctional service description – WSDL1.1 vs. WSDL 2.0 – WSDL document, WSDL elements, WSDL binding, WSDL tools, WSDL port type – limitations of WSDL.

UNIT 4 SERVICE DISCOVERY & MESSAGING PATTERNS**9**

Service discovery – UDDI–The Emergence of SOAP – Understanding SOAP Specifications – Anatomy of a SOAP Message – SOAP Encoding – SOAP Message Exchange Model – SOAP Communication – SOAP over HTTP – SOAP Message Exchange Patterns

UNIT 5 BUILDING SOA-BASED APPLICATION**9**

Service Oriented Analysis and Design – Service Modeling – WS–BPEL – WS–Coordination – WS–Policy – WS–Security – SOA support in J2EE

Total : 45 Periods**TEXT BOOKS:**

1. Web Services & SOA Principles and Technology, Second Edition, Michael P. Papazoglou, 2008.
2. Developing Java Web Services, R. Nagappan, R. Skoczylas, R.P. Sriganesh, Wiley Publishing Inc., 2004.
3. Thomas Erl, "Service Oriented Architecture: Concepts, Technology, and Design", Pearson Education, 2005.

REFERENCES:

1. F.P. Coyle, "XML, Web Services, and the Data Revolution", Pearson Education.
2. McGovern, et al., "Java web Services Architecture", Morgan Kaufmann Publishers, 2005.
3. S. Chatterjee, J. Webber, "Developing Enterprise Web Services", Pearson Education.

e-RESOURCES:

1. <https://nptel.ac.in/courses/106/105/106105167/>, "Cloud Computing XML Basics", Prof Soumya Kanti Ghosh, IIT – Kharagpur.
2. <https://nptel.ac.in/courses/106/105/106105167/>, "Cloud Computing Web Services, Service oriented Architecture", Prof Soumya Kanti Ghosh, IIT – Kharagpur.

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

- CO1 Describe how the XML and web service technologies stack used to define, locate, implement, and make Web services interact with each other.
- CO2 Identify the evolution and emergence of Internet-enabled technologies that supports the SOA platforms.
- CO3 Construct web service architecture using WSDL, SOAP and UDDI for business applications.
- CO4 Identify the Service discovery function that allows agents to use each other's services and its exchanging mechanism.
- CO5 Discuss the web service specification like WS-BPEL, WS-Coordination, WS-Policy, and WS-Security to build secure vs. interaction SOA based applications

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	2	-	-	-	-	-	-	-	-	-	2	-
CO2	-	3	2	3	-	-	-	-	-	-	-	-	2	-
CO3	3	3	3	3	-	-	-	-	-	-	-	2	3	-
CO4	-	-	3	2	-	-	-	-	-	-	-	2	3	-
CO5	2	-	3	-	-	-	-	-	-	-	-	-	3	-

1 – Slight (Low), 2 – Moderate (Medium), 3 – Substantial (High).

Pre-requisites : Cloud Computing

Preamble

This course enables the student to understand Cloud Service Management terminology, definition & concepts. Compare and contrast cloud service management with traditional IT service management. Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems.

UNIT 1 CLOUD SERVICE MANAGEMENT FUNDAMENTALS

9

Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models.

Case Study: Create a Cloud Organization in AWS/Google Cloud.

UNIT 2 CLOUD SERVICES STRATEGY

9

Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, and Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture.

UNIT 3 CLOUD SERVICE MANAGEMENT

9

Cloud Service Reference Model, Cloud Service Life Cycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management.

Case Study: Create alerts for usage of Cloud resources

UNIT 4 CLOUD SERVICE ECONOMICS

9

Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models.

Case Study: Create Billing alerts for your Cloud Organization.

UNIT 5 CLOUD SERVICE GOVERNANCE & VALUE

9

IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership.

Case Study: Compare Cloud cost for a simple web application across AWS, Azure and GCP.

Total : 45 Periods

TEXT BOOKS:

1. Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications.
2. Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2013
3. Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour

REFERENCES:

1. Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
2. Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi

e-RESOURCES:

1. <https://nptel.ac.in/courses/106/105/106105223/>, "Google Cloud Computing Foundation Course", Prof. Soumya Kanti Ghosh, IIT Kharagpur.
2. https://onlinecourses.nptel.ac.in/noc21_cs14/preview

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

- CO1 Demonstrate the basic Cloud Service Management terminology, definition & concepts.
- CO2 Identifying the Cloud Strategy Fundamentals to reduce risk and eliminate issues associated with Cloud Service Architecture.
- CO3 Outline about the Cloud Service Operations in Cloud Service Management.
- CO4 Illustrate the Pricing models for Cloud Services.
- CO5 Define the Cloud Governance by measuring the value of Cloud Services, to solve real world problems.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	1	1	-	-	-	2	1	3	2	2	2
CO2	3	1	2	3	2	-	-	-	1	2	3	1	2	2
CO3	1	1	3	1	3	-	-	-	3	3	1	1	2	2
CO4	1	1	1	2	3	-	-	-	2	3	3	1	2	2
CO5	1	3	3	2	2	-	-	-	1	3	1	2	2	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : -

Preamble:

This course aims to provide a sound knowledge and understand the need and various research methods used in design. To explore the various Tools used in UI & UX and creating a wireframe and prototype.

UNIT 1 FOUNDATIONS OF DESIGN 9

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy-case study: Hands on design thinking process for a new product.

UNIT 2 FOUNDATIONS OF UI DESIGN 9

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides- case study: Designing a responsive layout for an societal application.

UNIT 3 FOUNDATIONS OF UX DESIGN 9

Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals.

UNIT 4 WIREFRAMING, PROTOTYPING AND TESTING 9

Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration.

UNIT 5 RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE 9

Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture-case study: Create a sample pattern library for that product

Total : 45 Periods

TEXT BOOKS:

1. Joel Marsh, “UX for Beginners”, O’Reilly , 2022.
2. Jon Yablonski, “Laws of UX using Psychology to Design Better Product & Services” O’Reilly 2021.

REFERENCES:

1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interface” 3 rd Edition , O’Reilly 2020.
2. Steve Schoger, Adam Wathan “Refactoring UI”, 2018.
3. Steve Krug, “Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile”, Third Edition, 2015.

e-RESOURCES:

1. <https://www.nngroup.com/articles/>
2. <https://www.interaction-design.org/literature>.

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

- CO1 Develop UI for user Applications
- CO2 Develop UI design for a given application.
- CO3 Demonstrate UX Skills in product development
- CO4 Create Wireframe and Prototype using UI design.
- CO5 Identify problem statements and research methods and explain the information architecture in UI and UX design.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	1	3	1	-	-	-	3	3	2	1	2	2
CO2	2	3	1	3	2	-	-	-	1	2	2	2	2	2
CO3	1	3	3	2	2	-	-	-	2	3	1	2	2	2
CO4	1	2	3	3	1	-	-	-	3	2	1	3	2	2
CO5	1	2	3	2	1	-	-	-	2	1	1	1	2	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites :-**Preamble**

The student must be able to gain a deeper understanding of test automation and the related technologies, focus on large testing domains, and comprehend a wide range of testing facets.

UNIT 1 FOUNDATIONS OF SOFTWARE TESTING**9**

Why do we test Software?, Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V-model of Software Testing, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults (Defects), Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing, Case Study: testing an e-commerce web/mobile application (www.amazon.in).

UNIT 2 TEST PLANNING**9**

The Goal of Test Planning, High Level Expectations, Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics, Case Study: Test the e-commerce application and report the defects in it.

UNIT 3 TEST DESIGN AND EXECUTION**9**

Test Objective Identification, Test Design Factors, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle, Case Study: Develop the test plan and design the test cases for an inventory control system.

UNIT 4 ADVANCED TESTING CONCEPTS**9**

Performance Testing: Load Testing, Stress Testing, Volume Testing, Fail-Over Testing, Recovery Testing, Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation, Security testing, Testing in the Agile Environment, Testing Web and Mobile Applications, Case Study: Test the performance of the e-commerce application.

UNIT 5 TEST AUTOMATION AND TOOLS**9**

Automated Software Testing, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports, Case Study: Automate the testing of e-commerce applications using Selenium.

Total : 45 Periods**TEXT BOOKS:**

1. Yogesh Singh, "Software Testing", Cambridge University Press, 2012.
2. Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" - Second Edition 2018.

REFERENCES:

1. Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, 2012, John Wiley & Sons, Inc.
2. Ron Patton, Software testing, 2nd Edition, 2006, Sams Publishing

e-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc23_cs91/preview
2. https://onlinecourses.nptel.ac.in/noc23_cs81/preview

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

- CO1 Explain the concepts of software testing and the need for software testing.
- CO2 Design Test planning and different activities involved in test planning.
- CO3 Design effective test cases that can uncover critical defects in the application.
- CO4 Carry out advanced types of testing.
- CO5 Automate the software testing using Selenium and TestNG.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	1	2	-	-	-	1	1	3	2	2	3
CO2	2	3	1	1	1	-	-	-	2	2	1	2	2	3
CO3	2	2	1	3	1	-	-	-	1	3	1	2	3	2
CO4	2	1	3	2	1	-	-	-	1	1	1	2	1	2
CO5	2	2	1	3	1	-	-	-	1	3	2	1	1	3

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : -**Preamble**

The main aim of this course is to understand the fundamentals of web application security and focus on wide aspects of secure development and deployment of web applications. This course makes the students to learn how to build secure APIs and learn the basics of vulnerability assessment and penetration testing. This course will enable the students to get an insight about Hacking techniques and Tools

UNIT 1 FUNDAMENTALS OF WEB APPLICATION SECURITY**9**

The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation. Case study: Study basic concepts of web application security

UNIT 2 SECURE DEVELOPMENT AND DEPLOYMENT**9**

Web Applications Security - Security Testing, Security Incident Response Planning, The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM). Case study: Identify the vulnerabilities using OWASP ZAP tool.

UNIT 3 SECURE API DEVELOPMENT**9**

API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests. Case study: Addressing threats with security controls

UNIT 4 VULNERABILITY ASSESSMENT AND PENETRATION TESTING**9**

Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database- based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.

UNIT 5 HACKING TECHNIQUES AND TOOLS**9**

Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.

Case study: Attack the website using Social Engineering method

Total : 45 Periods**TEXT BOOKS:**

1. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, First Edition, 2020, O'Reilly Media, Inc.
2. Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGraw-Hill Companies.
3. Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.

REFERENCES:

1. Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc.
2. Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.

e-RESOURCES:

1. <https://nptel.ac.in/courses/106106234/>,” NOC:Systems and Usable Security, Prof. Neminath Hubballi - IIT Indore.
2. <https://nptel.ac.in/courses/106106146/>,”NOC:Privacy and Security in Online Social Media, Prof. Ponnurangam Kumaraguru - IIIT Delhi.

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

- CO1 Identify security threats and Vulnerability issues in web application.
 CO2 Apply the security principles in developing a reliable web application.
 CO3 Analyze the skill to design and develop Secure Web Applications that use Secure APIs.
 CO4 Identify the importance of carrying out vulnerability assessment and penetration testing.
 CO5 Interpret the skill to think like a hacker and to use hackers tool sets.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	2	2	1	3	-	-	-	-	-	-	1	1	1
CO2	2	1	2	1	3	-	-	-	-	-	-	-	1	2
CO3	1	1	1	2	3	-	-	-	-	-	-	1	2	2
CO4	1	2	1	1	2	-	-	-	-	-	-	-	1	2
CO5	1	2	2	2	2	-	-	-	-	-	-	1	1	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites: - Web Technology & Java Programming**Preamble**

This course discusses about DevOps terminology, different Version control tools, Integration/ Continuous Testing/ Continuous Deployment, Configuration management using Ansible, cloud-based Devops tools.

UNIT 1 INTRODUCTION TO DEVOPS 9

Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github, case study: Create Maven Build pipeline in Azure.

UNIT 2 COMPILE AND BUILD USING MAVEN & GRADLE 9

Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases(compile build, test, package) Maven Profiles, Maven repositories(local, central, global),Maven plugins, Maven create and build Artifacts, Dependency management, Installation of Gradle, Understand build using Gradle

UNIT 3 CONTINUOUS INTEGRATION USING JENKINS 9

Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace, case study: Create CI pipeline using Jenkins.

UNIT 4 CONFIGURATION MANAGEMENT USING ANSIBLE 9

Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, case study: Create an Ansible playbook for a simple web application infrastructure.

UNIT 5 BUILDING DEVOPS PIPELINES USING AZURE 9

Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file

Total: 45 Periods**TEXT BOOKS:**

1. Roberto Vormittag, "A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises", Second Edition, Kindle Edition, 2016.
2. Jason Cannon, "Linux for Beginners: An Introduction to the Linux Operating System and Command Line", Kindle Edition, 2014.

REFERENCES:

1. Hands-On Azure Devops: Cid Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for DevOps and Microsoft Azure (English Edition) Paperback – 1 January 2020 by Mitesh Soni.
2. Jeff Geerling, "Ansible for DevOps: Server and configuration management for humans", First Edition, 2015.
3. David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps", Second Edition, 2016.
4. Mariot Tsitoara, "Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer", Second Edition, 2019.

e-RESOURCES:

1. <https://www.jenkins.io/user-handbook.pdf>
2. <https://maven.apache.org/guides/getting-started/>

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

- CO1 Explain the actions performed through Version control tools like Git.
- CO2 Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.
- CO3 Illustrate jenkins configuration to work with java,git and maven.
- CO4 Demonstrate an ansible playbook for a simple web application infrastructure.
- CO5 Determine the benefits and drive the adoption of cloud-based Devops tools to solve real world problems.

Mapping of COs with POs and PSOs

Cos/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	3	-	-	-	-	-	-	-	2	-
CO2	3	3	3	2	3	-	-	-	-	-	-	-	2	-
CO3	3	3	3	2	3	-	-	-	-	-	-	-	2	-
CO4	3	3	3	2	3	-	-	-	-	-	-	-	2	-
CO5	3	3	3	2	3	-	-	-	-	-	-	-	2	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High), '-' - no correlation.

Pre-requisites: -**Preamble**

This course describes about the semantics of programming languages, data types, and basic statements, object-orientation, concurrency, and event handling and non-procedural programming paradigms.

UNIT 1 SYNTAX AND SEMANTICS**9**

Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom up parsing .

UNIT 2 DATA, DATA TYPES, AND BASIC STATEMENTS**9**

Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection – primitive data types – strings – array types – associative arrays – record types – union types – pointers and references – Arithmetic expressions – overloaded operators – type conversions – relational and boolean expressions – assignment statements – mixed mode assignments – control structures – selection – iterations – branching – guarded statements

UNIT 3 SUBPROGRAMS AND IMPLEMENTATIONS**9**

Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return – implementing simple subprograms – stack and dynamic local variables – nested subprograms – blocks – dynamic scoping

UNIT 4 OBJECT-ORIENTATION, CONCURRENCY, AND EVENT HANDLING**9**

Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads – statement level concurrency – exception handling – event handling.

UNIT 5 FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES**9**

Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming with Prolog – multi-paradigm languages

Total: 45 Periods**TEXT BOOKS:**

1. Robert W. Sebesta, “Concepts of Programming Languages”, Twelfth Edition (Global Edition), Pearson, 2022.
2. Michael L. Scott, “Programming Language Pragmatics”, Fourth Edition, Elsevier, 2018.

REFERENCES:

1. R. Kent Dybvig, “The Scheme programming language”, Fourth Edition, Prentice Hall, 2011.
2. Jeffrey D. Ullman, “Elements of ML programming”, Second Edition, Pearson, 1997.
3. W. F. Clocksin and C. S. Mellish, “Programming in Prolog: Using the ISO Standard”, Fifth Edition, Springer, 2003.

e-RESOURCES

1. <https://nptel.ac.in/courses/106102067> ,”Principles of Programming Languages, Prof. S. Arun Kumar V , IIT Delhi”
2. <https://www.geeksforgeeks.org/introduction-of-programming-paradigms/>

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

- CO1 Examine the correctness of the grammar using parsing.
- CO2 Analyze arithmetic expressions, type conversions, boolean expressions, assignment statements in programming languages..
- CO3 Determine methods and functions for solving problems in programming languages.
- CO4 Apply design and implementation concepts for object oriented programming.
- CO5 Explain functional programming languages and Develop programs with Scheme, ML, and Prolog.

Mapping of COs with POs and PSOs

Cos/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	3	2	1	-	-	-	-	-	-	3	1	
CO2	3	3	3	2	2	-	-	-	-	-	-	3	1	
CO3	3	3	3	2	2	-	-	-	-	-	-	3	2	
CO4	3	3	3	3	2	2	-	-	-	-	-	-	2	
CO5	3	3	3	3	3	3	2	2	1	3	1	3	2	

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High), '-' - no correlation.

Pre-requisites : Computer Networks**Preamble**

This course focus on cloud computing models for enabling ubiquitous, convenient, on demand access to a shared computing resources. It also enables the students to understand the benefits, risk and recommendations for cloud security implications from technical perspective. In addition to this, the course provides an understanding of pros and cons of different approaches to virtualization enabling students to gain research competence from industry.

UNIT 1 INTRODUCTION TO VIRTUALIZATION**9**

Virtualization and cloud computing - Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations- Types of hardware virtualization: Full virtualization - partial virtualization - Paravirtualization-Types of Hypervisors – case study Shrink and extend virtual disk.

UNIT 2 SERVER AND DESKTOP VIRTUALIZATION**9**

Virtual machine basics- Types of virtual machines- Understanding Server Virtualization- types of server virtualization- Business Cases for Server Virtualization – Uses of Virtual Server Consolidation – Selecting Server Virtualization Platform-Desktop Virtualization-Types of Desktop Virtualization- Case study Desktop Virtualization using Chrome Remote Desktop.

UNIT 3 NETWORK VIRTUALIZATION**9**

Introduction to Network Virtualization-Advantages- Functions-Tools for Network Virtualization- VLAN-WAN Architecture-WAN Virtualization – Case study Create a VLAN in CISCO packet tracer.

UNIT 4 STORAGE VIRTUALIZATION**9**

Memory Virtualization-Types of Storage Virtualization-Block, File-Address space Remapping-Risks of Storage Virtualization-SAN-NAS-RAID – Case study Create RAID 5 volume.

UNIT 5 VIRTUALIZATION TOOLS**9**

VMWare-Amaon AWS-Microsoft HyperV- Oracle VM Virtual Box - IBM PowerVM- Google Virtualization- Case study Install Guest OS on that VMWARE.

Total : 45 Periods**TEXT BOOKS:**

1. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
2. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011

REFERENCES:

1. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
2. David Marshall, Wade A. Reynolds, “Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center”, Auerbach Publications, 2006.

e-RESOURCES:

1. Cloud Computing, By Prof. Soumya Kanti Ghosh | IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc23_cs89
2. Distributed Systems,By Prof. Rajiv Misra | IIT Patna, https://onlinecourses.nptel.ac.in/noc23_cs72

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

- CO1 To develop the understanding of fundamentals and technological aspects of Virtualization along with various terminologies and the keywords used in virtualization.
- CO2 Apply virtualization concepts at server, client and desktop level using Chrome Remote Desktop.
- CO3 Install & Configure the different VM platforms
- CO4 Experiment with the VM with various software
- CO5 Implementation of private cloud platform using virtualization

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3	1	3	2				1	1	3	1	1	3
CO2	3	2	2	1	2				1	2	2	3	3	2
CO3	3	2	1	3	1				2	2	1	3	3	3
CO4	1	1	2	3	3				3	3	1	1	3	2
CO5	1	3	2	3	1				2	1	3	3	1	1

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : Database Management Systems

Preamble

The student must be able to understand the basic concepts of data warehouse architecture, OLAP technology, partitioning strategy and the roles of process manager & system manager.

UNIT 1 INTRODUCTION TO DATA WAREHOUSE

9

Data warehouse Introduction - Data warehouse components- operational database Vs data warehouse – Data warehouse Architecture – Three-tier Data Warehouse Architecture - Autonomous Data Warehouse- Autonomous Data Warehouse Vs Snowflake - Modern Data Warehouse-Case Study: Design data warehouse for real time applications.

UNIT 2 ETL AND OLAP TECHNOLOGY

9

What is ETL – ETL Vs ELT – Types of Data warehouses - Data warehouse Design and Modeling - Delivery Process - Online Analytical Processing (OLAP) - Characteristics of OLAP - Online Transaction Processing (OLTP) Vs OLAP - OLAP operations- Types of OLAP- ROLAP Vs MOLAP Vs HOLAP-Case Study: Data exploration and integration with WEKA.

UNIT 3 META DATA, DATA MART AND PARTITION STRATEGY

9

Meta Data – Categories of Metadata – Role of Metadata – Metadata Repository – Challenges for Meta Management - Data Mart – Need of Data Mart- Cost Effective Data Mart- Designing Data Marts- Cost of Data Marts- Partitioning Strategy – Vertical partition – Normalization – Row Splitting – Horizontal Partition

UNIT 4 DIMENSIONAL MODELING AND SCHEMA

9

Dimensional Modeling- Multi-Dimensional Data Modeling – Data Cube- Star Schema- Snowflake schema- Star Vs Snowflake schema- Fact constellation Schema- Schema Definition - Process Architecture- Types of Data Base Parallelism – Datawarehouse Tools - Case Study: Analyse the dimensional Modeling.

UNIT 5 SYSTEM & PROCESS MANAGERS

9

Data Warehousing System Managers: System Configuration Manager- System Scheduling Manager - System Event Manager - System Database Manager - System Backup Recovery Manager - Data Warehousing Process Managers: Load Manager – Warehouse Manager- Query Manager – Tuning – Testing- Case Study: Implementation of warehouse testing.

Total : 45 Periods

TEXT BOOKS:

1. Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Thirteenth Reprint 2008.
2. Ralph Kimball, “The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling”, Third edition, 2013.

REFERENCES:

1. Paul Raj Ponniah, “Data warehousing fundamentals for IT Professionals”, 2012.
2. K.P. Soman, ShyamDiwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.

e-RESOURCES:

1. <http://nptel.ac.in/courses/106106093/31>, “Introduction to Data warehousing and OLAP”, Prof. Dr.S.Srinath, IIT-Madras.
2. <https://www.coursera.org/professional-certificates/data-warehouse-engineering>

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

- CO1 Demonstrate data warehouse architecture for real time applications..
- CO2 Classify the OLAP Technology Data exploration and integration using WEKA tool.
- CO3 Explain the types of partitioning strategy.
- CO4 Interpret the differentiation of various schema for given problem.
- CO5 Outline the roles of process manager and system manager.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	2	-	-	-	3	-	-	3	2	3
CO2	3	2	2	2	3	-	-	-	2	-	2	2	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3	2
CO4	3	3	3	3	-	-	-	-	-	-	2	3	3	3
CO5	3	2	2	2	-	2	-	-	-	-	-	2	2	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : Database Management System

Preamble:

The students can able to Characterize the functionalities of logical and physical components of storage, Describe various storage networking technologies, Identify different storage virtualization technologies, Discuss the different backup and recovery strategies, Understand common storage management activities and solutions

UNIT 1 STORAGE SYSTEMS

9

Introduction to Information Storage: Digital data and its types, Information storage, Key characteristics of data center and Evolution of computing platforms. Information Lifecycle Management. Third Platform Technologies: Cloud computing and its essential characteristics, Cloud services and cloud deployment models, Big data analytics, Social networking and mobile computing, Characteristics of third platform infrastructure and Imperatives for third platform transformation. Data Center Environment: Building blocks of a data center, Compute systems and compute virtualization and Software-defined data center.

UNIT 2 INTELLIGENT STORAGE SYSTEMS AND RAID

5

Components of an intelligent storage system, Components, addressing, and performance of hard disk drives and solid-state drives, RAID, Types of intelligent storage systems, Scale-up and scale out storage Architecture.

UNIT 3 STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION

13

Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage. Fibre Channel SAN: Software-defined networking, FC SAN components and architecture, FC SAN topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switch aggregation, and VLAN, FCIP protocol, connectivity, and configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN, FCoE SAN connectivity, Converged Enhanced Ethernet, FCoE architecture.

UNIT 4 BACKUP, ARCHIVE AND REPLICATION

12

Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS).

UNIT 5 SECURING STORAGE INFRASTRUCTURE

6

Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.

Total : 45 Periods

TEXT BOOKS:

1. EMC Corporation, Information Storage and Management, Wiley, India
2. Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas, Introduction to Storage Area Networks, Ninth Edition, IBM - Redbooks, December 2017
3. Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein, Storage Networks Explained, Second Edition, Wiley, 2009

REFERENCES:

1. G. Somasundaram, Alok Shrivastava, Information Storage and Management, EMC Education Series, Wiley, Publishing Inc., 2011.

2. Gustavo Santana, Data Center Virtualization Fundamentals: Understanding Techniques and Designs for Highly Efficient Data Centers with Cisco Nexus, UCS, MDS, and Beyond, Cisco Press; 1 edition, 2013

e-RESOURCES:

1. <https://www.sciencedirect.com/topics/computer-science/storage-technology>
2. <https://ecomputernotes.com/fundamental/input-output-and-memory/explain-secondary-storage-devices>

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

- CO1 Demonstrate the fundamentals of information storage management and various models of Cloud infrastructure services and deployment
- CO2 Illustrate the usage of advanced intelligent storage systems and RAID
- CO3 Interpret various storage networking architectures - SAN, including storage subsystems and virtualization
- CO4 Explain the different role in providing disaster recovery and remote replication technologies
- CO5 Infer the security needs and security measures to be employed in information storage management

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	2	1	3	3	-	-	-	1	1	1	3	2	2
CO2	3	1	2	3	3	-	-	-	3	2	3	2	2	3
CO3	1	1	3	2	2	-	-	-	3	1	1	2	2	3
CO4	3	2	1	2	2	-	-	-	1	1	3	1	3	2
CO5	1	3	2	1	2	-	-	-	1	2	3	1	3	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites: Computer Networks, Cloud Computing

Preamble

The main aim of this course is to make understand the need for SDN and its data plane operations, to understand the functions of control plane, to comprehend the migration of networking functions to SDN environment, to explore various techniques of network function virtualization and to comprehend the concepts behind network virtualization

UNIT 1 SDN: INTRODUCTION

9

Evolving Network Requirements – The SDN Approach – SDN architecture - SDN Data Plane , Control plane and Application Plane- Case Study: Virtualbox/Mininet Environment for SDN.

