NETAJI SUBHAS UNIVERSITY OF TECHNOLOGY

A STATE UNIVERSITY

UNDER DELHI ACT 06 OF 2018, GOVT. OF NCT OF DELHI

Azad Hind Fauj Marg, Sector-3, Dwarka, New Delhi-110078

SCHEME OF COURSES AND EXAMINATION

FOR

BACHELOR OF TECHNOLOGY

COMPUTER SCIENCE & ENGINEERING

(ARTIFICIAL INTELLIGENCE)

(Effective from the Session: 2019-2020)

APPROVED BY

The Senate in its II to VII meetings

The Board of Management in its meeting held on

August 14, 2019

Contents

1. INTRODUCTION

NSUT has embarked on its journey towards excellence in academics through the introduction of a novel system of learning that is being followed in many reputed universities globally. The Choice Based Credit System (CBCS) has been proposed by University Grants Commission (UGC) on recommendations of the National Knowledge Commission, to improve the quality of higher education in India. NSUT proposes to adopt CBCS for its Bachelor of Technology courses

CBCS is the mother of student centric educational reforms. A student is provided with an academically rich, highly flexible learning system blended with abundant provision for skill practice and activity orientation that he/she could learn in depth without sacrificing his/her creativity. A student can exercise the option to decide his/her own pace of learning- slow, normal or accelerated plan and sequence his/her choice of paper, learn to face challenges through term work/ project work and may venture out to acquire extra knowledge/ proficiency through add- on facilities. The great advantage of CBCS is that the learning process is made continuous and the evaluation process is not only made continuous but also made learner-centric and is designed to recognize the capability and talent of a student.

2. CURRICULUM STRUCTURE

B.Tech. programme of the University shall be based upon CBCS and shall have well defined Programme Educational Objectives (PEOs). All the courses shall have well-defined Course Outcomes (COs).Courses shall be of three kinds: Core, Elective and Foundation.

a. Core Course (CC): This is a course which is to be compulsorily studied by a student as a core requirement to complete the requirements of the B.Tech. programme.
b. Elective Course: This is a course which can be chosen from a pool of elective courses. It is intended to support the discipline of study by

providing an expanded scope, enabling exposure to another discipline/domain and nurturing a student's proficiency and skill. An elective may be of the following types:

i. Discipline Centric Elective (ED): It is an elective course that adds proficiency to the students in the discipline.

ii. Generic Elective (EG): It is an elective course taken from other engineering subjects and enhances the generic proficiency and interdisciplinary perspective of students.

iii. Open Elective (EO): It is an elective course taken from a common pool of non-engineering disciplines that broadens the perspective of an engineering student. These electives shall comprise two groups: Open electives of the Humanities, Social Sciences and Management group and Open electives of the Sciences group.

c. Foundation Course: A Foundation course leads to knowledge enhancement and provides value-based training. Foundation courses may be of two kinds:

i. Compulsory Foundation (FC): It is based upon the content that leads to fundamental knowledge enhancement in Sciences, Humanities, Social Sciences and Basic engineering. They are mandatory for all disciplines.

ii. Elective Foundation (FE): It can be taken from among a common pool of foundation courses which aim at value-based education. They may provide hands-on training to improve competencies, skills or provide education on human, societal, environmental and national values. These shall be mandatory, non-credit courses, which do not carry any credits but a student has to pass in order to be eligible for award of degree.

2.1 EVALUATION AND ASSESSMENT

The performance of a student in a semester shall be evaluated through continuous class assessment, MSE and ESE. Both the MSE and ESE shall be University examinations and will be conducted as notified by the CoE of

the University. The marks for continuous assessment (Sessional marks) shall be awarded at the end of the semester. The continuous assessment shall be based on class tests, assignments/tutorials, quizzes/viva-voce and attendance etc. The MSE/ESE shall comprise of written papers, practicals and viva-voce, inspection of certified course work in classes and laboratories, project work, design reports or by means of any combination of these methods.

The weightage of each of these modes of evaluation for the different types of courses shall be as per Table 1. Further, the mechanism for continuous assessment shall be as per Table 2.

Table-1: Evaluation Scheme

S. No.	Type of Course	Continuous Assessment (CA) Theory	Mid-Semester Examination (MSE) Theory	End-Semester Examination (ESE) Theory	Continuous Assessment (CA) Practical	End-Semester Examination (ES) Practical
1	FE courses	Continuous Assessment only (100 marks)				
2	CC/FC/ED/EG/EO Theory with Tutorial	25	25	50	Nil	Nil
3	CC/FC/ED/EG/EO Theory with Practical	15	15	40	15	15
4	Project I and Project II	Nil	Nil	Nil	40	60
5	Training	Nil	Nil	Nil	40	60
6	Work shop based Course	30	--	20	30	20
7	Audit Courses*	-	-	-	-	-
*The distribution of marks of practical and/or theory components for Audit courses shall be determined by the respective Departments.						

Table 2: Continuous Assessment

S. No.	Type of Course	Continuous Assessment (CA)
1	CC/FC/ED/EG/EO Theory with Tutorial	Two class tests, Assignments, Teachers' assessment (quizzes, viva-voce, attendance)
	CC/FC/ED/EG/EO Theory with Practical	One class test, One Lab test, Assignments/Projects, Teachers' assessment
2	FE courses ***	Two class tests, Assignments, Teachers' assessment
3	Project I /II	Mid-Semester Presentation, Report, Supervisor's Assessment
4	Training	As specified by the Department
5	Audit Courses	As specified by the Department

*** Foundation Elective Courses are value-based courses which may enhance the proficiency /skill. These electives could be communication skills, Spoken English, soft skills, Business and Management courses, entrepreneurship development, Knowledge of an additional Foreign Language, Personality Development through sports, music, theatre, dance, etc.

The University provides to the students a pool of Foundation elective courses which may be offered by the following departments of the University:

i) Department of Humanities
ii)Department of Management
iii)Department of Personality Development

Note for Undergraduate students--

i)An Undergraduate student will have the liberty to choose any three foundation elective course to study from the given list.

ii) He/She can take only one foundation elective course in an ongoing semester.

iii) The study and clearing of foundation elective course is to be done by the end of 2nd year (fourth semester).

iv) For getting a Degree, it is mandatory to clear the entire three chosen foundation elective course.

v) Foundation elective courses are auditable course and there is no credits awarded to the students.

Note for Course Teacher--

The evaluation of the student is done through continuous assessment.

[Subject having Theory only] --The course teacher evaluate through TWO class tests (25 marks each), ONE Assignment/Project (40 marks) and internal evaluation [one such component is attendance] (10 marks).
[Subject having Theory and Practical]—Here, a course teacher evaluate for theory part through TWO class test (20 marks each) and internal evaluation [one such component is attendance] (10 marks). Similarly, for practical part ONE practical test (40 marks) and internal evaluation [one such component is attendance] (10 marks)
[Subject having Practical only]—The course teacher takes TWO practical test (45 marks each) and internal evaluation [one such component is attendance] (10 marks)

2.2 SEMESTER WISE COURSE/CREDIT DISTRIBUTION

Table 3 :

Semester	Types of courses as per NSUT Nomenclature						Courses/credits	Credits
	FE (NON-CREDIT)	FC	CC	ED	ED/EG/EO/ EO-Sciences / EO-SS & Mgmt	Training Project etc.		
I	01	05	00	00	00	00	06 courses 20 credits	84 credits
II	00	03	03	00	00	00	06 courses 24 credits	
III	01	00	05	00	00	00	06 courses 20 credits	
IV	01	00	05	00	00	00	06 courses 20 credits	
V	00	00	04	--	--	00	04 –07 courses 16-28 credits	86 credits
VI	00	00	04	--	-	00	04 –07 courses 16-28 credits	
VII	00	00	00	--	--	06	00 – 05 courses 06-26 credits	
VIII	00	00	00	--	--	08	00 – 05 courses 08-28 credits	
TOTAL CREDITS								170

1. **ED : At least 4 courses (16 credits)**
2. **EO- Sciences : At least 1 courses (04 credits)**
3. **EO-SS & Mgmt : At least 2 courses (08 credits)**

2.3 COURSE CODE NOMENCLATURE

The courses of various B.Tech programmes shall be assigned a course code as per the following nomenclature

2.3.1 COURSE/DEPARTMENT/SPECIALIZATION/BRANCH CODING .

The courses of various B.Tech programmes shall be assigned a course code as per the defined nomenclature (Given later). This nomenclature shall use course/department/specialization/branch coding which are defined as given below.

TABLE 4: COURSE/DEPARTMENT CODES

XX	Course Category Code	FC	Foundation Core
		FE	Foundation Elective
		EO	Open Elective
YY	Name of Department Code	BT	Bio Technology
		CH	Chemistry
		CP	Computer Engineering, East Campus
		CS	Computer Science & Engineering
		CW	Civil Engg, West Campus
		EE	Electrical Engineering
		EC	Electronics & Communication Engineering
		EP	Electronics & Communication Engineering, East Campus
		HS	Humanities
		IC	Instrumentation & Control Engineering
		IT	Information Technology
		IW	Information Technology, West Campus
		ME	Mechanical Engineering
		MG	Management
		MP	Manufacturing Process & Automation
		MT	Mathematics
		MW	Mechanical Engineering, West Campus
		PD*	Personality Development
		PH	Physics

Note : Second Alphabet P indicates East Campus, and W indicates West Campus

TABLE 5 : B.TECH SPECIALIZATION/BRANCH CODES

ZZ	BT	Bio Technology
	CA	Computer Science & Engineering with Artificial Intelligence
	CB	Computer Science and Engineering (Big Data Analytics) (CSDA)(NSUT EAST CAMPUS)
	CD	Computer Science and Engineering (Data Science) (CSDS)
	CE	Civil Engineering (CE)(NSUT WEST CAMPUS)
	CG	Geoinformatics (GI)(NSUT WEST CAMPUS)
	CI	Computer Science and Engineering (IOT) (CIOT)(EAST CAMPUS)
	CM	Mathematics & Computing
	CO	Computer Science & Engineering, Main Campus
	EA	Electronics and Communication Engineering (Artificial Intelligence and Machine Learning) (ECAM) (NSUT EAST CAMPUS)
	EC	Electronics & Communication Engineering

	EI	Electronics & Communication Engineering (Internet of Things)
	EE	Electrical Engineering
	IC	Instrumentation & Control Engineering
	II	Information Technology (Internet of Things) (IIOT)(NSUT WEST CAMPUS)
	IN	Information Technology (Network security)
	IT	Information Technology
	ME	Mechanical Engineering
	MP	Manufacturing Process & Automation
	MV	Mechanical Engineering (Electric Vehicles) (MEEV)(NSUT WEST CAMPUS)

2.3.2 B.TECH COURSE CODE NOMENCLATURE

FOUNDATION CORE AND ELECTIVE COURSES AND OPEN ELECTIVE COURSES:

Course Category		Offering Department Code			Course No.	
X	X	Y	Y	0	*	*

** can take numeric values only

XX and YY maybe chosen as given in Tables 1,2:

*PD offers FE courses like music, dance, yoga, sports, NSS, etc. A BOS for FE courses of PD nature (like Music, Dance, Yoga, NSS, etc), has be constituted with Dean Academics as the chairperson.

OTHER CORE AND ELECTIVE COURSES:

Program Code		Offering Department Code		Course Category	Course No.	
Z	Z	Y	Y	C/E	*	*

** can take numeric only;

C for Core and E for Elective (Discipline Centric);
YY and ZZ maybe chosen as given in Tables 1,2.

2.3.3 MOOCS (NPTEL BASED) FOUNDATION ELECTIVE COURSES AND OPEN ELECTIVE COURSES:

Course Category		Offering Department (NPTEL) Code		UG/PG	Course No.	
X	X	F	F	G	*	*

** can take numeric only;

XX	Course Category Code	FE	Foundation Elective
		EO	Open Elective

FF	Name of Offering Department Code for NPTEL	NH	Humanities & Social Sciences
		NM	Management
		NP	Personality Development
		NS	Sciences
G	UG/PG	0	B.Tech
		I	M.Tech

2.3.4 STUDENT ROLL NUMBER NOMENCLATURE:

Students shall be assigned roll numbers as given below.

1. B.Tech:

Year of Admission	U	ZZ (FROM TABLE 2)	4 DIGIT NUMBER

3 SEMESTER WISE COURSE ALLOCATION

3.1 COURSE ALLOCATION FOR SEMESTER I

Refer to the separate manual on Equivalent courses and scheme of courses with pre-requites if you want to find the linked courses and pre_requisites for opting for EG courses.

B.Tech - ***Computer Science & Engineering (Artificial Intelligence)*** SEMESTER I														
Course Code	Type	Course	L	T	P	Credits	Evaluation Scheme (Percentage weights)					Offering Dept.	AICTE COURSE TYPE
							Theory			Practical			
							CA	MS	ES	CA	ES		
FCMT001	FC	Mathematics-I	3	1	0	4	25	25	50	-	-	Maths	BASIC SCIENCES
FCCS002 /FCHS005	FC	Computer Programming /English	3	0	2	4	15	15	40	15	15	CSE/ IT	ENGG SCIENCES/ HUSS
FCEC003	FC	Electronics and Electrical Engineering	3	0	2	4	15	15	40	15	15	ECE/ ICE /EE	ENGG SCIENCES
FCPH004 / FCCH008	FC	Physics/Environment Science and Green Chemistry	3	0	2	4	15	15	40	15	15	PHYSICS/ CHEMISTRY	BASIC SCIENCES
FCME006	FC	Basics of Mechanical Engg.	4	0	0	4	25	25	50	-	-	MPAE/ ME	ENGG SCIENCES
FEXXxxx 2*	FE	Elective Foundation	-	-	-	NIL	-	-	-	-	-	-	MANDATORY COURSE

			28 contact hours 2*	20	

1: One week induction program as per AICTE norms. Classes for I semester will commence one week later.
2*: The course codes, LTP distribution and Evaluation Scheme for Foundation Electives are given in Table 3 (list under preparation). The actual weekly load depends upon the Foundation Elective Course.

Students of the Departments of Group I shall be offered courses as follows:

1. Semester I : Computer Programming, Physics
2. Semester II : English, Environment Science and Green Chemistry

Students of the Departments of Group II shall be offered courses as follows:

1. Semester I : English, Environment Science and Green Chemistry
2. Semester II : Computer Programming, Physics

3.2 COURSE ALLOCATION FOR SEMESTER II

B.Tech. ***Computer Science & Engineering (Artificial Intelligence)*** SEMESTER II

Course No.	Type	Course	L	T	P	Credits	Evaluation Scheme (Percentage weights)					Offering Dept.	AICTE COURSE TYPE
							Theory			Practical			
							CA	MS	ES	CA	ES		
FCHS005 / FCCS002	FC	English /Computer Programming	3	0	2	4	15	15	40	15	15	CSE/ IT	ENGG SCIENCES/ HUSS
FCMT007	FC	Mathematics -II	3	1	0	4	25	25	50	-	-	MATHS	BASIC SCIENCES
FCCH008 / FCPH004	FC	Environment Science and Green Chem./ Physics	3	0	2	4	15	15	40	15	15	CHEMISTRY/ PHYSICS	BASIC SCIENCES
CACSC01	**CC**	**Discrete Structures**	**3**	**1**	**0**	**4**	**25**	**25**	**50**	**-**	**-**	**CSE**	**PROGRAM CORE/ ENGG SCIENCES**
CACSC02	**CC**	**Data Structures**	**3**	**0**	**2**	**4**	**15**	**15**	**40**	**15**	**15**	**CSE**	
CAECC03	**CC**	**Digital Logic Design**	**3**	**0**	**2**	**4**	**15**	**15**	**40**	**15**	**15**	**ECE**	
			28			24							

2*: The actual weekly load depends upon the Core Courses offered by the Department

3.2 COURSE ALLOCATION FOR SEMESTER III

B.Tech. ***Computer Science & Engineering (Artificial Intelligence)*** SEMESTER III													
Course No.	Type	Course	L	T	P	Credits	Evaluation Scheme (Percentage weights)					Offering Dept.	AICTE COURSE TYPE
							Theory			Practical			
							CA	MS	ES	CA	ES		
CACSC04	**CC**	**Web Technology**	**3**	**0**	**2**	**4**	**15**	**15**	**40**	**15**	**15**	**CSE**	**PROGRAM CORE**
CACSC05	**CC**	**Database Management Systems**	**3**	**0**	**2**	**4**	**15**	**15**	**40**	**15**	**15**	**CSE**	**PROGRAM CORE**
CACSC06	**CC**	**Design and Analysis of Algorithms**	**3**	**0**	**2**	**4**	**15**	**15**	**40**	**15**	**15**	**CSE**	**PROGRAM CORE**
CACSC07	**CC**	**Computer Architecture and Organization**	**3**	**1**	**0**	**4**	**25**	**25**	**50**	**-**	**-**	**CSE**	**PROGRAM CORE**
CAECC08	**CC**	**Microprocessor and Microcontrollers**	**3**	**0**	**2**	**4**	**15**	**15**	**40**	**15**	**15**	**ECE**	ENGG **SCIENCES**
FE***02*	FE	Elective Foundation	-	-	-	NIL	-	-	-	-	-	-	MANDATORY COURSE
			20*			20							
*: The actual weekly load depends upon the Core Courses defined by the Department													

3.4 COURSE ALLOCATION FOR SEMESTER IV

B.Tech. *Computer Science & Engineering (Artificial Intelligence)* **SEMESTER IV**														
Course No.	**Type**	**Course**	**L**	**T**	**P**	**Credits**	**Evaluation Scheme (Percentage weights)**					**Offering Dept.**	**AICTE COURSE TYPE**
							Theory			**Practical**			
							CA	**MS**	**ES**	**CA**	**ES**		
CACSC09	CC	Operating Systems	3	0	2	4	15	15	40	15	15	CSE	PROGRAM CORE
CACSC10	CC	Theory of Automata & Formal languages	3	1	0	4	25	25	50			CSE	PROGRAM CORE
CACSC11	CC	Artificial Intelligence	3	0	2	4	15	15	40	15	15	CSE	PROGRAM CORE
CAECC12	**CC**	Data Communication	3	0	2	4	15	15	40	15	15	ECE	ENGG SCIENCES
CAMTC13	CC	Probability and Stochastic Processes	3	1	0	4	25	25	50			MATHS	BASIC SCIENCES
FExxx03*	FE	Elective Foundation	-	-	-	NIL	-	-	-	-	-	-	MANDATORY COURSE
			28 2*			**20**							
2*: The actual weekly load depends upon the elective chosen by the student under FE.													

3.5 COURSE ALLOCATION FOR SEMESTER V

B.Tech. *Computer Science & Engineering (Artificial Intelligence)* **SEMESTER V**															
Course No.	**Type**	**Course**	**L**	**T**	**P**	**Credits**	**Evaluation Scheme (Percentage weights)**					**Offering Dept.**	**AICTE COURSE TYPE**	**Pre-requisite**	
							Theory			**Practical**					
							CA	**MS**	**ES**	**CA**	**ES**			**Code**	**Title**
CACSC14	CC	Principles of Compiler Construction	3	0	2	4	15	15	40	15	15	CSE	PROGRAM CORE	CACSC10	Theory of Automata & Formal languages
CACSC15	CC	Distributed Computing	3	0	2	4	15	15	40	15	15	CSE	PROGRAM CORE	CAECC12	Data Communication
CACSC16	CC	Game Theory and Applications	3	0	2	4	15	15	40	15	15	CSE	PROGRAM CORE	CACSC06	Design and Analysis of Algorithms
CACSC17	CC	Machine Learning	3	0	2	4	15	15	40	15	15	CSE	PROGRAM CORE	CAMTC13	Probability and Stochastic Processes
CACSExx	ED					4									
CACSExx	ED					4									
	EO	Elective Open	-	-	-	4	-	-	-	-	-	-	MANDATORY COURSE		
			28 2*			**28**									
2*: The actual weekly load depends upon the elective chosen by the student under FE. Maximum 28 credits.															

B.Tech. *Computer Science & Engineering (Artificial Intelligence)* **SEMESTER V (Discipline Centric Electives: EDs)**		
Course No.	**Course Name**	**Prerequisite**

CACSE01	**Semantic Web 3 1 0**	**CACSC05**
CACSE02	**Object oriented analysis and design 3 0 2**	**CACSC02**
CACSE03	**Cryptography techniques 3 1 0**	**CACSC01**

3.6 COURSE ALLOCATION FOR SEMESTER VI

B. Tech (CSAI) - Semester - VI															
Course Code	Type	Course	L	T	P	Credits	Evaluation Scheme (Percentage weights)					Offering Dept.	Pre-Requisites Course		Equivalent Course Codes
							Theory			Practical					
							CA	MS	ES	CA	ES		Code	Name	
CACSC18	CC	Deep Learning	3	1	0	4	25	25	50	-	-	CSE	CACSC17	Machine Learning	None
CACSC19	CC	AI Hardware and Tools W/S	2	0	4	4	30	-	20	30	20	CSE			None
CACSC20	CC	High Performance Computing	3	0	2	4	15	15	40	15	15	CSE	CACSC07	Computer Architecture and Organization	COCSC18, CACSC20
ELECTIVE COURSES															
CACSE20	ED	Computer Vision	3	1	0	4	25	25	50	-	-	CSE	CACSC11	Artificial Intelligence	COCSE26,CACSE20
CACSE21	ED	Natural Language Processing	3	1	0	4	25	25	50	-	-	CSE	CACSC11	Artificial Intelligence	CACSE21, COCSE27
CACSE22	ED	Advanced Algorithms	3	0	2	4	15	15	40	15	15	CSE	CACSC06	Design and Analysis of Algorithms	CACSE22, CDCSE23, COCSE23
CACSE23	ED	IOT Systems and the Cloud	3	1	0	4	25	25	50	-	-	CSE	CAECC12	Data Communication	COCSE28, CACSE23
CACSE24	ED	Data Privacy and Security	3	1	0	4	25	25	50	-	-	CSE	CACSC04	Web Technology	CACSE24, COCSE29

3.7 COURSE ALLOCATION FOR SEMESTER VII/VIII

Course Code	Type	Course	L	T	P	Credits	Evaluation Scheme (Percentage weights)					Offering Dept.	Pre-Requisites Course		Equivalent Course Codes
							Theory			Practical					
							CA	MS	ES	CA	ES		Code	Name	
B. Tech (CSAI) - Semester - VII															
ELECTIVE COURSES															
CACSC21	CC	Training	0	0	4	2	-	-	-	40	60	CSE	-	-	
CACSC22	CC	Project-I	0	0	8	4	-	-	-	40	60	CSE	-	-	
B. Tech (CSAI) - Semester - VIII															
CACSC23	CC	Project-II	0	0	16	8	-	-	-	40	60	CSE	-	-	
ELECTIVE COURSES (Semester - VII & VIII)															
CACSE50	ED	Optimization Technique for machine learning	3	1	0	4	25	25	50	-	-	CSE	CACSC17	Machine Learning	
CACSE51	ED	Intelligent Computing	3	1	0	4	25	25	50	-	-	CSE	CACSC11	Artificial Intelligence	
CACSE52	ED	Randomized Algorithms	3	0	2	4	15	15	40	15	15	CSE	CACSC06	Design and Analysis of Algorithms	
CACSE53	ED	Augmented Reality	3	0	2	4	15	15	40	15	15	CSE	CACSC11	Artificial Intelligence	
CACSE54	ED	Knowledge Based System	3	1	0	4	25	25	50	-	-	CSE	CACSC11	Artificial Intelligence	
CACSE55	ED	Human Computer Interface	3	1	0	4	25	25	50	-	-	CSE	CACSC07	Computer Architecture and Organisation	
CACSE56	ED	Pattern Processing using AI	3	0	2	4	15	15	40	15	15	CSE	CACSC11	Artificial Intelligence	
CACSE57	ED	Responsible AI	3	1	0	4	25	25	50	-	-	CSE	CACSC11	Artificial Intelligence	
CACSE58	ED	Multimodal AI	3	1	0	4	25	25	50	-	-	CSE	CACSC11	Artificial Intelligence	

4. SYLLABUS OF COURSES

4.1 SYLLABUS OF FOUNDATION COMPULSORY COURSES

Course No.	Title of the Course	Course Structure	Pre-requisite
FCMT001	**Mathematics - I**	**3L - 1T - 0P**	**None**

COURSE OUTCOMES (COs):

1. Analyze and test Infinite Series and its convergence,
2. Successive differentiation and expansion of the function,
3. Curvature and Radius of Curvature in different coordinate systems,
4. Applications of definite integral,
5. Consistency of system of equations, Eigenvalue and Eigenvector.

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	-	-	-	-
CO 2	3	2	2	2	2	-	-	-	-	-	-	-
CO 3	3	2	2	2	2	-	-	-	-	-	-	-
CO 4	3	2	2	2	2	-	-	-	-	-	-	-
CO 5	3	2	2	2	2	-	-	-	-	-	-	-

COURSE CONTENT:

UNIT-I

Infinite Series: Tests for convergence of series: p-series (with proof), Comparison of ratios, Ratio, Integral, Raabe's, Logarithmic and Cauchy's nth root (all tests without proofs), Alternating series, Absolute convergence, Conditional convergence. Function of Single

UNIT-II

Variable: Hyperbolic functions, inverse hyperbolic function, successive differentiation, Leibniz theorem, Taylor's and Maclaurin's theorems (without remainder terms).

UNIT-III

Curvature: Polar Curves, Differential coefficients of length of arc, Cartesian, polar and parametric forms, pedal equation, Angle between tangent and radius vector, Curvature and Radius of Curvature in Cartesian, polar and pedal forms.

UNIT-IV

Applications of definite integral: Asymptotes (in Cartesian), elementary knowledge of curve tracing, area, length, surface area and volume of revolution (in Cartesian, parametric and polar co-ordinates).

UNIT-V

Matrices: Elementary row transformation, Rank of matrix, consistency and inconsistency of system of simultaneous equations, solution of non-homogeneous and homogeneous equations, Eigenvalue and Eigenvector, Characteristic equation, Cayley-Hamilton theorem. Modal matrix

SUGGESTED READINGS:

1. Calculus and Analytic Geometry by G.B. Thomas (Pearson Education)
2. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Publication)
3. Advanced Engineering Mathematics by Michael Greenberg (Pearson Education)
4. Advanced Engineering Mathematics by R. K. Jain and S.R.K. Iyenger (Narosa Publication)
5. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication)

Course No.	**Title of the Course**	**Course Structure**	**Pre-requisite**
FCCS002	**Computer Programming**	**3L - 0T - 2P**	**None**

COURSE OUTCOMES (COs):

1. To understand the basic terminology and program structures used in computer programming to solve real world problems.
2. To understand the need for continuing to learn new languages to solve complex problems in different domains.
3. To learn the process of representing problems and writing, compiling and debugging programs.
4. To develop programming skills in using different types of data, decision structures, loops functions, pointers, data files and dynamic memory allocation/de-allocation.
5. To be able to code using Procedural and Object-Oriented languages.

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	-	-	-	-
CO 2	3	2	2	2	2	-	-	-	-	-	-	-
CO 3	3	2	2	2	2	-	-	-	-	-	-	-

CO 4	3	2	2	2	2	-	-	-	-	-	-
CO 5	3	2	2	2	2	-	-	-	-	-	-

COURSE CONTENT:

UNIT-I

Basics of C: Basic features of C Language like Identifier, Keywords, Variable, data types, Operators and Expression, basic screen and keyboard I/O, Control Statements, iteration, nested loops, Enumerated data types, bitwise operators, C Preprocessor statements. [6 hours]

UNIT-II

Arrays and Pointers: One and multidimensional dimensional arrays, strings arrays, operations on strings, Array and Pointers, Pointer to Pointer, other aspect of pointers, User Defined Data Types: Structures, Unions. [6 hours]

UNIT-III

Functions: Concept of modular programming, Using functions, Scope of data, Recursive functions, Pointers and functions, Command line arguments.

Files: Types of files, working with files, usage of file management functions. [6 hours]

UNIT-IV

Overview of Object Oriented Programming: Python Programming, Concepts and Terminology. Data Types and Collection Data Types: Identifiers and keyword, Integral types floating point types, operations and formatting, Sequence types, Tuples, named Tuples, lists, set Types, sets, frozen sets, mapping types, Dictionaries, Iterating and Copying collections iterators and interactable operations and functions copying collection.

Central Structures and Functions: Conditional branching, looping, Exception handling catching and raising exceptions, custom exceptions custom functions, Names and Docstrings, Argument and Parameter unpacking, Accessing variables in Global scope, lambda functions. [9 hours]

UNIT-V

Modules and Packages: Packages, custom modules, overview of python's standard library, string handling, mathematics and Numbers, Times and dates, File formats, Data persistence.

File Handling: Writing and Reading binary data, raw binary data, compression, parsing text files, Random Access binary files, generic binary record file class.

[9 hours]

Guidelines for practical work:

Programs based on concepts of above languages.

SUGGESTED READINGS:

1. B. W. Kernighan and D.M. Ritchie, "The C programming language", Prentice Hall.
2. Herbert Schildt and Tata McGraw Hill, "The Complete Reference".
3. O Reilly Learning Python
4. Programming in Python 3: A Complete Introduction to the Python Language Pearson by Mark Summerfield

Course Type	Title of the Course	Credits	Course Structure	Pre-Requisite
FCEC003	**ELECTRONICS AND ELECTRICAL ENGINEERING**	**4**	**3-0-2**	**None**

Course Outcomes:

1. To understand the basics of AC and DC circuits, transformers along with DC generator and motor
2. To analyze series-parallel RLC circuits and
3. To implement basic circuits using diodes, BJTs and op-amps as circuit elements
4. To get familiarized with OP-AMP and its applications
5. To develop circuits using basic electrical and electronic components

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11
CO 1	3	2	2	2	2	-	-	-	-	-	-
CO 2	3	2	2	2	2	-	-	-	-	-	-
CO 3	3	2	2	2	2	-	-	-	-	-	-
CO 4	3	2	2	2	2	-	-	-	-	-	-
CO 5	3	2	2	2	2	-	-	-	-	-	-

COURSE CONTENT

Unit-I

Electric Circuits: Basic Circuit Elements, Nodal and Loop Analysis,

Superposition, Thevenin's Theorem & Norton's Theorem and Maximum Power Transfer Theorem;

Unit-II

Steady-state analysis of AC circuits: Sinusoidal and phasor representation of Voltage and current, single phase AC circuit, behavior of R, L and C

Combination of R, L and C in series and parallel, Resonance; Introduction to three-phase circuits, Star-Delta Transformation

Unit-III

Transformers: Principle of operation and construction of single-phase transformer, Introduction to DC Motor.

Electronics Devices and Circuits: Junction Diode, Applications: rectifiers, clipping and clamping circuits, LEDs;

Unit-IV

Bipolar-junction Transistor: Physical operation, operating point, load-line, Self-bias circuit, single-stage CE amplifier configuration

Ideal op-amp, inverting, non-inverting and unity gain amplifiers, integrator, differentiator, summer/subtractor.

Unit-V

Digital circuits- Boolean Algebra, logic gates, K-Maps upto 4-variables, Combinational circuits: Adders and subtractors.

Flip-Flops: SR, JK, D, T and their characteristic tables. Introduction to Sensors, Introduction to Embedded Computers.

List of experiments for Electrical and Electronics Engineering

1. Verification of Maximum Power Transfer theorem
2. Verification of Thevenin's and Norton's theorems
3. Study of resonance in series RLC and parallel RLC circuits
4. Analysis of step-up and step-down transformer

5. Implement of series RC circuit as differentiator and integrator. Also perform their analysis as low pass and high pass filters
6. Implementation of clipping and clamping circuits
7. Implementation of half-wave and full wave rectifier circuits
8. Application of LEDs in electronic circuits
9. Implementation of CE amplifying configuration. Plot gain vs frequency graph
10. Implementation of Adders and subtractors.
11. Implementation of JK and Toggle flip-flops. Subsequently implement 3-bit asynchronous up-counter.
12. Measurement of power in single phase circuits using three voltmeter and three ammeter method.
13. Experiments with common sensors
14. Experiment with embedded computers

Suggested Reading:

1. M.E. Van Valkenburg, "Network Analysis" Pearson publishers, 3rd Edition
2. Boylestad and Nashelsky, "Electronic Devices and Circuit Theory" Pearson publishers, 10th Edition
3. Edward Hughes, "Electrical and Electronic technology", Pearson publishers, 10th Edition
4. Malvino and Leach, " Digital Principles and Applications", TMH publishers, 8th Edition

Course No.	Title of the Course	Course Structure	Pre-Requisite
FCPH004	**Physics**	**3L-0T-2P**	**None**

COURSE OUTCOMESS (CO):

1. Knowing important concepts and phenomena linked to relativity
2. The concept of waves and oscillations are useful for doing analytical and numerical calculations for measurements, observations and gravitational wave communications.
3. The course is helpful to the students in understanding various optical wave phenomena which are required for optical & electromagnetic wave communications and in optical devices.
4. To develop the basic understanding of laser for gaining advance knowledge in the field of optical communication and opto-electronics.
5. The Concepts of Optical Fiber for modern developments in physics which are helpful in designing and developing new devices used in optical communications, medicine, environment, Industries and related physics.

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

COURSE CONTENT:

UNIT-I

Relativity: Special Relativity, Lorentz Transformations, Velocity addition, Time dilation, Length Contraction, Variation of mass with velocity, Mass and energy, Relativistic momentum and relativistic energy, General theory of relativity, Einstein's theory of Gravitation, Gravitational waves, Gravity and Light.

UNIT-II

Oscillations and Waves: Damped and forced oscillations, Sharpness of resonance, Q-factor, Application in resonance, Acoustic waves, Pressure wave equations, Intensity pressure relation, Acoustic impedance, Reflection and transmission of acoustic waves, Impedance matching; Ultrasonics and its applications.

UNIT-III

Optics: Interference: Interference due to thin films, Newton's rings, and determination of the wavelength of sodium light, Interference due to wedge shaped film. Diffraction: Fraunhofer diffraction due to single slit and N Slits, Plane transmission grating, Rayleigh criterion of resolution, Resolving power of a grating, Polarization: Polarization in light, Birefringence, Nicol prism, Quarter and half wave plates, Production and analysis of plane, Circularly and elliptically polarized light, Optical rotation, specific rotation, Polarimeter.

UNIT-IV

Lasers: Absorption and emission of radiation, Main features of a laser, Spatial and temporal coherence, Einstein Coefficients, condition for light amplification, Basic requirement for Laser, Population Inversion - Threshold Condition, Line shape function, Optical Resonators, Three level and four level systems. Classification of Lasers: Solid State Laser-Ruby laser and Gas Laser- He-Ne laser (Principle, Construction and working), Optical properties of semiconductor, Semiconductor laser (Principle, Construction and working), Applications of lasers in the field of medicine, Industry, Environment and Communication.

UNIT-V

Fibre Optics: Need for fiber Optic Communication, Physical nature of Optical fiber, Theory of Light propagation in optical fiber, Acceptance angle and numerical aperture, Step index and graded index fibers, Single mode and multimode fibers, Losses in optical fiber, Optical Fiber cables and bundles, Dispersion in optical fibers: Intermodal and Intramodal dispersion.

List of Experiments:

1. To determine the value of "g" by Bar Pendulum and find the radius of gyration.
2. To determine the wavelength of He-Ne laser.
3. To find the numerical aperture and angle of acceptance of optical fiber.
4. To find the resolving power of a telescope.
5. To find the wavelength of sodium light by Newton's ring.
6. To find the wavelength of sodium light by Biprism.
7. To find the wavelength of Mercury green line by diffraction grating using spectrometer.
8. To find the focal length of combination of two lenses by Nodal slide assembly and verify the formula.
9. To find the specific rotation of canesugar by polarimeter.
10. To find the dispersive power of prism material using spectrometer.

Text Books:

T1 Arthur Beiser, Shobhit Mahajan, `` Concepts of Modern Physics," Mc-Graw Hill

T2 D S Mathur, ``Mechanics," S Chand & co.

T3 N. Subramaniam and Brij Lal, ``A Text Book of Optics," S Chand &Co.

T4 A K Jha "A Text Book of Applied Physics, Volume-1" I.K. International Publishing House.

T5 Indu Prakash, ``A Text Book of Practical Physics, Volume-1," Kitab Mahal Publication.

Reference:

R1 Serwey, Moses, Moyer, ``Modern Physics," Cengage Learning

R2 Jenkins and White, ``Fundamentals of Optics," McGraw Hill

R3 Ajay Ghatak "Optics" McGraw Hill

SYLLABUS OF CORE ENGLISH

Course No.	Title of the Course	Course Structure	Prerequisite
FCHS 005	Core English	3L 0T 2P	None

Course Outcomes

CO 1: Acquire competence in Basic English grammar. Grammatical accuracy, avoiding inappropriacy and using language naturally and confidently

CO 2: Improve in the four integral skills of language and to be able to use language as a tool for effective communication

CO 3: Enable the learner to express and be understood by others with clarity and precision, in both written and spoken forms, minimizing ambiguity and verbosity.

CO 4: Understand creative use of language through translation, articles and paragraph writing.

CO 5: Reading: Encouraging the habit of reading for different purposes and to analyse, paraphrase and read critically.

CO 6: Develop competence in formal Standard English pronunciation and usage

CO 7: Build confidence to use a standard spoken form of English to face job interviews, and workplace interactive situations besides enabling the learner to pursue advanced professional courses.

COs.	**Theory**	**Hours**	**Lab**
1.	1. Vocabulary Enhancement CO 1 1.1 Using a standard dictionary- word spellings, meanings, usage, pronunciation, making sentences 1.2 Word collocations 1.3 Commonly misused words, verbal reasoning 1.4 One word substitutions 1.5 Abbreviations & foreign phrases	4	Lab Activity No 1: Phonetics: Sounds Used in English Language CO 6 Lab Activity No 2: Reading from newspapers/magazines/blogs to build up a repertoire of words CO 5
2.	2. Remedial & Applied Grammar CO1 & CO 2 2.1 Tenses & Voice 2.2 Subject-Verb Agreement	6	Lab Activity No 3: Introducing Oneself: Breaking the Ice CO 5

	2.3Narration,Interrogative structures and Question tags 2.4 Prepositions, Pronouns and Adverbs 2.5 Redundancy 2.6 Idiomatic use of language 2.7 Identification of errors and editing		Lab Activity No 4: Situational & Spontaneous English(tense, registers) through Role Play CO 7 Lab Activity No 5: Question Formation & Mock Press Conference CO 5
3.	3 Techniques of Good Writing CO 5 & CO 2 & 3 3.1Writing self assessment tasks 3.2 Precis writing and note-making. 3.3 Paragraph and Essay writing. 3.4 Article writing and summarizing	10	Lab Activity No 6: Blog Writing/Creating a Newsletter Lab Activity No 7: Script writing & enacting for a street play CO 6
4.	4. Business Communication: CO 4 & CO 3 4.1 Formal and Informal Letter writing 4.2 Statement of Purpose 4.3 Job application & CV (summary statement of academic & professional profiles) 4.4Power point presentations through relevant slides.	10	Lab Activity No 7: Communication at Workplace. Develop negotiating skills by using appropriate language of courtesy Lab Activity No 8: Recording individual efforts and holding paired interactions and Group Discussions Lab Activity No 9: Preparing and practising for Interviews. CO 7

5.	5.Written Comprehension CO 3 & 4 5.1 The ability to write after listening to and reading select speeches, news bulletins, presentations and answering questions based on what has been heard. 5.2 Reading the given texts to skim, scan, infer and answer comprehension questions. 5.3 Reading texts like case studies and project reports for critical assessment. 5.4 Book Review	10	Lab Activity No 10:)Introduction to Podcast and Understanding Audio texts Lab Activity No 11: Declamation and/or speeches Lab Activity No 12: Reading, GD and presentation based on listed texts CO 7

Course No	Title of the Course	Course Structure	Pre-Requisite
FCME006	Basics of Mechanical Engineering	L-T-P: 4-0-0	None

COURSE OUTCOMES (COs)

After completion of this course, the students are expected to be able to demonstrate the following knowledge, skills and attitudes:

1. To know force, its nature and applications.
2. To know the basic principles of civil and mechanical structures.
3. To understand the fundamentals of thermodynamics and fluid mechanics.
4. To know the working principles of IC Engines.
5. To understand the importance of different engineering materials.
6. To understand the different manufacturing processes and machining operations.
7. To know the use of Automation in manufacturing.

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11
CO 1	3	2	2	1	1	-	-	-	-	-	-
CO 2	3	2	2	1	1	-	-	-	-	-	-
CO 3	3	2	2	2	2	1	-	-	-	-	-
CO 4	3	2	2	2	2	1	-	-	-	-	-
CO 5	3	2	2	2	2	1	-	-	-	-	-
CO 6	3	2	2	2	2	1	-	-	-	-	-
CO 7	3	2	2	2	2	1	-	-	-	-	-

COURSE CONTENT

Group A

Unit-I

Introduction to Engineering Mechanics: Rigid and Elastic bodies, Force and its type, Law of parallelogram of forces, Triangle law of forces, Polygon law of forces, Lami's theorem, Laws of motion, Moment, Couple, Varignon's theorem, Conditions of equilibrium, Concept of free body diagram, Coulomb's friction, Plane trusses, Analysis of trusses, Numerical problems. (6 Hours)

Unit-II

Introduction to Strength of Materials: Simple stresses and strains, Direct, shear, and volumetric stresses and strains, Hooke's law, Tension test, Elastic constants, Poisson's ratio, Factor of safety, Introduction to beam, Types of beams, Types of loads, Shear force and bending moment diagrams (SFD and BMD) for Simple and Cantilever beams under various loading conditions, Numerical problems. (6 Hours)

Unit-III

Introduction to Manufacturing Engineering: Classification and use of engineering materials, Basic principles and applications of methods of manufacturing such as casting, forming and joining; Working principles and applications of machining operations such as Turning, Thread cutting, Milling, Shaping, Grinding, etc., Use of automation in manufacturing. (6 Hours)

Group B

Unit-IV

Introduction to Thermodynamics: Thermodynamic system, Cycle, Path, Thermodynamic properties, Extensive and intensive properties, Thermodynamic equilibrium, Reversible and irreversible processes, isochoric, Isothermal, Isobaric, Isentropic and Polytropic processes, First

law of thermodynamics applied to a cycle and process, Kelvin-Planck and Clausius statements of Second law of thermodynamics, Carnot cycle, Entropy, Clausius inequality, Internal combustion (IC) engines, IC engines terminology, Spark ignition (SI) and Compression ignition (CI) engines, Two and four stroke engines, Air standard cycles such as Otto, Diesel, Dual and Brayton cycles, Numerical problems. (12 Hours)

Unit-V

Introduction to Fluid Mechanics: Properties of a fluid, Density, Specific volume, Specific weight, Specific gravity, Kinetic and Kinematic viscosity, Pascal's law and its applications, Laminar and turbulent flow, Use of continuity equation and Bernoulli's equation, Numerical problems. (6 Hours)

SUGGESTED READINGS

1. Engineering Mechanics- Beer and Johnston, Pearson
2. Strength of Materials- D.K. Singh, CRC Press
3. Engineering Thermodynamics- Nag, McGraw-Hill
4. Fluid Mechanics- Cengel, McGraw-Hill
5. Fundamentals of Manufacturing Engineering- D.K. Singh, CRC Press

Course No.	Title of the Course	Course Structure	Pre-Requisite
FCMT007	**Mathematics II**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO)

1. Ordinary Differential Equations,
2. Partial Derivatives, Maxima and Minima for functions of two or more variables,
3. Evaluation of double and triple integral,
4. Concept of Numerical Methods and its Applications,
5. Concept of Probability and Statistics and its Applications.

COURSE CONTENT:

UNIT-I Ordinary Differential Equations:
Second & higher order linear differential equation with constant coefficients, general solution of homogenous and non-homogenous equations, Euler-Cauchy equation, Series solution by Frobenius method.

UNIT-II Function of Several Variables:
Partial Derivatives, Euler's Theorem, Total differentiations, Change of Variables, Jacobian and its basic properties, Taylor's theorem, Maxima and Minima for functions of two or more variables, Lagrange's method of undetermined multipliers.

UNIT-III Multiple Integrals:

Evaluation of double integral (in Cartesian and polar co-ordinates), change of order of integration, change of variables. Triple integral (in Cartesian) and its applications. Gamma and beta function.

UNIT-IV Numerical Methods:
Solution of system of linear equations using Gauss elimination method, LU decomposition method Gauss Seidel iteration method, Solution of polynomial and Transcendental equations by Newton-Raphson method, Numerical Integration by trapezoidal rule and Simpson's 1/3 and 3/8 rule, Numerical Solutions of first order ordinary differential equations: Euler's method, Runge-Kutta method of fourth order.

UNIT-V Probability and Statistics:
Conditional probability, Random Variables, Probability distribution functions-binomial, Poisson, exponential, uniform and normal distributions; Correlation, rank correlation and regression analysis; Sampling Theorem.

Recommended Books:

1. Calculus and Analytic Geometry by G.B. Thomas (Pearson Education)
2. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Publication)
3. Advanced Engineering Mathematics by Michael Greenberg (Pearson Education)
4. Advanced Engineering Mathematics by R. K. Jain and S.R.K. Iyenger (Narosa Publication)
5. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication)
6. Probability and Statistics for Engineers by Anthony J. Hayter (Cengage Learning)
7. Numerical Methods for Scientific and Engg. Computations by M. K. Jain, S. R. K. Iyenger and R. K. Jain, (Wiley Eastern Ltd.)

4.2 FOUNDATION ELECTIVE COURSES

4.2.1 LIST OF FOUNDATION ELECTIVES

Table 3: FOUNDATION ELECTIVES

Code	Name of Foundation Elective	L T P Allocation			Evaluation Scheme Theory Practical					Pre-Requisites
		L	T	P	CA	MS	ES	CA	ES	
FEPD001	Sports-I	0	0	4	-	-	-	100	-	None
FEPD002	Sports-II	0	0	4	-	-	-	100	-	FE001
FEPD003	NSS	0	0	4	-	-	-	100	-	None
FEPD004	NCC	0	0	4	-	-	-	100	-	None
FEMG005	Corporate Social	2	0	0	100	-	-	-	-	None

	Responsibility									
FEPD006	Music	0	0	4	-	-	-	100	-	None
FEHS007	Basic of social sciences	2	0	0	100	-	-	-	-	None
FEHS008	Spoken Skills in English	0	0	4	-	-	-	100	-	None
FEMG009	Financial Literacy	2	0	0	100	-	-	-	-	None
FEHS010	Introduction to Ethics	2	0	0	100	-	-	-	-	None
FEHS011	Stress Management	1	0	2	50	-	-	50	-	None
FEHS012	Organizational Behavior	2	0	0	100	-	-	-	-	None
FEPD013	Theatre	0	0	4	-	-	-	100	-	None
FEPD014	Dance	0	0	4	-	-	-	100	-	None
FEPD015	Yoga	0	0	4	-	-	-	100	-	None
FEPD016	Digital Film Making	0	0	4	-	-	-	100	-	None
FEPD017	Workshop (Electrical and Mechanical)	0	0	4	-	-	-	100	-	None
FEHS018	Ethical Decision Making	2	0	0	100	-	-	-	-	None

4.2.2 SYLLABI OF FOUNDATION ELECTIVES

Course No.	**Title of the Course**	**Course Structure**	**Pre-Requisite**
FEPD001	**Sports-I**	**0L-0T-4P**	**None**

COURSE OUTCOMES (CO):

To evolve a higher education system that is suitability blended with provision for knowledge values and skill practice where every student learns in without sacrificing his/her creativity.