UNIT 2 SDN DATA PLANE AND CONTROL PLANE

9

Data Plane functions and protocols - OpenFlow Protocol - Flow Table - Control Plane Functions - Southbound Interface, Northbound Interface – SDN Controllers - Ryu, OpenDaylight, ONOS - Distributed Controllers – Case Study: mininet topology with SDN controller and use Wireshark to capture and visualize the OpenFlow messages such as OpenFlow FLOW MOD, PACKET IN, PACKET OUT etc.

UNIT 3 SDN APPLICATIONS

9

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking-Case Study: Northbound API to program flow table rules on the switch for various use cases like L2 learning switch, Traffic Engineering, Firewall etc.

UNIT 4 NETWORK FUNCTION VIRTUALIZATION

9

Network Virtualization - Virtual LANs – OpenFlow VLAN Support - NFV Concepts – Benefits and Requirements – Reference Architecture-Case Study: end-to-end network service with two VNFs using vim-emu.

UNIT 5 NFV FUNCTIONALITY

9

NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV –Case Study: Installing OSM and onboard and orchestrate network service.

Total : 45 Periods

TEXT BOOKS:

1. William Stallings, “Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud”, Pearson Education, 1st Edition, 2015.

REFERENCES:

1. Ken Gray, Thomas D. Nadeau, “Network Function Virtualization”, Morgan Kauffman, 2016.
2. Thomas D Nadeau, Ken Gray, “SDN: Software Defined Networks”, O’Reilly Media, 2013.
3. Fei Hu, “Network Innovation through OpenFlow and SDN: Principles and Design”, 1st Edition, CRC Press, 2014.
4. Paul Goransson, Chuck Black Timothy Culver, “Software Defined Networks: A Comprehensive Approach”, 2nd Edition, Morgan Kaufmann Press, 2016.
5. Oswald Coker, Siamak Azodolmolky, “Software-Defined Networking with OpenFlow”, 2nd Edition, O’Reilly Media, 2017

e-RESOURCES:

1. <https://www.kathara.org>
2. <http://mininet.org>

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

- CO1 Describe the SDN architecture for Virtualbox/Mininet Environment using SDN Data plane, control plane and application plane.
- CO2 Identify the functions of the data plane and control plane for SDN controller and use Wireshark to capture and visualize the OpenFlow messages.
- CO3 Design and develop SDN applications with security measures for L2 learning switch, Traffic Engineering and Firewall.
- CO4 Discuss the concepts of network virtualization for two VNFs using vim-emu.
- CO5 Explain NFV infrastructure, management and orchestration for OSM compared with SDN.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	2	3	1	3	-	-	-	2	3	1	3	2	2
CO2	2	1	2	2	3	-	-	-	2	2	2	2	2	2
CO3	2	2	2	3	3	-	-	-	3	1	1	2	2	2
CO4	1	2	3	2	3	-	-	-	2	2	2	2	2	2
CO5	3	2	1	3	2	-	-	-	2	1	1	3	2	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : Data Warehousing, Database Management Systems

Preamble

Introduce Data Processing terminology, definition & concepts. Define different types of Data Processing Explain the concepts of Real-time Data processing Select appropriate structures for designing and running real-time data services in a business environment Illustrate the benefits and drive the adoption of real-time data services to solve real world problems

UNIT 1 FOUNDATIONS OF DATA SYSTEMS

9

Introduction to Data Processing, Stages of Data processing, Data Analytics, Batch Processing, Stream processing, Data Migration, Transactional Data processing, Data Mining, Data Management Strategy, Storage, Processing, Integration, Analytics, Benefits of Data as a Service, Challenges. Case Study : Design and Implement Simple application using MongoDB.

UNIT 2 REAL-TIME DATA PROCESSING

9

Introduction to Big data, Big data infrastructure, Real-time Analytics, Near real-time solution, Lambda architecture, Kappa Architecture, Stream Processing, Understanding Data Streams, Message Broker, Stream Processor, Batch & Real-time ETL tools, Streaming Data Storage.

UNIT 3 DATA MODELS AND QUERY LANGUAGES

9

Relational Model, Document Model, Key-Value Pairs, NoSQL, Object-Relational Mismatch, Many-to-One and Many-to-Many Relationships, Network data models, Schema Flexibility, Structured Query Language, Data Locality for Queries, Declarative Queries, Graph Data models, Cypher Query Language, Graph Queries in SQL, The Semantic Web, CODASYL, SPARQL – Case Study : Query the designed system using MongoDB.

UNIT 4 EVENT PROCESSING WITH APACHE KAFKA

9

Apache Kafka, Kafka as Event Streaming platform, Events, Producers, Consumers, Topics, Partitions, Brokers, Kafka APIs, Admin API, Producer API, Consumer API, Kafka Streams API, Kafka Connect API - Case Study : Create a Event Stream with Apache Kafka.

UNIT 5 REAL-TIME PROCESSING USING SPARK STREAMING

9

Structured Streaming, Basic Concepts, Handling Event-time and Late Data, Fault-tolerant Semantics, Exactly-once Semantics, Creating Streaming Datasets, Schema Inference, Partitioning of Streaming datasets, Operations on Streaming Data, Selection, Aggregation, Projection, Watermarking, Window operations, Types of Time windows, Join Operations, Deduplication - Case Study : Create a Real-time Stream processing application using Spark Streaming

Total : 45 Periods

TEXT BOOKS:

1. Streaming Systems: The What, Where, When and How of Large-Scale Data Processing by Tyler Akidau, Slava Chemyak, Reuven Lax, O'Reilly publication
2. Designing Data-Intensive Applications by Martin Kleppmann, O'Reilly Media
3. Practical Real-time Data Processing and Analytics : Distributed Computing and Event Processing using Apache Spark, Flink, Storm and Kafka, Packt Publishing

REFERENCES:

1. <https://spark.apache.org/docs/latest/streaming-programming-guide.html>
2. [Kafka.apache.org](https://kafka.apache.org)

e-RESOURCES:

1. <https://nptel.ac.in/courses/106105174>
2. <https://nptel.ac.in/courses/106105175>

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

- CO1 Explain the applicability and utility of streaming algorithms.
- CO2 Describe and apply current research trends in data-stream processing.
- CO3 Analyze the suitability of stream mining algorithms for data stream systems.
- CO4 Program and build stream processing systems, services and applications.
- CO5 Solve problems in real-world applications that process data streams.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	3	1	-	-	-	2	3	1	2	1	3
CO2	2	1	1	2	2	-	-	-	3	2	2	3	1	2
CO3	3	1	2	3	3	-	-	-	2	2	1	1	2	2
CO4	2	1	3	3	3	-	-	-	3	3	1	1	1	2
CO5	3	3	1	2	2	-	-	-	3	3	2	3	2	3

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites :Cloud Computing

Preamble

This course is aimed at enabling the students to understand the cloud computing terminology, definition, security design and architectural consideration for cloud. It grooms the students to understand the identity access control mechanism and enable them to monitor and audit cloud application for security. It imparts students to follow the best practice for cloud security using various security design patterns.

UNIT 1 FUNDAMENTALS OF CLOUD SECURITY CONCEPTS

9

Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Nonrepudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures. Case Study: Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm present in Cloud Sim

UNIT 2 SECURITY DESIGN AND ARCHITECTURE FOR CLOUD

9

Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key. Case Study: Implement symmetric key based encryption algorithm to protect the messages on communication.

UNIT 3 ACCESS CONTROL AND IDENTITY MANAGEMENT

9

Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention. Case Study :Simulate a secure file sharing using a Cloud Sim.

UNIT 4 CLOUD SECURITY DESIGN PATTERN

9

Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud.

UNIT 5 MONITORING, AUDITING AND MANAGEMENT

9

Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management. Case Study: Simulate log forensics using Cloud Sim.

Total : 45 Periods

TEXT BOOKS:

1. Raj Kumar Buyya , James Broberg, andrzejGoscinski, —Cloud Computing, Wiley 2013
2. Dave shackleford, —Virtualization Security, SYBEX a wiley Brand 2013.
3. Mather, Kumaraswamy and Latif, —Cloud Security and Privacy, OREILLY 2011

REFERENCES:

1. Mark C. Chu-Carroll —Code in the Cloud,CRC Press, 2011
2. Mastering Cloud Computing Foundations and Applications Programming RajkumarBuyya, Christian Vechhiola, S. ThamaraiSelvi

e-RESOURCES:

1. <https://www.geeksforgeeks.org/cloud-computing-simulation-using-cloudsim/>
2. <https://www.youtube.com/watch?v=44IBhZwa4ZM>

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

- CO1 Identify the essential security services to be applied in cloud environments.
- CO2 Explain the security challenges faced in cloud architecture for different strategies.
- CO3 Illustrate the policy grants permitted and procedure available to identify and verify the access mechanisms in cloud.
- CO4 Outline the Secure design patterns that eliminate the accidental insertion of vulnerabilities into code and to mitigate the consequences of these vulnerabilities in the cloud.
- CO5 Interpret the compliance program's detection mechanisms like auditing and monitoring in finding risks that have been escalated or in detecting new risks.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	1	2	-	-	-	1	1	1	3	3	1
CO2	1	3	2	3	1	-	-	-	2	2	3	2	3	1
CO3	3	2	2	3	2	-	-	-	3	1	1	2	2	3
CO4	2	1	2	3	3	-	-	-	3	2	3	3	1	1
CO5	1	3	3	1	1	-	-	-	2	3	3	2	2	3

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites :-**Preamble:**

This course aims to explore the concepts of knowledge required to protect against the hacker for the information in a system, web service and wireless networks. Students are able to understand the issues relating to ethical hacking and to employ network defense measures for the information security.

UNIT 1 INTRODUCTION TO HACKING**9**

Introduction to Hacking – Penetration Test – Vulnerability Assessments versus Penetration Test – Rules of Engagement – Penetration Testing Methodologies – OSSTMM – NIST – OWASP – Categories and Types of Penetration Tests – Vulnerability Assessment Reports. Case study : Use security tools in Kali Linux to assess the vulnerabilities.

UNIT 2 INFORMATION GATHERING AND SCANNING**9**

Information Gathering Techniques – Active and Passive Information Gathering –Traceroute – ICMP Traceroute – TCP Traceroute – UDP Traceroute – Enumerating and Fingerprinting the Web servers – DNS, SNMP, SMTP Enumeration – Target Enumeration and Port Scanning Techniques. Case Study: Understand the network protocols and port scanning techniques using Kali Linux.

UNIT 3 NETWORK ATTACKS**9**

Vulnerability Data Resources – Network Sniffing – Types of Sniffing – MITM Attacks – ARP Attacks – Denial of Service Attacks –DNS Spoofing – ARP Spoofing Attack – DHCP Spoofing – Remote Exploitation –Traditional Brute Force – Attacking SMTP – Attacking SQL Servers – Testing for Weak Authentication. Case study: Demonstrating the MITM attack using ARP Poisoning using Kali Linux.

UNIT 4 EXPLOITATION**9**

Introduction to Metasploit – Reconnaissance, Port Scanning with Metasploit – E-Mails with Malicious Attachments – Browser Exploitation – Post-Exploitation – Hashing Algorithms – Windows Hashing Methods – Cracking the Hashes – Brute force Dictionary Attacks – Password Salts – Rainbow Tables – John the Ripper. Case studies: Understand the Metasploit and Exploitations.

UNIT 5 WIRELESS AND WEB HACKING**9**

Wireless Hacking – Aircrack– Cracking the WEP – Evil Twin Attack – Web Hacking – Brute Force and Dictionary Attacks – Types of Authentication – Captcha Validation Flaw – Captcha RESET Flaw – Authentication Bypass Attacks – Session Attacks – SQL Injection Attacks – XSS (Cross-Site Scripting) – CSRF – SSRF Attacks.

Total : 45 Periods**TEXT BOOKS:**

1. Rafay Baloch, "Ethical Hacking and Penetration Testing Guide", CRC Press, 2017.
2. Kevin Beaver, "Ethical Hacking for Dummies", Sixth Edition, Wiley, 2018.

REFERENCES:

1. Jon Erickson , "Hacking: The Art of Exploitation", Second Edition, Rogunix, 2008.
2. Georgia Weidman, "Penetration Testing: A Hands-On Introduction to Hacking", 1 st Edition, 2014.
3. DafyddStuttard, Marcus Pinto,"The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws", 2nd Edition, 2011.

e-RESOURCES:

1. <https://nptel.ac.in/courses/106/105/106105217/>, "Ethical Hacking", Prof. Indranil Sengupta, IIT Kharagpur.
2. <https://www.edureka.co/blog/ethical-hacking-tutorial/>, "Introduction to Cyber security and Ethical Hacking".

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

- CO1 Predict the vulnerabilities across any computing system using penetration testing.
- CO2 Explain the Foot printing, scanning and Enumeration method of reconnaissance about the target systems in a network.
- CO3 Analyze active and passive sniffing, DNS, ARP, DHCP spoofing techniques in the network systems.
- CO4 Analyze the Metasploit, Browser and post Exploitations for hacking the information from a system.
- CO5 Identify vulnerabilities/threats/attacks in system, wireless and web services.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	1	-	2	1	-	-	3	-	1	-	-	2	2
CO2	-	1	-	2	-	-	-	3	-	1	-	-	2	2
CO3	-	1	-	2	1	-	-	3	-	-	-	-	2	2
CO4	-	1	-	2	1	-	-	3	-	-	-	-	2	2
CO5	-	1	-	2	-	-	-	3	-	-	-	-	2	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites: Essentials of Ethical Hacking

Preamble

This course aims to explore basics of digital forensics and techniques and understanding digital crime and investigation, digital forensic readiness, use of forensics tools for iOS devices and use of forensics tools for Android devices.

UNIT 1 INTRODUCTION TO DIGITAL FORENSICS

9

Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process – Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase. Case Study: Installation of Sleuth Kit on Linux. List all data blocks. Analyze allocated as well as unallocated blocks of a disk image.

UNIT 2 DIGITAL CRIME AND INVESTIGATION

9

Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence.

UNIT 3 DIGITAL FORENSIC READINESS

9

Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness – Challenges in Digital Forensics.

UNIT 4 iOS FORENSICS

9

Mobile Hardware and Operating Systems - iOS Fundamentals – Jailbreaking – File System – Hardware – iPhone Security – iOS Forensics – Procedures and Processes – Tools – Oxygen Forensics – MobilEdit – iCloud. Case Study: Install Mobile Verification Toolkit or MVT and decrypt encrypted iOS backups. Process and parse records from the iOS system.

UNIT 5 ANDROID FORENSICS

9

Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security – Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling. Case Study: Extract installed applications from Android devices. Extract diagnostic information from Android devices through the adb protocol. 8. Generate a unified chronological timeline of extracted records,

Total : 45 Periods

TEXT BOOKS:

1. Andre Arnes, “Digital Forensics”, Wiley, 2018.
2. Chuck Easttom, “An In-depth Guide to Mobile Device Forensics”, First Edition, CRC Press, 2022.

REFERENCES:

1. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389

e-RESOURCES:

1. <https://www.open.edu/openlearn/science-maths-technology/digital-forensics/content-section---references>
2. [https://uou.ac.in/sites/default/files/slm/MIT\(CS\)-202.pdf](https://uou.ac.in/sites/default/files/slm/MIT(CS)-202.pdf)

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

- CO1 Explain about the basics of digital forensics and techniques.
- CO2 Relate digital crime with offense for investigation strategies.
- CO3 Identify the Frameworks, Standards and Methodologies for digital forensics.
- CO4 Summarize the iOS Fundamentals to process and parse records from the iOS system.
- CO5 Illustrate the android basics to identify and extract digital evidence from Android devices.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	3	2	1	-	-	-	1	1	3	3	2	2
CO2	3	3	3	3	3	-	-	-	2	2	1	2	2	2
CO3	3	3	2	3	1	-	-	-	3	2	1	1	2	2
CO4	3	1	2	2	3	-	-	-	1	3	3	2	2	2
CO5	1	3	2	3	2	-	-	-	2	3	2	3	2	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : Computer Networks

Preamble

The main aim of this course is to understand the concepts of Social Networks with respect to the Privacy and Security issues in Social Networking. This course makes the students to develop semantic web related simple applications and discuss the prediction of human behavior in social communities. This course will enable the students to describe the Access Control, Privacy and Security management of social networks

UNIT 1 FUNDAMENTALS OF SOCIAL NETWORKING 9

Introduction to Semantic Web, Limitations of current Web, Development of Semantic Web, Emergence of the Social Web, Social Network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis, Historical overview of privacy and security, Major paradigms, for understanding privacy and security. case study: Develop semantic web related simple applications.

UNIT 2 SECURITY ISSUES IN SOCIAL NETWORKS 9

The evolution of privacy and security concerns with networked technologies, Contextual influences on privacy attitudes and behaviors, Anonymity in a networked world. case study: Investigate Address Privacy and Security issues in Social Networking

UNIT 3 EXTRACTION AND MINING IN SOCIAL NETWORKING DATA 9

Extracting evolution of Web Community from a Series of Web Archive, Detecting communities in social networks, Definition of community, Evaluating communities, Methods for community detection and mining, Applications of community mining algorithms, Tools for detecting communities social network infrastructures and communities, Big data and Privacy.

UNIT 4 PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES 9

Understanding and predicting human behavior for social communities, User data Management, Inference and Distribution, Enabling new human experiences, Reality mining, Context, Awareness, Privacy in online social networks, Trust in online environment, What is Neo4j, Nodes, Relationships, Properties. case study: the prediction of human behavior in social communities.

UNIT 5 ACCESS CONTROL, PRIVACY AND IDENTITY MANAGEMENT 9

Understand the access control requirements for Social Network, Enforcing Access Control Strategies, Authentication and Authorization, Roles-based Access Control, Host, storage and network access control options, Firewalls, Authentication, and Authorization in Social Network, Identity & Access Management, Single Sign-on, Identity Federation, Identity providers and service consumers, The role of Identity provisioning.

Total : 45 Periods

TEXT BOOKS:

1. Peter Mika, Social Networks and the Semantic Web, First Edition, Springer 2007.
2. Borko Furht, Handbook of Social Network Technologies and Application, First Edition, Springer, 2010.
3. David Easley, Jon Kleinberg, Networks, Crowds, and Markets: Reasoning about a Highly Connected World, First Edition, Cambridge University Press, 2010.

REFERENCES:

1. Easley D. Kleinberg J., Networks, Crowds, and Markets – Reasoning about a Highly Connected World, Cambridge University Press, 2010.
2. Jackson, Matthew O., Social and Economic Networks, Princeton University Press, 2008.

e-RESOURCES:

1. <https://nptel.ac.in/courses/106106239/>, “Social Network analysis”, Prof. Tanmoy Chakraborty, IIT –Delhi.
2. <https://nptel.ac.in/courses/106106169/>, “Social Networks: The challenge”, Prof. Sudharshan Iyengar, IIT –Ropar.

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

CO1 Explain semantic web related applications using Social Network Analysis.

CO2 Identify the Address Privacy and Security issues in Social Networking.

CO3 Illustrate the methods and tools to detecting communities of social networks.

CO4 Explain the human behavior and privacy issues in social network communities.

CO5 Demonstrate the access control ,authentication, and authorization techniques in Social Network.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	2	3	2	-	-	-	3	2	1	2	3	3
CO2	2	2	2	3	3	-	-	-	1	2	2	3	3	3
CO3	2	1	1	3	2	-	-	-	1	2	1	1	1	3
CO4	3	3	3	3	2	-	-	-	1	1	1	1	2	1
CO5	1	3	2	2	2	-	-	-	1	1	3	1	2	3

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : Computer Networks

Preamble

Cyber security is the practice of protecting electronic information by mitigating information risks and vulnerabilities. Information risks can include unauthorized access, use, disclosure, interception, or data destruction.

UNIT 1 INTRODUCTION

9

Introduction to Cyber Security and Cybercrime: Definition - Cybercrime and Information Security- Cybercriminals- Classifications of Cybercrimes- Cybercrime: The Legal Perspectives- Cybercrimes: An Indian Perspective - Cybercrime and the Indian ITA 2000- A Global Perspective on Cybercrimes.

UNIT 2 CYBER OFFENCES

9

Types of Attacks - Social Engineering- Cyberstalking- Cyber cafe and Cybercrimes, Botnets- Attack Vector-Cloud Computing. Introduction, Proliferation of Mobile and Wireless Devices- Trends in Mobility - Credit Card Frauds in Mobile and Wireless Computing Era- Security Challenges Posed by Mobile Devices- Registry Settings for Mobile Devices- Authentication Service Security- Attacks on Mobile/Cell Phones.

UNIT 3 TOOLS

9

Proxy servers and Anonymizers-Phishing-Password cracking-Keyloggers and Spywares-Virus and Worms-Trojan Horses and Backdoors- Steganography- DoS and DDoS attacks-SQL Injection-Buffer Overflow- Attacks on wireless networks- Case study: Brute-force attacks on the Linux server using Hydra.

UNIT 4 INTRUSION DETECTION

9

Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort. Case study: Real-time network traffic analysis and data packet logging using Snort.

UNIT 5 INTRUSION PREVENTION

9

Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations – Intrusion Prevention Systems – Example Unified Threat Management Products.

Total : 45 Periods

TEXT BOOKS:

1. Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley Publishers, 2011 (Unit 1,2 and 3).
2. William Stallings, Lawrie Brown, "Computer Security Principles and Practice", Third Edition, Pearson Education, 2015 (Units 4 and 5)

REFERENCES:

1. David Kim, Michael G. Solomon, "Fundamentals of Information Systems Security", Jones & Bartlett Learning Publishers, 2013
2. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy", Elsevier, 2011.

e-RESOURCES:

1. <https://owasp.org/www-project-top-ten/>
2. <https://nptel.ac.in/courses/106105031/>, "Cryptography and Network Security", Dr. Debdeep Mukhopadhyay, IIT Kharagpur.

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

- CO1 Explain the basics of cyber security, cyber crime and cyber law and legal perspectives based on Indian ITA 2000.
- CO2 Classify the attacks in wired and wireless computing.
- CO3 Apply tools to launch the attacks in networks.
- CO4 Explain intrusion techniques to detect intrusion using snort.
- CO5 Apply intrusion prevention techniques to prevent intrusion using firewalls.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1	1	1	-	1	-	-	-	-	1	-	2	2
CO2	1	3	1	3	2	1	-	-	-	-	-	-	2	2
CO3	2	1	1	1	-	1	-	-	-	-	1	-	2	2
CO4	3	3	2	2	2	1	-	-	-	-	-	-	2	2
CO5	3	2	1	1	1	1	-	1	-	-	1	-	2	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : -**Preamble**

The course covers the importance and need for software security. Students can learn about various software attacks. This course intends to learn about secure software design and to understand the risk management in secure software development. The students can classify the working of tools related to software security.

UNIT 1 NEED OF SOFTWARE SECURITY AND LOW-LEVEL ATTACKS**9**

Software Assurance and Software Security - Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security - Properties of Secure Software – Memory- Based Attacks: Low-Level Attacks Against Heap and Stack - Defense Against Memory-Based Attacks – Case study: Implement the SQL injection attack

UNIT 2 SECURE SOFTWARE DESIGN**9**

Requirements Engineering for secure software - SQUARE process Model - Requirements elicitation and prioritization- Isolating The Effects of Untrusted Executable Content - Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles– Case study: Implement the Buffer Overflow attack

UNIT 3 SECURITY RISK MANAGEMENT**9**

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management- Case Study: eBay Risk Management System with Progress Corticon

UNIT 4 SECURITY TESTING**9**

Traditional Software Testing – Comparison - Secure Software Development Life Cycle - Risk Based Security Testing – Prioritizing Security Testing With Threat Modeling – Penetration Testing - Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection
- Tools for Penetration Testing - Case Study: Penetration test using kali Linux

UNIT 5 SECURE PROJECT MANAGEMENT**9**

Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice - Case study: Facebook Data breach 2021

Total : 45 Periods**TEXT BOOKS:**

1. Julia H. Allen, “Software Security Engineering”, Pearson Education, 2008
2. Evan Wheeler, “Security Risk Management: Building an Information Security Risk Management Program from the Ground Up”, First edition, Syngress Publishing, 2011
Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, “The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)”, Addison-Wesley Professional, 2006

REFERENCES:

1. Robert C. Seacord, “Secure Coding in C and C++ (SEI Series in Software Engineering)”, Addison-Wesley Professional, 2005
2. Jon Erickson, “Hacking: The Art of Exploitation”, 2nd Edition, No Starch Press, 2008.

e-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_cs30/preview
2. <https://www.softwaretestinghelp.com/penetration-testing-guide/>

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

- CO1 Classify stack based and Heap based Low-Level Memory Attacks by outlining the software assurance and security.
- CO2 Explain the security principles by using SQUARE process Model and Threat model in software development.
- CO3 Outline the Risk management processes with risk management, risk mitigation, evaluation and assessment and identify the extent of risk.
- CO4 Identify Penetration testing techniques related to software security in the testing phase of software development
- CO5 Explain the security frameworks that help organizations to assess their capability maturity state and to address the procedural, technical and human aspects of information security governance and management process.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	2	3	2	-	-	-	2	1	2	2	2	2
CO2	2	2	2	3	3	-	-	-	2	1	2	2	1	2
CO3	1	2	2	2	1	-	-	-	1	1	2	1	2	2
CO4	2	3	2	2	2	-	-	-	2	1	2	2	2	2
CO5	2	1	2	2	3	-	-	-	2	1	1	2	2	1

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : Database Management System, Social Network Security

Preamble:

This course answers how Block chain and Crypto currency works and the difference between them and address the security issues, anonymous nature of their users and price determination.

UNIT 1 INTRODUCTION TO BLOCKCHAIN 9

Blockchain- Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, Transactions The Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic –Hash Function, Properties of a hash function-Hash pointer and Merkle tree.

Case Study: Interact with a blockchain network. Execute transactions and requests against a blockchain network by creating an app to test the network and its rules

UNIT 2 BITCOIN AND CRYPTOCURRENCY 9

A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay.

UNIT 3 BITCOIN CONSENSUS 9

Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin PoW, Attacks on PoW, monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases.

Case Study: Smart Switch Dapp

UNIT 4 HYPERLEDGER FABRIC & ETHEREUM 9

Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

UNIT 5 BLOCKCHAIN APPLICATIONS 9

Smart contracts, Truffle Desig and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance,etc.

Case Study: Create and deploy a blockchain network using Hyperledger Fabric SDK for Java Set up and initialize the channel, install and instantiate chain code, and perform invoke and query on your blockchain network.

Total : 45 Periods

TEXT BOOKS:

1. Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, Cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2. Andreas Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies, O'Reilly, 2014.

REFERENCES:

1. Treccani, A., Lipton, A. Blockchain and Distributed Ledgers: Mathematics, Technology, and Economics – First Edition, Singapore Word Scientific Publishing company.
Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder.
2. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016

e-RESOURCES:

1. Ethereum Development Resources - <https://ethereum.org/en/developers>
2. Hyperledger Tutorials - <https://www.hyperledger.org/use/tutorials>

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

- CO1 Analyze the functionalist's of cryptographic techniques used in Blockchain technology.
- CO2 Analyze the challenges and technical aspects of crypto currency for the operations of Bitcoin network and its underlying technology.
- CO3 Examine the techniques needed to verify the proof of work and mine the Bitcoins with models and use cases.
- CO4 Use hyperledger Fabric and Ethereum platform to implement the Block chain Application.
- CO5 Examine the role of Blockchain in ensuring the security of distributed ledgers and their contents.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	1	-	-	-	1	-	-	2	3	3
CO2	3	3	2	3	1	-	-	-	2	-	-	2	3	3
CO3	3	3	2	3	2	-	-	-	3	-	-	2	3	3
CO4	3	3	2	2	3	-	-	-	3	-	-	2	3	2
CO5	3	2	2	3	3	-	-	-	2	-	-	2	3	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : -**Preamble**

To focus on how cryptographic algorithms and protocols work and how to use them, To build a Pseudorandom permutation, To construct Basic cryptanalytic techniques, To provide instruction on how to use the concepts of block ciphers and message authentication codes.

UNIT 1 INTRODUCTION**9**

Basics of Symmetric Key Cryptography, Basics of Asymmetric Key Cryptography, Hardness of Functions. Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI, Hard Core Predicate, Trap-door permutation, Goldwasser-Micali Encryption. Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations.

UNIT 2 FORMAL NOTIONS OF ATTACKS**9**

Attacks under Message Indistinguishability: Chosen Plaintext Attack (IND-CPA), Chosen Ciphertext Attacks (IND-CCA1 and IND-CCA2), Attacks under Message Non-malleability: NM-CPA and NM-CCA2, Inter-relations among the attack model

UNIT 3 RANDOM ORACLES**9**

Provable Security and asymmetric cryptography, hash functions. One-way functions: Weak and Strong one-way functions. Pseudo-random Generators (PRG): Blum-Micali-Yao Construction, Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudorandom Functions (PRF)- Case Study : Schnorr identification protocol.

UNIT 4 BUILDING A PSEUDORANDOM PERMUTATION**9**

The LubyRackoff Construction: Formal Definition, Application of the LubyRackoff Construction to the construction of Block Ciphers, The DES in the light of LubyRackoff Construction.

UNIT 5 MESSAGE AUTHENTICATION CODES**9**

Left or Right Security (LOR). Formal Definition of Weak and Strong MACs, Using a PRF as a MAC, Variable length MAC. Public Key Signature Schemes: Formal Definitions, Signing and Verification, Formal Proofs of Security of Full Domain Hashing. Assumptions for Public Key Signature Schemes: One-way functions Imply Secure One-time Signatures. Shamir's Secret Sharing Scheme. Formally Analyzing Cryptographic Protocols. Zero Knowledge Proofs and Protocols - Case Study : Authentication trees and one-time signatures.

Total : 45 Periods**TEXT BOOKS:**

1. Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag.
2. Wenbo Mao, Modern Cryptography, Theory and Practice, Pearson Education (Low Priced Edition)

REFERENCES:

1. ShaffiGoldwasser and MihirBellare, Lecture Notes on Cryptography, Available at <http://citeseerx.ist.psu.edu/>.
2. OdedGoldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available), Part 1 and Part 23
3. William Stallings, "Cryptography and Network Security: Principles and Practice", PHI 3rd Edition, 2006.

e-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_cs16/preview
2. <https://cse.iitpkd.ac.in/courses/cs5613-Cryptography/>

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

- CO1 Interpret the basic principles of cryptography and general cryptanalysis
- CO2 Determine the concepts of symmetric encryption and authentication.
- CO3 Identify the use of public key encryption, digital signatures, and key establishment.
- CO4 Demonstrate the cryptographic algorithms to compose, build and analyze simple cryptographic solutions.
- CO5 Outline the use of Message Authentication Codes using Cryptographic Protocols.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	1	-	-	-	2	1	1	2	1	1
CO2	1	3	2	1	2	-	-	-	3	2	2	2	1	3
CO3	1	1	2	3	2	-	-	-	1	1	1	3	1	3
CO4	3	1	2	1	3	-	-	-	3	2	1	2	2	1
CO5	2	3	3	3	3	-	-	-	3	1	1	1	1	1

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : Java Programming

Preamble:

This course is designed to give historical and modern overviews and perspectives on augmented reality and virtual reality. It describes the fundamentals of sensation, perception, technical and engineering aspects of augmented reality and virtual reality systems.

UNIT 1 INTRODUCTION TO AUGMENTED REALITY(AR)

9

History of AR - Augmented reality characteristics – Difference between Augmented Reality and Virtual Reality – AR technological components – Technologies used in AR – Feature Extraction – Hardware components – AR devices – Importance of AR - Real world uses of AR – AR types – Software tools available for AR.

UNIT 2 TECHNOLOGIES NEEDED FOR AUGMENTED REALITY

9

Hardware technology – virtual scenes – 3D objects – AR components – Display – HMD – Eyeglasses – Contact Lenses – significance of AR – AR powered devices – AR application development drawbacks – Compatibility – Performance – AR libraries – Motion tracking – Environmental understanding – Anchors.

UNIT 3 INTRODUCTION TO VIRTUAL REALITY(VR)

9

Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output- Visual, Aural & Haptic Displays, Applications of Virtual Reality.

UNIT 4 VR MODELING

9

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management.

UNIT 5 AUGMENTED REALITY AND VIRTUAL REALITY FOR MICRO LEARNING

9

Micro learning techniques – Utilizing VR for learning – VR for Practical online assessment – VR info graphics – Virtual case considerations - Utilizing AR for learning – Accessible learning – sensible data – elevated learner engagement - VR technology – Components of VR – VR Hardware – VR applications – Civil Engineering – Real Estate – Biology and Medicine – Virtual Mall – VR in Education – Virtual Laboratory – Factory Planning – Automobile Industry.

Total : 45 Periods

TEXT BOOKS:

1. Kaliraj, P., Devi, T. “Innovating with Augmented Reality: Applications in Education and Industry” (P. Kaliraj, Ed.) (1st ed.). CRC Press (2021). Taylor & Francis Group
2. Steven M. LaValle, “Virtual Reality”, Cambridge University Press, 2023.
3. John Vince, “Introduction to Virtual Reality”, Springer-Verlag, 2004

REFERENCES:

1. Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018
2. Schmalstieg / Hollerer,- “Augmented Reality: Principles & Practice” - Pearson Education India; First edition (12 October 2016),ISBN-10: 9332578494

e-RESOURCES:

1. <https://www.vttresearch.com/sites/default/files/pdf/science/2012/S3.pdf>
2. <http://lavallo.pl/vr/book.html>

3. <https://www.coursera.org/learn/introduction-virtual-reality>
4. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0133115621849497605635_shared/overview
https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0136088334576271366/overview

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

- CO1 Explain the types and choose appropriate tool for designing augmented reality based applications
- CO2 Analyze the hardware requirement of AR and explain the use of computer vision concepts for designing AR.
- CO3 Describe the working of VR systems and explain the human vision and its implications.
- CO4 Categorize and explain different models in VR modeling and choose appropriate modeling technique for a given problem.
- CO5 Design and Explain a solution for a given scenario using AR-VR components and micro learning tools.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	2	1	-	-	-	-	1	1	2	2
CO2	3	3	2	2	2	1	-	-	-	-	1	2	2	2
CO3	3	3	2	2	2	1	-	-	-	-	1	1	2	2
CO4	3	3	2	2	2	1	2	-	-	-	1	2	3	3
CO5	3	3	2	2	2	1	2	-	-	-	1	2	3	3

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : Web Technology, Mobile Application Development

Preamble

The main aim of this course is to expose the concepts of Multimedia is the major source of information in today's era. Audio, video and image signals require vast amount of data for its representation and storage. This course enables the learner to study the various representations of multimedia such as text, audio, image and video.

UNIT 1 INTRODUCTION TO MULTIMEDIA 9

Definitions, Elements, Multimedia Hardware and Software, Distributed multimedia systems, challenges: security, sharing / distribution, storage, retrieval, processing, computing. Multimedia metadata, Multimedia databases, Hypermedia, Multimedia Learning. Case study: Install tools like GIMP.

UNIT 2 MULTIMEDIA FILE FORMATS AND STANDARDS 9

File formats – Text, Image file formats, Graphic and animation file formats, Digital audio and Video file formats, Color in image and video, Color Models. Multimedia data and file formats for the web. Case study: Install tools like OpenShot.

UNIT 3 MULTIMEDIA AUTHORIZING 9

Authoring metaphors, Tools Features and Types: Card and Page Based Tools, Icon and Object Based Tools, Time Based Tools, Cross Platform Authoring Tools, Editing Tools, Painting and Drawing Tools, 3D Modeling and Animation Tools, Image Editing Tools, audio Editing Tools, Digital Movie Tools, Creating interactive presentations, virtual learning, simulations. Case Study: KompoZer, Aptana Studio.

UNIT 4 ANIMATION 9

Principles of animation: staging, squash and stretch, timing, onion skinning, secondary action, 2D, 2 ½ D, and 3D animation, Animation techniques: Keyframe, Morphing, Inverse Kinematics, Hand Drawn, Character rigging, vector animation, stop motion, motion graphics, , Fluid Simulation, skeletal animation, skinning Virtual Reality, Augmented Reality. Case study: Origami studio, Lottie.

UNIT 5 MULTIMEDIA APPLICATIONS 9

Multimedia Big data computing, social networks, smart phones, surveillance, Analytics, Multimedia Cloud Computing, Multimedia streaming cloud, media on demand, security and forensics, Online social networking, multimedia ontology, Content based retrieval from digital libraries.

Total : 45 Periods

TEXT BOOKS:

1. Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, "Fundamentals of Multimedia", Third Edition, Springer Texts in Computer Science, 2021. (UNIT-I, II, III)

REFERENCES:

1. John M Blain, The Complete Guide to Blender Graphics: Computer Modeling & Animation, CRC press, 3rd Edition, 2016.
2. Gerald Friedland, Ramesh Jain, "Multimedia Computing", Cambridge University Press, 2018
3. Mohsen Amini Salehi, Xiangbo Li, "Multimedia Cloud Computing Systems", Springer Nature, 1st Edition, 2021
4. Emilio Rodriguez Martinez, Mireia Alegre Ruiz, "UI Animations with Lottie and After Effects: Create, render, and ship stunning After Effects animations natively on mobile with React Native", Packet Publishing, 2022

e-RESOURCES:

1. <https://itsfoss.com>
2. <https://www.ucl.ac.uk/slade/know/3396>
3. <https://opensource.com/article/18/2/open-source-audio-visual-production-tools> <https://camstudio.org/>
4. <https://developer.android.com/training/animation/overview> (UNIT-IV)
5. <https://handbrake.fr>

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

- CO1 Classify the bigger picture of the context of Multimedia and its applications
- CO2 List the different types of media elements of different formats on content pages
- CO3 Outline 2D and 3D creative and interactive presentations for different target multimedia applications.
- CO4 Classify different standard animation techniques for 2D, 21/2 D, 3D applications
- CO5 Explain the complexity of multimedia applications in the context of cloud, security, bigdata streaming, social networking, CBIR etc

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	2	3	-	-	-	3	2	1	2	3	2
CO2	3	3	3	3	3	-	-	-	3	3	2	2	3	2
CO3	3	3	3	3	3	-	-	-	3	3	2	3	3	2
CO4	3	3	3	3	3	2	-	-	3	3	3	3	3	3
CO5	3	3	3	3	3	2	-	-	3	3	3	3	3	3

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : -**Preamble**

The student must be able to understand the basic concepts of broad perspective of linear and nonlinear editing, Storytelling styles, audio - video recording and AVID XPRESS DV 4.

UNIT 1 FUNDAMENTALS**9**

Evolution of filmmaking - linear editing - non-linear digital video - Economy of Expression - risks associated with altering reality through editing- Case Study: Write a Movie Synopsis (Individual/Team Writing)

UNIT 2 STORY TELLING**9**

Storytelling styles in a digital world through jump cuts, L-cuts, match cuts, cutaways, dissolves, split edits - Consumer and pro NLE systems - digitizing images - managing resolutions - mechanics of digital editing - pointer files - media management - Case Study: Present team stories in class.

UNIT 3 USING AUDIO AND VIDEO**9**

Capturing digital and analog video importing audio putting video on exporting digital video to tape recording to CDs and VCDs – Case Study: Pre-Production: Personnel, budgeting, scheduling, location scouting, casting, contracts & agreements.

UNIT 4 WORKING WITH FINAL CUT PRO**9**

Working with clips and the Viewer - working with sequences, the Timeline, and the canvas - Basic Editing - Adding and Editing Testing Effects - Advanced Editing and Training Techniques - Working with Audio - Using Media Tools - Viewing and Setting Preferences – Case Study: Writing The Final Proposal: Overview, Media Treatments, Summary, Pitching.

UNIT 5 WORKING WITH AVID XPRESS DV 4**9**

Starting Projects and Working with Project Window - Using Basic Tools and Logging - Preparing to Record and Recording - Importing Files - Organizing with Bins - Viewing and Making Footage - Using Timeline and Working in Trim Mode - Working with Audio - Output Options – Case Study: Post-production: Editing, Sound design, Finishing.

Total : 45 Periods**TEXT BOOKS:**

1. Avid Xpress DV 4 User Guide, 2007.
2. Final Cut Pro 6 User Manual, 2004.
3. Keith Underdahl, "Digital Video for Dummies", Third Edition, Dummy Series, 2001.
4. Robert M. Goodman and Partick McGarth, "Editing Digital Video: The Complete Creative and Technical Guide", Digital Video and Audio, McGraw – Hill 2003.

REFERENCES:

1. Roy Thompson Christopher J. Bowen, "Grammar of the Edit", Second Edition, 2009, Elsevier Inc.
2. Aaron Goold, "The Video Editing Handbook: For Beginners", John Goold, 2021.

e-RESOURCES:

1. <https://courseware.cutm.ac.in/courses/certificate-in-video-editing/>

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

- CO1 Compare the strengths and limitations of Nonlinear editing.
- CO2 Identify the infrastructure and significance of storytelling.
- CO3 Apply suitable methods for recording to CDs and VCDs.
- CO4 Extend the core issues of advanced editing and training techniques.
- CO5 Experiment with projects using AVID XPRESS DV 4

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	2	1	1	-	-	-	1	2	3	2	2	3
CO2	2	3	3	3	1	-	-	-	1	2	2	1	3	3
CO3	2	2	3	3	1	-	-	-	3	1	1	1	3	2
CO4	2	2	2	2	1	-	-	-	3	1	1	1	3	3
CO5	2	1	3	3	1	-	-	-	3	2	1	2	2	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : -**Preamble**

The primary objective of this course is to examine and explore the role and importance of digital marketing in today's rapidly changing business environment. It also focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured.

UNIT 1 INTRODUCTION TO ONLINE MARKET**9**

Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing. Case study: Subscribe to a weekly/quarterly newsletter and analyze how its content and structure aid with the branding of the company and how it aids its potential customer segments.

UNIT 2 SEARCH ENGINE OPTIMISATION**9**

Search Engine optimisation - Keyword Strategy- SEO Strategy - SEO success factors -On-Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- PPC advertising -Display Advertisement

UNIT 3 E- MAIL MARKETING**9**

E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting. Case study: Discuss regarding how an insurance company manages leads.

UNIT 4 SOCIAL MEDIA MARKETING**9**

Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing. Case study: Discuss negative and positive impacts and ethical implications of using social media for political advertising.

UNIT 5 DIGITAL TRANSFORMATION**9**

Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.

Total : 45 Periods**TEXT BOOKS:**

1. Fundamentals of Digital Marketing by Puneet Singh Bhatia;Publisher: Pearson Education; First edition (July 2017);ISBN-10: 933258737X;ISBN-13: 978-9332587373.
2. Digital Marketing by Vandana Ahuja ;Publisher: Oxford University Press (April 2015). ISBN-10: 0199455449
3. Marketing 4.0: Moving from Traditional to Digital by Philip Kotler;Publisher: Wiley; 1st edition (April 2017); ISBN10: 9788126566938;ISBN 13: 9788126566938;ASIN: 8126566930.

REFERENCES:

1. Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited
2. Barker, Barker, Bormann and Neher(2017), Social Media Marketing: A Strategic Approach, 2E South-Western ,Cengage Learning

e-RESOURCES:

1. https://onlinecourses.swayam2.ac.in/ugc19_hs26/preview
2. www.shiksha.com/online-courses/basics-of-digital-marketing-by-nptel-course-nptel43

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

- CO1 Examine and explore the role and importance of digital marketing in today's rapidly changing business environment
- CO2 Explain how digital marketing can be utilized by organizations and how its effectiveness can be measured
- CO3 Explain the key elements of a digital marketing strategy
- CO4 Study how the effectiveness of a digital marketing campaign can be measured
- CO5 Demonstrate advanced practical skills in common digital marketing tools such as SEO, SEM, Social media and Blogs.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	1	3	-	-	-	1	2	3	3	3	3
CO2	2	2	2	1	3	-	-	-	1	2	3	3	3	3
CO3	1	1	1	2	2	-	-	-	1	2	1	1	3	2
CO4	3	2	2	3	1	-	-	-	1	3	2	3	2	3
CO5	2	3	1	3	3	-	-	-	2	3	1	2	1	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : -**Preamble**

The main of this course to get a basic idea on animation principles and techniques. To get exposure to CGI, color and light elements of VFX. To have a better understanding of basic special effects techniques. To have a knowledge of state of the art vfx techniques. To become familiar with popular compositing techniques.

UNIT 1 ANIMATION BASICS**9**

VFX production pipeline, Principles of animation, Techniques: Keyframe, kinematics, Full animation, limited animation, Rotoscoping, stop motion, object animation, pixilation, rigging, shape keys, motion paths.

UNIT 2 CGI, COLOR, LIGHT**9**

CGI – virtual worlds, Photorealism, physical realism, function realism, 3D Modeling and Rendering: color - Color spaces, color depth, Color grading, color effects, HDRI, Light – Area and mesh lights, image based lights, PBR lights, photometric light, BRDF shading model. Case Study: Using Natron, work with color and color grading..

UNIT 3 SPECIAL EFFECTS**9**

Special Effects – props, scaled models, animatronics, pyrotechniques, Schufftan process, Particle effects – wind, rain, fog, fire. Case Study: Using Natron, work with merging of images.

UNIT 4 VISUAL EFFECTS TECHNIQUES**9**

Motion Capture, Matt Painting, Rigging, Front Projection. Rotoscoping, Match Moving – Tracking, camera reconstruction, planar tracking, Calibration, Point Cloud Projection, Ground plane determination, 3D Match Moving. .Case Study: Using Natron, work with Rotopaint.

UNIT 5 COMPOSITING**9**

Compositing – chroma key, blue screen/green screen, background projection, alpha compositing, deep image compositing, multiple exposure, matting, VFX tools - Blender, Natron, GIMP. Case Study: Using Natron, work with stereoscopic compositing

Total : 45 Periods**TEXT BOOKS:**

1. Chris Roda, Real Time Visual Effects for the Technical Artist, CRC Press, 1st Edition, 2022.
2. Steve Wright, Digital Compositing for film and video, Routledge, 4th Edition, 2017.

REFERENCES:

1. Jon Gress, “Digital Visual Effects and Compositing”, New Riders Press, 1st Edition, 2014.
2. Robin Brinkman, The Art and Science of Digital Compositing: Techniques for Visual Effects, Animation and Motion Graphics”, Morgan Kauffman, 2008.

e-RESOURCES:

1. <https://www.blender.org/features/vfx/>
2. <https://natrongithub.github.io/>

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

- CO1 Implement animation in 2D / 3D following the principles and techniques
- CO2 Use CGI, color and light elements in VFX applications
- CO3 Create special effects using any of the state of the art tools
- CO4 Apply popular visual effects techniques using advanced tools
- CO5 Use compositing tools for creating VFX for a variety of applications

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	1	-	-	-	1	2	1	1	2	-
CO2	1	3	3	2	1	-	-	-	3	2	2	2	2	-
CO3	2	3	3	2	1	-	-	-	1	2	1	2	2	-
CO4	3	3	2	2	3	-	-	-	3	3	2	2	2	-
CO5	1	2	1	1	2	-	-	-	1	3	2	3	2	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites: Programming in C

Preamble

The main aim of this course to know the basics of 2D and 3D graphics for game development, to know the stages of game development, to understand the basics of a game engine, to survey the gaming development environment and tool kits and to learn and develop simple games using Pygame environment.

UNIT 1 3D GRAPHICS FOR GAME DESIGN 9

Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components – 2D and 3D Transformations – Projections – Color Models – Illumination and Shader Models – Animation – Controller Based Animation - Case Study: Installation of a game engine, e.g., Unity, Unreal Engine, familiarization of the GUI. Conceptualize the theme for a 2D game

UNIT 2 GAME DESIGN PRINCIPLES 9

Character Development, Storyboard Development for Gaming – Script Design – Script Narration, Game Balancing, Core Mechanics, Principles of Level Design – Proposals – Writing for Preproduction, Production and Post – Production– Case Study: Character design, sprites, movement and character control, Level design: design of the world in the form of tiles along with interactive and collectible objects.

UNIT 3 GAME ENGINE DESIGN 9

Rendering Concept – Software Rendering – Hardware Rendering – Spatial Sorting Algorithms – Algorithms for Game Engine– Collision Detection – Game Logic – Game AI – Pathfinding–Case Study: Design of interaction between the player and the world, optionally using the physics engine.

UNIT 4 OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS 9

Pygame Game development – Unity – Unity Scripts –Mobile Gaming, Game Studio, Unity Single player and Multi-Player games–Case Study: Developing a 2D interactive using Pygame, Developing a Puzzle game, Design of menus and user interaction in mobile platforms.

UNIT 5 GAME DEVELOPMENT USING PYGAME 9

Developing 2D and 3D interactive games using Pygame – Avatar Creation – 2D and 3D Graphics Programming – Incorporating music and sound – Asset Creations – Game Physics algorithms Development – Device Handling in Pygame – Overview of Isometric and Tile Based arcade Games – Puzzle Games.– Case Study: Developing a 3D Game using Unreal, Developing a Multiplayer game using unity

Total : 45 Periods

TEXT BOOKS:

1. Sanjay Madhav, “Game Programming Algorithms and Techniques: A Platform Agnostic Approach”, Addison Wesley, 2013.
2. Will McGugan, “Beginning Game Development with Python and Pygame: From Novice to Professional”, Apress, 2007.

REFERENCES:

1. Paul Craven, “Python Arcade games”, Apress Publishers, 2016.
2. David H. Eberly, “3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics”, Second Edition, CRC Press, 2006.
3. Jung Hyun Han, “3D Graphics for Game Programming”, Chapman and Hall/CRC, 2011

e-RESOURCES:

1. <https://freecomputerbooks.com/compscGameProgrammingBooks.html>
2. <https://unity.com/learn>

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

- CO1 Explain the concepts of 2D and 3d Graphics and conceptualize the theme for a 2D game using color models and animation,.
- CO2 Discuss the principles involved in game design applying character design and control for an application.
- CO3 Design an interaction between the player and the world, using the physics engine with rendering concepts and algorithms. .
- CO4 Discuss gaming environments and frameworks and design a puzzle game with user interactions in mobile platforms..
- CO5 Develop 2D and 3D interactive games in Pygame using unity and unreal.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	1	2	-	-	-	-	-	-	-	2	2
CO2	1	2	2	1	2	-	-	-	-	-	-	-	2	2
CO3	1	1	1	2	1	-	-	-	-	-	-	-	2	2
CO4	3	3	1	3	3	-	-	-	-	-	-	-	2	2
CO5	3	3	2	1	3	-	-	-	-	-	-	-	2	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites :-
Preamble

To understand text, image, and video compression techniques with compression algorithms and consistency of data availability in storage devices and the concepts of data streaming services.

UNIT 1 BASICS OF DATA COMPRESSION 9

Introduction —Lossless and Lossy Compression– Basics of Huffman coding- Arithmetic coding Dictionary techniques- Context based compression – Applications – Case Study: Construct Huffman codes for given symbol probabilities

UNIT 2 IMAGE COMPRESSION 9

Lossless Image compression – JPEG-CALIC-JPEG LS-Prediction using conditional averages – Progressive Image Transmission – Lossless Image compression formats – Applications - Facsimile encoding – Case Study: Write a shell script, which converts all images in the current directory in JPEG.