COURSE CONTENT: (Any 2 out Of 5 Components)

A. INTRODUCTION TO PHYSICAL EDUCATION IN THE CONTEMPORARY CONTEXT (Any Two)

1. Learn and demonstrate the technique of Suryanamaskar.
2. Develop Physical Fitness through Calisthenics / Aerobics / Circuit-Training / Weight-Training and demonstrate the chosen activity.
3. Select any one game available in the college and learn different techniques involved in its play

B. CORE PHYSICAL EDUCATION-: FITNESS, WELLNESS AND NUTRITION (Any Two)

1. Measurement of Fitness Components – Leg-raise for Minimal Strength (Muscular Strength); Sit-ups Muscular Endurance); Harvard Step Test, Run and Walk Test (Cardiovascular Endurance); Sit and Reach Test (Flexibility)
2. Measuring height, weight, waist circumference and hip circumference, Calculation of BMI (Body Mass Index) and Waist-Hip Ratio
3. Engage in at least one wellness programme and write a report on it.

C. CORE PHYSICAL EDUCATION-: POSTURE, ATHLETIC CARE AND FIRST AID (Any Two)

1. Demonstrate Stretching and Strengthening Exercises for Kyphosis, Scoliosis, Lordosis, Knock Knees, Bow Legs, Flat Foot, Back Pain and Neck Pain
2. Illustration and Demonstration of Active and Passive Exercises
3. Asanas with Therapeutic Value (Any five asanas): Karnapeedasana, Padmasana, Dhanurasana, Sarvangasana, Paschimottanasana, Chakrasana, Halasana, Matsyasana, Ardhmatsyendrasana, Usthrasana, Mayurasana, Shirshasana, Vajrasana.
4. Practice P.R.I.C.E. in First Aid.

D. SPORTS ADMINISTRATION & MANAGEMENT (Any Two)

1. Demonstration of Supervision activities in Sports Management.
2. Demonstration of skills of Management.
3. Demonstration of fixtures of various kinds in sports competitions.
4. Demonstration of technical and non-technical purchase procedure.

E. Adventure Sports and Leadership Training

SUGGESTED READINGS:

1. Graham, G., ``Teaching Children Physical Education: Becoming a Master Teacher. Human Kinetics," Champaign, Illinois, USA.
2. Corbin, C. B., G. J. Welk, W. R Corbin, K. A. Welk, ``Concepts of Physical Fitness: Active Lifestyle for Wellness," McGraw Hill, New York, USA.
3. Anspaugh, D.J., G. Ezell and K.N. Goodman, `` Teaching Today Health," Mosby Publishers
4. Beotra, Alka, ``Drug Education Handbook on Drug Abuse in Sports," Applied Nutrition Sciences, Mumbai.
5. Ammon,R., Southall , R.M. and Blair, D.A., ``Sports Facility Management, "West Virginia, USA: Fitness Information Technology Publishers

Course No.	Title of the Course	Course Structure	Pre-Requisite
FEPD002	Sports-II	0L-0T-4P	FE001

COURSE OUTCOMES (CO):

To evolve a higher education system that is suitability blended with provision for knowledge values and skill practice where every student learns in without sacrificing his/her creativity.

COURSE CONTENT:

(Any 3 out Of 5 Components)

A. Sports for all (Any Two)

1. To participate in any intramural Tournaments (one team game and one Individual Game) of choice.
2. To participate/ attend at least 15 hours in Fitness training at Field or at Gymnasium.
3. Participate in at least one track and one field event on Annual Sports day.
4. To participate in Inter College Tournament

B. Skill Enhancement Courses (any one out of three)

1. Wellness and Fitness
2. Holistic personality Development
3. Sports Journalism
4. Mass demonstration Activities

C. MEDIA AND CAREERS IN PHYSICAL EDUCATION (Any Two)

1. Organize an event / intramural / tournament in your college.
2. Prepare a News Report of an observed Sports competition.
3. Create a presentation on any topic from Physical Education using an audio-visual aid.
4. Demonstrate Warming-up / Conditioning / Cooling-down exercises.

D. MANAGEMENT OF AEROBICS & GROUP TRAINING (Any Two)

1. Measurement of Fitness Components – Leg-raise for Minimal Strength (Muscular Strength); Sit-ups (Muscular Endurance); Harvard Step Test or Run and Walk Test (Cardiovascular Endurance); Sit and Reach Test (Flexibility)
2. Measurement of Pulse Rate / Heart Rate at Radial Artery and Carotid Artery, Calculation of Target Heart Rate
3. Developing a 5-10 minute routine of aerobics with appropriate music for each component of health related physical fitness

E. SPORTS INDUSTRY & MARKETING (Any Two)

1. Identify an issue or a trend in the sports industry: o Players in professional or college sports o Ownership
2. Marketing Plan: Environmental Factors and Product Plan Draft, Paper bibliography/works cited.
3. Sponsorship proposal
4. Developing a budget plan for an event
5. Athlete branding

SUGGESTED READINGS:

1. Covey, S. , `` 7 Habits of Highly Effective People, '' Covey Publications, USA
2. Magill, R.A., `` Motor Learning and Control: Concepts and Applications,'' McGraw Hill Publication.
3. Masteralexis, L.P., C. Barr and M. Humms, ``Principles and Practices of Sport Management,'' Jones and Bartlett Publisher

4. Bishop, J.G., ``Fitness through Aerobics,'' Benjamin Cummings USA.
5. Brown K.M., `` Physical Activity and Health: An Interactive Approach,'' Jones and Bartlett Publisher
6. Cornwell. T.B, `` Sponsorship in marketing: Effective communications through sports, arts and events, '' Routledge Publishers
7. DeGarris, L., ``Sports Marketing: A Practical Approach,'' Routledge Publishers, USA

Course No.	Title of the Course	Course Structure	Pre-Requisite
FEPD003	**National Service Scheme (NSS)**	**0L-0T-4P**	**None**

COURSE OUTCOMES (CO):

1. Develop among them a sense of social and civic responsibility;
2. Utilize their knowledge in finding practical solution to individual and community problems;
3. Identify the needs and problems of the community and involve them in problem solving process;
4. Utilize their knowledge in finding practical solution to individual and community problems;
5. Develop capacity to meet emergencies and natural disasters

COURSE CONTENT:

Unit-I

Introduction to NSS: Orientation and structure of NSS, History of Social Reforms in Modern India: Brahmo Samaj, Arya Samaj, Satya Shodhak Samaj: Principles and Functions

Unit-II

Regular activities: Distribution of working hours- association between issues and programs- community project- urban rural activities, association- modes of activity evaluation

Unit-III

concept of society- development of Indian society: Features- Division of labors and cast system in India; Features of Indian constitution; Provisions related to social integrity and development

Unit – IV

N.S.S. Regular Activities
A) College campus activities
B) N.S.S.activities in Urban and Rural areas
C) Role of Non-Government Organisation (NGO) in social Reforms
i) Red Cross
ii) Rotary

SUGGESTED READINGS:

1. National Service Scheme Manual, Govt. of India
2. Training Programme on National Programme scheme, TISS.
3. Orientation Courses for N.S.S. programme officers, TISS.
4. Ram Ahuja, ``Social Problems in India,'' Rawat Publication.

5. History of Social Reforms in Maharashtra, Ed. J. Y. Bhosale, S. U. Kolhapur

Course No.	Title of the Course	Course Structure	Pre-Requisite
FEPD004	**National Cadet Corps (NCC)**	**0L-0T-4P**	**None**

COURSE OUTCOMES (CO):

1. Develop among them a sense of social and civic responsibility;
2. Utilize their knowledge in finding practical solution to individual and community problems;
3. Identify the needs and problems of the community and involve them in problem solving process;
4. Utilize their knowledge in finding practical solution to individual and community problems;
5. Develop capacity to meet emergencies and natural disasters.

COURSE CONTENT:

UNIT I:

Introduction to NCC, National Integration & Awareness: Religions, Culture, Traditions and Customs of India, National Integration: Importance and Necessity, Freedom Struggle.

UNIT II:

Adventure Training: – Obstacle course, Slithering, Trekking, Cycling, Rock Climbing, Para Sailing, gliding, Scuba Diving- methods and use.

UNIT III:

Environment Awareness and Conservation: Natural Resources – Conservation and Management. Water Conservation and Rainwater Harvesting

UNIT IV:

Personality Development and Leadership: Introduction to Personality Development, Factors Influencing /Shaping Personality: Physical, Social, Physiological, Philosophical and Psychological, Self-Awareness Know yourself/ Insight, Change Your Mind Set, Communication Skills: Group Discussion / Lecturettes (Public Speaking), Leadership Traits, Types of Leadership

SUGGESTED READINGS:

1. Bhogle Anita & Bhogle Harsha, ``The Winning way, Learning from sports for managers,'' Westland Publications
2. Sharma Robin, `` The leader had no title, '' Simon and Schuster Ltd.

Course No.	Title of the Course	Course Structure	Pre-Requisite
FEMG005	**Corporate social responsibilities**	**2L-0T-0P**	**None**

COURSE OUTCOMES (CO):

1. The course will help students to understand corporate and emerging social responsibility for the corporate in reference to India and global situation
2. The course will support students to prepare themselves to work with corporate understanding collective aspiration of the society, individual and corporate social responsibility.

COURSE CONTENT:

UNIT I: Corporate social responsibility in Indian context and International: CSR – Definition, concepts, Approaches of CSR, overview of corporate social responsibility and corporate social accountability, SR Tools, National and International CSR activities, corporate philanthropy, drivers of CSR, difference between corporate governance, corporate philanthropy and CSR

UNIT II: Business ethics and corporate social responsibility: Concept of business ethics – meaning, Importance and factors influencing business ethics. Corporate Governance – meaning, significance, principles and dimensions. Ethical decision – making in different culture, consumer protection, environment protection, gender issues in multiculturalism, ethics and corruption, ethics and safety. Business benefits of CSR

UNIT III: Legislative measures of CSR: Corporate, labor, stake holders, Environmental and pollution. Social Accounting, Social Auditing, SA: 8000 and Corporate Social Reporting.

SUGGESTED READINGS:

1. Harsh Srivastava,`` The business of social responsibility,” books for change
2. CV. Baxi and Ajit Prasad,`` Corporate social responsibility – concepts and cases,” Excel Books
3. Dr. M. Mahmoudi,`` Global strategic management,” Deep & Deep Publications Pvt. Ltd.
4. S K. Bhatia,`` International Human resource management – Global perspective,” Deep & Deep Publications Pvt. Ltd.
5. J.P. Sharma, ``Governance, Ethics and Social responsibility of business, ‘’ Ane books Ltd.
6. Kotler Philip and Lee Nancy, `` Corporate social responsibility; doing the most good for your company,” John Wiley
7. Simpson, Justine and Taylor, John R, `` Corporate Governance Ethics and and CSR,” Kogan Page Publishers

Course No.	Title of the Course	Course Structure	Pre-Requisite
FEPD006	**Music**	**0L-0T-4P**	**None**

COURSE OUTCOMES (CO):

The student will be familiarized with the basic terms used in Indian classical music. Also it familiarizes with the life history of some dignitaries in the field of music. This course also throws some light on the ancient music and its origins in India.

COURSE CONTENT:

Unit 1: Study of the following terms: - Mela (Thāt), ĀshrayRāga, Rāga, Lakshana, Shruti, Alankar, Gamak, Vadi-SamvādiAnuvādi-Vivādi, VakraSwara, Varjit-Swara.

Unit 2: Biographies & contributions of the following: - Jaidev, MansinghTomar, Abdul Karim Khan, Tyagaraja, Pt. Bhatkhande, Pt. Ravi Shankar

Unit 3: Study of following Rāgas&TālaRāga- Yaman, Jaunpuri, Khamaj. Tāla- Ektāl, Jhaptāl

Unit 4: Genaral discussion and definition of the following: -
a. Khyāl, MaseetKhani – Razakhani gat, Dhrupad, Tarana, Meend, Soot, Murki, Kan, Khatka, Krintan, Harmony, Melody.
b. Writing of Bhatkhande Swarlipi Paddhati.
c. Writing of Tālasand Compositions in Notation.
d. Detailed study of Rāgas (Rāga- Bihag, Malkauns, Vrindavani Sarang) and comparative study of Rāgas.
e. Essay, Shastriya Sangeet (Classical Music) & SugamSangeet(Light Music)

Unit 5: Vedic Music – Samvedic Sangeet, Swara, Vadya, Bhakti, Vikār. General study of Natyashastra, SangeetRatnakar.

SUGGESTED READINGS:

1. Vasant and Laxmi Narayan Garg,`` Sangeet Visharad," Sangeet Karyalay
2. Sarat Chandra Pranjpayee and Chowbhamda ,`` BhartiyaSangeetkaItihas," Surbharti Prakashan
3. Bharat Muni,`` NatyaShastra,"
4. Sharangdeva ,`` SangeetRatnakar,"
5. Sharad Chandra Pranjpayee ,`` Sangeet Bodh,"
6. Thakur Jaidev Singh ,`` Indian Music," Sangeet research academy
7. V. N. Bhatkhande,`` Mallika Part II & III," KramikPustak.

8. V. N. Patwardhan,`` RaagVigyan,"
9. RaginiTrivedi,`` Ragvibodha Mishrabani, Vol. I & II,"

Course No.	Title of the Course	Course Structure	Pre-Requisite
FEHS007	**Basics of Social Sciences**	**2L-0T-0P**	**None**

COURSE OUTCOMES (CO):

Social science is a major category of academic disciplines, concerned with society and the relationships among individuals within a society. It in turn has many branches, each of which is considered a "social science".

COURSE CONTENT:

Unit I: Economics, political science, human geography, demography and sociology.

Unit II: Humanities, anthropology, archaeology, jurisprudence, psychology, history, and linguistic.

Unit III: Political science, economics, sociology, international politics and scientific methodology.

SUGGESTED READINGS:

1. A.C. Kapoor, "Principles of Political Science," S. Chand Publications
2. A.K. Sharma, "Issues in Social Demography," Mittal Publications
3. Kathy S. Stolley, "The Basics of Sociology," Greenwood Press.
4. Paul M. Muchinsky ,"Psychology Applied to Work," Thomson Learning Inc

Course No.	Title of the Course	Course Structure	Pre-Requisite
FEHS008	**Spoken Skills in English**	**0L-0T-4P**	**None**

COURSE OUTCOMES (CO):

1. This course will focus on oral & presentation skills of students with practice sessions in the language lab.
2. This course will develop confidence building in oral skills of learners.
3. It will seek to encourage the day to day conversations/dialogues and communicative needs of learners with ample practice in the lab.
4. The theory class will boost practice in ample language exercises to encourage oral skills.

5. This will also involve practice sessions in interview skills, group discussions & pair work.
6. Basics of communication process, Barriers to Oral Communication
7. Elevator pitches - Practicals

COURSE CONTENT:

1. Practice on listening and reading comprehension
2. Language lab practice for group discussion and interviews
3. Definition and discussion on communication & the barriers in communication with practical training to use language as a tool for sharing, discussing, handling and convincing others.

SUGGESTED READINGS:
Everyday English I & II Cambridge University Press/Foundation books

Course No.	Title of the Course	Course Structure	Pre-Requisite
FEMG009	**Financial Literacy**	**2L-0T-0P**	**None**

COURSE OUTCOMES (CO):

1. To provide in-depth knowledge of the banking and Principles of Investment, financial planning.
2. Help students in understanding stocks, sell strategy, mutual fund options, investing in education, planning for the future, purchasing your first home, taxes and tax planning, life insurance options, health insurance, property insurance, estate planning, and keeping money in perspective.

COURSE CONTENT:

UNIT I: Banking- Definition, Role of Bank in growth of saving and Investment, Types of banks , Services offered by banks, Deposits and Loans, Types of A/c, Opening a bank A/c, How to Transact with banks, KYC norms, (A/c opening form, Address Proof), How to read bank statement, Banking products and services, Calculating Interests – Saving, FD, Simple and Compound Interest, Power of compounding Loans, Types of loans, taking a home loan, Definition of EMI, Calculation of EMI, Post office-Account and transactions, Basic of foreign Exchange, Importance and Use of Foreign Exchange, Regulator Role of RBI, mutual funds.

UNIT II: Investment: Principles of Investment – Safety, Liquidity and Return, Investment plans, Hybrid plans-Ulip, SIP and VIP of mutual funds, index funds

UNIT III: Financial Planning- Meaning, Household financial health checkup, Important life stages, Medical and other Emergencies, ; Insurance, Meaning, Need and Wants, Loss protection, Life, non-life and health, Benefits of Insurance, Term plans, Social obligations Budgeting, Buying a house, Plan

a vacation, Retirement planning, Price of procrastination, Market and financial instruments, Primary market, Secondary market, Financial Statement analysis,

UNIT IV: Scams, Fraud Schemes-Insider trading, Money laundering; Consumer protection and redressal mechanism, Rights of Consumers, Applicable to financial services, Filing a complaint, Complain to entity concerned, Regulators, Arbitration, Consumer courts, Govt. Websites-(PG Portals), Investor Associations, Taxes, Meaning, Need of Taxes, Types of taxes, How taxes impact income, Income, wealth and gift tax, Service tax, STT, Stamp Duty, Tax planning v/s tax evasion, Tax rates, Tax free bonds, Tax saving investment

SUGGESTED READINGS:

1. Braunstein, Sandra, and Carolyn Welch, `` Financial literacy: An overview of practice, research, and policy," Fed. Res. Bull.
2. Cole, Shawn A., and Gauri Kartini Shastry,`` Smart money: The effect of education, cognitive ability, and financial literacy on financial market participation," Harvard Business School, 2009.
3. Study material of NSE.
4. Gitman, joehnk and Billingsley, ``Personal financial planning," Cengage Learning
5. Madura Jeff,`` Personal finance student edition," Prentice Hall PTR.

Course No.	Title of the Course	Course Structure	Pre-Requisite
FEHS010	**Introduction to Ethics**	**2L-0T-0P**	**None**

COURSE OBJECTIVES (CO):

1. It is aimed to comprehend right from wrong, to act upon something tricky with a deliberative analysis.

Course Outcomes:

2. Helps in addressing issues with a moral reasoning and analysis.

COURSE CONTENT:

1. Fundamentals of Ethics
2. Issues in Moral Philosophy
3. Theories of Justice and their Applications
4. Ethical Decision Making
5. Applied Ethics
6. Media Ethics
7. Environmental Ethics
8. Technology & Ethics
9. Feminism

SUGGESTED READINGS:

Course No.	Title of the Course	Course Structure	Pre-Requisite
FEHS011	**Stress Management**	**1L-0T-2P**	**None**

COURSE OBJECTIVES (CO):

The objective of this course to help the students to understand the nature of stress, sources of stress and to identify the symptoms of stress through first unit. Second Unit aims to teach the students to learn certain skills and the strategies required for effectively managing the stress and ability to cope up from the stressful situations.

COURSE OUTCOMES (CO):

1. To understand the nature, sources of stress and consequences of stress
2. To overcome from the constraints in managing stress
3. To develop the motivation to adopt different technology

COURSE CONTENT:

UNIT I: Stress (GAS Model), Learning about sources of stress and its symptoms: Nature of stress- various sources of stress environmental, social (including social media), physiological and psychological; Symptoms of stress - emotional response, physiological & behavioral; relationship between stress and performance, relationship between stress and health

UNIT II: Learning to manage stress effectively: Methods - yoga, meditation, Vipassana,
relaxation techniques, clarifying problem, alternate actions, support (Problem focused) emotion focused constructive approach, Indian Case Studies

Practical: (50 marks)

Any two practical's based on Unit I and II

SUGGESTED READINGS:

1. DiMatteo, M.R. & Martin, L.R.(2002). Health psychology. New Delhi: Pearson. Neiten, W. & Lloyd, M.A (2007). Psychology applied to Modern life. Thomson Detmar Learning .
2. Taylor, S.E. (2006). Health psychology, 6th Edition. New Delhi: Tata McGraw Hill

Course No.	Title of the Course	Course Structure	Pre-Requisite
FEHS012	**Organizational Behavior**	**2L-0T-0P**	**None**

COURSE OUTCOMES (CO):

1. The course aims at providing a comprehensive understanding of organization (structure and culture) and its functioning, at the levels of the individual, group and organization as a whole.
2. To acquaint the students with employee motivation and work attitudes and its relationship with performance and productivity.

3. To help students gain insights into the concept of organization change in the context of ever changing business environment and provide them with various tools of organizational development.
4. To provide students an overview of organizational dynamics in the light of power, politics and stress.

COURSE CONTENT:

Unit 1: Understanding Organizational Behavior: Defining organization and Organizational Behavior (OB), OB Model; the Organizational structure; Common Organizational Designs; New Design Options

Unit 2: Employee Attitudes and Motivation: Job Satisfaction; Organizational Commitment; Organizational Citizenship behavior; Positive Organizational Behavior (POB):
Theories of Work motivation: Content theory (Maslow, Herzberg), Process theory (Vroom's Expectancy Theory, Equity Theory), Contemporary theories (Goal Setting theory and Self-Regulation theory)

Unit 3: Dynamics of Organizational Behavior: Organizational culture; Power and Politics: Influence, sexual harassment, organizational politics, Causes & Consequences of stress at the workplace:

Unit 4: Organizational change and development: concept of organizational change, model of organizational change (one model), organizational development: concepts, models (one model), techniques of organizational development

Unit 5: Organizational behavior in startups

SUGGESTED READINGS:

1 Aamodt, M. G. (2016). *Industrial/Organizational psychology: An applied approach*. Boston: Cengage Learning.
2 Luthans, F. (2011). Organizational behaviour:An evidence based approach,12th Edition. McGraw Hill
3 Muchinsky, P.(2007). Psychology applied to work: An introduction to Industrial and Organizational Psychology. NC: Hypergraphic Press.
4 Pareek, U. &Khanna,S.(2012,Third edition). Understanding Organizational Behaviour. Oxford: Oxford University Press.
5 Pareek, U., & Gupta, R. K. (2010).*Organizational behaviour*. New Delhi: Tata McGraw Hill.
6 Robbins, S.P., Judge T.A. and Sanghi, S.(2009) Essentials of Organizational Behaviour,10th edition. Pearson Education , India.
7 Schultz, D & Schultz, S (2013).Psychology and Work Today. Pearson Education, India.

Course No.	Title of the Course	Course Structure	Pre-Requisite
FEPD013	**Theatre**	**0L-0T-4P**	**None**

COURSE OUTCOMES (CO):

Our goal is to nurture artist-scholars who are well read in dramatic literature, who understand the social and historical contexts of that literature, who appreciate contemporary performance and dance, who think critically, who master discipline-specific skills, and who make compelling artistic choices on stage.

COURSE CONTENT:

Unit 1: Concept of Acting in Indian Classical theatre. Western styles of theatre acting.