UNIT 3 VIDEO COMPRESSION 9

Introduction – Motion Compensation – Video Signal Representation – H.261 – MPEG-1- MPEG-2- H.263 - Case Study: Write a program to split images from a video without using any primitives.

UNIT 4 DATA PLACEMENT ON DISKS 9

Statistical placement on Disks – Striping on Disks – Replication Placement on Disks – Constraint allocation on Disks – Tertiary storage Devices – Continuous Placement on Hierarchical storage system – Statistical placement on Hierarchical storage systems – Constraint allocation on Hierarchical storage system - Case Study: Write the code for identifying the popularity of content retrieval from media server

UNIT 5 DISK SCHEDULING METHODS 9

Scheduling methods for disk requests – Feasibility conditions of concurrent streams– Scheduling methods for request streams - Case Study: Program for scheduling requests for data streams

Total : 45 Periods

TEXT BOOKS:

1. Khalid Sayood, "Introduction to Data Compression, Morgan Kaufmann Series in Multimedia Information and Systems", 2018, 5th Edition.
2. Philip K.C.Tse, "Multimedia Information Storage and Retrieval: Techniques and Technologies", 2008

REFERENCES:

1. David Salomon, A concise introduction to data compression, 2008.
2. Lenald Best, "Best's Guide to Live Stream Video Broadcasting", BCB Live Teaching series, 2017.
3. Yun-Qing Shi, "Image And Video Compression For Multimedia Engineering Fundamentals Algorithms And Standards", Taylor & Francis, 2019
4. Irina Bocharova, "Compression for Multimedia", Cambridge University Press; 1st edition, 2009

e-RESOURCES:

1. Audio and Video Compression - https://www.youtube.com/watch?v=rC16fhvXZOo&ab_channel=npTELhrd
2. Basic Image Compression techniques and different image file formats - https://www.youtube.com/watch?v=4-AsEtIpEWg&ab_channel=IITRoorkeeJuly2018.

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

- CO1 Examine lossless and lossy compression techniques for text, image, and video compression
- CO2 Identify the efficiency of lossless image compression such as JPEG and CALIC with their application in streamlined context and facsimile encoding
- CO3 Explore the applications of various compression techniques used in motion pictures
- CO4 Identify the best data placement techniques on disks and gain knowledge in hierarchical storage systems.
- CO5 Apply and optimize the scheduling methods for disk requests, considering feasibility conditions of concurrent streams.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	1	1	-	-	-	-	-	-	-	2	2
CO2	3	2	2	1	2	-	-	-	-	-	-	-	2	2
CO3	3	2	2	1	2	-	-	-	-	-	-	-	2	2
CO4	3	2	2	1	1	-	-	-	-	-	-	-	2	2
CO5	3	2	2	1	1	-	-	-	-	-	-	-	2	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites: -**Preamble**

The Student must be able to understand the basics of Knowledge Engineering, methodologies and modeling for Agent Design and Development ,ontologies and also learn about rule learning.

UNIT 1 REASONING UNDER UNCERTAINTY 9

Introduction – Abductive reasoning – Probabilistic reasoning: Enumerative Probabilities – Subjective Bayesian view – Belief Functions – Baconian Probability – Fuzzy Probability – case study: Perform operations on Probability Based Reasoning. – Uncertainty methods - Evidence-based reasoning – Intelligent Agent – Mixed-Initiative Reasoning – Knowledge Engineering.

UNIT 2 METHODOLOGY AND MODELING 9

Conventional Design and Development – Development tools and Reusable Ontologies – Agent Design and Development using Learning Technology – Problem Solving through Analysis and Synthesis – Inquiry-driven Analysis and Synthesis – Evidence-based Assessment – Believability Assessment –case study: Perform Believability Analysis – Drill-Down Analysis, Assumption-based Reasoning, and What-If Scenarios.

UNIT 3 ONTOLOGIES – DESIGN AND DEVELOPMENT 9

Concepts and Instances – Generalization Hierarchies – Object Features – Defining Features – Representation – Transitivity – Inheritance – Concepts as Feature Values – Ontology Matching. Design and Development Methodologies – Steps in Ontology Development – Domain Understanding and Concept Elicitation – Modelling-based Ontology Specification.

UNIT 4 REASONING WITH ONTOLOGIES AND RULES 9

Production System Architecture – Complex Ontology-based Concepts – Reduction and Synthesis rules and the Inference Engine – Evidence-based hypothesis analysis – Rule and Ontology Matching – case study : Construction of Ontology for a given domain – Partially Learned Knowledge – Reasoning with Partially Learned Knowledge.

UNIT 5 LEARNING AND RULE LEARNING 9

Machine Learning – Concepts – Generalization and Specialization Rules – Types – Formal definition of Generalization. Modelling, Learning and Problem Solving – Rule learning and Refinement – case study: Implement Rule Learning and refinement – Overview – Rule Generation and Analysis – Hypothesis Learning.

Total: 45 Periods

TEXT BOOKS:

1. Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, First Edition, 2016. (Unit 1 – Chapter 1 / Unit 2 – Chapter 3,4 / Unit 3 – Chapter 5, 6 / Unit 4 - 7 , Unit 5 – Chapter 8, 9)

REFERENCES:

1. Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
2. Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018.

3. John F. Sowa: Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 2000.
4. King, Knowledge Management and Organizational Learning, Springer, 2009.
5. Jay Liebowitz, Knowledge Management Learning from Knowledge Engineering, 1st Edition, 2001.

e-RESOURCES:

1. <https://nptel.ac.in/courses/106106140>, “Knowledge Representation and Reasoning, Prof. Deepak Khemani IIT Madras”.
2. <https://nptel.ac.in/courses/106106139>, “Introduction to Machine Learning, Dr. Balaraman Ravindran, IIT Madras”.

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

- CO1 Identify and describe knowledge Engineering and their roles in probability based reasoning operations .
- CO2 Apply methodologies and modeling for Agent Design and Development.
- CO3 Experiment with ontology development based Concepts as Feature values.
- CO4 Explain reasoning with ontologies and rules in Knowledge Engineering
- CO5 Utilize Generalization and Specialization Rules for solving a given problem.

Mapping of COs with POs and PSOs

Cos/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	1	1	1	1	-	-	1	2	1	2	1	-
CO2	3	2	3	2	2	-	-	-	2	1	2	1	2	-
CO3	2	2	3	2	3	-	-	-	3	2	2	2	2	-
CO4	2	2	3	1	1	-	-	-	2	2	2	2	2	-
CO5	2	2	2	1	1	-	-	-	2	1	1	1	2	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High), '-' - no correlation.

Pre-requisites :-**Preamble**

The concepts of fuzzy sets, fuzzy logic, and the use of heuristics based on human experience are the main topics of this course. It also offers the mathematical foundation needed to implement optimization related to neural network learning and to learn different evolutionary algorithms. Students gain knowledge of neural networks that can generalize from specific examples to provide suitable rules for inference systems.

UNIT 1 INTRODUCTION TO SOFT COMPUTING AND FUZZY LOGIC**9**

Introduction - Fuzzy Logic - Fuzzy Sets, Fuzzy Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Operations on Fuzzy Relations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems

UNIT 2 NEURAL NETWORKS**9**

Supervised Learning Neural Networks – Perceptrons - Back propagation -Multilayer Perceptrons – Unsupervised Learning Neural Networks – Kohonen Self-Organizing Networks. Case Study : Illustrate the neural network architecture for AI applications

UNIT 3 GENETIC ALGORITHMS**9**

Chromosome Encoding Schemes -Population initialization and selection methods - Evaluation function - Genetic operators- Cross over – Mutation - Fitness Function – Maximizing function. Case Study : Functionality of Genetic Algorithms in Optimization problems

UNIT 4 NEURO FUZZY MODELING**9**

ANFIS architecture – hybrid learning – ANFIS as universal approximator – Coactive Neuro fuzzy modeling – Framework – Neuron functions for adaptive networks – Neuro fuzzy spectrum - Analysis of Adaptive Learning Capability. Case Study : Applications of Neuro fuzzy systems

UNIT 5 APPLICATIONS**9**

Modeling a two input sine function - Printed Character Recognition – Fuzzy filtered neural networks – Plasma Spectrum Analysis – Hand written neural recognition - Soft Computing for Color Recipe Prediction. Case Study : Illustrate the intelligent behavior of programs based on soft computing

Total : 45 Periods**TEXT BOOKS:**

1. SaJANG, J.-S. R., SUN, C.-T., & MIZUTANI, E. (1997). Neuro-fuzzy and soft computing: A computational approach to learning and machine intelligence. Upper Saddle River, NJ, Prentice Hall, 1997
2. Himanshu Singh, Yunis Ahmad Lone, Deep Neuro-Fuzzy Systems with Python With Case Studies and Applications from the Industry, Apress, 2020

REFERENCES:

1. Roj Kaushik and Sunita Tiwari, Soft Computing-Fundamentals Techniques and Applications, 1st Edition, McGraw Hill, 2018
2. Samir Roy, Udit Chakraborty, Introduction to Soft Computing, Neuro Fuzzy and Genetic Algorithms, Pearson Education, 2013.
3. S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, Third Edition, Wiley India Pvt Ltd, 2019.

e-RESOURCES:

1. <https://nptel.ac.in/courses/106105173>
2. <https://cse.iitkgp.ac.in/~dsamanta/courses/sca/index.html>

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

- CO1 Explain the basic principles for fuzzy logic operators and inference mechanisms in Soft computing
- CO2 Discuss the Supervised and Unsupervised Learning network architecture for AI applications in Neural Networks.
- CO3 Analyze the functionality of Genetic Algorithms in Optimization problems
- CO4 Analyze the Adaptive Learning Capability of Neural networks and Fuzzy logic using hybrid techniques.
- CO5 Apply the soft computing techniques to illustrate the intelligent behavior of real world problems

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	3	3	-	-	-	3	1	3	2	2	2
CO2	2	3	3	2	3	-	-	-	3	2	3	2	2	2
CO3	1	3	2	2	1	-	-	-	3	1	1	2	2	2
CO4	1	2	1	3	2	-	-	-	3	3	1	1	2	2
CO5	2	3	1	2	1	-	-	-	3	3	3	2	2	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : -**Preamble**

The course provides the foundation on Natural Language Processing concepts. Starting from words as the unit of a language, this course deals with statistical models, word embeddings and sequence modeling using advanced neural architectures. It also illustrates some practical NLP systems like Machine translation, Question Answering systems and chatbots.

UNIT 1 WORDS AND THEIR STATISTICAL MODELS**9**

Regular Expressions – Words – Corpora – Text normalization – Minimum edit distance. N-Gram Language Models – N-Grams – Evaluating Language Models – Generalizations and zeros – Smoothing – Kneser-Ney Smoothing – Huge Language Models – Backoff – Perplexity vs. Entropy. Naive-Bayes classifiers – Naive-Bayes as Language Model – Evaluation – Test set and cross validation – Statistical significance testing.

UNIT 2 VECTORS AND EMBEDDINGS**9**

Lexical Semantics – Vector Semantics – Words and Vectors – Cosine for measuring similarity – TF-IDF: weighing terms in vectors – point wise Mutual Information (PMI) – Applications of TF-IDF and PPMI – Word2Vec – Visualizing embeddings – Bias and Embeddings – Evaluating vector models. Neural Network Language Models – Units – XOR problem – Feed Forward Neural Networks – Training Neural Nets – Neural Language Models.

UNIT 3 SEQUENCE LABELING AND DEEP LEARNING ARCHITECTURES**9**

English word classes – Part-of-Speech (PoS) Tagging – Named Entities and Named Entities Tagging – HMM PoS – Conditional Random Fields – Evaluation of Named Entity Recognition. Deep Learning Architectures for sequence modeling – Recurrent Neural Networks – Managing contexts in RNNs: LSTMs and GRUs – Self Attention Networks (Transformers) – Potential harms from Language Models.

UNIT 4 MACHINE TRANSLATION (MT) AND ENCODER-DECODER MODELS**9**

Language divergences and Typology – The Encoder-Decoder model – Encoder-Decoder with RNNs – Attention – Beam Search – Encoder-Decoder with Transformers – Practical details on building MT systems – MT evaluation – Bias and ethical issues.

UNIT 5 PRACTICAL NLP SYSTEMS**9**

Question Answering: Information Retrieval – IR based Factoid Question Answering – Entity Linking – Knowledge based Question Answering – Using Language Models for Question Answering – Classic QA models – Evaluation of factoid answers.

Chatbots and Dialogue systems – Properties of human conversations – Chatbots – GUS: a simple frame-based dialogue system – Evaluating dialogue systems – Dialogue system design.

Total : 45 Periods**TEXT BOOKS:**

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing", 3rd Edition, Pearson Education, New Delhi, 2020.
2. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, First Edition, O Reilly Media, 2009.

REFERENCES:

1. Li Deng and Yang Liu, "Deep Learning in Natural Language Processing", 1st Edition, Springer, 2018
2. Christopher Manning and Hinrich Schuetze, "Foundations of Statistical Natural Language Processing", 1st Edition, MIT Press, London, 2000

e-RESOURCES:

1. <https://nptel.ac.in/courses/106101007>, "Natural Language Processing", Prof. Pushpak Bhattacharyya, IIT Bombay.
2. <https://nptel.ac.in/courses/106105158>, "Natural Language Processing", Prof. Pawan Goyal, IIT Kharagpur.

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

CO1 Apply formal and statistical models for word processing in NLP.

CO2 Develop word vector embeddings for a given language using neural language models.

CO3 Apply deep learning architectures for modeling sequences in NLP

CO4 Apply encoder-decoders models to build Machine Translation systems for a given application.

CO5 Develop question answering and chatbots for practical applications using NLP models.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1	-	-	-	-	-	-	-	-	-	3	1
CO2	3	2	1	-	-	-	-	-	-	-	-	-	3	1
CO3	3	2	1	-	-	-	-	-	-	-	-	-	3	1
CO4	3	2	1	-	-	-	-	-	-	-	-	-	3	1
CO5	3	2	1	-	-	-	-	-	-	-	-	-	3	1

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites: Probability and Queuing Theory, Data Structures

Preamble

The main aim of this course is to introduce the student to the notion of a game, its solutions concepts, and other basic notions and tools of game theory, and the main applications for which they are appropriate, including electronic trading markets, to formalize the notion of strategic thinking and rational choice by using the tools of game theory, to provide insights into using game theory in modelling applications, to draw the connections between game theory, computer science, and economics, especially emphasizing the computational issues, to introduce contemporary topics in the intersection of game theory, computer science, and economics and to apply game theory in searching, auctioning and trading.

UNIT 1 INTRODUCTION

9

Introduction — Making rational choices: basics of Games — strategy — preferences — payoffs — Mathematical basics — Game theory — Rational Choice — Basic solution concepts-noncooperative versus cooperative games — Basic computational issues — finding equilibria and learning in games-Typical application areas for game theory (e.g. Google's sponsored search, eBay auctions, electricity trading markets).

UNIT 2 GAMES WITH PERFECT INFORMATION

9

Games with Perfect Information — Strategic games — prisoner's dilemma, matching pennies - Nash equilibria —mixed strategy equilibrium — zero-sum games— Case Study: Prisoner's dilemma, Pure Strategy Nash Equilibrium.

UNIT 3 GAMES WITH IMPERFECT INFORMATION

9

Games with Imperfect Information — Bayesian Games — Motivational Examples — General Definitions — Information aspects — Illustrations — Extensive Games with Imperfect — Information — Strategies — Nash Equilibrium —Repeated Games — The Prisoner's Dilemma — Bargaining-Case Study: Extensive Form – Graphs and Trees, Game Trees, Strategic Form – Elimination of dominant strategy.

UNIT 4 NON-COOPERATIVE GAME THEORY

9

Non-cooperative Game Theory — Self-interested agents — Games in normal form — Analyzing games: from optimality to equilibrium — Computing Solution Concepts of Normal — Form Games — Computing Nash equilibria of two-player, zero-sum games —Computing Nash equilibria of two player, general- sum games — Identifying dominated strategies-Case Study: Minimax theorem, minimax strategies, Perfect information games: trees, players assigned to nodes, payoffs, backward Induction, subgame perfect equilibrium

UNIT 5 MECHANISM DESIGN

9

Aggregating Preferences — Social Choice — Formal Model — Voting — Existence of social functions — Ranking systems — Protocols for Strategic Agents: Mechanism Design — Mechanism design with unrestricted preferences—Case Study: imperfect-information games - Mixed Strategy Nash Equilibrium - Finding mixed-strategy Nash equilibria for zero sum games, mixed versus behavioral strategies, Repeated Games

Total : 45 Periods

TEXT BOOKS:

1. M. J. Osborne, An Introduction to Game Theory. Oxford University Press, 2012.
2. M. Machler, E. Solan, S. Zamir, Game Theory, Cambridge University Press, 2013.
3. N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani, Algorithmic Game Theory. Cambridge University Press, 2007.
4. A.Dixit and S. Skeath, Games of Strategy, Second Edition. W W Norton & Co Inc, 2004.

REFERENCES:

1. YoavShoham, Kevin Leyton-Brown, Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Cambridge University Press 2008

2. Zhu Han, DusitNiyato, WalidSaad, TamerBasar and Are Hjorungnes, “Game Theory in Wireless and Communication Networks”, Cambridge University Press, 2012.
3. Y.Narahari, “Game Theory and Mechanism Design”, IISC Press, World Scientific.
4. William Spaniel, “Game Theory 101: The Complete Textbook”, CreateSpace Independent Publishing, 2011.

e-RESOURCES:

1. <https://gametheorysociety.org/resources/>
2. https://onlinecourses.nptel.ac.in/noc19_ge32/preview

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

- CO1 Discuss the notion of a strategic game and equilibria and identify the characteristics of eBay auctions and electricity trading markets..
- CO2 Explain the concepts of Games with perfect Information using Nash Equilibrium strategies for prisoner’s dilemma application. .
- CO3 Identify key strategic aspects of games with imperfect information using Nash Equilibrium for prisoner’s dilemma and Bargaining. .
- CO4 Identify the applications that need aspects of Bayesian Games in noncooperative game theory.
- CO5 Implement a typical Virtual Business scenario using Game theory with unrestricted preferences..

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	3	3	-	-	-	-	-	-	-	3	3
CO2	3	3	3	2	3	-	-	-	-	-	-	-	3	3
CO3	1	1	3	3	3	-	-	-	-	-	-	-	3	3
CO4	2	1	1	1	1	-	-	-	-	-	-	-	3	3
CO5	2	2	3	2	1	-	-	-	-	-	-	-	3	3

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : -**Preamble:**

This course aims to know the theoretical background of cognition and to understand the link between cognition and computational intelligence and explore probabilistic programming language and to study the computational inference and learning models of cognition.

UNIT 1 PHILOSOPHY, PSYCHOLOGY AND NEUROSCIENCE**9**

Philosophy: Mental-physical Relation – From Materialism to Mental Science – Logic and the Sciences of the Mind – Psychology: Place of Psychology within Cognitive Science – Science of Information Processing – Cognitive Neuroscience – Perception – Decision – Learning and Memory – Language Understanding and Processing.

UNIT 2 COMPUTATIONAL INTELLIGENCE**9**

Machines and Cognition – Artificial Intelligence – Architectures of Cognition – Knowledge Based Systems – Logical Representation and Reasoning – Logical Decision Making – Learning – Language – Vision-case study: Implementation of reasoning algorithms.

UNIT 3 PROBABILISTIC PROGRAMMING LANGUAGE**9**

WebPPL Language – Syntax – Using Javascript Libraries – Manipulating probability types and distributions – Finding Inference – Exploring random computation – Coroutines: Functions that receive continuations – Enumeration.

UNIT 4 INFERENCE MODELS OF COGNITION**9**

Generative Models – Conditioning – Causal and statistical dependence – Conditional dependence – Data Analysis – Algorithms for Inference- case study: Developing an application using conditional inference learning model.

UNIT 5 LEARNING MODELS OF COGNITION**9**

Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models– Learning (Deep) Continuous Functions – Mixture Models- case study: Application development using hierarchical model.

Total : 45 Periods**TEXT BOOKS:**

1. Vijay V Raghavan, Venkat N. Gudivada, Venu Govindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016.
2. Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley Publications, 2015.
3. Robert A. Wilson, Frank C. Keil, “The MIT Encyclopedia of the Cognitive Sciences”, The MIT Press, 1999.
4. Jose Luis Bermúdez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020.

REFERENCES:

1. Noah D. Goodman, Andreas Stuhlmüller, “The Design and Implementation of Probabilistic Programming Languages”, Electronic version of book, <https://dippl.org/>.
2. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, “Probabilistic Models of Cognition”, Second Edition, 2016, <https://probmods.org/>.

e-RESOURCES:

1. <http://nitttrc.edu.in/nptel/courses/video/109104171/L01.html>
2. <https://library.iitgn.ac.in/resourceguide/subjects/guide.php?subject=150>

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

- CO1 Explain the concepts of philosophy, psychology and neuroscience in cognitive science.
- CO2 Identify the relationship between the cognition elements and computational intelligence.
- CO3 Implement mathematical functions through WebPPL.
- CO4 Develop applications using cognitive inference model.
- CO5 Develop applications using cognitive learning model.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	3	2	2	-	-	-	1	1	2	2	2	2
CO2	2	2	1	1	2	-	-	-	3	2	3	1	2	2
CO3	1	3	1	3	3	-	-	-	1	3	1	3	2	2
CO4	2	1	1	2	3	-	-	-	1	2	3	1	2	2
CO5	1	2	3	2	2	-	-	-	1	2	2	2	2	2

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : -
Preamble

The main aim of this course is to Study the morality and ethics in AI and Learn ae Ethical initiatives in the field of artificial intelligence. This course makes the students to understand the AI standards and Regulations, social and ethical issues of Robot Ethics and AI and Ethics- challenges and opportunities

UNIT 1 INTRODUCTION

9

Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust

UNIT 2 ETHICAL INITIATIVES IN AI

9

International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles , Warfare and weaponization. Case Study: Ethical initiatives in healthcare, autonomous vehicles and defense

UNIT 3 AI STANDARDS AND REGULATION

9

Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems. Case Study: Compare the regression model without a bias and with bias

UNIT 4 ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS

9

Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility- Roboethics Taxonomy. Case Study: Ethics of Robotics in science and technology

UNIT 5 AI AND ETHICS- CHALLENGES AND OPPORTUNITIES

9

Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries-National and International Strategies on AI. Case Study: Identification on optimization in AI affecting ethics

Total : 45 Periods

TEXT BOOKS:

1. Y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield ,”The ethics of artificial intelligence: Issues and initiatives”, EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 – March 2020.
2. Patrick Lin, Keith Abney, George A Bekey,” Robot Ethics: The Ethical and Social Implications of Robotics”, The MIT Press- January 2014.

REFERENCES:

1. Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017
2. Mark Coeckelbergh,” AI Ethics”, The MIT Press Essential Knowledge series, April 2020

e-RESOURCES:

1. https://sci-hub.mkssa.top/10.1007/978-3-540-30301-5_65
2. <https://sci-hub.mkssa.top/10.1159/000492428>

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

- CO1 Learn about morality and ethics in AI and Acquire the knowledge of real time application ethics, issues and its challenges.
- CO2 Explain the ethical harms and ethical initiatives in AI.
- CO3 Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems
- CO4 Analyse the concepts of Roboethics and Morality with professional responsibilities
- CO5 Learn about the societal issues in AI with National and International Strategies on AI

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	3	1	-	-	-	1	2	1	1	3	1
CO2	2	1	1	2	1	-	-	-	1	2	1	1	3	3
CO3	2	3	1	1	3	-	-	-	2	1	1	2	3	2
CO4	3	1	3	3	2	-	-	-	2	2	3	1	2	1
CO5	3	1	1	3	3	-	-	-	2	3	3	3	1	3

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

The main aim of this course is to develop the understanding of programming using an object oriented language and to impart knowledge on applets to create effective GUI applications.

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

1. Demonstrate the knowledge of Object Oriented design principles in solving real world problems.
2. Write object oriented programs using classes and objects.
3. Implement the concept of reusability using interfaces and packages and handle runtime errors using exception handling.
4. Develop concurrent applications using IO packages and multithreading.
5. Design and Implement event driven applications using java applets.

UNIT 1 OBJECT ORIENTED PROGRAMMING CONCEPTS 9

Object Oriented Paradigm - Objects and classes - Data abstraction and Encapsulation - Inheritance - Polymorphism – Dynamic Binding – Message Communication-Java Evolution – Overview of Java- Constants, Variables and Data types - Operators & Expressions – Decision making: Branching and Looping.

UNIT 2 CLASSES AND OBJECTS 9

Arrays - Classes, Objects and Methods – Constructor -Method Overloading – Inheritance – Method Overriding – static –this – Garbage collection –final

UNIT 3 PACKAGES AND EXCEPTION HANDLING 9

Abstract Classes - Interfaces – Defining, Extending and Implementing Interfaces – Accessing Interface Variables. Packages – Managing Errors and Exceptions.

UNIT 4 IO PACKAGE AND MULTITHREADING 9

String- Managing Input and Output – Input Stream Classes – Output Stream Classes – Character Stream Classes-Multithreaded Programming.

UNIT 5 EVENT HANDLING AND APPLET 9

Event Handling-Delegation Event Model-Event classes-Key event class-Sources of Events-Event Listener Interfaces-Handling Mouse and Keyboard events-Adapter Classes. Applet Class- Applet Initialization and Termination- Applet display and repaint methods-Passing parameters to applet.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. E. Balagurusamy, “Programming with Java A Primer”, Tata McGrawHill, Fifth Edition, 2014.
2. Herbert Schildt, “Java the Complete Reference”, McGraw Hill Education, Ninth Edition, 2014.