Unit 2: Basics of the following: Acting in Grotowski's Poor Theatre, Folk Theatre of India

Unit 3: Acting for Camera –Knowledge of camera frames and movement within the confines of a frame, blocking, difference between theatre and Camera acting, Concentration.

Unit 4: Acting consistently for different takes, acting scenes out of order, Auditions, acting exercises. Art of Dubbing.

SUGGESTED READINGS:

1. Boleslavsky, Richard,`` Acting: the First Six Lessons," New York Theatre Arts.
2. Hagen, Uta,`` Respect for Acting," Macmillan Press.
3. Hodge, Alison,`` Twentieth Century Actor Training," London and New York.
4. Routledge ,Stanislavski, Konstantin,`` An Actor's Work: A Student's Diary," Trans. and ed. Jean
5. Jeremiah Comey ,`` The Art of Film Acting," Focal Press .
6. Philips B Zarrilli,`` Acting (Re) Considered," Routeledge .
7. Cathy Hassey,`` Acting for Film," Allworth Press 9. Singh. Y,`` Indian Sociology social conditioning and emerging concerns," Vistaar publication.

Course No.	Title of the Course	Course Structure	Pre-Requisite
FEPD014	**Dance**	**0L-0T-4P**	**None**

COURSE OUTCOMES (CO):

This course will provide the student with the fundamentals necessary for advanced dance skills. Further, this course will develop student appreciation of dance as an art form and lifetime activity. Designed to familiarize students with technique, the student will also study vocabulary, different forms of dance, issues in dance and the history pertaining to the world of dance. The student will develop kinesthetic awareness, movement memory, creative abilities and aesthetic appreciation of various dance forms. The enhancement and the development and maintenance of physical fitness, self-confidence, self-discipline and independence with the body by providing informal showings during class are the goals expected to be achieved. Each

student should leave this class having been encouraged, esteemed, and take with them a new appreciation of dance.

COURSE CONTENT:

- Basic workout
- Introduction to Hip Hop and B-Boying with a simple choreography
- Exercise like: Rolling, jumping, moving shoulders. Footwork, Floor steps, Beat knowledge.
- Freestyle combination along with House dance style.
- Expressions class: Body expressions, Face expressions.
- Introduction of Contemporary Dance. Basic exercise of Contemporary Dance. Exercise for flexibility, Floor steps, Spinning and Balancing.
- Introduction to Jazz. Basic exercise and proper routine practice.

SUGGESTED READINGS:

1. Jonathan Burrows, ``A Choreographer's Handbook,'' Routledge
2. Jacqueline M. Smith-Autard, ``Dance Composition: A Practical Guide to Creative Success in Dance Making,'' Routledge

Course No.	Title of the Course	Course Structure	Pre-Requisite
FEPD015	**Yoga**	**0L-0T-4P**	**None**

COURSE OUTCOMES (CO):

Students will learn about the importance of yoga in their lives. They will be exposed various types of yoga, their health benefits.

COURSE CONTENT:

UNIT-I

Origin of Yoga & its brief development, Meaning of Yoga & its importance, Yoga as a Science of Art (Yoga Philosophy),Meaning of meditation and its types and principles.

UNIT- II

Classification of Yoga/Types of Yoga, Hatha Yoga , Raja Yoga, Laya Yoga, Bhakti Yoga, Gyan Yoga, Karma Yoga, Asthang Yoga.

UNIT –III

Principles of Yogic Practices, Meaning of Asana, its types and principles, Meaning of Pranayama, its types and principles, Meaning of Kriya its types and principles.

UNIT -IV

Yogic therapies and modern concept of Yoga, Naturopathy, Hydrotherapy, Electrotherapy, Messotherapy, Acupressure, acupuncture, Meaning and importance of prayer, Psychology of mantras, Different mudras during prayers

SUGGESTED READINGS:

1. William Broad,`` The Science of Yoga: The Risks and the Rewards," Simon and Schuster
2. Swami Vishnu Devananda,`` The Complete Illustrated Book of Yoga," Harmony

Course No.	Title of the Course	Course Structure	Pre-Requisite
FEPD016	**Digital Film Making**	**0L-0T-4P**	**None**

COURSE OUTCOMES (CO):
Students will learn about various technicalities involved in digital film making. They will also expose to history of cinema, preproduction etc.

COURSE CONTENT:

Unit 1 – History of Cinema, Research & Script
Early Cinema, Development of Classical Indian & Hollywood Cinema, History of Global Film including European Film (1930-present), Origin of Classical narrative cinema-Soundless film, Exploration of film and analysis of the three-part beginning, middle and end of story, Research(Finding and Collecting materials and facts related to your story. Where and How to find the materials related to your story. Things to consider before sketching down your story), Script (Scriptwriting Process and its various phases), Film Grammar for Scriptwriting.

Unit 2 – Pre-Production
Digital Video Cinematography: Introduction to Digital Video Cinematography
Cinematography, Interactivity and emotions through Cinematography, Building blocks, Compositions, Lenses and Cameras, Types of lenses: Zoom Lens, Prime Lens, Types of Cameras: HD Cameras, Basics of Film Camera, Difference between, Film Camera and Digital Camera, DSLR and HDSLR Cameras, Lighting, Psychology of light, Visual Environment, Directional Effect of Light, Lighting design process, Three-point lighting, High-Key lighting, Low Key lighting, Construction of a Shot, Color, Contrast, Deep Focus, Shallow Focus, Depth of Filed, Exposure, Racking focus, Frame Rate, Telephoto shot, Zoom shot.

Unit 3- Digital Video Editing
Effective Editing, Principles of Video Editing, Non-Linear Editing (NLE) Concept, The Three-Point Edit, Non-Linear Editing (NLE) Techniques, Working in the Timeline, Transitions, Key framing, Applying Filters, Ingesting.

Unit-4 Advanced Editing Techniques
NLE Compositing, Color Correction & Color Grading, Working on Audio, Titling

SUGGESTED READINGS:

1. Mark Brindle and Chris Jones, `` The Digital Filmmaking Handbook," Quercus

Course No.	Title of the Course	Course Structure	Pre-Requisite
FEPD017	**Workshop (Electrical and Mechanical)**	**2L-0T-0P**	**None**

COURSE OUTCOMES (CO):

1. Student will be able to make various joints in the given object with the available work material.
2. The students will be able to understand various wiring connections

COURSE CONTENT:

Mechanical Workshop Experiments

1. Blacksmith
2. Carpentry
3. Fitting
4. Foundry
5. Welding

Electrical workshop Experiments

1. Study & Performance Of Different Types Of Wire Joints
2. Study And Performance Of Staircase Wiring
3. Study And Performance Of Series And Parallel Connection Of Flourescent Tube Light
4. Study And Performance Of Godown Wiring
5. Series And Parallel Connection Of Bulbs And Power Sockets By Single Switch And Multi Switches.

SUGGESTED READINGS:

1. Hajra Choudhury, Hazra Choudhary and Nirjhar Roy, ``Elements of Workshop Technology, vol. I, " Media promoters and Publishers Pvt. Ltd.
2. W A J Chapman, Workshop Technology,`` Part -1, 1st South Asian Edition," Viva Book Pvt Ltd.
3. P.N. Rao, ``Manufacturing Technology, Vol.1," Tata McGraw Hill
4. Kaushish J.P., `` Manufacturing Processes, " Prentice Hall

Course No.	Title of the Course	Course Structure	Pre-Requisite
FEHS018	**Ethical Decision Making**	**2L-0T-0P**	**None**

COURSE OUTCOMES (CO):

COURSE CONTENT:

UNIT I: ETHICAL CONCEPTS AND ETHICAL APPROACHES

1. Values, Dilemma and Choices
2. Responsibility, Justice & Fairness
3. Respect for self and others

UNIT II: ETHICAL DECISION PROCESS

1. Ethical codes and tests
2. Steps to ethical decision-making
3. Case studies and Situational role plays

SUGGESTED READINGS:

1. Blanchard, K., & Peale, N.V. (1988) The Power of Ethical Management, New York: William Morrow and Co. pp. 20-24. http://www.blanchardbowleslibrary.com/books/powerofethicalmanagement.htm
2. Brown, M. (1996) The Quest for Moral Foundations: An Introduction to Ethics Georgetown University Press
3. Davis, M. (1999) Ethics and The University, New York: Routledge.
4. Heller, R. (1998) Making Decisions, New York: DK.
5. Josephson, M. S. (2002) Making Ethical Decisions, Josephson Institute of Ethics.
6. Kardasz, F. (2008) Ethics Training For Law Enforcement: Practices and Trends, VDM, Verlag Dr. M.ller.
7. Nosich, G. M. (2002) Learning to Think Things Through: A Guide to Critical Thinking, Prentice Hall.

4.3 PROGRAM CORE COURSES

4.3.1 LIST OF PROGRAM CORE COURSES

SEM.	Code	Name of Core Course	L T P Allocation			Evaluation Scheme Theory Practical					Syllabus page Nos
			L	T	P	CA	MS	ES	CA(P)	ES(P)	
II	CACSC01	Discrete Structures	3	1	0	25	25	50	-	-	51
	CACSC02	Data Structures	3	0	2	15	15	40	15	15	52
	CAECC03	Digital Logic Design	3	0	2	15	15	40	15	15	54
III	CACSC04	Web Technology	3	0	2	15	15	40	15	15	57
	CACSC05	Database Management Systems	3	0	2	15	15	40	15	15	62

	CACSC06	Design and Analysis of Algorithms	3	0	2	15	15	40	15	15	66
	CACSC07	Computer Architecture and Organization	3	1	0	25	25	50	-	-	69
	CAECC08	Microprocessor and Microcontrollers	3	0	2	15	15	40	15	15	71
IV	CACSC09	Operating Systems	3	0	2	15	15	40	15	15	76
	CACSC10	Theory of Automata & Formal languages	3	1	0	25	25	50			77
	CACSC11	Artificial Intelligence	3	0	2	15	15	40	15	15	77
	CAECC12	Data Communication	3	0	2	15	15	40	15	15	79
	CAMTC13	probability and stochastic processes	3	1	0	25	25	50			82
V	CACSC14	Principles of Compiler Construction	3	0	2	15	15	40	15	15	84
	CACSC15	Distributed Computing	3	0	2	15	15	40	15	15	85
	CACSC16	Game Theory and Applications	3	0	2	15	15	40	15	15	87
	CACSC17	Machine Learning	3	0	2	15	15	40	15	15	88
VI	CACSC18	Deep Learning	3	1	0	25	25	50	-	-	90
	CACSC19	AI Hardware and Tools W/S	2	0	4	30	-	20	30	20	91
	CACSC20	High Performance Computing	3	0	2	15	15	40	15	15	93
VII	CACSC21	Training	0	0	2	-	-	-	40	60	95
	CACSC22	Project-I	0	0	4	-	-	-	40	60	96
VIII	CACSC23	Project-II	0	0	16	-	-	-	40	60	95

4.3.2 SYLLABI OF PROGRAM CORE COURSES : II SEMESTER

SEMESTER II B. TECH. COMPUTER SCIENCS & ENGINEERING (ARTIFICIAL INTELLIGENCE)

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSC01	CC	Discrete Structures	3	1	0	4	25	25	50	-	-	None

COURSE OUTCOMES

1. To be able to analyze and compute time and space complexity of various computing problems.
2. To be able to design algorithms for solving various problems using the concepts of discrete mathematics.
3. To apply the concepts and algorithms learnt in developing large scale applications and modify them.
4. Get a grasp of the practical problems and their relation with discrete structures.
5. Implement practical problems using the discrete structures approach.

COURSE CONTENT

UNIT-I

Logic: Mathematical Logic, Propositions, Truth Tables, and Logical inferences, Methods of Proof, Propositional Logic, Logical Inference, First order logic, applications, Predicates and quantifiers.

Set Theory, Relations and Functions: Elements of Set Theory, Primitives of set theory, binary Relation and its Representation, type of Binary Relations, Equivalence relations and partitions. Functions, Types of functions, Inverses and composition of Functions.

UNIT-II

Counting: Counting and analysis of algorithms, Principles of inclusion-exclusion, Pigeon hole principle, Permutations, Combinations.

Mathematical induction: proof by induction, Recursion, Characteristic Polynomial, Recurrence relation, generating functions, Asymptotic behavior of algorithms.

UNIT-III

Posets, Lattices and Group Theory: Posets, Hasse Diagram, Lattices: Definition, Properties of lattices – Bounded, Complemented, Modular and Complete lattice, Boolean Algebra, Groups & rings.

Number Theory: Infinity and Natural numbers, Integers, Divisibility and Euclidean algorithm, Prime numbers, Congruence, Modular arithmetic, Euler ϕfunction.

UNIT-IV

Graphs: Graph isomorphism, Paths and Cycles, Graph coloring, Critical Path, Eulerian paths and circuits, Hamiltonian paths and circuits, Bipartite Graphs, Digraphs, Multigraphs.

UNIT-V

Probability: Overview of probability theory, Discrete distributions.

SUGGESTED READINGS

1. Keneth H. Rosen, “Discrete Mathematics and Its Applications”, TMH.
2. C.L. Liu, “Elements of Discrete Mathematics”, TMH.
3. Kolman, Busby & Ross, “Discrete Mathematical Structures”, PHI.

4. NarsinghDeo, “Graph Theory With Application to Engineering and Computer Science”,PHI.
5. Charles S. Grimmstead, J. Laurie Snell “Introduction to Probability”.
Kai Lai Chung, “A Course in probability theory”.
6. J.P.Tremblay & R. Manohar, “Discrete Mathematical Structure with Applications to Computer Science” Mc.Graw Hill.

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSC02	CC	Data Structures	3	0	2	4	15	15	40	15	15	None

COURSE OUTCOMES

1. Candidate will be able to choose the appropriate data structure for a specified problem and determine the same in different scenarios of real world problems.
2. Become familiar with writing recursive methods and reducing larger problems recursively in smaller problems with applications to practical problems.
3. Be able to understand the abstract properties of various data structures such as stacks, queues, lists, trees and graphs and apply the same to real life problems of sorting, searching, and traversals for skill enhancement in problem solving.
4. Be able to implement various data structures in more than one manner
5. Understand the advantages and disadvantages of the different implementations by using efficient representation of problems.

COURSE CONTENT

UNIT-I

Introduction: Basic Terminology: Elementary Data Organization, Data Structure Operations, Algorithms Complexity and Time-Space Trade off.
Arrays: Array Definition and Analysis, Representation of Linear Arrays in Memory, Traversing, Insertion And Deletion in Array, Single Dimensional Arrays, Two Dimensional Arrays, Bubble Sorting, Selection Sorting, Linear Search, Binary Search, Multidimensional Arrays, Function Associated with Arrays, Character String in C, Character String Operations, Arrays as parameters, Implementing One Dimensional Array.

UNIT-II

Stacks and Queues: Introduction to Operations Associated with Stacks Push & Pop, Array representation of stacks, Operation associated with stacks: Create, Add, Delete, Application of stacks recursion polish expression and their compilation conversion of

infix expression to prefix and postfix expression, Tower of Hanoi problem, Representation of Queues, Operations of queues: Create, Add, Delete, Front, Empty, Priority Queues and Heaps, Dequeue.

UNIT-III

Recursion**:** Recursive thinking, Recursive Definition of Mathematical Formulae, Recursive Array Search, Recursive Data Structure, Problem Solving With Recursion, Back Tracking
Linked Lists:More operations on linked list, polynomial addition, Header nodes, doubly linked list, generalized list, circular linked lists.

UNIT-IV

Trees: Trees – mathematical properties, Binary Search Trees and their representation, expression evaluation, Complete Binary trees, Extended binary trees, Traversing binary trees, Searching, Insertion and Deletion in binary search trees, Complexity of searching algorithm, Path length, Huffman's algorithm, General trees, AVL trees, Threaded trees, B trees, Trie data structure

UNIT-V

Sorting: Insertion Sort, Quick sort, two-way Merge sort, Heap sort, sorting on different keys, External sorting.
Graphs: Sequential representation of graphs, Adjacency matrices, Search and Traversal of graphs: Depth first, breadth first, topological sort.
Outline of Practical Work:
- Programs based on sorting and searching, implementing stacks, queues , simple calculator using postfix expression, command line calculator changing infix to postfix, implementation of linked lists - a simple editor program, traversal of binary trees , binary search tree creation, insertion, deletion, traversal sorting. AVL tree creation and rotations, Traversal of graphs using BFS and DFS , implementation of topological sorting. Templates and Containers Survey of new data structures.

Suggestive List of Experiments

1. Write a program to find the mean and the median of the numbers stored in an array.
2. Write a program to insert one element in an array and delete an element from an array.
3. Write a program to search for a number in an array.
4. Write a program to sort an array.
5. Write a program to merge two sorted arrays.
6. Write a program to store the marks obtained by 10 students in 5 courses in a two-dimensional array.
7. Write a program to implement a linked list.
8. Write a program to insert a node in a linked list and delete a node from a linked list.
9. Write a program to print the elements of a linked list in reverse order without disturbing the linked list.
10. Write a program to reverse a linked list.
11. Write a program to add two polynomials using linked lists.
12. Write a program to implement a doubly-linked list.
13. Write a program to implement a stack using an array.

14. Write a program to implement a stack using a linked list.
15. Write a program to implement a queue using an array.
16. Write a program to implement a queue using a linked list.
17. Write a program to implement a circular queue using an array.
18. Write a program to implement a priority queue using a linked list.
19. Write a program to implement a double-ended queue using a linked list.
20. Write a program to construct a binary tree and display its preorder, inorder and postorder traversals.
21. Write a program to construct a binary search tree.
22. Write a program to construct a graph.
23. Write a program to calculate the distance between two vertices in a graph.
24. Write a program to calculate the distances between every pairs of vertices in a graph.
25. Write a program to construct a minimal spanning tree of a graph.

References and Text Books:

1. Nell B Dale,"C++ data structures",ISBN-10: 1449646751, 5-th edition.
2. Freetextbooks.com. Algorithms and data structures. Available :http://www.freetechbooks.com/algorithms-and-data-structures-f11.html
3. Robert Lafore,"Data structures in Java".
4. Data Structures – Horowitz Sahani PHI
5. Data Structures – Lipshutz TMH

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CAECC03	CC	**Digital Logic Design**	3	0	2	4	15	15	40	15	15	None

COURSE OUTCOMES

1. To get familiarized with number systems, codes, logic gates and Boolean algebra
2. To understand fundamental concepts of VHDL modelling for basic digital circuits
3. To understand the basic characteristics of various logic families
4. To analyze and understand the design process associated with sequential circuits
5. To develop basic understanding of programmable logic devices

COURSE CONTENT

UNIT-I

Introduction to Digital Systems, Number Systems and Codes: Binary, octal and hexadecimal number systems, Number-Base Conversions, Complements of Numbers, Signed numbers, Fixed and floating point numbers, Binary Arithmetic, Binary Codes: BCD, Gray, Excess-3, ASCII, Error detection and correction codes - parity check codes and Hamming code.

Logic gates, Boolean Algebra and logic minimization: Basic logic operation, Logic gates and Truth tables, Positive and Negative Logic, Boolean Algebra: Basic postulates and fundamental theorems, SOP and POS forms, Min terms, Max terms, Canonical Form, Gate level Minimization: K-map and Quine-McCluskey tabular methods, NAND/NOR implementations

UNIT-II

Design Concepts using Hardware Description Language: VHDL Programming Structure, Model, Test Bench, Simulation Tool.

Combinational Logic Modules, their applications and VHDL Modeling: Decoders, encoders, multiplexers, demultiplexers, Parity circuits, Comparators, Code Converters, Arithmetic modules- adders, subtractors, BCD Adder, ALU and multipliers, Implementing boolean function with multiplexers / decoders

UNIT-III

Introduction to different logic families: Operational characteristics of BJT and MOSFET as switch, Structure and operations of TTL and CMOS gates, Electrical characteristics of logic gates – logic levels and noise margins, fan-out, propagation delay, transition time, power consumption and power-delay product etc.

UNIT-IV

Sequential Logic systems and VHDL Modeling: Basic sequential circuits- latches and flip-flops: RS-latch, SR-flip flop, D-latch, D flip-flop, JK flip-flop, T flip-flop, Setup-time, HOLD Time, Propagation delay, Timing hazards and races, Characteristic Equations.

Sequential logic modules, their applications and VHDL Modeling: shift register: Bidirectional, Universal and Ring Counter; counters: Ripple, Up/Down, Mod N, BCD Counters etc.

UNIT-V

State machines: Definition, Classification: Mealy, Moore; Analysis and design of state machines using D flip-flops and JK flip-flops etc.

Memory: Read-only memory, Read/Write memory - SRAM and DRAM, EPROM, EEPROM, USB Flash drive, Testing and testability of logic circuits, Programmable Logic Devices: PROM, PLA, PAL, Basics of CPLD, FPGA etc.

Text Books:

1. M. Morris Mano and Michael D. Ciletti,"Digital Design", 5th Edition, Pearson
2. Charles Roth and Larry Kinney, "Fundamentals of Logic Design," Cengage Learning, 7th Edition.

References:

1. Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital Logic with VHDL Design", 3rd Edition, McGraw-Hill
2. R.J. Tocci., N.S.Widmer, G.L. Moss, "Digital Systems, Principles and Applications",11th Edition, Pearson Education
3. Mohammed Ferdjallah,"Introduction to Digital Systems: Modeling, Synthesis, and Simulation Using VHDL", Wiley.

DIGITAL LOGIC DESIGN LAB

LIST OF EXPERIMENTS

(1) Verify the truth table of AND, OR, NOT, NAND, NOR, X-OR, X-NOR gates
(2) Implement all the above mentioned gates by using NAND gates and NOR gates only.
(3) Design and Implement Half-adder, Full-adder, Half-subtractor, Full-subtractor using logic gates.
(4) Design a 4 bit parallel adder and subtractor using IC. Further using the same IC implement BCD to excess-3 code convertor.
(5) Design a 4 bit magnitude comparator using IC. Also implement 2 bit magnitude comparator using gates only.
(6) Design and implement a full adder circuit using DECODER and gates. Also implement the same by using complimentary output decoder.
(7) Design the following Flip-flop using NAND/NOR gates
    (i) S-R FF
    (ii) D FF
    (iii) J-K FF
    (iv) T FF
(8) Design and implement a MOD 6 synchronous UP counter using T FF.
(9) Design a 2 bit UP/DOWN counter using J-K FF
(10) Implementation of full adder

(11) Implementation of 4X1 MUX
(12) Conversion of BCD to Excess-3 code
(13) Implement 3X8 decoder
(14) Implement 2 bit by 2 bit magnitude comparator

4.3.3 SYLLABI OF PROGRAM CORE COURSES : III SEMESTER

SYLLABI III SEMESTER B. Tech. (CSAI)

B.Tech. ***Computer Science & Engineering(Artificial Intelligence)***-SEMESTER III												
Course Code	**Type**	**Subject**	**L**	**T**	**P**	**Credits**	**CA**	**MS**	**ES**	**CA**	**ES**	**Pre-requisites**
CACSC04	CC	Web Technology	3	0	2	4	15	15	40	15	15	CACSC02

COURSE OUTCOMES

1. To understand the development and transition of the web.
2. To Learn creating the web pages and apply the styles
3. To learn the web programming for simple day to day work.
4. To learn fetching the object using latest technologies and using them to process information
5. To write a full-fledged web based application and deploy it.

COURSE CONTENT

UNIT-1

Introduction , Web Browser , Web 2.0

Introduction , W3C,Web 2.0 , Personal, Distributed and Client/Server Computing , Browser Portability , Software Technologies , Web Resources, Customizing Browser Setting ,Searching the Internet, Keeping Track of Your Favorite Sites, File Transfer Protocol (FTP),Online Help, Web Resources, Web 2.0?, Search, Content Networks , User-Generated Content, Blogging, Social Networking, Social Media, Tagging , Social Bookmarking , Software Development , Rich Internet Applications (RIAs), Web Services, Mashups, Widgets and Gadgets, Location-Based Services, XML, RSS, Atom, JOSN and VolP, Web 2.0 Monetization Models, Web 2.0 Business Models, Future of the Web , Where to GO for more Web 2.0 Information , XHTML , Cascading Style Sheets(CSS)

Introduction , Editing XHTML, First XHTML Example, W3CXHTML Validation Service, Headings, Linking , Images, Special Characters and Horizontal Rules , Lists, Tables, Forms, Internal Linking , Meta Elements, Inline Styles, Embedded Style Sheers, Conflicting Style, Linking External Style sheers, Positioning Elements, Backgrounds, Element Dimensions, Box Model and Text Flow, Media Types, Building a CSS Drop-Down Menu, User Style Sheets, CSS 3, Web Resources

UNIT-2

JavaScript: Introduction to Scripting

Introduction , Simple Program: Displaying a Line of Text in a Web Page , Modifying Our First Program , Obtaining User Input with Prompt Dialogs, Dynamic Welcome Page, Adding Integers, Memory Concepts, Arithmetic, Decision Making: Equality and Relational Operators, Web Resources,

JavaScript: Control Statements

Introduction, Algorithms, Pseudo code, Control Structures, i f Selection Statement, i f …else selection Statement, Formulating Algorithms: Counter-Controlled Repetition , Formulating Algorithms: Sentinel-Controlled Repetition, Formulating Algorithms: Nested Control Statements, Assignment Operators, Increment and Decrement Operators, Essentials of Counter-Controlled Repetition , For Repetition Statement , Examples Using the for Statement, Switch Multiple-Selection Statement , do….while Repetition Statement , break and continue Statements, Labeled break and Continue Statements, Logical Operators, Summary of Structures Programming , Web Resources

JavaScript: Functions

Introduction , Program Modules in JavaScript, Programmer-Definitions Functions, Function Defamations , Random Number Generation, Example: Game of Chance, Another Example: Random Image Generation , JavaScript Global Functions, Recursion , Recursion vs. Iteration ,

JavaScript: Arrays

Introduction, Arrays, Declaring and Allocating Arrays, Examples Using Arrays, Random Image Generator Using Arrays, References and Reference Parameters, Passing Arrays to Functions, Sorting Arrays, Searching Arrays: Linear Search and Binary Search, Multidimensional Arrays, Building an Online Quiz, Introduction to Object Technology, Math Object, String Object, Fundamentals of Characters and Strings, Methods of the string Object , Character-Processing Methods, Searching Methods, Splitting Steins and Obtaining Substrings, XHTML Markup Methods, Date Object, Boolean and Number Objects

Document object Model (DOM):Objects and Collections, introduction , Modeling a Document: DOM Nodes and Trees , Traversing and Modifying a DOM Tree, DOM Collections, Dynamic Styles, Summary of the DOM Objects and Collection, Web Resources , JavaScript: Events, Introduction, Registering Event Handlers, Event onload , Event onmousemove, the event Object and this , Rollovers with onmouseover and onmouseout, From Processing with onfoucus and onblur, More Form Processing with onsubmit and onreset , Event Building , More Events

UNIT-3

XML and RSS

Introduction, XML Basics, Structuring Data, ZXML Namespaces, Document Type Definitions (DTDs), W3CXML Schema Documents, XML Vocabularies, MathML™, Other Markup Languages, Extensible Stylesheet Language and XSL Transformations, Document Object Model (DOM), RSS,

Ajax- Enabled Rich Internet Applications

Introduction, Traditional Web Application vs. Ajax Applications, Rich Internet Applications (RIAs) with Ajax, History of Ajax, "Raw" Ajax Example Using the XMLHttpRequest Object, Using XML and the DOM, Creating a Full-Scale Ajax-Enabled Application, Dojo Toolkit

UNIT-4

IIS and Apache: introduction, architecture, client – server side scripting, requesting documents.Database: Introduction, RDBMS, SQL – simple queries, ADO.NET object model, Java DB/ Apache DerbyPHP: introduction, basics, form processing and business logic, connecting to a database, using cookies.Ruby on Rails: Intro, Ruby, Rails Framework, scripting

UNIT-5

ASP.NET and ASP.NET Ajax: introduction, creating and running a simple web form example, relationship, generating XHTML code, web controls, sessions tracking. JavaServer Faces Web Applications:

Java Web technologies, creating and running a simple application in Netbeans, examining a JSP file, event processing life cycle, JSF components, Text vs. graphics components, validation, session cookies, web services

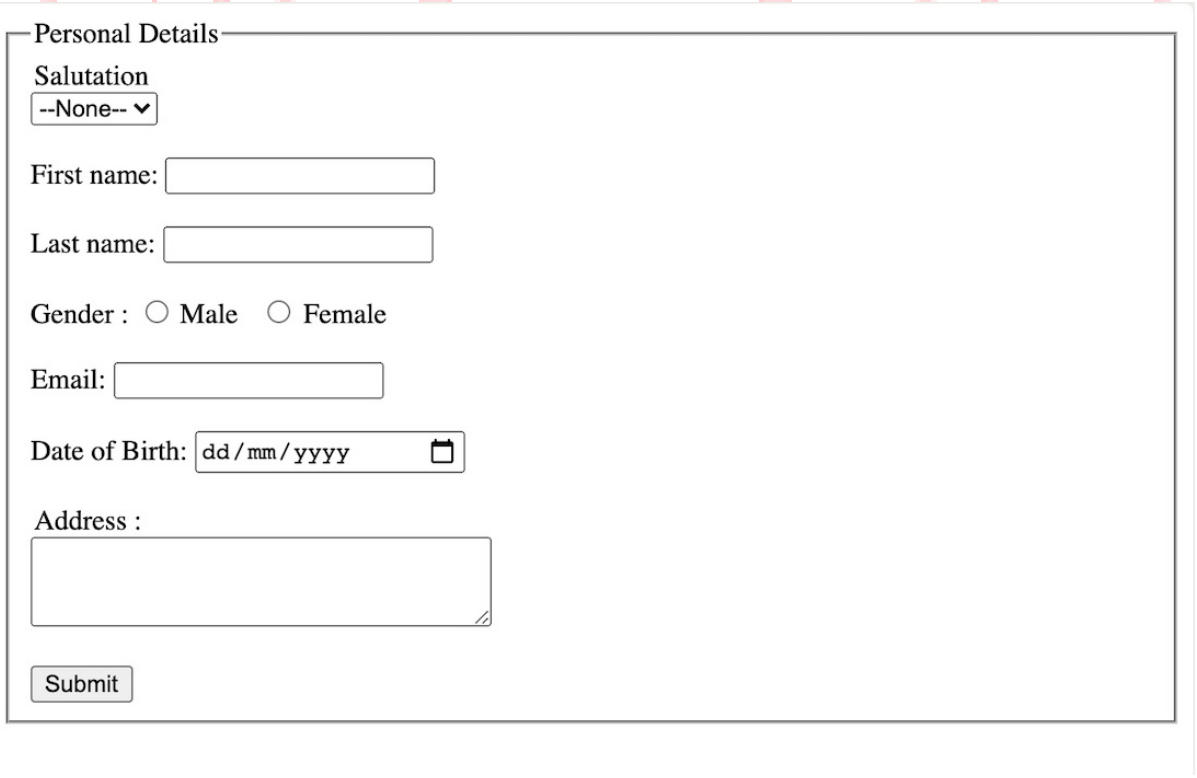
List of Suggested Practicals but not restricted to these only:

1. Create a table using rowspan and colspan attributes.

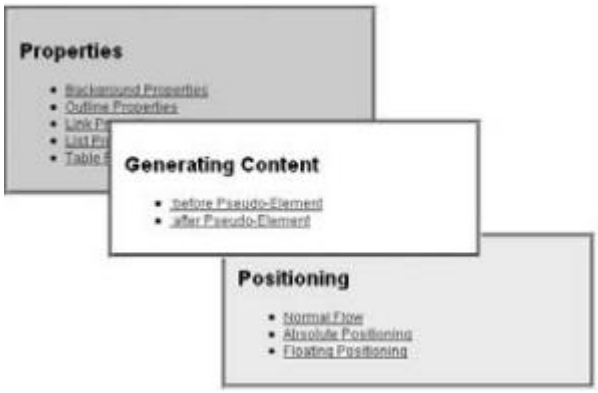
State of Health	Fasting Value		After Eating
	Minimum	Maximum	2 hours after eating
Healthy	70	100	Less than 140
Pre-Diabetes	101	126	140 to 200
Diabetes	More than 126	N/A	More than 200

2. Create a form using following attributes:

a) Label
b) Input
c) Dropdown list
d) Radio Button
e) TextArea
f) Button



3. In this exercise, you test your CSS positioning skills. Each block will be absolutely positioned in a diagonal top-left to bottom-right direction. The middle box should appear on top



4. Create a following given webpage:

5. Write a JavaScript code to add five images and when a user click on a button then among 5 images, random image will appear on the page.

6. Create an XML FILE with the following structure.
   Root Element- <BankAccountDetails>
   Child Elements as - a) Account No b) Account Type c) Balance d) Customer_id e) Customer Name
7. Create an XSLT FILE to read the above XML File.

8. $colour = array (4 => 'white', 6 => 'green', 11=> 'red');
   Write a PHP script to get the first element of the above array.

9. $colour = array ('white', 'green', 'red''). Write a PHP script which will display the colours

in the following way:

Output:

white, green, red.

10. Write a code to depict a concept of AJAX that sends request to server and getting back the response and display the text in the webpage.
11. Embedding a YouTube video or a Google Maps location on a webpage.
12. Adding basic authentication to a webpage using JavaScript or PHP.
13. Creating a basic chat application using Node.js and Socket.io.
14. Implementing a simple RESTful API using JSON.
15. Creating a basic online store with product listings and shopping cart functionality using HTML, CSS, JavaScript and PHP.

REFERENCE BOOKS

1. Deitel and Deitel: Internet and Worldwide Web programming, Pearson
2. Frank Barbier: Reactive Internet programming, ACM Books
3. Tara Calishain: Google hacks, O'Reilly Media
4. Sergei Dunaev Advanced Internet Programming, IT Master

B.Tech. ***Computer Science & Engineering (Artificial Intelligence)***-SEMESTER III												
Course Code	**Type**	**Subject**	**L**	**T**	**P**	**Credits**	**CA**	**MS**	**ES**	**CA**	**ES**	**Pre-requisites**
CACSC 05	**CC**	**Database Management Systems**	**3**	**0**	**2**	**4**	**15**	**15**	**40**	**15**	**15**	**CACSC02**

COURSE OUTCOMES

At the end of the course students will be able to

CO1: understand fundamentals of database management systems.
CO2: design database models and learn database languages to write queries to extract information from databases.
CO3: Identify database anomalies and improve the design of database management system
CO4: understand transaction management and concurrency control.
CO5: understand storage organization and database recovery.

COURSE CONTENT

UNIT 1

Introduction: Database management system Characteristics of the Database, Database Systems and Architecture, Data Models, Schemes & Instances, DBMS Architecture & Data Independence, Database administrator & Database Users, Database Languages & Interfaces, DDL, DML, DCL, Overview Relational Data Base Management Systems

UNIT 2

Data Modeling: Data modeling using The Entity-Relationship Model – Entities, Attributes and Relationships, Cardinality of Relationships, Strong and Weak Entity Sets, Generalization, Specialization, and Aggregation, Translating your ER Model into Relational Model, Relationships of higher degree.

UNIT 3

Relational Model, Languages & Systems: Relational Data Model concepts, Relational

Model Constraints, integrity constraints ,Keys domain constraints, referential integrity, assertions triggers, foreign key

Relational Algebra and calculus, SQL. Database security.

Relational Data Base Design: Functional Dependencies & Normalization for Relational Databases, Functional Dependencies, Normal Forms Based on Primary Keys, (1NF, 2NF, 3NF & BCNF), Lossless Join and Dependency Preserving Decomposition, Functional dependencies and its closure, covers and equivalence.

UNIT 4

Transaction Management: Transaction Concept and State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability: Testing of serializability, Serializability of schedules, conflict & view serializable schedule.

Concurrency Control Techniques: Lock-Based Protocols, Timestamp-based Protocols, validation based protocol. Deadlock Handling

UNIT 5

Recovery System

Recoverability: Failure Classification, Storage Structure, Recovery and Atomicity, Log-based Recovery, Shadow Paging, Recovery with Concurrent Transactions

Storage organization : Indexing, Hashing ,file storage.

List of Experiments:

Following is only a suggestive list of experiments. For better coverage faculty may increase the list of experiments.

Q 1: Consider the following relational schema

SAILORS (sid, sname, rating, date_of_birth)

BOATS (bid, bname, color)

RESERVES (sid, bid, date, time slot)

Write the following queries in SQL and relational algebra

a) Find sailors who've reserved at least one boat
b) Find names of sailors who've reserved a red or a green boat in the month of March.
c) Find names of sailors who've reserved a red and a green boat
d) Find sid of sailors who have not reserved a boat after Jan 2018.
e) Find sailors whose rating is greater than that of all the sailors named "John"
f) Find sailors who've reserved all boats
g) Find name and age of the oldest sailor(s)
h) Find the age of the youngest sailor for each rating with at least 2 such sailors

Q2. Consider the following relational schema:

CUSTOMER (cust_num, cust_lname , cust_fname, cust_balance);

PRODUCT (prod_num, prod_name, price)

INVOICE (inv_num, prod_num, cust_num, inv_date ,unit_sold, inv_amount);

Write SQL queries and relational algebraic expression for the following

a) Find the names of the customer who have purchased no item. Set default value of Cust_balance as 0 for such customers.
b) Write the trigger to update the CUST_BALANCE in the CUSTOMER table when a new invoice record is entered for the customer.
c) Find the customers who have purchased more than three units of a product on a day.
d) Write a query to illustrate Left Outer, Right Outer and Full Outer Join.
e) Count number of products sold on each date.

f) As soon as customer balance becomes greater than Rs. 100,000, copy the customer_num in new table called "GOLD_CUSTOMER"
g) Add a new attribute CUST_DOB in customer table

Q 3: Consider the following relational schema

DEPARTMENT(Department_ID, Name, Location_ID)

JOB (Job_ID , Function)

EMPLOYEE (Employee_ID, name, DOB, Job_ID , Manager_ID, Hire_Date, Salary, department_id)

Answer the following queries using SQL and relational algebra:

a) Write a query to count number of employees who joined in March 2015
b) Display the Nth highest salary drawing employee details.
c) Find the budget (total salary) of each department.
d) Find the department with maximum budget.
e) Create a view to show number of employees working in Delhi and update it automatically when the database is modified.
f) Write a trigger to ensure that no employee of age less than 25 can be inserted in the database.

Q4: PROJECT

Students are required to develop a DBMS for the applications assigned to them. Following items are required to be submitted for the project

a) Problem Statement
b) ER model/ Relational Model
c) Integrity Constraints implemented
d) Suitable Queries to create and manage database

Note: Students have to make sure that they have defined proper integrity constraints to ensure consistency of database used in assignments as well as project.

SUGGESTED READINGS:

Text book:

1. Korth ,Silbertz, Sudarshan, "Data base concepts", McGraw-Hill, 2013

Reference books

1.Elmasri, Navathe, "Fundamentals of Database systems", Addison Wesley, 2010

2.Date C.J., "An Introduction to Database systems", Addison-Wesley Longman, Inc.,2004

B.Tech. *Computer Science & Engineering (Artificial Intelligence)* -SEMESTER III												
Course Code	Type	Subject	L	T	P	Credits	Evaluation Scheme (Percentage weights)					Pre-requisites
							Theory			Practical		
							CA	MS	ES	CA	ES	
CACSC06	**CC**	**Design and Analysis of Algorithms**	**3**	**0**	**2**	**4**	**15**	**15**	**40**	**15**	**15**	**CACSC02**

COURSE OUTCOMES

1. To be able to analyze the asymptotic performance of algorithms.
2. To be able to write rigorous correctness proofs for algorithms.
3. Ably demonstrate a familiarity with major algorithms and data structures.
4. To be able to apply important algorithmic design paradigms and methods of analysis.
5. To be able to synthesize efficient algorithms in common engineering design situations.

CONTENTS

UNIT I

Design and Analysis of Algorithms Asymptotic notations and their significance, introduction to RAM model of computation, complexity analysis of algorithms, worst case and average case. Basic introduction to algorithmic paradigms like divide and conquer, recursion, greedy, etc.

UNIT II

Searching: binary search trees, balanced binary search trees, AVL trees and red-black trees, B-trees, skip lists, hashing Priority queues, heaps, Interval trees, tries. Order

statistics. Sorting: comparison based sorting - quick sort, heap sort, merge sort: worst and average case analysis. Decision tree model and (worst case) lower bound on sorting. Sorting in linear time - radix sort, bucket sort, counting sort, etc. String matching.

UNIT III

Graph Algorithms: BFS, DFS, connected components, topological sort, minimum spanning trees, shortest paths - single source and all pairs. Models of computation: RAM model and its logarithmic cost. Formal introduction to algorithmic paradigms: divide and conquer, recursion, dynamic programming, greedy, branch and bound, etc. Advanced data structures: Fibonacci heap, union-find, splay trees. Amortized complexity analysis

UNIT IV

Randomized algorithms: Randomized algorithms to be introduced a bit early, i.e., before NP-completeness to highlight randomization as an algorithmic technique. Application areas: Geometric algorithms: convex hulls, nearest neighbor, Voronoi diagram, etc. Algebraic and number-theoretic algorithms: FFT, primality testing, etc.

UNIT V

Graph algorithms: network flows, matching, etc. Optimization techniques: linear programming Reducibility between problems and NP-completeness: discussion of different NP-complete problems like satisfiability, clique, vertex cover, independent set, Hamiltonian cycle, TSP, knapsack, set cover, bin packing, etc. Backtracking, branch and bound, Approximation algorithms: Constant ratio approximation algorithms.

List of some of the Practicals:

1. Perform the following sorting algorithms: - Merge sort, Quick sort, Radix sort, Count sort, Heap sort, and Shell sort.
2. Perform searching algorithm: - Linear and Binary search.
3. Perform the Tower of Honoi.
4. Write a program for inserting and deleting elements in:
    a. AVL tree
    b. Red Black Tree
    c. Binary Search Tree
5. Write a program for the fractional and dynamic knapsack problem.
6. Implement Minimum Spanning trees: Prim's algorithm and Kruskal's algorithm.
7. Write a program to implement Strassen's Matrix Multiplication.
8. Write a program to implement Longest Common Subsequence.
9. Find maximum and minimum of array using Dynamic programming.
10. Write a program to implement Naive Based String Matching.
11. Implement All-Pairs Shortest Paths Problem using Floyd's algorithm.
12. Implement the Travelling Salesman Problem, Max-flow-min cut Problem.
13. Implement N Queen's problem using Back Tracking.
14. Implement the Stable Marriages Problem for perfect matching in bipartite graphs.
15. Implement greedy algorithm for graph colouring.

REFERENCE BOOKS

1. E. Horowitz, S. Sahni, and S. Rajsekaran, "Fundamentals of Computer Algorithms," Galotia Publication

2. T .H . Cormen, C .E .Leiserson, R .L .Rivest “Introduction to Algorithms”, PHI.
3. Sedgewich, Algorithms in C, Galgotia
4. Berman. Paul, “Algorithms, Cengage Learning”.
5. Richard Neopolitan, Kumar SS Naimipour, “Foundations of Algorithms”

B.Tech. ***Computer Science & Engineering (Artificial Intelligence)*** - SEMESTER III

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSC07	CC	Computer Architecture and Organization	3	1	0	4	25	25	50	-	-	CACSC02

COURSE OUTCOMES

1. To understand the architecture of modern processors and organization of its components, and relationship between hardware and software in digital machines.
2. To design instructions and corresponding logic circuits for a simple CPU with its essential components such as ALU, a register file, memory and input-output.
3. To understand the organization of computer systems
4. To understand the computation standards and using them in writing algorithms
5. To appreciate the evolving technology that governs the evolution of modern computers and continue to keep abreast of state-of-art in computing technology

COURSE CONTENT

UNIT-1

Overview of computer organization: Characteristics of a general purpose computer, The stored program concept, von Neumann architecture, Harvard architecture, Programmer's model - the Instruction set architecture (ISA), ISA design and performance criteria, Basic computer organization with CPU, memory and IO subsystems, Interconnect busses, Evolution of CISC and RISC based processors and their merging.

UNIT-2

Instruction Set Architectures: Machine instruction, Machine cycle and Instruction cycles, Instruction Set: memory and non-memory reference instructions, instruction categories: data movement, data manipulation, program control and machine control instructions, CISC types addressing modes and instruction formats, RISC type addressing modes and instruction formats.

UNIT-3

Central Processing Unit: Specification of a simple CPU using RTL, Design of the data path for the simple CPU, Designing the hardwired control path for the simple CPU, Performance analysis of the simple CPU, Enhancement of the ISA for the simple CPU and design extensions, Characteristics of RISC CPU design: ISA characteristics, pipelining, data and instruction caches, Practical case studies in CISC type and RISC type CPU designs.

UNIT-4

Microprogrammed Control Unit: Control memory system, Microinstruction-sequencing, conditional branch, mapping and subroutines, direct, horizontal and vertical microcoding, micro-instruction format and symbolic representation, design of micro-control unit for a simple CPU, applications of microprogramming

Memory organization: Memory hierarchy, Cache organization: Direct, associative and Set associative cache, Auxiliary memory organization, RAID organizations

Input output organization: IO interfacing, Asynchronous data transfer, Programmed IO, Interrupt driven IO, Priority schemes, Direct Memory Access, Serial communication techniques

UNIT-5

Computer arithmetic: Design of Binary addition and subtraction units, Algorithms for multiplication and division and their implementation, Floating point arithmetic, etc.

Pipelined architecture: Basic concepts of pipelining, Speedup and throughput, Minimum Average Latency, Instruction pipeline.

GPU architecture: Hardware Basics, Execution Model, GPU instruction set architecture, NVIDIA GPU instruction set architecture

Guidelines for Project work:

- Exercises using assembly-level programming and debugging to illustrate the working of instructions in the ISA of a CISC based /RISC based processor. These exercises should illustrate the status of various registers, flags, counters and pointers after data movement, data manipulation, program control, and stack operations.
- Semester-long group project on the design and simulation /hardware emulation of a simple processor.

REFERENCE BOOKS

1. William stallings, “Computer Organization and Architectue, PHI” 2. M. Morris Mano,
2. M. Morris Mano, “Computer System Architecture” , PHI
3. J.D. Carpinelli, “Computer Systems Organization and Architecture,” Pearson Education
4. Heuring and Jordan, Pearson Education, “Computer Systems Design and Architecture”
5. Tor M. Aamodt, Wilson Wai Lun Fung, Timothy G. Rogers General-Purpose Graphics Processor Architectures

B.Tech. ***Computer Science & Engineering (Artificial Intelligence)***-SEMESTER III

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CAECC08	CC	Microprocessors and Microcontrollers	3	0	2	4	15	15	40	15	15	CAECC03

COURSE OUTCOMES

1. Acquire knowledge of architecture and programming of microprocessors.
2. Understand the salient features of the x86 architecture.
3. Acquire hands-on knowledge of interfacing microprocessors with peripherals.
4. Understand the architecture and working of microcontrollers and their utility.
5. Acquire introductory knowledge about high-end microprocessors and microcontrollers.