REFERENCES:

1. Paul Deitel, Harvey Deitel, “Java How to Program”, Prentice Hall, Tenth Edition, 2014.
2. Cay S.Horstmann and Gary Cornell, “Core Java- Volume I Fundamentals”, Pearson Education, Ninth Edition, 2012.
3. Daniel Liang, “Introduction to Java Programming, Comprehensive Version”, Pearson Education, Ninth Edition, 2014.

e-RESOURCES:

1. <http://nptel.ac.in/courses/106106147/>, “Java Basics”, Prof. Pushpendra Singh, IIT – Madras.
2. <http://nptel.ac.in/courses/106105084/28>, “Java – Applets Part:1”, Prof. Indranil Sengupta, IIT – Kharagpur.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3	2	3	-	-	-	-	-	-	-	1	-	-
CO2	1	3	2	3	-	-	-	-	-	-	-	1	-	-
CO3	1	3	2	3	-	-	-	-	-	-	-	1	-	-
CO4	1	3	2	3	-	-	-	-	-	-	-	1	-	-
CO5	1	3	2	3	-	-	-	-	-	-	-	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

This course aims to explore the concepts of knowledge required to protect against the hacker for the information in a system, web service and wireless networks. Students are able to understand the issues relating to ethical hacking and to employ network defense measures for the information security.

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

1. Predict the vulnerabilities across any computing system using penetration testing.
2. Explain the Foot printing, scanning and Enumeration method of reconnaissance about the target systems in a network.
3. Analyze active and passive sniffing, DNS, ARP, DHCP spoofing techniques in the network systems.
4. Analyze the Metasploit, Browser and post Exploitations for hacking the information from a system.
5. Identify vulnerabilities/threats/attacks in system, wireless and web services.

UNIT 1 INTRODUCTION TO HACKING**9**

Introduction to Hacking – Penetration Test – Vulnerability Assessments versus Penetration Test – Rules of Engagement – Penetration Testing Methodologies – OSSTMM – NIST – OWASP – Categories and Types of Penetration Tests – Vulnerability Assessment Reports. Case study: Use security tools in Kali Linux to assess the vulnerabilities.

UNIT 2 INFORMATION GATHERING AND SCANNING**9**

Information Gathering Techniques – Active and Passive Information Gathering – Traceroute – ICMP Traceroute – TCP Traceroute – UDP Traceroute – Enumerating and Fingerprinting the Webservers – DNS, SNMP, SMTP Enumeration – Target Enumeration and Port Scanning Techniques. Case Study: Understand the network protocols and port scanning techniques using Kali Linux.

UNIT 3 NETWORK ATTACKS**9**

Vulnerability Data Resources – Network Sniffing – Types of Sniffing – MITM Attacks – ARP Attacks – Denial of Service Attacks – DNS Spoofing – ARP Spoofing Attack – DHCP Spoofing – Remote Exploitation – Traditional Brute Force – Attacking SMTP – Attacking SQL Servers – Testing for Weak Authentication. Case study: Demonstrating the MITM attack using ARP Poisoning using Kali Linux.

UNIT 4 EXPLOITATION**9**

Introduction to Metasploit – Reconnaissance, Port Scanning with Metasploit – E-Mails with Malicious Attachments – Browser Exploitation – Post-Exploitation – Hashing Algorithms – Windows Hashing Methods – Cracking the Hashes – Brute force Dictionary Attacks – Password Salts – Rainbow Tables – John the Ripper. Case studies: Understand the Metasploit and Exploitations.

UNIT 5 WIRELESS AND WEB HACKING**9**

Wireless Hacking – Aircrack – Cracking the WEP – Evil Twin Attack – Web Hacking – Brute Force and Dictionary Attacks – Types of Authentication – Captcha Validation Flaw – Captcha RESET Flaw – Authentication Bypass Attacks – Session Attacks – SQL Injection Attacks – XSS (Cross-Site Scripting) – CSRF – SSRF Attacks.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rafay Baloch, “Ethical Hacking and Penetration Testing Guide”, CRC Press, 2017.
2. Kevin Beaver, “Ethical Hacking for Dummies”, Sixth Edition, Wiley, 2018.

REFERENCES:

1. Jon Erickson, “Hacking: The Art of Exploitation”, Second Edition, Rogunix, 2008.
2. Georgia Weidman, “Penetration Testing: A Hands-On Introduction to Hacking”, 1st Edition, 2014.
3. Dafydd Stuttard, Marcus Pinto, “The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws”, 2nd Edition, 2011.

e-RESOURCES:

1. <https://nptel.ac.in/courses/106/105/106105217/>, “Ethical Hacking”, Prof. Indranil Sengupta, IIT Kharagpur.
2. <https://www.edureka.co/blog/ethical-hacking-tutorial/>, “Introduction to Cyber security and Ethical Hacking”.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO2	-	1	-	2	-	-	-	3	-	1	-	-	-	-
CO3	-	1	-	2	1	-	-	3	-	-	-	-	-	-
CO4	-	1	-	2	1	-	-	3	-	-	-	-	-	-
CO5	-	1	-	2	-	-	-	3	-	-	-	-	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble

This course focuses on principles of E-commerce from a business perspective, providing an overview of business and technology topics, business models, virtual value chains and social innovation and marketing strategies. In addition, some of the major issues associated with e-commerce-security, privacy, intellectual property rights, authentication, encryption, acceptable use policies, and legal liabilities will be explored. Students will build their own web presence and market it using an online platform

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

1. Examine the concepts of E-commerce and E-Business and develop B2C and B2B business models for a e-commerce website.
2. Select appropriate infrastructure to develop a mobile website and mobile applications using E-Commerce site tools.
3. Apply the technology solutions, management policies and laws for securing the E-commerce environment.
4. Analyze the impact of digital commerce marketing and advertising strategies in E-Commerce platform.
5. Explain ethical, social and political issues of E-commerce and interpret the present and future of E-Commerce industry in India.

UNIT 1 INTRODUCTION**9**

E-Commerce – Difference between E-Commerce and E-Business - Features of E-Commerce technology – types of E-commerce – Growth of the Internet, Web and Mobile platform – Understanding E-commerce: organizing themes - E-Commerce business models - major Business –to-Consumer (B2C) business models – Major Business–to-Business (B2B) business models – E-Commerce enablers – how ecommerce changes business. Case Study: Identify Key components, strategy, B2B, B2C Models of E-commerce Business model of any e-commerce website

UNIT 2 E-COMMERCE INFRASTRUCTURE**9**

The internet – internet today – future internet infrastructure – web- internet and web – mobile applications – building an E-Commerce presence – choosing software and hardware – other E-Commerce site tools – developing a mobile web site and building mobile applications.

UNIT 3 E-COMMERCE SECURITY AND PAYMENT SYSTEMS**9**

E-Commerce security environment – security threats in E-Commerce environment – technology solutions – management policies, business procedures and public laws – E-Commerce payment systems – electronic billing presentment and payment.

UNIT 4 E-COMMERCE BUSINESS CONCEPTS**9**

Consumers online – Digital commerce marketing and advertising strategies and tools – internet marketing technologies – understanding the costs and benefits of online marketing communications – social marketing – mobile marketing – local and location-based marketing.

UNIT 5 SCM, LEGAL AND ETHICAL ISSUES**9**

Understanding ethical, social and political issues in ecommerce – privacy and information rights – intellectual property rights – governance – public safety and welfare – E-commerce in action: E-tailing business models – service sector: offline and online – online publishing industry – B2B ecommerce and supply chain management. Case study: Present and Future of E- commerce Industry in India.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Kenneth C.Laudon, Carol Guercio Traver, “E-commerce business Technology society”, 10thedition, Pearson Education, 2016.
2. P.T.JosephS.J, “E-Commerce An Indian Perspective”, 5thedition, PHI Learning Pvt. Ltd., 2015.
3. Ravi Kalakota, Andrew B. Whinston, “Frontiers of Electronic Commerce”, Pearson Education, 1996.

REFERENCES:

1. Dave Chaffey, “E-Business and E-Commerce Management: Strategy, Implementation and Practice”, 5th edition, Prentice Hall, 2013.
2. IsitaLahiri, Sujit Kumar Ghosh, “Principles of Marketing and E – Commerce”, Pearson Education, 2012.
3. AdeshK.Pandey, "Introduction to E-Commerce and ERP", KatsonBooks , 2012.

e-RESOURCES:

1. <http://www.nptel.ac.in/courses/106105084/35>, “Electronic Commerce”, Prof. Indranil Sengupta, IIT-Kharagpur.
2. http://onlinevideolecture.com/?course_id=1295, “E-Commerce”, Prof.Saadat Nisar
3. <https://e-commerce2018.com/TOC.html>

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO3	-	3	-	-	-	-	2	-	-	1	-	-	-	-
CO4	-	3	-	-	-	-	2	-	-	1	-	-	-	-
CO5	-	3	-	-	-	-	2	-	-	1	-	-	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble

The main aim of this course is to introduce the students to the structure of android mobile application development frameworks. The course imparts knowledge on components, layout managers and database for designing android applications.

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

1. Identify and explain the fundamentals of object oriented programming concepts and decision making statements of java programming.
2. Explain the elements, frames, forms of HTML and XML framework.
3. Analyze architecture, features and configuration of Android operating system.
4. Identify the layouts, views, button and notifications of android user interface
5. Demonstrate the knowledge on Android Mobile Operating Systems, database and application.

UNIT 1 BASICS OF JAVA, HTML**9**

Overview of java– Constants, Variables and Data types –Operators & Expressions – Decision making: Branching and Looping – Classes, Objects and Methods – Arrays–Inheritance –Interface – Exception handling

UNIT 2 INTRODUCTION TO HTML AND XML**9**

Fundamental HTML elements– Lists – Tables – Frames – Forms– XML Introduction – Structuring data – XML namespaces – DTDs – XML Schema documents - XML vocabularies – XSL – XPath – XSLT

UNIT 3 INTRODUCTION TO ANDROID**9**

Introduction to Android Operating System: Android Ecosystem – Android versions – Android Activity – Features of Android – Android Architecture–Configuration of Android Environment: Android SDK – Android Development Tools (ADT) –Android Virtual Devices (AVDs)– Emulators – Dalvik Virtual Machine –Steps To Install and Configure Eclipse and SDK– Create the First Android Application– Directory Structure

UNIT 4 ANDROID USER INTERFACE**9**

Linear Layout –Absolute Layout –Frame Layout –Relative Layout– Table Layout –View: Text View – Button –Image Button –Edit Text –Check Box –Toggle Button –Radio Button and Radio Group –Progress Bar –Auto complete Text View –Spinner –List View –Grid View Card View–Custom Toast Alert –Date Picker.

UNIT 5 ACTIVITY, MENU AND SQLITEDATABASE**9**

Activity: Intent – Activity life cycle – Broadcast Life cycle – Service –Menus –Option Menu – Adding and Updating menu items – Handling menu items. Android Notification –SQLite Database –Creation and connection of the database –Extracting value from a Cursors – Transactions

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Herbert Schildt, “Java: The Complete Reference”, 11th Edition, McGraw Hill Education, 2019.
2. Jeffrey C. Jackson, “Web Technologies- A Computer Science Perspective”, Eleventh Impression, Pearson Education in South Asia, 2012.
3. Prasanna Kumar Dixit, “Android”, 1st Edition, Vikas Publishing House, 2014

REFERENCES:

1. B.M. Harwani, “Android Programming Unleashed”, 1st Edition, Pearson Education, 2013
2. Ronan Schwarz, Phil Dutson, James Steele, Nelson To, “The Android Developer's Cookbook: Building Applications with the Android SDK”, Second Edition, Pearson Education, 2013

e-RESOURCES:

1. <https://nptel.ac.in/courses/106106147/>, “Mobile Computing – Starting Android Programming”, Prof. Pushpendra Singh, Prof. Sridhar Iyer, IIT-Madras.
2. <https://nptel.ac.in/courses/106106156/>, “Introduction to Modern Application Development”, Prof. Gaurav Raina, Mr Tanmai Gopal, IIT-Madras

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	2	2	-	1	-	-	-	-	-	1	2	3
CO2	2	3	3	2	-	1	-	-	-	-	-	1	2	3
CO3	2	3	2	2	-	1	-	-	-	-	-	1	2	3
CO4	2	3	3	2	-	1	-	-	-	-	-	1	2	3
CO5	1	3	3	2	-	1	-	-	-	-	-	1	1	3

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble

The technology revolution has brought about the need to process, store, analyze, and comprehend large volumes of diverse data in meaningful ways. Data science is a compilation of techniques that extract value from data. The course is intended to clarify the basic concepts of data science techniques with a basic grasp of mathematics to implement these techniques.

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

1. Explain the need for data science and define its process interlinking AI and Machine Learning.
2. Identify the type of data, explore data sets used in applications and discuss visualization techniques for the data sets used in an application.
3. Discuss the process to classify the data set according to the requirement and explain the regression techniques for the given data set.
4. Explain the clustering process, identify and compare the type of clustering technique that can be used for a given dataset.
5. Describe text mining process and explain the implementation process for keyword clustering and prediction of gender of blog authors.

UNIT 1 DATA SCIENCE AND ITS PROCESS 9

AI, Machine Learning and Data Science – What is Data Science? – Case for Data Science – Data Science Classification – Data Science Algorithms – Data Science Process: Data Preparation – Modeling – Application.

UNIT 2 DATA EXPLORATION 9

Data Sets – Types of Data – Descriptive Statistics: Univariate and Multivariate Exploration – Data Visualization: Univariate – Multivariate Visualization – Visualizing High Dimensional Data.

UNIT 3 CLASSIFICATION AND REGRESSION 9

Classification: Decision Trees – k-Nearest Neighbors – Naïve Bayesian – Regression Methods: Linear Regression and Logistic Regression.

UNIT 4 CLUSTERING 9

Clustering to describe the data – Clustering for Preprocessing – Types of Clustering Techniques – k-means clustering – DBSCAN Clustering – Self Organizing Maps.

UNIT 5 TEXT MINING 9

Term Frequency – Inverse Document Frequency – Terminology – Case Studies: Keyword Clustering - Predicting the Gender of Blog Authors.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Vijay Kotu, Bala Deshpande, “Data Science Concepts and Practice”, Second Edition, Morgan Kaufmann Publishers, 2019.
2. John Paul Mueller, Luca Massaron, “Python for Data Science for Dummies”, Second Edition, Wiley, 2019.

REFERENCES:

1. V.K. Jain, “Data Science and Analytics (with Python, R and SPSS Programming)”, First Edition, Khanna Books, 2018.
2. John D. Kelleher and Brendan Tierney, “Data Science (MIT Press Essential Knowledge series)”, Illustrated Edition, The MIT Press, 2018.
3. Joel Grus, “Data Science from Scratch: First Principles with Python”, Second Edition, O'Reilly Media, 2019.

e-RESOURCES:

1. <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs28/>, “Data Science for Engineers”, Prof. RangunathanRengasamy, Prof. Shankar Narasimhan, IIT- Madras.

2. <https://nptel.ac.in/courses/106/106/106106212/>, “Python for Data Science”, Prof. RagunathanRengasamy, IIT-Madras.

Mapping of COs with POs and PSOs

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2
CO1	1	3	2	-	-	1	-	-	-	-	-	1	-	-
CO2	1	3	2	-	-	1	-	-	-	-	-	1	-	-
CO3	1	3	2	-	-	1	-	-	-	-	-	1	-	-
CO4	1	3	2	-	-	1	-	-	-	-	-	1	-	-
CO5	1	3	2	-	-	1	-	-	-	-	-	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Preamble:

This course is aimed to cover the basics of R programming working environment. It also includes concepts involved in importing data, manipulating data for specific needs, running summary statistics and data visualizations through graphs, charts and plots.

UNIT 1 R - FUNDAMENTALS 9

Overview of the R language: Defining the R project, Obtaining R, Generating R codes, Scripts, Comments, Text editors for R, Graphical User Interfaces (GUIs) for R, Packages.

UNIT 2 R - DATA STRUCTURES, CLASSES AND LISTS 9

R Objects and data structures: Variable classes, Vectors and matrices, Data frames and lists, Array and Factors.

UNIT 3 R – MANIPULATIONS 9

Manipulating objects in R: Mathematical operations, Decision making, loops, functions and Strings.

UNIT 4 R - DATA EXPLORATIONS 9

Exploratory Data Analysis: Reading, creating and storing R -CSV file, Excel File, Binary file, XML File - R -Mean, Median, Mode- Regression.

UNIT 5 R – PRESENTATIONS 9

Graphical Representation: R-PIE chart – Bar chart – Box plots-Histograms – line graphs - Scatter plots.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jared P. Lander, “R for Everyone: Advanced Analytics and Graphics”, Pearson Education, 2nd Edition, 2015.

REFERENCES:

1. Norman Matloff, “The Art of R Programming: A Tour of Statistical Software Design” No Starch Press, 2011.

e-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_ma75/preview
2. <http://www.cyclisme.org/tutorial/RI>
3. <http://www.r-tutor.com/r-introduction>

Preamble:

This course covers the fundamentals from Artificial Neural Network to the current trending topic of Convolution Neural Network. Deep Learning is one of the most exciting and promising segments of Artificial Intelligence and machine learning technologies. However, with the increased availability of vast amounts of data and computational capability, it has evolved to a field of its own. In the last few years with numerous applications in computer vision, speech analysis, healthcare, agriculture, and understanding climate change etc. Thus this course aims to provide basic knowledge about the deep learning.

UNIT 1 INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS 9

Fundamentals Of Neural Networks – Model of Artificial Neuron – Neural Network Architectures – Learning Methods – Taxonomy Of Neural Network Architectures – Applications.

UNIT 2 FEED FORWARD NEURAL NETWORKS 9

Perceptron Models: Discrete, Continuous and Multi-Category – Training Algorithms: Discrete and Continuous Perceptron Networks – Limitations of the Perceptron – Model. Credit Assignment Problem – Generalized Delta Rule, Derivation of Back propagation (BP) Training, and Summary of Back propagation Algorithm – Kolmogorov Theorem.

UNIT 3 OTHER ANN ARCHITECTURES 9

Associative Memory – Exponential BAM – Associative Memory For Real Coded Pattern Pairs – Applications Adaptive Resonance Theory – Introduction – ART 1 – ART2 – Applications – Neural Networks Based On Competition – Kohonen Self Organizing Maps – Learning Vector Quantization – Counter Propagation Networks – Industrial Applications.

UNIT 4 DEEP LEARNING 9

Deep Feed Forward network, regularizations, training deep models, dropouts, Training Deep Neural Networks using Back Propagation-Setup and initialization issues, vanishing and exploding Gradient problems, Gradient- Descent Strategies.

UNIT 5 CONVOLUTIONAL NEURAL NETWORK 9

Convolutional Neural Network, Basic structure of Convolutional Network, Case studies: Alex net, VGGNet, GoogLeNet, Applications of CNN– Object Detection, Content based image Retrieval.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Charu C. Aggarwal “Neural Networks and Deep learning” Springer International Publishing, 2018.
2. Satish Kumar, “Neural Networks, A Classroom Approach”, Tata McGraw -Hill, 2007.
3. Simon Haykin, “Neural Networks, A Comprehensive Foundation”, 2nd Edition, Addison Wesley Longman, 2001.

REFERENCES:

1. Bishop, Christopher M. Pattern Recognition and Machine Learning. Springer, 2006.
2. Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience, 2000.

e-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_cs76/preview
2. Michael Nielsen, “Neural Networks and Deep Learning”, Determination Press, 2015.
<http://neuralnetworksanddeeplearning.com/>

Preamble:

This Course aims at providing the knowledge about the organizational stress and how to cope with the use of emotional intelligence.

UNIT 1 UNDERSTANDING STRESS**9**

What is Stress, Stressors Personal causes of stress - Organizational causes of stress - The General Adaptation Syndrome - Fight or flight response

UNIT 2 SYMPTOMS OF STRESS**9**

Symptoms of stress, The three Ps - Consequences of Stress - Cultural difference causing stress, constructive versus Destructive stress - Episodic versus chronic stress.

UNIT 3 GENERAL STRESS INTERVENTIONS**9**

Types of intervention - General coping strategies - Stress problem solving Sequence - ABCDE problem solving Model.

UNIT 4 STRESS IN INDIVIDUALS**9**

Types of personalities - Transactional Analysis - Locus of Control - Work life Balance.

UNIT 5 EMOTIONAL INTELLIGENCE**9**

Definition History and the measurement of emotional Intelligence - Impact of emotional Intelligence on business environment - Emotional intelligence skills - Business Solution and emotional intelligence.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. Fielding Gray, "Stress Management: Techniques On How To Deal With Stress And Anxiety", Kindle Edition, 2014.
2. Howard E. Book and Steven J. Stein "The EQ Edge: Emotional Intelligence and Your Success", Wiley, 2011.

REFERENCES:

1. I'M ok-You're ok – Thomas Harris.M.D.
2. Stress Management & Emotional Intelligence- Daniel Goleman.
3. Ann Edworthy, Managing Stress, Open University Press, Buckingham, Phildephia.

e-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_ge18/preview
2. <https://www.classcentral.com/course/swayam-emotional-intelligence-7980>
3. <https://www.udemy.com/topic/emotional-intelligence/>

Preamble:

This course helps students to learn concept of Kotlin, also this course teaches how to develop applications for the Android operating system using Kotlin

UNIT 1 KOTLIN INTRODUCTION 8

Introduction, Overview, Environment Setup, Basic Syntax, Architecture, Variable, Datatypes, Operator, Conditional statements, Loops, Enum.

UNIT 2 ARRAYS, STRINGS AND FUNCTIONS 10

Array- Generic Array, Arrays of Primitives, Create an Array, Create an array using closure, Create an uninitialized array. String- String Equality, String Literals, Elements of string. Kotlin Application- Kotlin on server side, Kotlin on Android. Functions- Definition, Recursive Function, Default and Named Argument, Higher order function, Inline function, Vararg parameter in function, Basic Lambdas. Ranges- Integral types Ranges, downTo() function, step() function, until function.

UNIT 3 CLASSES AND OBJECTS 10

Defining Class Hierarchies- Class, Visibility Modifiers, Inner and nested classes, Inheritance. Declaring a Class with nontrivial constructor or properties: Primary Constructor and initializer blocks, Secondary constructor, initializing the superclass in different ways, implementing properties declared in interfaces. Compiler-generated methods: Universal object methods, Data Classes, Class Delegation -Declaring an instance- Object Declaration: Singleton Objects, Annotations

UNIT 4 EXCEPTION HANDLING AND NULL SAFETY 9

Exception Handling: Introduction, try catch, Multiple catch Block, Nested try-catch block, finally Block, throw keyword Null Safety: Nullable Types and Non-Nullable Types, Smart cast, Unsafe and Safe Cast Operator, Elvis Operator

UNIT 5 KOTLIN FOR ANDROID 8

Kotlin on Android, Setting up kotlin for android, Using Kotlin in Android Studio, Auto-Generated Gradle Configuration, Converting Java Code to Kotlin,

TOTAL: 45 PERIODS

TEXT BOOKS:

1. "Kotlin in Action" Dmitry Jemerov, Svetlana Isakova -Manning Publications-2017

REFERENCES:

1. "Kotlin for Android App Development" by Peter Sommerhoff.

e-RESOURCES:

1. https://onlinecourses.swayam2.ac.in/aic20_sp02/preview

Pre-requisites : -**Preamble**

The main aim of this course is to expose the concepts in maximizing the return on investment in a way that fulfils the needs of any firm while keeping the risks under control.

UNIT 1 INTRODUCTION TO FINANCIAL MANGEMENT**9**

Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of money- Risk and return concepts.

UNIT 2 SOURCES OF FINANCE**9**

Long term sources of Finance -Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc.

UNIT 3 INVESTMENT DECISIONS**9**

Investment Decisions: Capital budgeting – Need and Importance – Techniques of Capital Budgeting– Payback -ARR – NPV – IRR –Profitability Index.

Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock- Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

UNIT 4 FINANCING AND DIVIDEND DECISION**9**

Operating Leverage and Financial Leverage- EBIT-EPS analysis. Capital Structure – determinants of Capital structure- Designing an Optimum capital structure.

Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - - Determinants of Dividend Policy.

UNIT 5 WORKING CAPITAL DECISION**9**

Working Capital Management: Working Capital Management - concepts - importance -Determinants of Working capital. Cash Management: Motives for holding cash – Objectives and Strategies of Cash Management. Receivables Management: Objectives - Credit policies.

Total : 45 Periods**TEXT BOOKS:**

1. M.Y. Khan and P.K.Jain Financial management, Text, Tata McGraw Hill.
2. M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd.

REFERENCES:

1. James C. Vanhorne –Fundamentals of Financial Management– PHI Learning,
2. Prasanna Chandra, Financial Management, Theory and Practice, McGraw Hill, 10th Edition.
3. Srivatsava, Mishra, Financial Management, Oxford University Press, 2011

e-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_mg31/preview
2. <https://emeritus.org/in/learn/what-is-financial-management/>

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

- CO1 Acquire the knowledge of the decision areas in finance.
- CO2 Learn the various sources of Finance
- CO3 Describe about capital budgeting and cost of capital.
- CO4 Discuss on how to construct a robust capital structure and dividend policy
- CO5 Develop an understanding of tools on Working Capital Management.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	2	-	1	-	-	-	-	3	1	-	-
CO2	3	2	-	2	-	1	-	-	-	-	3	1	-	-
CO3	3	2	-	2	-	1	-	1	-	-	3	1	-	-
CO4	3	3	-	2	-	1	-	1	-	-	3	1	-	-
CO5	3	3	-	2	2	1	-	1	-	-	3	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : -**Preamble**

The main aim of this course is to introduce the quantitative techniques that apply to investment valuation and management.

UNIT 1 THE INVESTMENT ENVIRONMENT**9**

The investment decision process, Types of Investments – Commodities, Real Estate and Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return.

UNIT 2 FIXED INCOME SECURITIES**9**

Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating.