COURSE CONTENT

Unit 1 - Intel 8085 microprocessor: Basic concepts of microprocessor, microcomputer, microcontroller. Architecture (pins, signals, buses, register set), addressing modes, instruction set (instruction format, opcode, mnemonic), subroutines, timing diagrams and t-states of different instructions, programming, recursive programs, vectored and non-vectored interrupts and interrupt handling of 8085.

Unit 2 - Intel 8086 microprocessor: Architecture (pins, bus interface unit, execution unit, register set, pipelining), memory addressing, segmentation, instruction set (data transfer, arithmetic, logic, string, long and short control transfer and processor control), timing diagrams, operating modes, programming, assemblers, address-objects,

parameter passing to subroutines, hardware and software interrupts and interrupt handling of 8086.

Unit 3 - Interfacing of microprocessors: Interfacing a microprocessor with RAM and ROM chips, address allocation and decoding techniques. Interfacing with LED, LCD, ADC, DAC, toggle switch and keypad. Memory-mapped i/o. Interfacing with 8255 programmable peripheral interface (architecture, ports, i/o modes and BSR mode). Basic architecture and features of 8254 programmable timer, 8257 programmable DMA controller, 8259 programmable interrupt controller, 8279 programmable keyboard and display controller and 8087 math coprocessor.

Unit 4 - Microcontrollers: 8051 microcontroller: architecture, i/o ports, memory organization, addressing modes, instruction set, simple programs. Introduction to IoT: basic architecture, sensing and actuating, application domains.

Unit 5 - High-end microprocessors and microcontrollers: Important features of 32-bit processors, RISC and Pentium. Implementation of memory management schemes like segmentation, paging and virtual memory at the hardware level. Introduction to Arduino: basic architecture, hardware and software, simple programs.

Guidelines for practical work:

1. Write an assembly program to generate the numbers of the Fibonacci series.
2. Write an assembly program to clear all flags without using any data transfer instruction.
3. Write an assembly program to search for a number in a list.
4. Write an assembly program to sort a list.
5. Write an assembly program to copy a list from one part of the memory to another.
6. Write an assembly program to multiply two numbers using successive additions.
7. Write an assembly program to calculate the square root of a number.
8. Write an assembly program to calculate the factorial of a number using recursion.
9. Write a self-replicating assembly program.
10. Interface 8255 with a microprocessor and use all its modes.
11. Interface 8254 with a microprocessor and use it to generate differ types of clock signals.
12. Interface 8259 with a microprocessor and use all its features.
13. Interface 8257 with a microprocessor and write a program to control a keypad and a LED display.
14. Design digital systems with Arduino and simple sensors and actuators.

SUGGESTED READINGS

1. Ramesh S. Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085” Prentice Hall.
2. D. V. Hall, “Microprocessor and Interfacing Programming & Hardware” TMH – 2nd Edition.

3. S. P. Morse, “8086 Primer: An Introduction to Its Architecture, System Design and Programming” Hayden Book Co.

4. S. Monk, “Programming Arduino: Getting Started with Sketches”, 2nd Edition, McGraw-Hill.

5. M.A. Mazidi et. al. “The 8051 Microcontroller and Embedded Systems: Using Assembly and C” Pearson Publishers.

4.3.4 SYLLABI OF PROGRAM CORE COURSES : IV SEMESTER

SYLLABI B. TECH. *Computer Science & Engineering (Artificial Intelligence)* IV SEMESTER

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSC09	CC	Operating Systems	3	0	2	4	15	15	40	15	15	**Design and Analysis of Algorithms**

COURSE OUTCOMES

1. Understand the function, structure, history of an operating system and the design issues associated with an operating system.
2. Understand the concept of multithreading, process management concepts including scheduling, synchronization and deadlocks.
3. Learn the memory management concepts including virtual memory.
4. Comprehend file system interface and implementation and disk management.
5. Be familiar with protection and security mechanisms.

COURSE CONTENT

Unit 1

Overview: Operating systems – structure, operations, components, types, services, user interfaces. System calls, system programs, system boot.
Process management: Processes – concept, scheduling, operations on processes, interprocess communications. IPC Methods, pipes, popen, pclose functions, Co-Processes, FIFOs, Message Queues, Shared Memory, Stream pipes, Threads – single- and multi-threaded processes.

Unit 2

CPU scheduling – criteria, algorithms, multiple-processor scheduling.
Process synchronization – critical-section problem, semaphores, classic synchronization problems, monitors.

Unit 3

Deadlocks – characterization, deadlock prevention, deadlock avoidance, deadlock detection, prevention, avoidance, recovery from deadlock.
Memory management: Objective and functions, Simple monitor resident program, overlays-swapping, Main memory – memory allocation schemes, paging, segmentation. Virtual memory concept– demand paging, page interrupt fault, page replacement algorithms, segmentation – simple, multilevel, segmentation with paging, frame allocation, thrashing.

Unit 4

Storage management: File system – files and directories, structure and implementation of file systems, mounting and unmounting, storage allocation methods, free-space management. Disk – structure, scheduling, management.

Unit 5

I/o management: i/o hardware, i/o interface, kernel i/o subsystem.
Protection and security: Access matrix, security threats.
Case studies of latest operating systems.

Practical List

Implement these programs in C/C++ using Linux/Unix environment operating system. Maintain hard copy of the same for final assessment.

1. Process creation and termination for operating system (fork, wait, signal, exit etc.).
2. Threads.
3. CPU scheduling algorithms: FCFS, SJF, Round Robin, Preemptive Priority Scheduling.
4. Inter process communication.
5. Critical Section problem.
6. Producer – Consumer problem using bounded and unbounded buffer.
7. Reader Writers problem, Dining Philosophers problem using semaphores.
8. Banker's algorithm.
9. Page replacement algorithms: LRU, LRU-Approximation, FIFO, Optimal.
10. File operation system calls (open, read, close, append etc.)
11. Disk scheduling algorithms: FCFS, SSTF, SCAN, CSCAN, LOOK, CLOOK.

Text Book:

1. Silberschatz, A., Galvin, P. B., and Gagne, G. 2009. "Operating System Principles (8th ed.)", Wiley.

Reference Book:

1. Stallings, W. 2014. "Operating Systems: Internals and Design Principles (8th ed.)", Pearson.
2. Tanenbaum, A. S. 2007. "Modern Operating Systems (3rd ed.)", Pearson.
3. UNIX System Programming Using C++,by Terrence Chan: Prentice Hall India, 1999.
4. Advanced Programming in UNIX Environment, by W. Richard Stevens: 2nd Ed, Pearson Education, 2005.
5. Operating Systems – William Stallings, Pearson Education Asia (2002)
6. Operating Systems - Nutt, Pearson Education Asia (2003)

B.Tech. *Computer Science & Engineering (Artificial Intelligence)* SEMESTER IV

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSC10	CC	**Theory of Automata & Formal languages**	3	1	0	4	25	25	50			Discrete Structures Computer Programming

COURSE OUTCOMES

1. Students will be able to demonstrate knowledge of basic mathematical models of computation and relate them to the formal languages.
2. Acquire knowledge of Regular Languages, FA, CFG, Push Down Automata and Turing recognizable languages
3. Be able to get a broad overview of the theoretical foundations of computer science
4. Be able to think analytically and intuitively for problem solving situations in related areas of theory of computer science
5. Students will understand the limitations of computers and learn examples of unsolvable problems.

COURSE CONTENT

UNIT I

Finite Automata: Deterministic FA, Non deterministic FA, Regular expressions, Finite Automaton with €- moves, Regular Expression, Regular Languages and Kleene's theorem– Conversion of NFA to DFA, Equivalence of finite Automaton and regular expressions, Arden's Theorem. Myhill Nerode Theorem, Minimization of DFA, Pumping Lemma for Regular sets, Problems based on Pumping Lemma.

UNIT II

Context Free Grammar: Grammar, Types of Grammar, Context Free Grammars and Languages, Derivations, Ambiguity, Relationship between derivation and derivation trees, Simplification of CFG, Elimination of Useless symbols - Unit productions - Null productions, Chomsky normal form (CNF), Greibach Normal form (GNF), Problems related to CNF and GNF.

UNIT III

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

UNIT IV

Turing Machine: Definitions of Turing machines, Computable languages and functions, Techniques for Turing machine construction, Multi head and Multi tape Turing Machines, The Halting problem, Partial Solvability, Problems about Turing machine- Chomsky hierarchy of languages.

UNIT V

Difficult problems: Unsolvable Problems and Computable Functions, Primitive recursive functions, Recursive and recursively enumerable languages, Universal Turing machine, Measuring and classifying complexity - Tractable and Intractable problems.

SUGGESTED READINGS

1. Hopcroft J.E., Motwani R. and Ullman J.D, "Introduction to Automata Theory, Languages and Computations", Second Edition, Pearson Education.
2. John C Martin, "Introduction to Languages and the Theory of Computation", Third Edition, Tata McGraw Hill Publishing Company, New Delhi
3. Marvin L. Minsky "Computation: Finite and Infinite" – Prentice Hall, 1967
4. Michael Sipser "Introduction to the Theory of Computation" , Third Edition, 2012 Cengage Learning
5. Peter Lenz – An Introduction to Formal languages and Automata – 3rd Edition Narosa, 2003
6. Thomas A. Sukamp – An introduction to the theory of computer science languages and machines – 3rd edition, Pearson Education, 2007.
7. G E Reevsz "Introduction to Formal Languages" TMH, 2000

B.Tech. *Computer Science & Engineering (Artificial Intelligence)* SEMESTER IV

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSC11	**CC**	**Artificial Intelligence**	**3**	**0**	**2**	**4**	**15**	**15**	**40**	**15**	**15**	**None**

COURSE OUTCOMES

1. Distinguish between a conventional system and an intelligent system
2. Explain Artificial Intelligence concept and its applications
3. Represent knowledge using various different techniques
4. Use the appropriate searching techniques and reasoning methods in achieving desired goals.
5. Understand the future of AI and ethical implications of developments in AI

Course Contents

UNIT 1:

Fundamentals of AI

Introduction

What Is AI, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art, Risks and Benefits of AI

Intelligence Agents

Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

UNIT 2:

Problem-solving – I

Solving Problems by Searching

Problem-Solving Agents, Example Problems, Search Algorithms, Uniformed Search Strategies, Informed (Heuristic) Search strategies, Heuristic Functions

Search in Complex Environments

Local Search and Optimization Problems, Local Search in Continuous Spaces, Search with Nondeterministic Actions, Search in Partially Observable Environments, Online Search Agents and Unknown Environments

UNIT 3:

Problem-solving – II

Adversarial Search and Games

Game Theory, Optimal Decisions in Games, Heuristic Alpha-Beta Tree Search, Limitation of Game Search Algorithms

Constraint Satisfaction Problems

Defining Constraint Satisfactions Problems, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems.

UNIT 4:

Logical Agents

Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic: A very simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic.

First-Order Logic

Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic.

Inference in First –Order Logic

Propositional vs. First-Order Inference, Unification and First-Order Inference, Forward Chaining, Backward Chaining, Resolution

Unit 5:

Knowledge Representation

Ontological Engineering, Categories and Objects, Events, Mental Objects and Modal Logic, Reasoning Systems for Categories, Reasoning with Default Information

List of Some of the suggested Practicals(not limited to these only):

1. Prolog introduction and It's basics
2. Implementation the following uninformed search algorithms
   - BFS, DFS
3. Implementation the following uninformed search algorithms:
4. ● Uniform Cost Search,
5. ● Bidirectional Search,

6. ● Depth Limited Search
7. Implementation of various informed search algorithms:
8. ● A* Algorithm
9. ● Best First Search
10. Implementation of Water Jug problem
11. Implementation of 8-puzzle problem
12. Implementation of backward and forward Channing concept
13. Implementation of River Crossing problem
14. Implementation of Alpha-Bata Pruning algorithm
15. Implementation of Monkey Banana Problem
16. Implementation of Tower of Hanoi Problem
17. Implementation of Travelling Salesman Problem
18. Implementation of N- Queens problem
19. Missionaries-Cannibals Problem
20. Implementation of Tic-Tac-Toe game

SUGGESTED READINGS

1. R . S. Pressman, Bruce R. Maxim "Software Engineering – A practitioner's approach", McGraw Hill Int. Edition, Eight Edition, 2019
2. Sommerville, "Software Engineering", 10th Edition, Pearson, 2017
3. Sangeeta Sabharwal, "Software Engineering: Principles and Techniques", Second Edition, Published by New Age International Publishers, 2020
4. Rajib Mall, "Fundamentals of Software Engineering" , PHI learning Pvt Ltd, 2018

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CAECC12	CC	Data Communication	3	0	2	4	15	15	40	15	15	None

COURSE OUTCOMES

1. To introduce students about different digital modulation schemes.
2. To introduce the students the functions of different layers of networking.
3. To introduce various types of access control methods.
4. To make students to get familiarized with different protocols and network components.
5. To introduce the students about basic queuing models

COURSE CONTENT

UNIT-I

Digital Communication: Sampling theorem (Instantaneous Sampling, Natural Sampling and Flat Top Sampling), PAM, PPM, PWM, Quantization noise, PCM, Binary Modulation: ASK, PSK, FSK, MSK, DPSK, QPSK and their probability of error calculation.

UNIT-II

Data Communications: Review of Error Detection and Correction codes. Need of line coding, Line coding scheme: Unipolar, Polar, Bipolar and Multilevel Encoding, Network and Protocol Architecture, Reference Model ISO-OSI, TCP/IP-Overview, topology, DTE-DCE interface, interface standards, modems, cable modem, transmission media. Switching: Circuit switching (space-division, time division and space-time division), packet switching (virtual circuit and Datagram approach), message switching,

UNIT-III

Data Link Layer: Data Link Control and Protocols: Flow and Error Control, Stop-and-wait ARQ. Sliding window protocol, Go-Back-N ARQ, Selective Repeat ARQ, HDLC, Point-to –Point Access: PPP Point –to- Point Protocol, PPP Stack, IEEE standard 802.3 & 802.11 for LANS, high speed LANs, Token ring, Token Bus, FDDI based LAN, Network Devices-repeaters, hubs, switches bridges.

UNIT-IV

Medium Access Sub layer: Channel allocation problem, multiple access protocols (ALOHA, CSMA and CSMA/CD)

Network Layer**:** Design issues, Routing algorithms, Congestion control algorithms, Host to Host Delivery: Internetworking

UNIT-V

Queuing Theory: Finite Markov Chain –Discrete and continuous time Markov chains, Classification of states, Limiting distribution, Birth and death process, Poisson process, Steady state and transient distributions, Simple Markovian queuing models (M/M/1, M/M/1/N).

List of Experiments

1. Introduction to MATLAB
   a. Matrix computation.
   b. To Plot Sine Wave of frequency 200 Hz.
   c. To plot a pulse of width 10.
   d. Plot the spectrum (Amplitude and phase) 0f the pulse generated in 3.
2. Uniform random number and plot its density function. Find its mean and variance.
3. Generate Gaussian distributed random number and plot its density function. Find its mean and variance.
4. Compute the Signal to quantization Noise ratio of Uniform Quantization. Plot SNQR versus Quantization levels.
5. Compute the Signal to quantization Noise ratio of Non-Uniform Quantization. Plot SNQR versus Quantization levels.
6. Study of passband digital communication technique BPSK. Calculate the BER of BPSK modulated signal.
7. Given is a linear block code with the generator matrix G

1 1 0 0 1 0 1

a. G = 0 1 1 1 1 0 0 1 1 1 0 0 1 1

a. Calculate the number of valid code words N and the code rate RC. Specify the complete Code set C.

b. Determine the generator matrix G′ of the appropriate systematic (separable) code C'.

c. Determine the syndrome table for single error.

8. To generate a M/M/1 Queue having infinite buffer space with parameters (λ, μ) and plot the average delay per packet vs λ/μ.
9. To generate a M/M/1 Queue having finite buffer space with parameters (λ, μ) and plot blocking probability with respect to variation with buffer space.
10. To simulate STOP and WAIT protocol using M/M/1 queuing system and plot average delay per packet vs λ/μ.
11. To simulate SLIDING WINDOW protocol and evaluate its performance with variation of window size.
12. Observe and measure the performance of TOKEN BUS MAC Layer protocols by changing the network load, distance between the nodes.
13. Observe and measure the performance of ALOHA protocol by changing the network load, distance between the nodes.
14. Observe and measure the performance of CSMA protocols by changing the network load, distance between the nodes.
15. Observe and measure the performance of CSMA/CD protocols by changing the network load, distance between the nodes.

Text Book:

1. A. S. Tannenbum, D. Wetherall, "Computer Networks", Prentice Hall, Pearson, 5 th Ed [T2] Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill, 4th Ed

Reference:

1. Fred Halsall, "Computer Networks", Addison – Wesley Pub. Co. 1996.
2. Larry L, Peterson and Bruce S. Davie, "Computer Networks: A system Approach", Elsevier, 4 th Ed
3. Tomasi, "Introduction To Data Communications & Networking", Pearson 7th impression 2011
4. William Stallings, "Data and Computer Communications", Prentice Hall, Imprint of Pearson, 9 th Ed.
5. Zheng , "Network for Computer Scientists & Engineers", Oxford University Press
6. Data Communications and Networking: White, Cengage Learning

Course No.	Title of the Course	Course Structure	Pre-Requisite

CAMTC13	Probability and Stochastic Processes	3L-1T-0P	None

COURSE OUTCOMES (CO)

1. To understand the detailed concept of probability and applications.
2. To know about Continuous Frequency distribution.
3. To know about MGF and Method of Least square.
4. To understand the concept of large samples.
5. To understand sampling theory for small samples and inference.

COURSE CONTENT:

UNIT-1

Probability: Mathematical and Statistical definitions and problems, Marginal probability, Random variables, discrete and continuous random variables, Mathematical Expectation, Moments, Central moments, Kurtosis.

UNIT-2

Important Theoretical Distributions: Review of continuous and discrete probability distributions, Negative binomial distribution, Fitting of standard distributions, Fitting of Normal distribution by method of areas and method of ordinates, Hypergeometric distributions, Multinomial distribution, Rectangular distribution, Beta distribution of first and second kind, Gamma distribution, Cauchy's distribution, Geometrical probability, Tchebycheff's and Markov's inequalities.

UNIT-3

MGF and Method of Least Square: Change of origin and scale in MGF, moment generating functions of standard distributions (Poisson, Binomial, Exponential, Uniform, Normal, Gamma, chi square), Cumulants, characteristic function, Weak law of large numbers, Central limit theorem. Method of least squares: Fitting of straight lines, parabola and exponential curves.

UNIT-4

Simple sampling of attributes: Large samples, mean and S. D. in simple sampling of attributes, Test of significance for large samples, Standard error, Type I and II errors, Null hypothesis, Confidence limits, Chi-square distribution, Degree of freedom, Level of significance, Test of goodness of fit, Test of independence, Coefficient of contingency, Yate's correction for continuity.

UNIT-5

Sampling of variables and Inference: Small samples, t-distribution, test of significance of the mean of random sample from normal population, F-distribution, Relationship between t, F and chi square distributions, Inference: Point estimation, interval estimation, properties of good estimator, Maximum likelihood parameter.

Recommended Books:

1. An Introduction to Probability Theory and Its Applications, Vol. 1 (Wiley Series in Probability and Statistics) by W. Feller, 1968
2. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Publication), 2020
3. Probability & Statistics- SOS by Spiegel, McGraw Hill, 2010
4. Probability and Statistics for Engineers by Anthony J. Hayter (Cengage Learning), 2013
5. Mathematical Statistics, Krishna Prakashan Media by J. K. Goyal and J. N. Sharma, 2014

4.3.5 SYLLABI OF PROGRAM CORE COURSES : V SEMESTER

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSC14	CC	Principles of Compiler Construction	3	0	2	4	15	15	40	15	15	Theory Automata and Formal Languages

COURSE OUTCOMES

1 Understand the internal organization and behavior of the compilers and other language processors.
2 Apply the formal constructs for designing a compiler.
3 Study and understand the functioning of a compiler.
4 Gain an ability to design simple domain-specific languages (DSLs) using compiler construction tools.
5 Go for the translation of languages or design the tools for online processing.

COURSE CONTENTS

Unit 1

Introduction: Language processors, structure of a compiler, compiler-construction tools, evolution of programming languages, applications of compiler technology, Transition diagrams, bootstrapping, just-in-time compilation.

Unit 2

Lexical analysis: Input buffering, specification and recognition of tokens, lexical analyzer generator.

Unit 3

Syntax analysis: Specification of syntax using grammar. Top-down parsing – recursive-descent, predictive. Bottom-up parsing – shift-reduce, SLR, CLR, LALR. Parser generator.

Unit 4

Intermediate-code generation: Syntax-directed translation. Three-address code. Translation of declarations, expressions, control flow. Backpatching. Runtime environment: Activation trees and records.

Unit 5

Code optimization: Sources of optimization, basic blocks, optimization of basic blocks, data-flow analysis, loop optimizations. Code generation: Issues, register allocation and assignment, peephole optimization

Practical:

1. Develop simple language processors like desk calculator and assembler.
2. Design a small high-level language.
3. Develop a lexical analyzer and a syntax analyzer for the same using the LEX and YACC tools. Also implement the bookkeeper module.
4. Design a small high-level language and implement a compiler for the same. If the target machine of the compiler is a hypothetical machine, then implement a simulator for it.
5. Develop a simple calculator using LEX and YACC tools.
6. Implement a program for symbol table using hashing
7. Implement a two-pass assembler
8. Implement a bottom-up parser using YACC tool.
9. Represent 'C' language using Context Free Grammar
10. Add assignment statement, If then else statement and while loop to the calculator and generate the three address code for the same.

SUGGESTED READINGS

1. Aho, A. V., Lam, M. S., Sethi, R. and Ullman J. D., "Compilers – Principles, Techniques and Tools (2nd ed.)", Pearson.
2. Chattopadhyay, S. 2005, "Compiler Design, PHI".
3. Appel, A. W. 200, "Modern Compiler Implementation in C", Cambridge University Press.
4. Kenneth C. Louden (1997), Compiler Construction– Principles and Practice, 1st edition, PWS Publishing.

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSC15	CC	Distributed Computing	3	0	2	4	15	15	40	15	15	Computer Networks

COURSE OUTCOMES (CO)

1. Study software components of distributed computing systems. Know about the communication and interconnection architecture of multiple computer systems.
2. Recognize the inherent difficulties that arise due to distributedness of computing resources.
3. Understand basic problems in distributed computing, especially in relation to concurrency, parallelism, synchronization, deadlocks, safety and liveness properties.
4. Understand differences between various distributed computing models and widely used distributed computing schemes

Understanding communication mechanism among the distributed entities

COURSE CONTENT:

UNIT-I

CHARACTERIZATION OF DISTRIBUTED SYSTEMS: Introduction, Examples of distributed systems, Trends in distributed systems

SYSTEM MODELS: Physical models, Architectural models, Fundamental models.

UNIT-II

INTERPROCESS COMMUNICATION : The API for the Internet protocols, External data representation and marshalling, Multicast communication, Network virtualization: Overlay networks.

REMOTE INVOCATION: Request-reply protocols, Remote procedure call, Remote method invocation.