UNIT 3 APPROACHES TO EQUITY ANALYSIS**9**

Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.

UNIT 4 PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES**9**

Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India.

UNIT 5 INVESTOR PROTECTION**9**

Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors' awareness and activism.

Total : 45 Periods**TEXT BOOKS:**

1. Charles P. Jones, Gerald R. Jensen. Investments: analysis and management. Wiley, 14TH Edition, 2019.
2. Chandra, Prasanna. Investment analysis and portfolio management. McGraw-hill education, 5th, Edition, 2017.

REFERENCES:

1. Rustagi, R. P. Investment Management Theory and Practice. Sultan Chand & Sons, 2021.
2. ZviBodie, Alex Kane, Alan J Marcus, PitabusMohanty, Investments, McGraw Hill Education (India), 11 Edition(SIE), 2019

e-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc23_mg62/preview
2. <https://www.coursera.org/learn/investing-fundamentals>

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

- CO1 Describe the investment environment in which investment decisions are taken.
 CO2 Explain how to Value bonds and equities
 CO3 Explain the various approaches to value securities
 CO4 Describe how to create efficient portfolios through diversification
 CO5 Discuss the mechanism of investor protection in India.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	-	3	-	1	-	-	-	-	3	1	-	-
CO2	3	2	-	2	-	1	-	-	-	-	3	1	-	-
CO3	2	2	-	2	-	1	-	1	-	-	3	1	-	-
CO4	3	3	-	2	-	1	-	1	-	-	3	1	-	-
CO5	3	3	-	2	-	1	-	1	-	-	3	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites :-**Preamble**

The main aim of this course is to train the students in various aspects related to banking and its allied areas. Make to understand the objective of preparation of financial statements to the users of financial statements. It includes accounting of Banking, Insurance companies.

UNIT 1 INTRODUCTION TO INDIAN BANKING SYSTEM**9**

Overview of Banking system – Structure – Functions – Banking system in India - Key Regulations in Indian Banking sector – RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.

UNIT 2 MANAGING BANK FUNDS / PRODUCTS**9**

Liquid Assets - Investment in securities - Advances - Loans. Negotiable Instruments – Cheques, Bills of Exchange & Promissory Notes. Designing deposit schemes– Asset and Liability Management – NPA's – Current issues on NPA's – M&A's of banks into securities market.

UNIT 3 DEVELOPMENT IN BANKING TECHNOLOGY**9**

Payment system in India – paper based – e payment – electronic banking – plastic money – e-money – forecasting of cash demand at ATM's – The Information Technology Act, 2000 in India – RBI's Financial Sector Technology vision document – security threats in e-banking & RBI's Initiative.

UNIT 4 FINANCIAL SERVICES**9**

Introduction – Need for Financial Services – Financial Services Market in India – NBFC – Leasing and Hire Purchase – mutual funds. Venture Capital Financing – Bill discounting – factoring – Merchant Banking.

UNIT 5 INSURANCE**9**

Insurance – Concept - Need - History of Insurance industry in India. Insurance Act, 1938 – IRDA – Regulations – Life Insurance - Annuities and Unit Linked Policies - Lapse of the Policy – revival – settlement of claim.

Total : 45 Periods**TEXT BOOKS:**

1. Padmalatha Suresh and Justin Paul, "Management of Banking and Financial Services, Pearson, Delhi, 2017.
2. Meera Sharma, "Management of Financial Institutions – with emphasis on Bank and Risk Management", PHI Learning Pvt. Ltd., New Delhi 2010.

REFERENCES:

1. Peter S. Rose and Sylvia C. and Hudgins, "Bank Management and Financial Services", Tata McGraw Hill, New Delhi, 2017

e-RESOURCES:

1. https://onlinecourses.swayam2.ac.in/cec20_mg08/preview
2. <https://www.coursera.org/courses?query=banking>

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

- CO1 Explain the Banking system in India
- CO2 Grasp how banks raise their sources and how they deploy it
- CO3 Discuss the development in banking technology
- CO4 Utilize the financial services in India
- CO5 Know the insurance Industry in India

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	2	-	1	-	-	-	-	3	1	-	-
CO2	3	2	-	2	-	1	-	-	-	-	3	1	-	-
CO3	3	2	-	2	-	1	-	1	-	-	3	1	-	-
CO4	3	3	-	2	-	1	-	1	-	-	3	1	-	-
CO5	3	3	-	2	-	1	-	1	-	-	3	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : -

Preamble

Blockchain is a self-sustaining, peer to peer distributed database ledger technology for managing and recording transactions with no central regulatory and ownership involvement. It is like an online bank ledger, open to both parties in a transaction. Blockchain gained increasing importance because of its relevance in facilitating a single shared version of the truth for any digital asset.

UNIT 1 INTRODUCTION TO BLOCKCHAIN 9

Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, Consensus: Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. Decentralization: Decentralization using blockchain - Methods of decentralization - Routes to decentralization- Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations- Platforms for decentralization.

UNIT 2 INTRODUCTION TO CRYPTOCURRENCY 9

Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin– Zcash – Smart Contracts – Ricardian Contracts- Deploying smart contracts on a blockchain.

UNIT 3 ETHEREUM 9

Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM),Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network.

UNIT 4 WEB3 AND HYPERLEDGE 9

Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.

UNIT 5 EMERGING TRENDS 9

Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.

Total : 45 Periods

TEXT BOOKS:

1. Imran. Bashir. Mastering block chain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained. Packt Publishing, 2nd Edition, 2018
2. Peter Borovykh , Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018.
3. ArshdeepBahga, Vijay Madisetti, “Blockchain Applications: A Hands On Approach”, VPT, 2017.

REFERENCES:

1. Andreas M. Antonopoulos ,” Mastering Bitcoin – Programming the Open Blockchain”, O’Reilly Publication,2017
2. William Mougayar, “The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology”, Wiley Edition, 2016

e-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_cs44/preview
2. https://onlinecourses.nptel.ac.in/noc20_cs01/preview

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

- CO1 Identify and explain the key benefits of block chain for a business or a network environment.
- CO2 Articulate the core components of Bitcoin Network with the necessary scriptlets and Design a Bitcoin Wallet.
- CO3 Describe Ethereum Eco system, Ethereum Virtual Machine and Encoding schemes and Develop a private network for a given business model.
- CO4 Explain the WEB3 and Hyperledge
- CO5 Investigate the given business model and critique the strengths and flaws of block chain implementation.

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO3	3	2	-	2	-	1	-	1	-	-	3	1	-	-
CO4	3	3	-	2	-	1	-	1	-	-	3	1	-	-
CO5	3	3	-	2	2	1	-	1	-	-	3	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : -**Preamble**

The main aim of this course is to introduce the fundamental building blocks of financial technologies and explore the disruptive force of changing payment methods, analyze the changing regulatory landscape, and gain a deeper understanding of Crypto currency, Bitcoin, InsurTech, crowdfunding, peer-to-peer lending.

UNIT 1 CURRENCY EXCHANGE AND PAYMENT**9**

Understand the concept of Crypto currency- Bitcoin and Applications -Cryptocurrencies and Digital Crypto Wallets -Types of Cryptocurrencies - Cryptocurrencies and Applications, block chain, Artificial Intelligence, machine learning. Fintech users, Individual Payments, RTGS Systems, Immediate Page 54 of 90 Payment Service (IMPS), Unified Payments Interface (UPI). Legal and Regulatory Implications of Crypto currencies, Payment systems and their regulations. Digital Payments Smart Cards, Stored-Value Cards, EC Micropayments, Payment Gateways, Mobile Payments, Digital and Virtual Currencies, Security, Ethical, Legal, Privacy, and Technology Issues.

UNIT 2 DIGITAL FINANCE AND ALTERNATIVE FINANCE**9**

A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity and Equity,. Introduction to the concept of Initial Coin Offering.

UNIT 3 INSURETECH**9**

InsurTech Introduction, Business model disruption AI/ML in InsurTech • IoT and InsurTech ,Risk Modeling ,Fraud Detection Processing claims and Underwriting Innovations in Insurance Services.

UNIT 4 PEER TO PEER LENDING**9**

P2P and Marketplace Lending, New Models and New Products in market place lending P2P Infrastructure and technologies , Concept of Crowdfunding, Crowdfunding Architecture and Technology, P2P and Crowdfunding unicorns and business models , SME/MSME Lending: Unique opportunities and Challenges, Solutions and Innovations.

UNIT 5 REGULATORY ISSUES**9**

FinTech Regulations: Global Regulations and Domestic Regulations, Evolution of RegTech, RegTech Ecosystem: Financial Institutions, RegTech Ecosystem: Startups RegTech, Startups: Challenges, RegTech Ecosystem: Regulators, Use of AI in regulation and Fraud detection.

Total : 45 Periods**TEXT BOOKS:**

1. Swanson Seth, Fintech for Beginners: Understanding and Utilizing the power of technology, Createspace Independent Publishing Platform, 2016.
2. Models AuTanda, Fintech Bigtech And Banks Digitalization and Its Impact On Banking Business, Springer, 2019

REFERENCES:

1. Henning Diedrich, Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations, Wildfire Publishing, 2016
2. Jacob William, FinTech: The Beginner's Guide to Financial Technology, Createspace Independent Publishing Platform, 2016
3. IIBF, Digital Banking, Taxmann Publication, 2016
4. Jacob William, Financial Technology, Create space Independent Pub, 2016
5. Luke Sutton, Financial Technology: Bitcoin & Blockchain, Createspace Independent Pub, 2016

e-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_mg20/preview
2. <https://www.coursera.org/specializations/wharton-fintech>

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

- CO1 Explain the currency exchange and payment
- CO2 Identify the digital finance and alternative finance
- CO3 Describe the InsurTech
- CO4 Identify the Peer to Peer lending
- CO5 Discuss the FinTech -regulatory issues

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	2	-	1	-	-	-	-	3	1	-	-
CO2	3	2	-	2	-	1	-	-	-	-	3	1	-	-
CO3	3	2	-	2	-	1	-	1	-	-	3	1	-	-
CO4	3	3	-	2	-	1	-	1	-	-	3	1	-	-
CO5	3	3	-	2	-	1	-	1	-	-	3	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

Pre-requisites : -**Preamble**

The main aim of this course is to set the stage for understanding the FinTech landscape and ecosystem and grappling with the potential direction of future change. Business and regulatory implications of technology for the financial industry and How new technology impacts economies, markets, companies and individuals

UNIT 1 INTRODUCTION**9**

Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT 2 PAYMENT INDUSTRY**9**

FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT 3 INSURANCE INDUSTRY**9**

FinTech in Wealth Management Industry-Financial Advice, Automated investing, Socially responsible investing, Fractional Investing, Social Investing. FinTech in Insurance Industry- P2P insurance, On-Demand Insurance, On-Demand Consultation, Customer engagement through Quote to sell, policy servicing, Claims Management, Investment linked health insurance.

UNIT 4 FINTECH AROUND THE GLOBE**9**

FinTech developments - US, Europe and UK, Germany, Sweden, France, China, India, Africa, Australia, New Zealand, Brazil and Middle East, Regulatory and Policy Assessment for Growth of FinTech. FinTech as disruptors, Financial institutions collaborating with FinTech companies, The new financial world.

UNIT 5 FUTURE OF FINTECH**9**

How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

Total : 45 Periods**TEXT BOOKS:**

1. Arner D., Barbers J., Buckley R, The evolution of FinTech: a new post crisis paradigm, University of New South Wales Research Series, 2015
2. Susanne Chishti, Janos Barberis, The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, Wiley Publications, 2016

REFERENCES:

1. Richard Hayen, FinTech: The Impact and Influence of Financial Technology on Banking and the Finance Industry, 2016
2. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018
3. Sanjay Phadke, Fintech Future : The Digital DNA of Finance Paperback .Sage Publications, 2020
4. Pranay Gupta, T. Mandy Tham, Fintech: The New DNA of Financial Services Paperback, 2018

e-RESOURCES:

1. <https://www.edx.org/course/introduction-to-fintech>
2. <https://nptel.ac.in/courses/110105121>

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

- CO1 Learn about history, importance and evolution of Fintech
- CO2 Acquire the knowledge of Fintech in payment industry
- CO3 Acquire the knowledge of Fintech in insurance industry
- CO4 Learn the Fintech developments around the world
- CO5 Know about the future of Fintech

Mapping of COs with POs and PSOs

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	2	-	1	-	-	-	-	3	1	-	-
CO2	2	2	-	2	-	1	-	-	-	-	3	1	-	-
CO3	3	2	-	2	-	1	-	1	-	-	3	1	-	-
CO4	3	3	-	2	-	1	-	1	-	-	3	1	-	-
CO5	3	3	-	2	2	1	-	1	-	-	3	1	-	-

1 - Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High).

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

1. Learn the basics of Entrepreneurship
2. Understand the business ownership patterns and environment
3. Understand the Job opportunities in Industries relating to Technopreneurship
4. Learn about applications of technopreneurship and successful technopreneurs
5. Acquaint with the recent and emerging trends in entrepreneurship

UNIT 1 INTRODUCTION TO ENTREPRENEURSHIP 9

Entrepreneurship- Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entrepreneurship to Economic Development.

UNIT 2 BUSINESS OWNERSHIP & ENVIRONMENT 9

Types of Business Ownership – Business Environmental Factors – Political-Economic-Sociological-Technological-Environmental-Legal aspects – Human Resources Mobilisation-Basics of Managing Finance-Essentials of Marketing Management - Production and Operations Planning – Systems Management and Administration

UNIT 3 FUNDAMENTALS OF TECHNOPRENEURSHIP 9

Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities in Technopreneurship - Recent trends

UNIT 4 APPLICATIONS OF TECHNOPRENEURSHIP 9

Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship – Success Stories of Technopreneurs - Case Studies

UNIT 5 EMERGING TRENDS IN ENTREPRENEURSHIP 9

Effective Business Management Strategies For Franchising - Sub-Contracting- Leasing- Technopreneurs – Agripreneurs - Netpreneurs- Portfolio entrepreneurship - NGO Entrepreneurship – Recent Entrepreneurial Developments - Local – National – Global perspectives

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S.S.Khanka, “Entrepreneurial Development” S.Chand & Co. Ltd. Ram Nagar New Delhi, 2021.
2. Donal F Kuratko Entrepreneurship (11th Edition) Theory, Process, Practice by Published 2019 by Cengage Learning

REFERENCES:

1. Daniel Mankani. 2003. Technopreneurship: The successful Entrepreneur in the new Economy. Prentice Hall
2. Edward Elgar. 2007. Entrepreneurship, Cooperation and the Firm: The Emergence and Survival of High- Technology Ventures in Europe. Edi: Jan Ulijn, Dominique Drillon, and Frank Lasch. Wiley Pub.
3. Lang, J. 2002, The High Tech Entrepreneur's Handbook, Ft.com
4. David Sheff 2002, China Dawn: The Story of a Technology and Business Revolution,
5. HarperBusiness, <https://fanny.staff.uns.ac.id/files/2013/12/Technopreneur-BASED-EDUCATION-REVOLUTION.pdf>
6. JumpStart: A Technopreneurship Fable, Dennis Posadas, (Singapore: Pearson Prentice Hall, 2009)

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

1. Learn the basics of managing teams for business.
2. Understand developing effective teams for business management.
3. Understand the fundamentals of leadership for running a business.
4. Learn about the importance of leadership for business development
5. Acquaint with emerging trends in leadership effectiveness for entrepreneurs.

UNIT 1 INTRODUCTION TO MANAGING TEAMS

9

Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development - Enhancing teamwork within a group - Team Coaching - Team Decision Making - Virtual Teams - Self Directed Work Teams (SDWTs) -Multicultural Teams.

UNIT 2 MANAGING AND DEVELOPING EFFECTIVE TEAMS

9

Team-based Organisations- Leadership roles in team-based organisations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building - Building High-Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team Building at the Top - Leadership in Teamwork Effectiveness

UNIT 3 INTRODUCTION TO LEADERSHIP

9

Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation - Leadership Attributes - Personality Traits and Leadership- Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment

UNIT 4 LEADERSHIP IN ORGANISATIONS

9

Leadership Styles – LMX Theory- Leadership Theory and Normative Decision Model - Situational Leadership Model - Contingency Model and Path Goal Theory – Transactional and Transformational Leadership - Charismatic Leadership - Role of Ethics and Values in Organisational Leadership.

UNIT 5 LEADERSHIP EFFECTIVENESS

9

Leadership Behaviour - Assessment of Leadership Behaviors - Destructive Leadership - Motivation and Leadership - Managerial Incompetence and Derailment Conflict Management - Negotiation and Leadership - Culture and Leadership - Global Leadership – Recent Trends in Leadership.

TOTAL: 45 PERIODS

REFERENCES:

1. Hughes, R.L., Ginnett, R.C., & Curphy, G.J., Leadership: Enhancing the lessons of experience, 9th Ed, McGraw Hill Education, Chennai, India. (2019).
2. Katzenback, J.R., Smith, D.K., The Wisdom of Teams: Creating the High Performance Organisations, Harvard Business Review Press, (2015).
3. Haldar, U.K., Leadership and Team Building, Oxford University Press, (2010).
4. Daft, R.L., The Leadership Experience, Cengage, (2015).
5. Daniel Levi, Group Dynamics for Teams ,4th Ed, (2014), Sage Publications.
6. Dyer, W. G., Dyer, W. G., Jr., & Dyer, J. H. Team building: Proven strategies for improving team performance, 5th ed, Jossey-Bass, (2013).

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

1. Learn the basics of creativity for developing Entrepreneurship
2. Understand the importance of creative intelligence for business growth
3. Understand the advances through Innovation in Industries
4. Learn about applications of innovation in building successful ventures
5. Acquaint with developing innovative business models to run the business efficiently and effectively

UNIT 1 CREATIVITY

9

Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Quality of Creativity-Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology- - Creative Personality and Motivation

UNIT 2 CREATIVE INTELLIGENCE

9

Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training-- Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.

UNIT 3 INNOVATION

9

Innovation: Definition- Levels of Innovation- Incremental Vs Radical Innovation-Product Innovation and Process- Technological, Organizational Innovation – Indicators- Characteristics of Innovation in Different Sectors. Theories in Innovation and Creativity- Design Thinking and Innovation- Innovation as Collective Change-Innovation as a system

UNIT 4 INNOVATION AND ENTREPRENEURSHIP

9

Innovation and Entrepreneurship: Entrepreneurial Mindset , Motivations and Behaviours- Opportunity Analysis and Decision Making- Industry Understanding - Entrepreneurial Opportunities- Entrepreneurial Strategies – Technology Pull/Market Push – Product -Market fit

UNIT 5 INNOVATIVE BUSINESS MODELS

9

Innovative Business Models: Customer Discovery-Customer Segments-Prospect Theory and Developing Value Propositions- Developing Business Models: Elements of Business Models – Innovative Business Models: Elements, Designing Innovative Business Models- Responsible Innovation and Creativity

TOTAL: 45 PERIODS

REFERENCES:

1. Creativity and Innovation in Entrepreneurship, Kankha, Sultan Chand
2. Pradip N Khandwalla, Lifelong Creativity, An Unending Quest, Tata Mc Graw Hill, 2004.
3. Paul Trott, Innovation Management and New Product Development, 4e, Pearson, 2018
4. Vinnie Jauhari, Sudanshu Bhushan, Innovation Management, Oxford Higher Education, 2014
5. Innovation Management, C.S.G. Krishnamacharyulu, R. Lalitha, Himalaya Publishing House, 2010.
6. Dale Timpe, Creativity, Jaico Publishing House, 2003.
7. Brian Clegg, Paul Birch, Creativity, Kogan Page, 2009.
8. Strategic Innovation: Building and Sustaining Innovative Organizations- Course Era, Raj Echambadi.

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

1. the awareness of marketing management process
2. Understand the marketing environment
3. Acquaint about product and pricing strategies
4. Knowledge of promotion and distribution in marketing management.
5. Comprehend the contemporary marketing scenarios and offer solutions to marketing issues

UNIT 1 INTRODUCTION TO MARKETING MANAGEMENT

9

Introduction - Market and Marketing – Concepts- Functions of Marketing - Importance of Marketing - Marketing Orientations - Marketing Mix-The Traditional 4Ps - The Modern Components of the Mix - The Additional 3Ps - Developing an Effective Marketing Mix.

UNIT 2 MARKETING ENVIRONMENT

9

Introduction - Environmental Scanning - Analysing the Organisation's, Micro Environment and Macro Environment - Differences between Micro and Macro Environment – Techniques of Environment Scanning - Marketing organization - Marketing Research and the Marketing Information System, Types and Components

UNIT 3 PRODUCT AND PRICING MANAGEMENT

9

Product- Meaning, Classification, Levels of Products – Product Life Cycle (PLC) - Product Strategies - Product Mix - Packaging and Labelling - New Product Development - Brand and Branding - Advantages and disadvantages of branding Pricing - Factors Affecting Price Decisions - Cost Based Pricing - Value Based and Competition Based Pricing - Pricing Strategies - National and Global Pricing.

UNIT 4 PROMOTION AND DISTRIBUTION MANAGEMENT

9

Introduction to Promotion – Marketing Channels- Integrated Marketing Communications (IMC) - Introduction to Advertising and Sales Promotion – Basics of Public Relations and Publicity - Personal Selling - Process - Direct Marketing - Segmentation, Targeting and Positioning (STP)-Logistics Management- Introduction to Retailing and Wholesaling

UNIT 5 CONTEMPORARY ISSUES IN MARKETING MANAGEMENT

9

Introduction - Relationship Marketing Vs. Relationship Management - Customer Relationship Management (CRM) - Forms of Relationship Management - CRM practices - Managing Customer Loyalty and Development – Buyer-Seller Relationships- Buying Situations in Industrial / Business Market - Buying Roles in Industrial Marketing - Factors that Influence Business - Services Marketing - E-Marketing or Online Marketing

TOTAL: 45 PERIODS

REFERENCES:

1. Marketing Management, Sherlekar S.A, Himalaya Publishing House, 2016.
2. Marketing Management, Philip Kotler and Kevin Lane Keller, PHI 15th Ed, 2015
3. Marketing Management- An Indian perspective, Vijay Prakash Anand, Biztantra, Second edition, 2016.
4. Marketing Management Global Perspective, Indian Context, V.S.Ramaswamy & S.Namakumari, Macmillan Publishers India, 5th edition, 2015
5. Marketing Management, S.H.H. Kazmi, 2013, Excel Books India
6. Marketing Management- text and Cases, Dr. C.B.Gupta & Dr. N.Rajan Nair, 17th edition, 2016.

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

1. To understand the Evolution of HRM and Challenges faced by HR Managers
2. To learn about the HR Planning Methods and practices
3. To acquaint about the Recruitment and Selection Techniques followed in Industries
4. To know about the methods of Training and Employee Development.
5. To comprehend the techniques of controlling human resources in organisations

UNIT 1 INTRODUCTION TO HRM

9

Concept, Definition, Objectives- Nature and Scope of HRM - Evolution of HRM - HR Manager Roles- Skills - Personnel Management Vs. HRM - Human Resource Policies - HR Accounting - HR Audit - Challenges in HRM

UNIT 2 HUMAN RESOURCE PLANNING

9

HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends

UNIT 3 RECRUITMENT AND SELECTION

9

Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources -eRecruitment - Selection Process- Selection techniques -eSelection- Interview Types- Employee Engagement.

UNIT 4 TRAINING AND EMPLOYEE DEVELOPMENT

9

Types of Training - On-The-Job, Off-The-Job - Training Needs Analysis – Induction and Socialisation Process - Employee Compensation - Wages and Salary Administration – Health and Social Security Measures- Green HRM Practices

UNIT 5 CONTROLLING HUMAN RESOURCES

9

Performance Appraisal – Types - Methods - Collective Bargaining - Grievances Redressal Methods – Employee Discipline – Promotion – Demotion - Transfer – Dismissal - Retrenchment - Union Management Relationship - Recent Trends

TOTAL: 45 PERIODS

REFERENCES:

1. Gary Dessler and Biju Varkkey, Human Resource Management, 14e , Pearson, 2015.
2. Mathis and Jackson, Human Resource Management, Cengage Learning 15e, 2017.
3. David A. Decenzo, Stephen.P.Robbins, and Susan L. Verhulst, Human Resource Management, Wiley, International Student Edition, 11th Edition, 2014
4. R. Wayne Mondy, Human Resource Management, Pearson , 2015.
5. Luis R.Gomez-Mejia, David B.Balkin, Robert L Cardy. Managing Human Resource. PHI Learning. 2012
6. John M. Ivancevich, Human Resource Management,12e, McGraw Hill Irwin,2013.
7. K. Aswathappa, Sathna Dash , Human Resource Management - Text and Cases , 9th Edition, McGraw Hill, 2021.
8. Uday Kumar Haldar, Juthika Sarkar. Human Resource management. Oxford. 2012

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

1. Learn the basics of starting a new business venture
2. Understand the basics of venture financing.
3. Understand the sources of debt financing.
4. Understand the sources of equity financing.
5. Acquaint with the methods of fund raising for new business ventures.

UNIT 1 ESSENTIALS OF NEW BUSINESS VENTURE

9

Setting up new Business Ventures – Need - Scope - Franchising - Location Strategy, Registration Process - State Directorate of Industries- Financing for New Ventures - Central and State Government Agencies - Types of loans – Financial Institutions - SFC, IDBI, NSIC and SIDCO.

UNIT 2 INTRODUCTION TO VENTURE FINANCING

9

Venture Finance – Definition – Historic Background - Funding New Ventures- Need – Scope – Types - Cost of Project - Means of Financing - Estimation of Working Capital - Requirement of funds – Mix of Debt and Equity - Challenges and Opportunities.

UNIT 3 SOURCES OF DEBT FINANCING

9

Fund for Capital Assets - Term Loans - Leasing and Hire-Purchase - Money Market instruments – Bonds, Corporate Papers – Preference Capital- Working Capital Management- Fund based Credit Facilities - Cash Credit - Over Draft.

UNIT 4 SOURCES OF EQUITY FINANCING

9

Own Capital, Unsecured Loan - Government Subsidies , Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital.

UNIT 5 METHODS OF FUND RAISING FOR NEW VENTURES

9

Investor Decision Process - Identifying the appropriate investors- Targeting investors- Developing Relationships with investors - Investor Selection Criteria- Company Creation- Raising Funds - Seed Funding- VC Selection Criteria – Process- Methods- Recent Trends

TOTAL: 45 PERIODS

REFERENCES:

1. Principles of Corporate Finance by Brealey and Myers et al., 12TH ed, McGraw Hill Education (India) Private Limited, 2018
2. Prasanna Chandra, Projects : Planning ,Analysis,Selection ,Financing,Implementation and Review, McGraw Hill Education India Pvt Ltd ,New Delhi , 2019.
3. Introduction to Project Finance. Andrew Fight, Butterworth-Heinemann, 2006.

UNIT 1**9**

Meaning, Nature and Scope of Public Administration - Importance of Public Administration - Evolution of Public Administration

UNIT 2**9**

New Public Administration - New Public Management - Public and Private Administration

UNIT 3**9**

Relationships with Political Science, History and Sociology - Classical Approach - Scientific Management Approach

UNIT 4**9**

Bureaucratic Approach: Max Weber - Human Relations Approach : Elton Mayo - Ecological Approach : Riggs

UNIT 5**9**

Leadership: Leadership - Styles - Approaches - Communication: Communication Types - Process - Barriers - Decision Making: Decision Making - Types, Techniques and Processes.

TOTAL : 45 PERIODS**REFERENCES:**

1. Avasthi and Maheswari: Public Administration in India, Agra:LakshmiNarain Agarwal,2013
2. Ramesh K Arora: Indian Public Administration, New Delhi: WishwaPrakashan, 2012.
3. R.B. Jain: Public Administration in India,21st Century Challenges for Good Governance, New Delhi: Deep and Deep, 2002.
4. RumkiBasu: Public Administration:Concept and Theories, New Delhi:Sterling, 2013.
5. R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.

UNIT 1	9
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Constitutional Development Since 1909 to 1947 - Making of the Constitution - Constituent Assembly

UNIT 2	9
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Fundamental Rights - Fundamental Duties - Directive Principles of State Policy

UNIT 3	9
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President – Parliament - Supreme Court

UNIT 4	9
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Governor - State Legislature - High Court

UNIT 5	9
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Secularism - Social Justice - Minority Safeguards

TOTAL : 45 PERIODS

REFERENCES:

1. Basu. D.D.: Introduction to Indian Constitution; Prentice Hall; New Delhi.
2. Kapur. A.C: Indian Government and Political System; S.Chand and Company Ltd., New Delhi.
3. Kapur. A.C: Indian Government and Political System; S.Chand and Company Ltd., New Delhi.
4. Agarwal R.C: Indian Political System; S.Chand& Co., New Delhi

UNIT 1**9**

Meaning - Scope and Importance of Personnel Administration - Types of Personnel Systems: Bureaucratic - Democratic and Representative systems.

UNIT 2**9**

Generalist Vs. Specialist - Civil Servants' Relationship with Political Executive - Integrity in Administration.

UNIT 3**9**

Recruitment: Direct Recruitment and Recruitment from Within - Training: Kinds of Training - Promotion

UNIT 4**9**

All India Services - Service Conditions - State Public Service Commission

UNIT 5**9**

Employer Employee Relations - Wage and Salary Administration - Allowances and Benefits

TOTAL : 45 PERIODS**REFERENCES:**

1. Stahl Glean O: Public Personnel Administration
2. ParnandikarPai V.A: Personnel System for Development Administration.
3. Bhambhiru . P: Bureaucracy and Policy in India.
4. Dwivedi O.P and Jain R.B: India's Administrative state.
5. Muttalis M.A: Union Public Service Commission.
6. BhakaraRao .V: Employer Employee Relations in India.
7. Davar R.S. Personnel Management & Industrial Relations

UNIT 1**9**

Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration

UNIT 2**9**

Theories of Organization: Scientific Management Theory, Classical Model, Human Relations Theory

UNIT 3**9**

Organization goals and Behavior, Groups in organization and group dynamics, Organizational Design.

UNIT 4**9**

Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making

UNIT 5**9**

Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard . Peter Drucker

TOTAL : 45 PERIODS**REFERENCES:**

1. Crozier M : The Bureaucratic phenomenon (Chand)
2. Blau. P.M and Scott. W : Formal Organizations (RKP)
3. Presthus. R : The Organizational Society (MAC)
4. Alvi, Shum Sun Nisa : Eminent Administrative Thinkers.
5. Keith Davis : Organization Theory (MAC)

UNIT 1**9**

Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India

UNIT 2**9**

Role & Functions of the District Collector, Relationship between the District Collector and Superintendent of Police, Role of Block Development Officer in development programmes, Local Government

UNIT 3**9**

Main Features of 73rd Constitutional Amendment Act 1992, Salient Features of 74th Constitutional Amendment Act 1992

UNIT 4**9**

Coalition politics in India, Integrity and Vigilance in Indian Administration

UNIT 5**9**

Corruption – Ombudsman, Lok Pal & LokAyuktha

TOTAL : 45 PERIODS**REFERENCES:**

1. S.R. Maheswari : Indian Administration
2. Khera. S.S : Administration in India
3. Ramesh K. Arora : Indian Public Administration
4. T.N. Chaturvedi : State administration in India
5. Basu, D.D : Introduction to the Constitution of India

UNIT 1**9**

Meaning and Definition of Public Policy - Nature, Scope and Importance of public policy – Public policy relationship with social sciences especially with political science and Public Administration

UNIT 2**9**

Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System's Approach – Dror's Optimal Model

UNIT 3**9**

Major stages involved in Policy making Process – Policy Formulation – Policy Implementation – Policy Evaluation.

UNIT 4**9**

Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties

UNIT 5**9**

Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy.

TOTAL : 45 PERIODS**REFERENCES:**

1. Rajesh Chakrabarti & Kaushik Sanyal : Public Policy in India, Oxford University Press, 2016.
2. Kuldeep Mathur : Public Policy and Politics in India, Oxford University Press, 2016.
3. Bidyut Chakrabarty: Public Policy: Concept, Theory and Practice, 2015.
4. Pradeep Saxena : Public Policy Administration and Development
5. Sapru R.K.: Public Policy: Formulation, Implementation and Evaluation, Sterling Publishers, 2016.

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

- CO1 Facilitate objective solutions in business decision making.
- CO2 Understand and solve business problems
- CO3 Apply statistical techniques to data sets, and correctly interpret the results.
- CO4 Develop skill-set that is in demand in both the research and business environments
- CO5 Enable the students to apply the statistical techniques in a work setting.

UNIT 1 INTRODUCTION

9

Basic definitions and rules for probability, Baye's theorem and random variables, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.

UNIT 2 SAMPLING DISTRIBUTION AND ESTIMATION

9

Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and Interval estimates of population parameters.

UNIT 3 TESTING OF HYPOTHESIS - PARAMETRIC TESTS

9

Hypothesis testing: one sample and two sample tests for means of large samples (z-test), one sample and two sample tests for means of small samples (t-test), ANOVA one way.

UNIT 4 TESTING OF HYPOTHESIS - PARAMETRIC TESTS

9

Chi-square tests for independence of attributes and goodness of fit, Kolmogorov-Smirnov – test for goodness of fit, Mann – Whitney U test and Kruskal Wallis test.

UNIT 5 CORRELATION AND REGRESSION

9

Correlation – Rank Correlation – Regression – Estimation of Regression line – Method of Least Squares – Standard Error of estimate.

Total : 45 Periods

TEXT BOOKS:

1. Richard I. Levin, David S. Rubin, Masood H. Siddiqui, Sanjay Rastogi, Statistics for Management, Pearson Education, 8th Edition, 2017.
2. Prem. S. Mann, Introductory Statistics, Wiley Publications, 9th Edition, 2015.

REFERENCES:

3. T N Srivastava and Shailaja Rego, Statistics for Management, Tata McGraw Hill, 3rd Edition 2017.
4. Ken Black, Applied Business Statistics, 7th Edition, Wiley India Edition, 2012.
5. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Jeffrey D. Camm, James J. Cochran, Statistics for business and economics, 13th edition, Thomson (South – Western) Asia, Singapore, 2016.
6. N. D. Vohra, Business Statistics, Tata McGraw Hill, 2017

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

CO1 Learn to apply various data mining techniques into various areas of different domains.

CO2 Be able to interact competently on the topic of data mining for business intelligence.

CO3 Apply various prediction techniques.

CO4 Learn about supervised and unsupervised learning technique

CO5 Develop and implement machine learning and Artificial algorithms

UNIT 1 INTRODUCTION

9

Data mining, Text mining, Web mining, Data ware house

UNIT 2 DATA MINING PROCESS

9

Data mining process – KDD, CRISP-DM, SEMMA Prediction performance measures

UNIT 3 PREDICTION TECHNIQUES

9

Data visualization, Time series – ARIMA, Winter Holts,

UNIT 4 CLASSIFICATION AND CLUSTERING TECHNIQUES

9

Classification, Association, Clustering.

UNIT 5 MACHINE LEARNING AND AI

9

Genetic algorithms, Neural network, Fuzzy logic, Ant Colony optimization, Particle Swarm optimization

Total : 45 Periods

TEXT BOOKS:

1. Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.

REFERENCES:

3. W.H.Inmon, Building the Data Warehouse, fourth edition Wiley India pvt. Ltd. 2005.
4. Ralph Kimball and Richard Merz, The data warehouse toolkit, John Wiley, 3rd edition, 2013.
5. Michel Berry and Gordon Linoff, Mastering Data mining, John Wiley and Sons Inc, 2nd Edition, 2011
6. Michel Berry and Gordon Linoff, Data mining techniques for Marketing, Sales and Customer support, John Wiley, 2011.

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

- CO1 Conversant about HR metrics and ready to apply at work settings.
- CO2 Resolve HR issues using people analytics in Recruitment
- CO3 Analyze HR analytics in Training and Development
- CO4 Analyze HR Analytics in Employee Engagement And Career Progression
- CO5 Analyze HR Analytics in Workforce Diversity And Development

UNIT 1 INTRODUCTION TO HR ANALYTICS

9

People Analytics - stages of maturity - Human Capital in the Value Chain : impact on business – HR metrics and KPIs.

UNIT 2 HR ANALYTICS I - RECRUITMENT

9

Recruitment Metrics : Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio- Quality of hire.

UNIT 3 HR ANALYTICS II - TRAINING AND DEVELOPMENT

9

Training & Development Metrics : Percentage of employees trained- Internally and externally trained - Training hours and cost per employee - ROI.

UNIT 4 HR ANALYTICS III - EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION

9

Employee Engagement Metrics :Talent Retention index - Voluntary and involuntary turnover- grades, performance, and service tenure - Internal hired index Career Progression Metrics: Promotion index - Rotation index - Career path index.

UNIT 5 HR ANALYTICS IV- WORKFORCE DIVERSITY AND DEVELOPMENT

9

Workforce Diversity and Development Metrics : Employees per manager – Workforce age profiling - Workforce service profiling - Churnover index - Workforce diversity index - Gender mix

Total : 45 Periods

TEXT BOOKS:

1. JacFitzenz , The New HR Analytics, AMACOM , 2010.
2. Edwards M. R., & Edwards K, Predictive HR Analytics: Mastering the HR Metric.London: Kogan Page.2016.

REFERENCES:

3. Human Resources kit for Dummies – 3 rd edition – Max Messmer, 2003
4. Dipak Kumar Bhattacharyya, HR Analytics ,Understanding Theories and Applications, SAGE Publications India ,2017.
5. Sesil, J. C. , Applying advanced analytics to HR management decisions: Methods fo selection, developing incentives, and improving collaboration. Upper Saddle River,New Jersey: Pearson Education,2014.
6. Pease, G., & Beresford, B, Developing Human Capital: Using Analytics to Plan and Optimize Your Learning and Development Investments. Wiley ,2014

21CSM44	DIGITAL MARKETING AND SOCIAL NETWORK ANALYTICS	L	T	P	C
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Course Outcomes: Upon completion of this course, students will be able to

- CO1 Analyze the Marketing Budget and performance.
- CO2 Create a community building in social media.
- CO3 Use the techniques in Social Media Policies And Measurements
- CO4 Analyze the web analytics in data collection.
- CO5 Apply the search analytics in various data visualization.

UNIT 1 MARKETING ANALYTICS 9

Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis

UNIT 2 COMMUNITY BUILDING AND MANAGEMENT 9

History and Evolution of Social Media-Understanding Science of Social Media –Goals for using Social Media- Social Media Audience and Influencers - Digital PR- Promoting Social Media Pages- Linking Social Media Accounts-The Viral Impact of Social Media.

UNIT 3 SOCIAL MEDIA POLICIES AND MEASUREMENTS 9

Social Media Policies-Etiquette, Privacy- ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.

UNIT 4 WEB ANALYTICS 9

Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.

UNIT 5 SEARCH ANALYTICS 9

Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization

Total : 45 Periods

TEXT BOOKS:

1. K. M. Shrivastava, Social Media in Business and Governance, Sterling Publishers Private Limited, 2013
2. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014

REFERENCES:

3. Bittu Kumar, Social Networking, V & S Publishers, 2013
4. Avinash Kaushik, Web Analytics - An Hour a Day, Wiley Publishing, 2007
5. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media and CafePress 2004
6. Takeshi Moriguchi, Web Analytics Consultant Official Textbook, 7th Edition, 2016

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

- CO1 Enable quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.
- CO2 Apply Warehousing Decisions in data collections
- CO3 Apply the various strategies in Inventory Management.
- CO4 Explain various Transportation Network Models
- CO5 Explain various MCDM Models

UNIT 1 INTRODUCTION

9

Descriptive, predictive and prescriptive analytics, Data Driven Supply Chains – Basics, transforming supply chains.

UNIT 2 WAREHOUSING DECISIONS

9

P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.

UNIT 3 INVENTORY MANAGEMENT

9

Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.

UNIT 4 TRANSPORTATION NETWORK MODELS

9

Minimal Spanning Tree, Shortest Path Algorithms, Maximal Flow Problems, Transportation Problems, Set covering and Set Partitioning Problems, Travelling Salesman Problem, Scheduling Algorithms.

UNIT 5 MCDM MODELS

9

Analytic Hierarchy Process(AHP), Data Envelopment Analysis (DEA), Fuzzy Logic and Techniques, the analytical network process (ANP), TOPSIS.

Total : 45 Periods

TEXT BOOKS:

1. Nada R. Sanders, Big data driven supply chain management: A framework for implementing analytics and turning information into intelligence, Pearson Education, 2014.
2. Michael Watson, Sara Lewis, Peter Cacioppi, Jay Jayaraman, Supply Chain Network Design: Applying Optimization and Analytics to the Global Supply Chain, Pearson Education, 2013.

REFERENCES:

2. Anna Nagurney, Min Yu, Amir H. Masoumi, Ladimer S. Nagurney, Networks Against Time: Supply Chain Analytics for Perishable Products, Springer, 2013.
3. Muthu Mathirajan, Chandrasekharan Rajendran, Sowmyanarayanan Sadagopan, Arunachalam Ravindran, Parasuram Balasubramanian, Analytics in Operations/Supply Chain Management , I.K. International Publishing House Pvt. Ltd., 2016.
4. Gerhard J. Plenert, Supply Chain Optimization through Segmentation and Analytics, CRC Press, Taylor & Francis Group, 2014.

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

- CO1 Perform financial analysis for decision making using Corporate Finance Analysis
- CO2 Perform financial analysis for decision making using Financial Market Analysis
- CO3 Perform financial analysis for decision making using Portfolio Analysis
- CO4 Perform financial analysis for decision making using Technical Analysis
- CO5 Perform financial analysis for decision making using Credit Risk Analysis

UNIT 1 CORPORATE FINANCE ANALYSIS

9

Basic corporate financial predictive modelling- Project analysis- cash flow analysis- cost of capital, Financial Break even modelling, Capital Budget model-Payback, NPV, IRR.

UNIT 2 FINANCIAL MARKET ANALYSIS

9

Estimation and prediction of risk and return (bond investment and stock investment) –Time series examining nature of data, Value at risk, ARMA, ARCH and GARC

UNIT 3 PORTFOLIO ANALYSIS

9

Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models- binomial model for options, Black Scholes model and Option implied volatility.

UNIT 4 TECHNICAL ANALYSIS

9

Prediction using charts and fundamentals – RSI, ROC, MACD, moving average and candle charts, simulating trading strategies. Prediction of share prices.

UNIT 5 CREDIT RISK ANALYSIS

9

Credit Risk analysis- Data processing, Decision trees, logistic regression and evaluating credit risk model.

Total : 45 Periods

TEXT BOOKS:

1. Financial analytics with R by Mark J. Bennett, Dirk L. Hugen, Cambridge university press.
2. Haskell Financial Data Modeling and Predictive Analytics Paperback – Import, 25 Oct 2013 by Pavel Ryzhov.

REFERENCES:

3. Quantitative Financial Analytics: The Path To Investment Profits Paperback – Import, 11 Sep 2017 by Edward E Williams (Author), John A Dobelman
4. Python for Finance - Paperback – Import, 30 Jun 2017 by Yuxing Yan (Author).
5. Mastering Python for Finance Paperback – Import, 29 Apr 2015 by James Ma Weiming.

Preamble

To impart knowledge about sustainable Infrastructure development goals, practices and to understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects.

UNIT 1 SUSTAINABLE DEVELOPMENT GOALS**9**

Definitions, principles and history of Sustainable Development - Sustainable development goals (SDG): global and Indian – Infrastructure Demand and Supply - Environment and Development linkages - societal and cultural demands – Sustainability indicators - Performance indicators of sustainability and Assessment mechanism - Policy frameworks and practices: global and Indian – Infrastructure Project finance – Infrastructure project life cycle - Constraints and barriers for sustainable development - future directions.

UNIT 2 SUSTAINABLE INFRASTRUCTURE PLANNING**9**

Overview of Infrastructure projects: Housing sector, Power sector, Water supply, road, rail and port transportation sector, rural and urban infrastructure. Environmental Impact Assessment (EIA), Land acquisition -Legal aspects, Resettlement & Rehabilitation and Development - Cost effectiveness Analysis - Risk Management Framework for Infrastructure Projects, Economic, demand, political, socio-environmental and cultural risks. Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Negotiating with multiple Stakeholders on Infrastructure Projects. Use of ICT tools in planning – Integrated planning - Clash detection in construction - BIM (Building Information Modelling).

UNIT 3 SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES**9**

Sustainability through lean construction approach - Enabling lean through information technology – Lean in planning and design - IPD (Integrated Project Delivery) - Location Based Management System - Geospatial Technologies for machine control, site management, precision control and real time progress monitoring - Role of logistics in achieving sustainable construction – Data management for integrated supply chains in construction - Resource efficiency benefits of effective logistics - Sustainability in geotechnical practice – Design considerations, Design Parameters and Procedures – Quality control and Assurance - Use of sustainable construction techniques: Precast concrete technology, Pre-engineered buildings.

UNIT 4 SUSTAINABLE CONSTRUCTION MATERIALS**9**

Construction materials: Concrete, steel, glass, aluminium, timber and FRP - No/Low cement concrete - Recycled and manufactured aggregate - Role of QC and durability - Sustainable consumption – Eco-efficiency - green consumerism - product stewardship and green engineering - Extended producer responsibility – Design for Environment Strategies, Practices, Guidelines, Methods, And Tools. Eco-design strategies –Design for Disassembly - Dematerialization, rematerialization, transmaterialization – Green procurement and green distribution - Analysis framework for reuse and recycling – Typical constraints on reuse and recycling - Communication of Life Cycle Information - Indian Eco mark scheme - Environmental product declarations – Environmental marketing- Life cycle Analysis (LCA), Advances in LCA: Hybrid LCA, Thermodynamic LCA - Extending LCA - economic dimension, social dimension - Life cycle costing (LCC) - Combining LCA and LCC – Case studies

UNIT 5 SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS**9**

Case Studies - Sustainable projects in developed countries and developing nations - An Integrated Framework for Successful Infrastructure Planning and Management - Information Technology and Systems for Successful Infrastructure Management, - Structural Health Monitoring for Infrastructure projects - Innovative Design and Maintenance of Infrastructure Facilities - Capacity Building and Improving the Governments Role in Infrastructure Implementation, Infrastructure Management Systems and Future Directions. – Use of Emerging Technologies – IoT, Big Data Analytics and Cloud

Computing, Artificial Intelligences, Machine and Deep Learning, Fifth Generation (5G) Network services for maintenance .

Total : 45 Periods

TEXT BOOKS:

1. Charles J Kibert, Sustainable Construction : Green Building Design & Delivery, 4th Edition , Wiley Publishers 2016.
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016.

REFERENCES:

1. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.
2. William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2016.

eRESOURCES:

1. <https://www.unep.org/explore-topics/green-economy/what-we-do/sustainable-infrastructureinvestment>.
2. <https://www.iisd.org/savi/>

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

- CO1 Understand the environment sustainability goals at global and Indian scenario.
- CO2 Understand risks in development of projects and suggest mitigation measures.
- CO3 Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.
- CO4 Explain Life Cycle Analysis and life cycle cost of construction materials.
- CO5 Explain the new technologies for maintenance of infrastructure projects.

Preamble

To educate the students about the issues of sustainability in agroecosystems, introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.

UNIT 1 AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS 9

Ecosystem definition - Biotic Vs. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems

UNIT 2 SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT 9

Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control

UNIT 3 WATER MANAGEMENT 9

Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use

UNIT 4 ENERGY AND WASTE MANAGEMENT 9

Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture

UNIT 5 EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS 9

Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies

Total : 45 Periods

TEXT BOOKS:

1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020
2. Natural bioactive products in sustainable agriculture, Singh, J. & Yadav, A.N., Springer, 2020

REFERENCES:

1. Organic Farming for Sustainable Agriculture, Nandwani, D., Springer, 2016
2. Principles of Agronomy for Sustainable Agriculture, Villalobos, F.J. & Fereres, E., Springer, 2016

eRESOURCES:

1. <https://link.springer.com/book/10.1007/978-981-13-6830-1>
2. <https://www.worldwildlife.org/industries/sustainable-agriculture>

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

- CO1 Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture
- CO2 Discuss the sustainable ways in managing soil health, nutrients, pests and diseases
- CO3 Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources
- CO4 Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas
- CO5 Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem

Preamble

The primary objective of this course is to impart knowledge of biomaterials and their properties. The Fundamentals aspects and significance of bioceramics, Biopolymers & bionanomaterials and their applications

UNIT 1 INTRODUCTION TO BIOMATERIALS**9**

Introduction: Definition of biomaterials, requirements & classification of biomaterials- Types of Biomaterials- Degradable and resorbable biomaterials- engineered natural materials- Biocompatibility- Hydrogels-pyrolitic carbon for long term medical implants-textured and porous materials-Bonding types-crystal structure-imperfection in crystalline structure-surface properties and adhesion of materials – strength of biological tissues-performance of implants-tissue response to implants- Impact and Future of Biomaterials

UNIT 2 BIO POLYMERS**9**

Molecular structure of polymers -Molecular weight - Types of polymerization techniques–Types of polymerization reactions- Physical states of polymers- Common polymeric biomaterials - Polyethylene - Polymethylmethacrylate (PMMA)-Polylactic acid (PLA) and polyglycolic acid (PGA) - Polycaprolactone (PCL) - Other biodegradable polymers –Polyurethane- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications

UNIT 3 BIO CERAMICS AND BIOCOMPOSITES**9**

General properties- Bio ceramics -Silicate glass - Alumina (Al₂O₃) -Zirconia (ZrO₂)-Carbon- Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites- Polymer Matrix Composite(PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)– glass ceramics - Orthopedic implants-Tissue engineering scaffolds

UNIT 4 METALS AS BIOMATERIALS**9**

Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys-Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants – biological tolerance of implant metals

UNIT 5 NANOBIOMATERIALS**9**

Meatlicnanobiomaterials–Nanopolymers-Nanoceramics- Nanocomposites -Carbon based nanobiomaterials - transport of nanoparticles- release rate-positive and negative effect of nanosize-nanofibres-Nano and micro features and their importance in implant performance-Nanosurface and coats-Applications nanoantibiotics-Nanomedicines- Biochips – Biomimetics- BioNEMs -Biosensor-Bioimaging/Molecular Imaging- challenges and future perspective.

Total : 45 Periods**TEXT BOOKS:**

1. C. MauliAgrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani “Introduction to Biomaterials Basic Theory with Engineering Applications” Cambridge University Press, 2014.
2. Buddy D.Ratner and Allan S.Hoffman Biomaterials Science “An Introduction to Material in Medicine” Third Edition, 2013.

REFERENCES:

1. VasifHasirci, NesrinHasirci “Fundamentals of Biomaterials” Springer, 2018
2. DevarajanThangadurai, JeyabalanSangeetha, Ram Prasad “Functional Bionanomaterials” springer, 2020.

eRESOURCES:

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6273984/>
2. <https://sustainablebiomaterials.org/>

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

- CO1 Students will gain familiarity with Biomaterials and they will understand their importance.
- CO2 Students will get an overview of different biopolymers and their properties
- CO3 Students gain knowledge on some of the important Bioceramics and Biocomposite materials
- CO4 Students gain knowledge on metals as biomaterials
- CO5 Student gains knowledge on the importance of nanobiomaterials in biomedical applications.

Preamble

The primary objective of this course is to familiarize the students about the challenges and demands of energy sustainability. To provide fundamental knowledge about electrochemical devices and the materials used and various types of fuel cell. The students will learn about novel materials and their usage in photovoltaic application and basic principles of various types Supercapacitors and the materials used.