INDIRECT COMMUNICATION: Group communication, Publish-subscribe systems, Message queues, Shared memory approaches

UNIT-III

DISTRIBUTED FILE SYSTEMS: File service architecture

TIME AND GLOBAL STATES: Clocks, events and process states, Synchronizing physical clocks, Logical time and logical clocks, Global states, Distributed debugging

UNIT-IV

COORDINATION AND AGREEMENT: Distributed mutual exclusion Elections, Coordination and agreement in group communication, Consensus and related problems

TRANSACTIONS AND CONCURRENCY CONTROL: Transactions, Nested transactions, Locks, Optimistic concurrency control, Timestamp ordering, Comparison of methods for concurrency control.

UNIT-V

DISTRIBUTED TRANSACTIONS: Flat and nested distributed transactions, Atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery.

REPLICATION: System model and the role of group communication, Fault-tolerant services, Transactions with replicated data.

SECURITY: Overview of security techniques, Cryptographic algorithms, Digital signatures, Cryptography pragmatics.

Recommended Books:

1. G. Coulouris, J. Dollimore, "Distributed Systems Concepts and Design," Addison Wesley.
2. Hwang & Dongarra & Fox, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things,"
3. M. Singhal, N.G. Shivarathri , "Advanced Operating Systems,", McGraw Hill.
4. Randy Chow, T. Johnson, "Distributed Operating Systems and Algorithms," Addison Wesley.
5. A.S. Tanenbaum, "Distributed Operating Systems," Prentice Hall.
6. M. Tamer Ozsu, PatrickValduriez, "Principles of Distributed Database Systems," Prentice Hall International

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSC16	CC	Game Theory and Applications	3	0	2	4	15	15	40	15	15	Design and Analysis of Algorithms

COURSE OUTCOMES:

1. The aim of this course is to introduce students to the novel concepts of Game.
2. Introduce the theory with special emphasis on its applications in diverse fields and current research.
3. To get familiar with perfect and imperfect information
4. To get familiar with the extensive and strategic games
5. To study various applications on auction and designing mechanisms

COURSE CONTENTS

Unit I: Introduction:

Introduction, overview, uses of game theory, some applications and examples, and formal definitions of: the normal form, payoffs, strategies, pure strategy Nash equilibrium, dominant strategies.

Unit II: Games with Perfect Information:

Normal form games, Dominant strategy equilibrium, Iterated strict dominance, Nash Equilibrium in pure strategies, Cournot duopoly, Prisoner's dilemma, Battle of Sexes, Problem of commons, Final offer arbitration, Strategic Voting, Non-existence of pure strategy Nash equilibrium.

Unit III:

Extensive Form Game with Perfect Information: Theory, Stackelberg Model of Duopoly, Buying Votes, Committee Decision-Making, Repeated games: The Prisoner's Dilemma, General Result.

Unit IV:

Strategic Games with Imperfect Information: Bayesian Games, Cournot's Duopoly with Imperfect Information, Radio Spectrum, With Arbitrary Distribution of Valuations.

Unit V:

Auction and Mechanism Design with Applications: Revenue Equivalence, Risk Averse Bidders, Asymmetries among Bidders, Mechanism, Optimal Mechanism.

SUGGESTED READINGS

1. Martin Osborne, An Introduction to Game Theory, Oxford University Press, 2003
2. Vijay Krishna, Auction Theory, Academic Press.
3. Prajit Dutta, Strategies and Games, MIT Press
4. http://www.ece.stevens-tech.edu/~ccomanic/ee800c.html
5. Allan MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSC17	CC	Machine Learning	3	0	2	4	15	15	40	15	15	Probability and Stochastic Processes or Algorithms

COURSE OUTCOMES

1. To develop an understanding of the fundamentals of machine learning.
2. To develop an understanding of statistical pattern recognition.
3. To gain an insight into the various components of machine learning such as supervised learning, unsupervised learning, learning theory, reinforcement learning and adaptive control.
4. To acquire skills that can be applied to various components of machine learning to applications like robotic control, data mining, autonomous navigation, bioinformatics, speech recognition, and text and web data processing.
5. To apply the knowledge gained to the projects

COURSE CONTENTS

Unit I

Introduction: Definition of learning systems. Goals and applications of machine learning. Inductive Classification: The concept learning task. Concept learning as search through a hypothesis space. General-to-specific ordering of hypotheses. Finding maximally specific hypotheses. Version spaces and the candidate elimination algorithm. Learning conjunctive concepts.

Unit II

Ensemble Learning: Using committees of multiple hypotheses. Bagging, boosting, and DECORATE. Active learning with ensembles.
Experimental Evaluation of Learning Algorithms: Measuring the accuracy of learned hypotheses.

Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing.

Unit III

Computational Learning Theory: Models of learnability: learning in the limit; probably approximately correct (PAC) learning. Sample complexity: quantifying the number of examples needed to PAC learn. Computational complexity of training.
Sample complexity for finite hypothesis spaces. PAC results for learning conjunctions, kDNF, and kCNF. Sample complexity for infinite hypothesis spaces, Vapnik- Chervonenkis dimension.

Unit IV

Rule Learning: Propositional and First-Order, Translating decision trees into rules. Heuristic rule induction using separate and conquer and information gain. First-order Horn-clause induction (Inductive Logic Programming) and Foil. Learning recursive rules. Inverse resolution, Golem, and Progol.
Artificial Neural Networks: Neurons and biological motivation. Linear threshold units. Perceptron: representational limitation and gradient descent training.
Multilayer networks and backpropagation. Hidden layers and constructing intermediate, distributed representations. Overfitting, learning network structure, recurrent networks.

Unit V

Support Vector Machines: Maximum margin linear separators. Quadratic programming solution to finding maximum margin separators. Kernels for learning non-linear functions.
Bayesian Learning: Probability theory and Bayes rule. Naive Bayes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logistic regression. Bayes nets and Markov nets for representing dependencies.

List of Some Practical:
Guidelines for project based work: Semester long projects, presentations, research work, term papers based on the above topics.
1. Write a python code for Linear regression
2. Write a python code for Logistic regression
3. Write a python code for Decision tree
4. Write a python code for SVM.
5. Write a python code for KNN
6. Write a python code for K-Mean
7. Write a python code for Random forest
8. Write a python code for Dimensionality reduction with LDA
9. Write a python code for Dimensionality reduction with PCA
10. Write a python code for Artificial neural network
11. Write a python code for Bayesian classification algorithm
12Write a python code for Gradient boosting Algorithm (XGBoost)
13.Write a python code for Gradient boosting Algorithm (LightGBM)
14.Write a python code for Apriori Algorithm
15.Write a python code for CatBoost

SUGGESTED READINGS

1. Richard Duda, Peter Hart and David Stork, Pattern Classification, 2nd ed. John Wiley & Sons, 2001.
2. Tom Mitchell, Machine Learning. McGraw-Hill, 1997.
3. Richard Sutton and Andrew Barto, Reinforcement Learning: An introduction. MIT Press, 1998
4. Trevor Hastie, Robert Tibshirani and Jerome Friedman, The Elements of Statistical Learning. Springer, 2009

4.3.6 SYLLABI OF PROGRAM CORE COURSES : VI SEMESTER

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSC18	CC	Deep Learning	3	1	0	4	25	25	50	-	-	CACSC17

COURSE OUTCOMES

1. Realize the characteristics of deep learning models that are useful to solve real-world problems.

2. Understand various dimensionality reduction techniques.

3. Implement different deep learning algorithms

4. Recognize different methodologies to create application using deep nets.

5. Identify and apply appropriate deep learning algorithms for analysing the data for variety of problems.

COURSE CONTENTS:

UNIT I

Introduction, History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent, Feed Forward Neural Networks, Back propagation

UNIT II

Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, Principal Component Analysis(PCA): PCA and its interpretations, Singular Value Decomposition, Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders

UNIT III

Regularization, Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Greedy Layerwise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization

UNIT IV

Convolutional Neural Networks, Learning Vectorial Representations of Words, Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Recurrent Neural Networks, Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs

UNIT V

Encoder Decoder Models, Attention Mechanism, Attention over images, Variational Autoencoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning, Applications: Vision, NLP, Speech

SUGGESTED READINGS

1. 1. Ian Goodfellow, YoshuaBengio and Aaron Courville, "Deep Learning", MIT Press, 2017.
2. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.
3. Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" Apress, 2018.

Course Code	Type	Course	L	T	P	Credits	Evaluation Scheme (Percentage weights)					Offering Dept.	Pre-Requisites Course		Equivalent Course Codes
							Theory			Practical					
							CA	MS	ES	CA	ES		Code	Name	
CACSC19	CC	AI Hardware and Tools Workshop	2	0	4	4	30	-	20	30	20	CSE			None

COURSE OUTCOMES:

1. To get acquaintance with the concept of machine learning libraries, usages for different platforms
2. Getting Exposure to R programming and hands on project in R for Analytics
3. Exposure and usage of the analytics tools such as PowerBI etc.
4. Understanding the distributed databases with Apache spark and implementation
5. Implement projects, based on the open source libraries and get acquainted with the current trends in the industry.

COURSE CONTENTS:

UNIT-1

Introduction to Machine Learning on AI Hardware

Introduction to Machine Learning libraries such as TinyML etc.
Capstone Project 1: Utilizing TinyML library, develop a project on a single board computer or microcontroller. Team should comprise a group with 2-3 students.

UNIT-2
Data visualization and Analytics
Introduction to automation and data visualization using R Language.
Capstone 2 Project: Utilizing R library, develop a project on data visualization and analytics. Team should comprise a group with 2-3 students.

UNIT-3
Advances in Data Visualization and Analytics
Introduction to advances in data visualization and analytics such as PowerBI etc.
Capstone 3 Project: Utilizing PowerBI library, develop a project on data visualization and analytics. Team should comprise a group with 2-3 students.

UNIT-4
Distributed Databases for AI
Introduction of distributed databases for AI using Open Source frameworks like Apache Spark etc.
Capstone 4 Project: Utilizing Apache Spark, develop a project on distributed databases. Team should comprise a group with 2-3 students.

UNIT-5
DevOps for AI
Introduction to DevOps for AI using any Open Source frameworks.
Capstone 5 Project: Utilizing Open Source framework, develop a project focused on DevOps for AI deployment. Team should comprise a group with 2-3 students.

References (but not limited to)

https://www.tinyml.org/
S. van Buuren. Flexible Imputation of Missing Data. Chapman & Hall/CRC Interdisciplinary Statistics. CRC Press LLC, 2018. ISBN 9781138588318.
https://www.routledge.com/Flexible-Imputation-of-Missing-Data-Second-Edition/Buuren/p/book/9781138588318]
Dan E. Kelley. Oceanographic Analysis with R. Springer-Verlag, New York, October 2018. ISBN 978-1-4939-8842-6. https://www.springer.com/us/book/9781493988426]
https://powerbi.microsoft.com/en-us/
https://medium.datadriveninvestor.com/distributed-data-processing-with-apache-spark-2a5e473b0cb1
https://spark.apache.org/
https://www.tensorflow.org/
https://keras.io/
https://scikit-learn.org/stable/
https://docs.microsoft.com/en-us/cognitive-toolkit/
http://www.deeplearning.net/software/theano/
http://caffe.berkeleyvision.org/
http://torch.ch/

http://accord-framework.net/

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSC20	CC	High Performance Computing	3	0	2	4	15	15	40	15	15	CACSC07

COURSE OUTCOMES

1. To understand the capabilities, limitations and performance of high-performance architectures and their applications in solving challenging problems.
2. Develop the skills to decompose parallelizable problems effectively.
3. Write parallel algorithms and use parallel programming paradigms to implement them.
4. Appreciate the multidisciplinary approach for developing and utilizing high performance systems.
5. Getting the exposure to set up a small cluster and various concepts of computing.

COURSE CONTENTS

UNIT-1

Introduction: Flynn's classification of parallel architectures, Kinds of parallelism-Temporal, data and mixed parallelism , Dependencies and hazards - data, control and resource dependencies, PRAM models.

UNIT-2

Parallel Programming paradigms: Granularity and Communication overheads, Program decomposition techniques, Shared Memory Programming (pthreads), SPMD model, Message Passing Programming (MPI/Open MP), Parallel sorting, even-odd transposition/ parallel multiplication/ Parallel matrix operations on PRAM models.

UNIT-3

High Performance Architectures: Instruction level parallelism-Delays in instruction pipelining, mechanisms to tackle pipeline stalls, superscalar, superpipelined architectures, VLIW processors. Array Processors -SIMD architectures, Vector processing architectures. Multiprocessor architectures shared memory symmetric multiprocessing, clusters and

grids. Interconnection networks - characteristics and routing mechanisms. Parallel algorithms on realistic architectures.

UNIT-4

Performance and scalability evaluation: Performance Laws: Amdahl's Law,

Guftanson's Law, Sun and Li Law, Performance Benchmarks, Overheads in parallel processing, Hardware software matching.

UNIT-5

Memory and cache Consistency: Memory consistency: strict consistency, Lamport's sequential consistency, strong and weak consistency models. Bus based and directory based cache coherence protocols.

Guidelines for practical work:

Shared memory inter-process communication using pthreads – develop

applications to demonstrate inter-process communication by thread creation, parameter passing, thread joining using semaphores, mutex and condition

variables.

- Message passing parallel programming – develop applications to demonstrate task partitioning and IPC using Message Passing Interface (MPI) and OpenMPI such as different parallel implementations of matrix multiplication and sorting. Create a simple cluster.

SUGGESTED READINGS

1. Kai Hwang, "Advanced Computer Architecture", McGrawHill
2. V. Rajaraman and C. Siva Ram Murthy, "Parallel Computers, architecture and programming, PHI
3. Michael J Quinn, "Parallel Programming in C with MPI and OpenMP", McGrawHill Edu.
4. Peter Pacheco, "An introduction to parallel programming".

4.3.7 SYLLABI OF PROGRAM CORE COURSES : VII & VIII SEMESTERS

Course No	Title of the Course	Course Structure	Pre-Requisite

CACSC21	Training	0L-0T-4P	----

COURSE OUTCOME:

CO1: To get a good exposure to a domain of interest.

CO2: To get a good domain and experience to various industrial activities.

Students of B. Tech Computer Science & Engineering will undergo at least 6-week training in the industry or research organization/reputed institute after VI semester. This will be evaluated as a VII semester course during end-semester examination. Industrial training/internship means work experience that is relevant for competence enhancement before graduation in Computer Science & Engineering.

Course No	Title of the Course	Course Structure	Pre-Requisite
CACSC22	Project-I	0L-0T-8P	----

COURSE OUTCOME:

CO1: To identify the topic, objectives and methodology to carry out the project work.

CO2: To develop aptitude for research and independent learning.

CO3: To demonstrate the ability to conduct literature survey and select unresolved problems in the relevant filed.

CO4: To gain the expertise of the tools required for the design and development of the project.

CO5: To develop the ability to write good technical report, to make oral presentation of the work, and to publish the work in reputed conference/journals.

The project in the seventh and eighth semesters offer the opportunity to apply and extend knowledge acquired during the B. Tech. program in Computer Science & Engineering. The project can be analytical work, simulation, hardware design or a combination of these in the emerging areas of Computer Science & Engineering under the supervision of a faculty from the Department of Computer Science & Engineering. Students will be required to perform a literature search to review current knowledge and developments in the chosen technical area; and undertake detailed technical work in the chosen area using one or more of the following:

1. Analytical models
2. Computer simulations
3. Hardware implementation

Project will be carried out in the group of maximum 4 students. The project group has to give two presentations for the evaluation of the project work during the seventh semester. The first presentation shall be conducted in the middle of the semester. By the time of the first evaluation, students are expected to complete the literature review, have a clear idea of the work to be done, and have learnt the analytical/software/ hardware tools. The second presentation shall be conducted at the end of the semester (end semester examination). By the time of the second evaluation, they are expected to present the results in the chosen topic, and write a technical report of the study. A student will be awarded the grade in the project work as per the norms issued by the University from time-to-time.

Course No	Title of the Course	Course Structure	Pre-Requisite
CACSC23	**Project-II**	**0L-0T-16P**	**None**

COURSE OUTCOME:

CO1: To identify the topic, objectives and methodology to carry out the project work.
CO2: To develop aptitude for research and independent learning.
CO3: To demonstrate the ability to conduct literature survey and select unresolved problems in the relevant filed.
CO4: To gain the expertise of the tools required for the design and development of the project.
CO5: To develop the ability to write good technical report, to make oral presentation of the work, and to publish the work in reputed conference/journals.

Project-II may be the continuation of the Project-I or it may be the new idea developed by the project group. Students will be required to undertake detailed technical work in the chosen area using one or more of the following:

1. Analytical models
2. Computer simulations
3. Hardware implementation

Project will be carried out in the group of maximum 4 students. The project group has to give two presentations for the evaluation of the project work during the seventh semester. The first presentation shall be conducted in the middle of the semester. The second presentation shall be conducted at the end of the semester (end semester examination). By the time of the second evaluation, they are expected to present the results in the chosen topic, and write a technical report of the study. A student will be awarded the grade in the project work as per the norms issued by the University from time-to-time.

4.4 DEPARTMENT ELECTIVE COURSES

4.4.1 LIST OF DEPARTMENT ELECTIVES

SEM.	Code	Name of Core Course	L T P Allocation			Evaluation Scheme Theory Practical					Syllabus page Nos
			L	T	P	CA	MS	ES	CA(P)	ES(P)	
V	CACSE01	Semantic Web	3	1	0	15	15	40	15	15	98
	CACSE02	Object oriented analysis and design	3	0	2	25	25	50			99
	CACSE03	Cryptography techniques	3	1	0	15	15	40	15	15	101
VI	CACSE20	Computer Vision	3	1	0	25	25	50			102
	CACSE21	Natural Language Processing	3	1	0	25	25	50			104
	CACSE22	Advanced Algorithms	3	0	2	15	15	40	15	15	105
	CACSE23	IOT Systems and the Cloud	3	1	0	25	25	50			107
	CACSE24	Data Privacy and Security	3	1	0	25	25	50			108
VII / VIII	CACSE50	Optimization Technique for machine learning	3	1	0	25	25	50			111
	CACSE51	Intelligent Computing	3	1	0	25	25	50			112
	CACSE52	Randomized Algorithms	3	0	2	15	15	40	15	15	113
	CACSE53	Augmented Reality	3	0	2	15	15	40	15	15	115
	CACSE54	Knowledge Based System	3	1	0	25	25	50			117
	CACSE55	Human Computer Interface	3	1	0	25	25	50			118
	CACSE56	Pattern Processing using AI	3	0	2	15	15	40	15	15	119
	CACSE57	Responsible AI	3	1	0	25	25	50			121
	CACSE58	Multimodal AI	3	1	0	25	25	50			122

4.4.2 SYLLABI OF DEPARTMENT ELECTIVES COURSES : V SEMESTER

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSE01	ED	Semantic Web	3	1	0	4	25	25	50	-	-	Algorithms

COURSE OUTCOMES

1. Understand the rationale behind Semantic Web.
2. Model ontologies using Resource Description Framework (RDF).
3. Design RDF Schemas for ontologies, model and design ontologies using Web Ontology Language (OWL).
4. Query ontologies using SPARQL.
5. Understand and reflect on the principles of Ontology Engineering, make an association between Semantic web and Web 2.0. And apply Semantic web technologies to real world applications.

COURSE CONTENTS

Unit I

Introduction to the Semantic Web, ontologies and description logic

Unit II

Overview and Introduction: Knowledge Representation, Semantic Web in Depth: RDF and RDF Schema, Semantic Web in Depth: OWL. Resource description framework, lightweight ontologies, a query language for Resource description framework (RDF) - SPARQL

Unit III

Writing OWL ontologies: Protégé, Semantic Web Methodologies and Design Patterns, Semantic Web in Depth: SPARQL, Semantic Web in Depth: Rules.

Unit IV

Publishing on the Semantic Web: Linked Data, Semantic Web Vocabularies and Applications, Semantic Web vs Web2.0, Trust and Community.

Unit V

Applications: Information Integration, Ontology Alignment, Scalable Reasoning and Knowledge Acquisition.

SUGGESTED READINGS

1. A Semantic Web Primer, third edition, MIT Press, 2012, Grigoris Antoniou, Paul Groth, Frank van Harmelen and Rinke Hoekstra
2. Grigoris Antoniou, Frank Van Harmelen, A Semantic Web Primer, MIT Press, 2008.
3. Pascal Hitzler, Markus Krotzsch, Sebastian Rudolph, Foundations of Semantic Web Technologies, CRC Press, 2009.
4. Dean Allemang, James Hendler, Semantic Web for the Working Ontologist: Effective Modeling in RDFS and OWL, Morgan Kauffmann, ISBN-10: 0-12-373556-4.

5. Geroimenko, Vladimir; Chen, Chaomei (Eds.) 2nd ed., 2006, XIV, 248 p. 108 illus., Hardcover ISBN: 978- 1-85233-976-0, Visualizing the Semantic Web XML-based Internet and Information Visualization, SpringerVerlag London Ltd; 2Rev Ed edition (Oct 2005).
6. Michael C. Daconta, Leo J. Obrst, Kevin T. Smith, The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management: A Guide to the Future of XML, Web Services and Knowledge Management, John Wiley & Sons (20 Jun 2003).
7. S Powers, Practical RDF (Paperback) , OReilly (1 Aug 2003).
8. Thomas B. Passin, Explorer's Guide to the Semantic Web (Paperback), Manning Publications (8 Jul 2004)

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSE02	**ED**	**Object Oriented Analysis and Design**	**3**	**0**	**2**	**4**	**15**	**15**	**40**	**15**	**15**	DBMS, data structures

COURSE OUTCOMES

1. To appreciate the fact that software development cannot be done in an adhoc fashion and has to follow a disciplined systematic approach for timely development of software within budget using suitable Process model and techniques
2. To learn various techniques for Requirements Elicitation and Specification in order to develop SRS for a problem domain
3. To model a problem domain using Object oriented analysis and design using UML
4. To learn Different techniques for software project management like Feasibility Analysis, Cost and Effort Estimation, Scheduling a project
5. To learn about different Software Quality frameworks, OO metrics, Configuration Management etc.

COURSE CONTENTS

Unit 1

Introduction: Introduction to software engineering, Importance of software, The Software evolution, Software characteristics, Software components, Software applications, Crisis-Problem and causes. Difference between software engineering and system engineering Software Process Models: Waterfall model, Evolutionary Models, prototyping, V Model, Spiral model Incremental Model, RAD Model etc. Introduction to Agile models like Scrum, Extreme Programming, Feature Driven Development, Crystal etc., Comparison between Traditional and Agile models

Unit 2

Requirement Engineering**:** Different Types of Requirements: Functional, Non Functional and Domain Requirements in detail, Requirement elicitation Techniques like interviews, questionnaire, brainstorming, JAD, Scenario, Mind mapping, Requirement workshop, Prototyping, CRC Cards etc. Requirements Management, Writing SRS as per IEEE standard, Quality characteristics of SRS

Unit 3

Requirements Specification: Difference between structured and Object Oriented Analysis, Different views of modeling, Quick review of ER diagram, Data flow diagrams, State Transition Diagrams, data Dictionary,
Introduction to Unified Modeling language Conceptual Model of Unified Modeling Language (UML), Use case Diagram, Activity Diagram, Class Diagram, Object Diagram,

Unit 4

Sequence Diagram, Communication Diagram, State Machine Diagram, Timing Diagram, Composite Structure diagram, Package Diagram, Component Diagram, Deployment Diagram, Introduction to Rational Unified Process(RUP)

Unit 5

Software project Management: Project Management Process, System Request, Feasibility Analysis in detail Project scheduling, Finding Critical Path, Effort Estimation for OO systems using Use case diagram, Introduction to Object Oriented Metrics, Configuration Management,
Software Quality : Software Quality Models like McCall's Quality model, Quality frameworks like Capability Maturity Model, ISO9001

Practical:

1. Choose a problem domain and textually write the Functional and Non Functional requirements of the domain. While writing make use of elicitation techniques discussed in the class
2. For a Problem domain develop a Mind-Map
3. Draw the static View and functional view of the Problem domain of exercise 1 using ER diagram and DFD
4. Draw the Dynamic view of working of an ATM Machine or Microwave Oven
5. Develop a Use Case Model(use Case diagram and Use case Narratives) for a problem domain
6. For the problem of Q5, draw activity diagram, sequence diagrams and Class diagram
7. Draw the state machine diagram for a CD player
8. Perform Effort estimation activity and Implement Critical path method using an open source Tool for a case study
9. Write SRS as per IEEE std-830 for the problem domain of Q5

SUGGESTED READINGS

1. Sommerville, "Software Engineering", 10th Edition Published by Pearson
2. Sangeeta Sabharwal, "Software Engineering: Principles and Techniques", Second Edition, Published by New Age International Publishers, 2020
3. R . S. Pressman, "Software Engineering – A practitioner's approach", McGraw Hill Int. Ed.