UNIT 1 SUSTAINABLE ENERGY SOURCES**9**

Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy

UNIT 2 ELECTROCHEMICAL DEVICES**9**

Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O₂ battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodioted hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO₂, LiFePO₄, LiMn₂O₄) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)

UNIT 3 FUEL CELLS**9**

Principle of operation of fuel cells – types of fuel cells (Proton exchange membrane fuel cells, alkaline fuel cell, direct methanol fuel cells, direct borohydride fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, and molten carbonate fuel cells) – Thermodynamics of fuel cell – Fuel utilization – electrolyte membrane (proton conducting and anion conducting) – Catalysts (Platinum, Platinum alloys, carbon supported platinum systems and metal oxide supported platinum catalysts) – Anatomy of fuel cells (gas diffusion layer, catalyst layer, flow field plate, current conductors, bipolar plates and monopolar plates).

UNIT 4 PHOTOVOLTAICS**9**

Physics of the solar cell – Theoretical limits of photovoltaic conversion – bulk crystal growth of Si and wafering for photovoltaic application - Crystalline silicon solar cells – thin film silicon solar cells – multijunction solar cells – amorphous silicon based solar cells – photovoltaic concentrators – Cu(InGa)Se₂ solar cells – Cadmium Telluride solar cells – dye sensitized solar cells – Perovskite solar cells – Measurement and characterization of solar cells - Materials used in solar cells (metallic oxides, CNT films, graphene, OD fullerenes, single-multi walled carbon nanotubes, two-dimensional Graphene, organic or Small molecule-based solar cells materials - copper-phthalocyanine and perylenetetracarboxylicbis - benzene – fullerenes - boron subphthalocyanine- tin (II) phthalocyanine)

UNIT 5 SUPERCAPACITORS**9**

Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor-Faradaic and non - Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite-conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon-carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

Total : 45 Periods

TEXT BOOKS:

1. Materials for Supercapacitor applications; B.Viswanathan. M.AuliceScibioh
2. Recent advances, practical challenges, and perspectives of intermediate temperature solid oxide fuel cell cathodes Amanda Ndubuisi, Sara Abouali, Kalpana Singh and VenkataramanThangadurai, J. Mater. Chem. A, 2022.

REFERENCES:

1. Functional materials for sustainable energy applications; John A. Kilner, Stephen J. Skinner, Stuart J. C. Irvine and Peter P. Edwards.
2. Hand Book of Fuel Cells: Fuel Cell Technology and Applications, Wolf Vielstich, Arnold Lamm, Hubert Andreas Gasteiger, Harumi Yokokawa, Wiley, London 2003.

eRESOURCES:

1. <https://www.nature.com/collections/pwybcfjfhb>
2. <https://mse.stanford.edu/research-impact/research-overview/materials-sustainability>

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

- CO1 Students will acquire knowledge about energy sustainability.
- CO2 Students understand the principles of different electrochemical devices.
- CO3 Students learn about the working of fuel cells and their application.
- CO4 Students will learn about various Photovoltaic applications and the materials used.
- CO5 The students gain knowledge on different types of supercapacitors and the performance of various materials

Preamble

To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability.

UNIT 1 PRINCIPLES OF GREEN CHEMISTRY**9**

Historical Perspectives and Basic Concepts. The twelve Principles of Green Chemistry and green engineering. Green chemistry metrics- atom economy, E factor, reaction mass efficiency, and other green chemistry metrics, application of green metrics analysis to synthetic plans.

UNIT 2 POLLUTION TYPES**9**

Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.

UNIT 3 GREEN REAGENTS AND GREEN SYNTHESIS**9**

Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions

UNIT 4 DESIGNING GREEN PROCESSES**9**

Safe design, process intensification, in process monitoring. Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention

UNIT 5 GREEN NANOTECHNOLOGY**9**

Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology

Total : 45 Periods**TEXT BOOKS:**

1. Green chemistry metrics - Alexi Lapkin and david Constable (Eds) ,Wiley publications,2008
2. Green Chemistry – An introductory text - M. Lancaster, RSC, 2016.

REFERENCES:

1. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017
2. Green technology and design for the environment, Samir B. Billatos, Nadia A. Basaly, Taylor & Francis, Washington, DC, ©1997

eRESOURCES:

1. <https://greenly.earth/en-us/blog/ecology-news/everything-you-need-to-know-about-green-technology-in-2022>
2. <https://unacademy.com/content/kerala-psc/study-material/science-technology/green-technology/>

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

- CO1 To understand the principles of green engineering and technology
- CO2 To learn about pollution using hazardous chemicals and solvents
- CO3 To modify processes and products to make them green and safe.
- CO4 To design processes and products using green technology
- CO5 To understand advanced technology in green synthesis

Preamble

To understand and study the complexity of the environment in relation to pollutants generated due to industrial activity

UNIT 1 ENVIRONMENTAL MONITORING AND STANDARDS 9

Introduction- Environmental Standards- Classification of Environmental Standards- Global Environmental Standards- Environmental Standards in India- Ambient air quality standards- water quality standard- Environmental Monitoring-Need for environmental monitoring- Concepts of environmental monitoring- Techniques of Environmental Monitoring.

UNIT 2 MONITORING OF ENVIRONMENTAL PARAMETERS 9

Current Environmental Issues- Global Environmental monitoring programme-International conventions- Application of Environmental Monitoring- Atmospheric Monitoring - screening parameters – Significance of environmental sampling- sampling methods – water sampling - sampling of ambient air- sampling of flue gas.

UNIT 3 ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING 9

Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods - Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis

UNIT 4 ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISKASSESSMENT 9

Water quality monitoring programme- national water quality monitoring- Parameters for National Water Quality Monitoring- monitoring protocol; Process of risk assessment- hazard identification-exposure assessment- dose-response assessment; risk characterization

UNIT 5 AUTOMATED DATA ACQUISITION AND PROCESSING 9

Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks -Sensors and transducers- classification of transducers- data acquisition system- types of data acquisition systems- data management and quality control; regulatory overview.

Total : 45 Periods

TEXT BOOKS:

1. Environmental monitoring Handbook, Frank R. Burden, © 2002 by The McGraw-Hill Companies, Inc.
2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and solid wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc

REFERENCES:

1. H. H. Willard, L. L. Merit, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis, CBP Publishers and Distributors, New Delhi, 1988.
2. Heaslip, G. (1975) Environmental Data Handling. John Wiley & Sons. New York.

eRESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ch33/
2. <https://unece.org/environmental-monitoring>

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

- CO1 Basic concepts of environmental standards and monitoring.
- CO2 The ambient air quality and water quality standards;
- CO3 The various instrumental methods and their principles for environmental monitoring
- CO4 The significance of environmental standards in monitoring quality and sustainability of the environment.
- CO5 The various ways of raising environmental awareness among the people.
- CO6 Know the standard research methods that are used worldwide for monitoring the environment.

Preamble

To create awareness on the energy scenario of India with respect to world and also to understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilisation

UNIT 1 ENERGY SCENARIO 9

Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy security

UNIT 2 ENERGY AND ENVIRONMENT 9

Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls

UNIT 3 SUSTAINABLE DEVELOPMENT 9

Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG) - Social development: Poverty, conceptual issues and measures, impact of poverty. Globalization and Economic growth - Economic development: Economic inequalities, Income and growth.

UNIT 4 RENEWABLE ENERGY TECHNOLOGY 9

Renewable Energy – Sources and Potential – Technologies for harnessing from Solar, Wind, Hydro, Biomass and Oceans – Principle of operation, relative merits and demerits

UNIT 5 ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT 9

National & State Energy Policy - National solar mission - Framework of Central Electricity Authority - National Hydrogen Mission - Energy and climate policy - State Energy Action Plan, RE integration, Road map for ethanol blending, Energy Efficiency and Energy Mix

Total : 45 Periods

TEXT BOOKS:

1. Energy Manager Training Manual (4 Volumes) available at <http://www.em-ea.org/gbook1.asp>, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India. 2004
2. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 2012

REFERENCES:

1. Dhandapani Alagiri, Energy Security in India Current Scenario, The ICFAI University Press, 2006.
2. M.H. Fulekar, Bhawana Pathak, R K Kale, “Environment and Sustainable Development” Springer, 2016

eRESOURCES:

1. https://inis.iaea.org/collection/NCLCollectionStore/_Public/42/067/42067676.pdf
2. <https://www.seforall.org/universal-integrated-energy-plans>

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

- CO1 Understand the world and Indian energy scenario
- CO2 Analyse energy projects, its impact on environment and suggest control strategies
- CO3 Recognise the need of Sustainable development and its impact on human resource development
- CO4 Apply renewable energy technologies for sustainable development
- CO5 Fathom Energy policies and planning for sustainable development.

Preamble

To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation and also to create awareness on energy audit and its impacts

UNIT 1 ENERGY AND ENVIRONMENT 9

Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP

UNIT 2 ENERGY AUDITING 9

Need and types of energy audit. Energy management (audit) approach-understanding energy costs, benchmarking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments

UNIT 3 ENERGY EFFICIENCY IN THERMAL UTILITIES 9

Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters. Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermocompression

UNIT 4 ENERGY CONSERVATION IN ELECTRICAL UTILITIES 9

Demand side management - Power factor improvement – Energy efficient transformers - Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers

UNIT 5 SUSTAINABLE DEVELOPMENT 9

Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG). Globalization and Economic growth. Economic development: Economic inequalities, Income and growth. Social development: Poverty, conceptual issues and measures, impact of poverty,

Total : 45 Periods

TEXT BOOKS:

1. Energy Manager Training Manual (4 Volumes) available at <http://www.em-ea.org/gbook1.asp>, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India. 2004
2. Robert A. Ristinen, Jack J. Kraushaar, Jeffrey T. Brack, "Energy and the Environment", 4th Edition, Wiley, 2022

REFERENCES:

1. M.H. Fulekar, Bhawana Pathak, R K Kale, "Environment and Sustainable Development" Springer, 2016
2. Robert A. Ristinen, Jack J. Kraushaar, Jeffrey T. Brack, "Energy and the Environment", 4th Edition, Wiley, 2022

eRESOURCES:

1. <https://www.seforall.org/energy-efficiency-for-sustainable-development>
2. <https://www.sciencedirect.com/science/article/abs/pii/S0360544221026141>

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

- CO1 Understand the prevailing energy scenario
- CO2 Familiarise on energy audits and its relevance
- CO3 Apply the concept of energy audit on thermal utilities
- CO4 Employ relevant techniques for energy improvement in electrical utilities
- CO5 Understand Sustainable development and its impact on human resource development

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

- CO1 Discuss about data science process for making business decisions.
- CO2 Understand different types of data and the concept of Normal Distributions and Standard (z) Scores for data analysis.
- CO3 Demonstrate the usage of statistical inference and regression models for a given application.
- CO4 Describe different types of machine learning approaches for analyzing business problems.
- CO5 Apply tools and techniques to handle large volumes of data in practical scenarios.

UNIT 1 INTRODUCTION

9

Data Science: Benefits and uses – facets of data – Data Science Process: Overview – Defining research goals – Retrieving data – data preparation – Exploratory Data analysis – build the model -presenting findings and building applications – Data Mining – Data Warehousing – Basic statistical descriptions of Data

UNIT 2 DESCRIBING DATA

9

Types of Data - Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores.

UNIT 3 DESCRIBING RELATIONSHIPS

9

Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula for correlation coefficient – Regression –regression line –least squares regression line – Standard error of estimate – interpretation of r^2 –multiple regression equations –regression towards the mean.

UNIT 4 MACHINE LEARNING

9

The modeling process – Types of machine learning – Supervised learning – Unsupervised learning - Semi-supervised learning- Classification, regression – Clustering – Outliers and Outlier Analysis

UNIT 5 HANDLING LARGE DATA

9

Problems – techniques for handling large volumes of data – programming tips for dealing with large data sets- Case studies: Predicting malicious URLs, Building a recommender system – Tools and techniques needed – Research question – Data preparation – Model building – Presentation and automation.

Total : 45 Periods

TEXT BOOKS:

- David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
- Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.
- Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017.

REFERENCES:

- Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press, 2014.

e-RESOURCES:

- <https://nptel.ac.in/courses/106106179>
- <https://www.coursera.org/learn/foundations-of-data-science>

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

- CO1 Explain intelligent agent frameworks and search strategies used in decision making.
- CO2 Apply problem solving techniques and obtain search spaces for partially defined and unknown environments.
- CO3 Apply game playing theory and constraint satisfaction problem solving techniques for a given application
- CO4 Perform logical reasoning and derive inferences using FOL forward chaining and backward chaining
- CO5 Perform probabilistic reasoning under uncertainty using Bayesian inference networks

UNIT I INTELLIGENT AGENTS

9

Introduction to AI – Agents and Environments – concept of rationality – nature of environments – structure of agents. Problem solving agents – search algorithms – uninformed search strategies.

UNIT II PROBLEM SOLVING

9

Heuristic search strategies – heuristic functions. Local search and optimization problems – local search in continuous space – search with non-deterministic actions – search in partially observable environments – online search agents and unknown environments.

UNIT III GAME PLAYING AND CSP

9

Game theory – optimal decisions in games – alpha-beta search – monte-carlo tree search – stochastic games – partially observable games. Constraint satisfaction problems – constraint propagation – backtracking search for CSP – local search for CSP – structure of CSP.

UNIT IV LOGICAL REASONING

9

Knowledge-based agents – propositional logic – propositional theorem proving – propositional model checking – agents based on propositional logic. First-order logic – syntax and semantics – knowledge representation and engineering – inferences in first-order logic – forward chaining – backward chaining – resolution.

UNIT V PROBABILISTIC REASONING

9

Acting under uncertainty – Bayesian inference – naïve Bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.

Total : 45 Periods

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021.

REFERENCES:

1. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education, 2007
2. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008
3. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006
4. Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013

e-RESOURCES:

1. <https://nptel.ac.in/courses/106106126>

Course Outcomes: Upon completion of the course, the students should be able to:

- CO1 Design a Data warehouse system and perform business analysis with OLAP tools.
- CO2 Apply suitable pre-processing and visualization techniques for data analysis
- CO3 Apply frequent pattern and association rule mining techniques for data analysis
- CO4 Apply appropriate classification and clustering techniques for data analysis
- CO5 Apply various classification and clustering techniques using tools

UNIT I DATA WAREHOUSING, BUSINESS ANALYSIS AND ON-LINE ANALYTICAL PROCESSING (OLAP) 9

Basic Concepts - Data Warehousing Components – Building a Data Warehouse – Database Architectures for Parallel Processing – Parallel DBMS Vendors - Multidimensional Data Model – Data Warehouse Schemas for Decision Support, Concept Hierarchies -Characteristics of OLAP Systems – Typical OLAP Operations, OLAP and OLTP.

UNIT II DATA MINING – INTRODUCTION 9

Introduction to Data Mining Systems – Knowledge Discovery Process – Data Mining Techniques – Issues – applications- Data Objects and attribute types, Statistical description of data, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and discretization, Data Visualization, Data similarity and dissimilarity measures.

UNIT III DATA MINING - FREQUENT PATTERN ANALYSIS 9

Mining Frequent Patterns, Associations and Correlations – Mining Methods- Pattern Evaluation Method – Pattern Mining in Multilevel, Multi Dimensional Space – Constraint Based Frequent Pattern Mining, Classification using Frequent Patterns

UNIT IV CLASSIFICATION AND CLUSTERING 9

Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Back Propagation – Support Vector Machines — Lazy Learners – Model Evaluation and Selection-Techniques to improve Classification Accuracy. Clustering Techniques – Cluster analysis-Partitioning Methods - Hierarchical Methods – Density Based Methods - Grid Based Methods – Evaluation of clustering – Clustering high dimensional data- Clustering with constraints, Outlier analysis-outlier detection methods.

UNIT V WEKA TOOL 9

Datasets – Introduction, Iris plants database, Breast cancer database, Auto imports database - Introduction to WEKA, The Explorer – Getting started, Exploring the explorer, Learning algorithms, Clustering algorithms, Association–rule learners.

Total : 45 Periods

TEXT BOOKS:

1. Jiawei Han and Micheline Kamber, —Data Mining Concepts and Techniques, Third Edition, Elsevier, 2012.

REFERENCES:

1. Alex Berson and Stephen J.Smith, —Data Warehousing, Data Mining & OLAP, Tata McGraw – Hill Edition, 35th Reprint 2016.
2. K.P. Soman, Shyam Diwakar and V. Ajay, —Insight into Data Mining Theory and Practicel, Eastern Economy Edition, Prentice Hall of India, 2006.
3. Ian H.Witten and Eibe Frank, —Data Mining: Practical Machine Learning Tools and Techniques, Elsevier, Second Edition.

e-RESOURCES:

1. <https://nptel.ac.in/courses/106105174>
2. <https://www.opensourceforu.com/2017/01/an-introduction-to-weka/>

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

- CO1 Differentiate between supervised, unsupervised, semi-supervised machine learning approaches
- CO2 Discuss the decision tree algorithm and overcome the problem of over fitting.
- CO3 Discuss and apply the back propagation algorithm and genetic algorithms to various problems.
- CO4 Apply the concept of Instant based learning to solve business problems.
- CO5 Analyze and apply advanced machine learning approaches for performing data analytics.

UNIT I INTRODUCTION 9

Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

UNIT II NEURAL NETWORKS AND GENETIC ALGORITHMS 9

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.

UNIT III BAYESIAN AND COMPUTATIONAL LEARNING 9

Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

UNIT IV INSTANT BASED LEARNING 9

K- Nearest Neighbour Learning – Locally weighted Regression – Radial Basis Functions – Case Based Learning.

UNIT V ADVANCED LEARNING 9

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning

Total : 45 Periods

TEXT BOOKS:

1. Tom M. Mitchell, —Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.

REFERENCES:

1. Ethem Alpaydin, —Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
2. Stephen Marsland, —Machine Learning: An Algorithmic Perspective, CRC Press, 2009.

e-RESOURCES:

1. <https://nptel.ac.in/courses/106106126>

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

- CO1 Understand the design of systems using human knowledge and/ or behavior as a basis.
- CO2 Explore traditional as well as new technologies for knowledge acquisition and representation
- CO3 Describe different methods of inference involved in expert systems
- CO4 Discuss the problem of uncertainty while incorporating artificial intelligence, expert, and decision systems into society.
- CO5 Design an expert system for a given scenario.

UNIT I INTRODUCTION TO EXPERT SYSTEMS 9

Overview, problem domain and knowledge domain, the advantages of an expert system, general stages in the development of an expert system, general characteristics of an expert system, history and uses of expert systems today, rule-based expert systems, procedural and nonprocedural paradigms, characteristics of artificial neural systems.

UNIT II REPRESENTATION OF KNOWLEDGE 9

The study of logic, difference between formal logic and informal logic. Knowledge representation, semantic nets, translate semantic nets into PROLOG, limitations of semantic nets, schemas, frames and their limitations, , propositional and first order predicate logic, quantifiers, limitations of propositional and predicate logic.

UNIT III METHODS OF INFERENCE 9

Trees, lattices, and graphs, state and problem spaces, AND-OR trees and goals, methods of inference, rules of inference, resolution rule of inference, resolution systems, and deduction, shallow and causal reasoning, additional methods of Inference, Meta knowledge, the Markov decision process.

UNIT IV REASONING UNDER UNCERTAINTY 9

Overview, types of errors attributed to uncertainty, features of classical probability, experimental and subjective probabilities, compound and conditional probabilities, hypothetical reasoning and backward induction, temporal reasoning, Markov chains, odds of belief, sufficiency and necessity, role of uncertainty in inference chains, implications of combining evidence.

UNIT V DESIGN OF EXPERT SYSTEMS 9

Overview, stages in the development of an expert system, types of errors in development stages, knowledge engineer role in expert systems, life cycle of an expert system.

Total : 45 Periods

TEXT BOOKS:

1. J. Giarratano and G. Riley, "Expert Systems -- Principles and Programming". 4th Edition, PWS Publishing Company, 2004.
2. Peter Jackson, Introduction to Expert Systems, Addison Wesley Longman, 1999. ISBN 0-20187686-8.

REFERENCES:

1. Durkin, J., Expert systems Design and Development, Macmillan, 1994
2. Elias M. Awad, Building Expert Systems, West Publishing Company 1996
3. Gonzalez and D. Dankel, "The Engineering of Knowledge-Based Systems", Prentice Hall, 1994.
4. Nikolopoulos, "Expert Systems", Marcel Dekker Inc. 1997. ISBN 0 8247 9927 5.

e-RESOURCES:

1. <https://nptel.ac.in/courses/106106126>

- CO1 Understand the underlying theory behind cognition from materialism to mental Science.
- CO2 Apply suitable Logical Representation and Reasoning to the cognition elements computationally
- CO3 Use probabilistic programming language to implement mathematical functions through WebPPL
- CO4 Develop applications using cognitive inference model and generative models for interactions
- CO5 Develop applications using cognitive learning model to learn new things faster.

UNIT 1 PHILOSOPHY, PSYCHOLOGY AND NEUROSCIENCE 8

Philosophy: Mental-physical Relation – From Materialism to Mental Science – Logic and the Sciences of the Mind – Psychology: Place of Psychology within Cognitive Science – Science of Information Processing –Cognitive Neuroscience – Perception – Decision – Learning and Memory – Language Understanding and Processing.

UNIT 2 COMPUTATIONAL INTELLIGENCE 9

Machines and Cognition – Artificial Intelligence – Architectures of Cognition – Knowledge Based Systems – Logical Representation and Reasoning – Logical Decision Making –Learning – Language – Vision- Case Study on reasoning algorithms

UNIT 3 PROBABILISTIC PROGRAMMING LANGUAGE 9

WebPPL Language – Syntax – Using Javascript Libraries – Manipulating probability types and distributions – Finding Inference – Exploring random computation – Co-routines: Functions that receive continuations – Enumeration- Case Study on Mathematical functions using WebPPL.

UNIT 4 INFERENCE MODELS OF COGNITION 9

Generative Models – Conditioning – Causal and statistical dependence – Conditional dependence – Data Analysis – Algorithms for Inference-Case Study on Conditional inference learning model and Generative Model

UNIT 5 LEARNING MODELS OF COGNITION 10

Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models– Learning (Deep) Continuous Functions – Mixture Models- Case Study on hierarchical model and Mixture model.

Total : 45 Periods

TEXT BOOKS:

1. Vijay V Raghavan,Venkat N.Gudivada, VenuGovindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016
2. Jose Luis Bermúdez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020

REFERENCES:

1. Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley Publications, 2015
2. Robert A. Wilson, Frank C. Keil, “The MIT Encyclopedia of the Cognitive Sciences”,The MIT Press, 1999.

e-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_hs29/preview, “Introduction to Cognitive Psychology”, By Prof. Naveen Kashyap, IIT Guwahati.
2. https://onlinecourses.nptel.ac.in/noc22_ee122/preview, “Cognition and its computation”, Prof. Sharba Bandyopadhyay and Prof. Rajlakshmi Guha , IIT- Kharagpur.

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

- CO1 Discuss the notion of a strategic game and equilibria and identify the characteristics of main applications of these concepts.
- CO2 Discuss the use of Nash Equilibrium for decision making problem.
- CO3 Identify key strategic aspects and based on these be able to connect them to appropriate game theoretic concepts given a real world situation.
- CO4 Identify some applications that need aspects of Bayesian Games to perform decision making.
- CO5 Discuss the purpose of Gamification concepts and apply in real world applications.

UNIT I INTRODUCTION

9

Introduction — Making rational choices: basics of Games — strategy — preferences — payoffs — Mathematical basics — Game theory — Rational Choice — Basic solution concepts-noncooperative versus cooperative games — Basic computational issues — finding equilibria and learning in games- Typical application areas for game theory (e.g. Google's sponsored search, eBay auctions, electricity trading markets).

UNIT II GAMES WITH PERFECT INFORMATION

9

Games with Perfect Information — Strategic games — prisoner's dilemma, matching pennies - Nash equilibria —mixed strategy equilibrium — zero-sum games

UNIT III GAMES WITH IMPERFECT INFORMATION

9

Games with Imperfect Information — Bayesian Games — Motivational Examples — General Definitions — Information aspects — Illustrations — Extensive Games with Imperfect — Information — Strategies — Nash Equilibrium —Repeated Games — The Prisoner's Dilemma — Bargaining

UNIT IV NON-COOPERATIVE GAME THEORY

9

Non-cooperative Game Theory — Self-interested agents — Games in normal form — Analyzing games: from optimality to equilibrium — Computing Solution Concepts of Normal — Form Games — Computing Nash equilibria of two-player, zero-sum games —Computing Nash equilibria of twoplayer, general- sum games — Identifying dominated strategies

UNIT V GAMIFICATION

9

Gamification Basics— The Business Value of Gamification -Design And Motivation— Player-Centric Gamification Design- Design Choices - Operant Conditioning - Self-Determination Theory - Behavioral Economics — Applications— Gamification for Marketing— Gamification at Work- Gamification and Learning— Gamification for Behavior Change.

Total : 45 Periods

TEXT BOOKS:

1. M. J. Osborne, An Introduction to Game Theory. Oxford University Press, 2012.
2. M. Machler, E. Solan, S. Zamir, Game Theory, Cambridge University Press, 2013
3. N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani, Algorithmic Game Theory. Cambridge University Press, 2007.
4. Kevin Werbach and Daniel Hunter, for the Win: How Game Thinking Can Revolutionize Your Business (Wharton Digital Press, 2012)

REFERENCES:

1. A.Dixit and S. Skeath, Games of Strategy, Second Edition. W W Norton & Co Inc, 2004.
2. YoavShoham, Kevin Leyton-Brown, Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Cambridge University Press 2008.
3. Zhu Han, DusitNiyato, WalidSaad, TamerBasar and Are Hjorungnes, "Game Theory in Wireless and Communication Networks", Cambridge University Press, 2012
4. Y.Narahari, "Game Theory and Mechanism Design", IISC Press, World Scientific

e-RESOURCES:

1. <https://nptel.ac.in/courses/110104063>