4. Object Oriented Modeling and Design with UML by Michael R Blaha and James R Rumbaugh, 2nd Edition, Pearson
5. UML distilled, Third Edition by Martin Fowler, Addison Wesley .
6. The Unified Software Development Process by I*var* Jacobson, Booch and Rumbaugh,Addison Wesley, 2007

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSE03	**ED**	**Cryptography techniques**	**3**	**1**	**0**	**4**	**25**	**25**	**50**	**-**	**-**	Networking

COURSE OUTCOMES

1. Explain common attacks against network assets, the associated threats and vulnerabilities, and what network security personnel do to secure assets,
2. Explain how to use cryptography to help protect information and how to choose an appropriate encryption method for an organization
3. Help protect information in an organization by using authentication and access control and deploy and manage certificates.
4. Help protect transmission of data by identifying threats to network devices and implementing security for common data transmission, remote access, and wireless network traffic
5. Identify common security threats and vulnerabilities to directory services and DNS, and then apply security methods to help protect them

COURSE CONTENTS

Unit I

Foundation of Security & Cryptography: OSI security architecture, Security attack, security services and mechanisms, model of security, Classical encryption techniques: Substitution Techniques, Transposition Techniques and Steganography.

Unit II

Block Ciphers and Public key cryptography: Design Principle of Block Ciphers: DES, AES, Multiple Encryption, Block Cipher modes of operation, stream ciphers, RC4, Public Key Cryptography: RSA, Key management, Diffie-Hellman Key exchange, Elliptic Curve Cryptography

Unit III

Hashes & Digital Signatures**:** Authentication functions, Message authentication codes, Hash functions and their security, HMAC, CMAC, Secure hash algorithms, Digital Signature: Certificates & standards, authentication protocols

Unit IV

Authentication Applications: Kerberos, X.509 Authentication service, public key infrastructure, electronic Mail Security: pretty good privacy, S/MIME

Unit V

IP and Web Security Protocols: IPsec, Secure socket layer and transport layer security, secure e-transaction, System Security: Computer Virus, Firewall & Intrusion Detection, Trusted systems

SUGGESTED READINGS

1. Cryptography & Network Security by Stallings, William (Fourth Edition or later)
2. Foundations of Cryptography (Basic Tools), Oded Goldreich Cambridge 2001.
3. Cryptography: Theory and Practice, by Douglas R. Stinson, First Edition, second edition: first volume
4. An Introduction to Cryptology, Henk C.A. van Tilborg, Kluwer Academic Publishers, 1987

4.4.3 SYLLABI OF DEPARTMENT ELECTIVES COURSES : VI SEMESTER

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSE20	ED	Computer Vision	3	1	0	4	25	25	50	-	-	CACSC11 AI

COURSE OUTCOMES

1. Implement fundamental image processing techniques required for computer vision.
2. Recognize Image formation process.
3. Perform shape analysis and extract features form Images and do analysis of Images.
4. Generate 3D model from images and develop applications using computer vision techniques.
5. Understand video processing, motion computation and 3D vision and geometry.

COURSE CONTENTS:

UNIT I

Introduction to computer vision, Overview of Diverse Computer Vision Applications: Document Image Analysis, Biometrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing, Multimedia, Virtual Reality and Augmented Reality, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

UNIT II

Monocular imaging system, Radiosity: The 'Physics' of Image Formation, Radiance, Irradiance, BRDF, colour etc, Camera model and Camera calibration, Binocular imaging systems, Multiple views geometry, Structure determination, shape from shading, Photometric Stereo, Depth from Defocus, Construction of 3D model from images, Homography, Rectification, DLT, RANSAC, 3-Dreconstruction framework, Auto-calibration.

UNIT III

Image Processing and Feature Extraction: Image pre-processing, Image representations (continuous and discrete), Edge detection, LOG, DOG; Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG,GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.
Motion Estimation: Regularization theory, Optical computation, Stereo Vision, Motion estimation, Structure from motion

UNIT IV

Shape Representation and Segmentation: Contour based representation, Region based representation, Deformable curves and surfaces, Snakes and active contours, Level set representations, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation, Fourier and wavelet descriptors, Medial representations, Multiresolution analysis

UNIT V

Object recognition: Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis, Shape priors for recognition. Image Understanding: Pattern recognition methods, HMM, GMM and EM.
Miscellaneous: Applications: CBIR, CBVR, Activity Recognition, computational photography, Biometrics, stitching and document processing; Modern trends-super-resolution; GPU, Augmented Reality; cognitive models, fusion and SR&CS.

SUGGESTED READINGS

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.

2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education,2003.
3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
4. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
5. Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall.
6. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSE21	ED	Natural Language Processing	3	1	0	4	25	25	50	-	-	CACSC11 AI

COURSE OUTCOMES

1. Realize the fundamentals of natural language processing.
2. Recognize the basics of Language modelling and Word level analysis.
3. Understand the use of CFG and PCFG in NLP.
4. Recognize the role of semantics of sentences and pragmatic.
5. Identify the recent trends and applications of NLP.

COURSE CONTENTS:

UNIT I

Introduction: Various stages of NLP, Why NLP is hard, Why NLP is useful, Classical problems, Introduction to basic language processing – tokens, sentences, paragraphs, Spelling Correction, Morphological analysis and generation using Finite State Automata and Finite State transducer**.**

UNIT II

Language Modeling (LM): Grammar-based LM, Statistical LM, Linguistics Fundamentals, Classical approaches to NLP with knowledge bases and linguistic rules; Data Driven and Machine Learning Approaches to NLP, Text classification evaluation, relation extraction

Word Level Analysis: Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT III

Syntactic Analysis: Context Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures.

UNIT IV

Semantics and Pragmatics: Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selection restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods

UNIT V

Applications of NLP: Speech Processing, Speech Analysis and Modelling, Machine Translation, Information Retrieval, Text Summarization, Text Classification, Sentiment analysis and opinion mining.

SUGGESTED READINGS

1. Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Christopher D. Manning and HinrichSchutze, "Foundations of Natural Language Processing", 6 th Edition, The MIT Press Cambridge, Massachusetts London, England, 2003.
3. Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python, First Edition, OReilly Media, 2009.
4. Hobson lane, Cole Howard, Hannes Hapke, "Natural language processing in action" MANNING Publications, 2019.

Course no.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSE22	ED	Advanced Algorithms	3	0	2	4	15	15	40	15	15	CACSC06

COURSE OUTCOMES

1. Candidate will be able to understand paradigms and approaches used to analyze and design algorithms and to appreciate the impact of algorithm design in practice with asymptotic notations.
2. Able to use different computational models (e.g., divide-and-conquer, greedy approach, dynamic programming, back tracking, branch and bound) with their complexity measures like running time, disk space for solving real life complex problems for lifelong learning.

3. Understand the difference between the lower and upper bounds of various problems and their importance in deciding the optimality of an algorithm and relating these analyses to real life problems.
4. Able to understand solvable / unsolvable problems.
5. Understanding the classes P, NP and NP Complete.

CONTENTS

Unit I

Advanced Solutions to Basic Data Structuring Problems: Fibonacci Heaps, Persistent data structures, Splay Trees, Van Emde Boas Priority Queues, Dynamic Data Structures for Graph Connectivity/Reachability

Unit II

Bit Tricks: Word-level Parallelism, Transdichotomous Model, O(n \log n) Integer Sorting ,String Algorithms: Rabin-Karp Fingerprinting Algorithm, Suffix Trees, Maximum Flows: Augmenting Paths and Push-Relabel Methods, Minimum Cost Flows, Bipartite Matching

Unit III

Linear Programming: Formulation of Problems as Linear Programs, Duality, Simplex, Interior Point, and Ellipsoid Algorithms Online Algorithms: Ski Rental, River Search Problem, Paging, The k-Server Problem, List Ordering and Move-to-Front

Unit IV

Approximation Algorithms: One Way of Coping with NP-Hardness, Greedy Approximation Algorithms, Dynamic Programming and Weakly Polynomial-Time Algorithms, Linear Programming Relaxations, Randomized Rounding, Vertex Cover, Wiring, and TSP Fixed-Parameter Algorithms: Another Way of Coping with NP-Hardness, Parameterized Complexity, Kernelization, Vertex Cover, Connections to Approximation

Unit V

Parallel Algorithms: PRAM, Pointer Jumping and Parallel Prefix, Tree Contraction, Divide and Conquer, Randomized Symmetry Breaking, Maximal Independent Set, External-Memory Algorithms: Accounting for the Cost of Accessing Data from Slow Memory, Sorting, B-trees Buffer Trees, Cache-oblivious Algorithms for Matrix Multiplication and Binary Search Computational Geometry: Convex Hull, Line-segment Intersection, Sweep Lines, Voronoi Diagrams, Range Trees, Seidel's Low-dimensional LP Algorithm Streaming Algorithms: Sketching, Distinct and Frequent Elements

SUGGESTED READINGS

1.A.V. Aho, J.E. Hopcroft, and J.D. Ullman, “Data Structures and Algorithms,” Addison Wesley, Reading Massachusetts, USA,

2.Donald Knuth, “The Art of Computer Programming: Fundamental Algorithms,” Addison-Wesley .

3.Donald Knuth,“The Art of Computer Programming,” Volume 3: Sorting and Searching,

Third Edition. Addison-Wesley.

4.Thomas H. Cormen, Charles E. Leiserson, RonaldL. Rivest, and Clifford Stein, "Introduction to Algorithms,".
5.Sartaj Sahni,"DataStructures and Applications," Chapman and Hall/CRC Press.

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSE23	ED	IOT Systems and the Cloud	3	1	0	4	25	25	50	-	-	CAECC12

COURSE OUTCOMES

1. To Understand the various concept of the IoT and their technologies.
2. To develop the IoT application using different hardware platforms.
3. To Implement the various IoT Protocols
4. To Understand the basic principles of cloud computing.
5. To Develop and deploy the IoT application into cloud environment

COURSE CONTENTS:

UNIT I

Introduction to IoT – IoT definition – Characteristics – IoT Complete Architectural Stack – IoT enabling Technologies – IoT Challenges.

Sensors and Hardware for IoT – Hardware Platforms – Arduino, Raspberry Pi, Node MCU. A Case study with any one of the boards and data acquisition from sensors.

UNIT II

Protocols for IoT – Infrastructure protocol (IPV4/V6/RPL), Identification (URIs), Transport (Wifi, Lifi, BLE), Discovery, Data Protocols, Device Management Protocols. – A Case Study with MQTT/CoAP usage-IoT privacy, security and vulnerability solutions.

UNIT III

Case studies with architectural analysis: IoT applications, Smart City, Smart Water, Smart Agriculture , Smart Energy, Smart Healthcare, Smart Transportation, Smart Retail, Smart waste management.

UNIT IV

Introduction to Cloud Computing, Service Model, Deployment Model: Virtualization Concepts, Cloud Platforms: Amazon AWS, Microsoft Azure ,Google APIs.

IoT and the Cloud , Role of Cloud Computing in IoT ,AWS Components: S3:Lambda – AWS, IoT Core: Connecting a web application to AWS, IoT using MQTT, AWS IoT Examples**.**

UNIT V

Security Concerns, Risk, Issues, and Legal Aspects of Cloud Computing- Cloud Data Security., Vulnerability Scanning, IOT Network segmentation, Robust Security protocols

SUGGESTED READINGS

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman, CRC Press.
2. Adrian McEwen, Designing the Internet of Things, Wiley, 2013.

Course Code	Type	Subject	L	T	P	Credits	TCA	TMS	TES	PCA	PES	Pre-requisites
CACSE24	**ED**	**Data Privacy and Security**	**3**	**1**	**0**	**4**	**25**	**25**	**50**	**-**	**-**	**CACSC04 Web Technology**

COURSE OUTCOMES

CO1- Interpret the key concept of data security, authentication, and authorization.

CO2- Identify the security issues in the data network and resolve it.

CO3- Describe the privacy aspects and anonymization models.

CO4- Identify the key technologies used for privacy preservation

CO5- To know about the current research on data security and privacy preservation in the emerging domains.

COURSE CONTENT

UNIT-I

INTRODUCTION TO DATA PRIVACY and SECURITY

Fundamentals of Data Privacy & Security, Databases and Exploratory Data Analysis, Data Representation and Storage, Authentication and Authorization, Database Security, Data protection and privacy laws with overview of cyber-crime laws, consumer protection and e-transaction laws.

UNIT-II

DATA SECURITY FUNDAMENTALS

Classical Encryption Techniques Symmetric, Block Ciphers and the data encryption standard: Traditional block Cipher structure, stream Ciphers and block Ciphers, the Feistel Cipher. Public-Key Cryptography: Principles of Public-key Cryptosystems, Public-Key Cryptosystems, RSA, Diffie-Hellman Key Exchange Algorithm, key distribution. Public keys certificates, X.509certificates. Public key infrastructure, PKIX Management Functions & Protocols.

UNIT III

AUTHENTICATION & AUTHORIZATION

Authentication Vs Authorization, Authentication Methods –Password authentication, Public Key Cryptography, Biometric authentication, Out of band, Authentication Protocols – SSL, Password Authentication Protocol (PAP), Kerberos, Email authentication- PGP, Database authentication, Message authentication; secure hash functions and Authorization Approaches to hmac; Public-key cryptography algorithms, digital signatures, key management. Kerberos, x.509 directory authentication service. Authorization Definition, Multilayer authorization,

UNIT IV

DATA PRIVACY AND ANONYMIZATION

Understanding Privacy: Social Aspects of Privacy Legal Aspects of Privacy and Privacy Regulations Effect of Database and Data Mining technologies on privacy challenges raised by new emerging technologies such RFID, biometrics, etc., Privacy Models, Introduction to Anonymization, Anonymization models: K-anonymity, l-diversity, t-closeness, differential privacy Database as a service

UNIT V

DATA PRIVACY FOR DATA SCIENCE

Using technology for preserving privacy. Statistical Database security Inference Control Secure Multi-party computation and Cryptography Privacy-preserving Data

mining Hippocratic databases Emerging Applications: Social Network Privacy, Location Privacy, Query Log Privacy, Biomedical Privacy

REFERENCES AND TEXTBOOKS:

1. William Stallings, Cryptography and Network Security Principles and Practice, 6th edition, Pearson Education

2. Charu C Aggarwal, Yu Philips, S., Privacy-Preserving Data Mining- Models and Algorithms, Springer

3. Michael E. Whitman and Herbert J. Mattord, Principles of Information Security, Information Security Professional - 4th Edition,Thompson

4. Padmanabhan T R, Shyamala C and Harini N, "Cryptography and Security", Wiley Publications 2011.

4.4.4 SYLLABI OF DEPARTMENT ELECTIVES COURSES : VII & VIII SEMESTERS

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSE50	**ED**	**Optimization Technique for machine learning**	**3**	**1**	**0**	**4**	**25**	**25**	**50**	**-**	**-**	**Machine Learning**

COURSE OUTCOMES

1. Understand the implementation procedures for the machine learning algorithms.
2. Recognize classes of optimization problems in machine learning and related disciplines.
3. Understand the features of machine learning to apply to real-world problems
4. Understand the fundamental concepts of the evolutionary algorithms
5. Ability to apply the theory of optimization methods and algorithms to develop and for solving various types of optimization problems

COURSE CONTENTS

UNIT-1

Introduction to Optimization: Engineering application of Optimization, Statement of an Optimization problem, Optimal Problem formulation, Classification of Optimization problem. Optimum design concepts: Definition of Global and Local optima, Optimality criteria, Review of basic calculus concepts, Global optimality.

UNIT-2

Convex optimization: convex sets, convexity-preserving operations, examples of convex programs (linear programming (LP), second-order cone programming (SOCP), semidefinite programming (SDP), convex relaxation, KKT conditions, duality.

UNIT-3

Gradient-based methods: Gradient descent, subgradient, mirror descent, Frank–Wolfe method, Nesterov's accelerated gradient method, ODE interpretations, dual methods, Nesterov's smoothing, proximal gradient methods, Moreau–Yosida regularization

Operator splitting methods: Augmented Lagrangian methods, alternating direction method of multipliers (ADMM), monotone operators, Douglas–Rachford splitting, primal and dual decomposition

UNIT-4

Stochastic and nonconvex optimization: Dual averaging, Polyak–Juditsky averaging, stochastic variance reduced gradient (SVRG), Langevin dynamics, escaping saddle points, landscape of nonconvex problems.

UNIT-5

Modern methods of Optimization: Evolutionary algorithms, Genetic Algorithms, Swarm Intelligence methods, Particle swarm optimization method, Grey Wolf Optimizer, Applications.

Real world applications of Image/Video/Multimedia Processing

SUGGESTED READINGS

1. Stephen Boyd and Lieven Vandenberghe's book: Convex Optimization
2. Nesterov's new book: Lectures on Convex Optimization
3. Introduction to Nonlinear Optimization - Theory, Algorithms and Applications by Amir Beck
4. K. Deb, 'Optimization for Engineering Design Algorithms and Examples', PHI, 2000
5. Kulkarni, A. J., & Satapathy, S. C. (Eds.). (2020). Optimization in machine learning and applications (pp. 51-68). Heidelberg: Springer.

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSE51	**ED**	**Intelligent Computing**	**3**	**1**	**0**	**4**	**25**	**25**	**50**			

COURSE OUTCOMES

1. Identify the difference between different branches of AI.
2. Analyze a fuzzy based system.
3. Design Neural Networks to solve problems.
4. Understand the various concepts, terminologies, and architecture of IoT systems.
5. Identify the components of a cloud-based system.

COURSE CONTENTS

UNIT-1

Introduction

Defining concepts of Computing, Conventional Computing vs. Intelligent Computing, Applications and Need of Intelligent Computing, Current trends in Intelligent Computing

UNIT-2

Soft Computing Concepts:
Hard Computing vs. Soft Computing, Paradigms of Soft Computing, Soft Computing Constituents, Real Life applications of Soft Computing

Fuzzy Logic:
Classical Sets Vs Fuzzy Sets, Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Fuzzy Composition (Max-Min, Max-Product), Defuzzification, Fuzzy Inference System

Evolutionary Computation:
Principle of Optimization, Traditional vs Evolutionary optimization, Search Operators and Representations Genetic Algorithm: Genetic Programming, Multi-objective Evolutionary Optimization: Pareto optimality, multi-objective evolutionary algorithms.

UNIT-3

AI Concepts:

Introduction to AI, AI problems and Solution approaches, Fundamentals of problem-solving using Search and Heuristics, Foundations for AI: Application areas, AI Basics (Divide and Conquer, Greedy, Branch and Bound, Gradient Descent), NN basics (Perceptron and MLP, FFN, Backpropagation), Use Cases in Business and Scope: Credit card Fraud Analysis, Recommendation Systems and Collaborative filtering, Sales Funnel Analysis, etc.

UNIT-4

Cloud Computing:
Conventional Computing, Historical developments, Cloud Computing reference model, Cloud Architecture- Layers and Models
Overview of Virtualization: Introduction, Types of cloud, Cloud Platforms: Amazon Web Services, Microsoft Azure, Cloud Applications

UNIT-5

IoT Concepts:
The IoT Paradigm, Concept of Things, IoT

Hardware, IoT Protocols, IoT Architecture, enabling technologies of IoT, IoT Designing and its levels.

SUGGESTED READINGS

1. Rich Elaine, Knight Kevin, Nair S. B. Artificial Intelligence, 3rd Edition, Tata Mc. Graw Hill.
2. Padhy N. P., Simon S. P. Soft Computing: With MATLAB Programming, Oxford University Press, 2015.
3. Buyya Raj Kumar, Vecchiola Christian &Selvi S. Thamarai , Mastering Cloud Computing, McGraw Hill Publication, New Delhi, 2013.
4. Madisetti Vijay and BahgaArshdeep, Internet of Things (A Hands-on-Approach), 1st Edition, VPT, 2014.
5. Fuzzy Logic with Engineering Applications, Timothy J. Ross, McGraw-Hill, 1997.

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSE52	**ED**	**Randomized Algorithms**	**3**	**0**	**2**	**4**	**15**	**15**	**40**	**15**	**15**	**Design and Analysis of Algorithms**

COURSE OUTCOMES

1. The objective of this course is to help the students to understand the power of randomization in the design and analysis of algorithms.
2. Students will gain the knowledge about the fundamentals of randomized algorithm design, and the probabilistic tools and techniques used to analyse randomized algorithms.
3. To understand some of the main paradigms used in the analysis of randomised algorithms,

such as foiling an adversary, abundance of witnesses, fingerprinting, amplification, and random sampling.

4. To design faster algorithms with weaker (but provable) performance guarantees for problems where the best known exact deterministic algorithms have large running times.
5. To learn various data structures suitable for randomization

COURSE CONTENTS

UNIT-I

Introduction and Game-Theoretic Techniques: Introduction to Randomized Algorithms, Min-Cut Algorithm, Monte Carlo, Las Vegas Algorithms, Binary Planar Partitions, A Probability Recurrence, Computation Model and Complexity Classes, Game tree Evaluation, minimax Principle, Randomness and Non-uniformity

Moments and Deviation: Occupancy Problems, Markov and Chebyshev Inequalities, Randomized Selection, Two-Point Sampling, Stable Marriage Problem, Coupon Collector's Problem, Stable Marriage, Markov Inequality, Chernoff Bound and applications

UNIT-II

Probabilistic Method: Overview, Maximum Satisfiability, Expanding Graphs, Oblivious Routing, Lovasz Local Lemma, Method of Conditional Probabilities

Markov Chains and Random Walks: 2-SAT Example, Markov Chains, Random Walks on Graphs, Electrical Networks, Cover Times, Graph Connectivity, Expanders and Rapidly Mixing Random Walks

UNIT-III

Algebraic Techniques: Fingerprinting and Freivalds Technique, Verifying Polynomial Identities, Perfect Matchings in Graphs, Verifying Equality of Strings, Comparison of Fingerprinting Techniques, Pattern Matching

Approximate Counting: Randomized Approximation Schemes, DNF Counting Problem, Approximating the Permanent, Volume Estimation

UNIT-IV

Solutions to Data structuring Problems using Randomization: Fundamentals, Random Treaps, Skip Lists, Hash Tables, Universal Family of Hash Functions, Perfect Hashing

Genetic Algorithms and Linear Programming: Randomized Incremental Construction, Convex Hull in the Plane, Duality, Half-space Intersections, Delaunay Triangulations, Trapezoidal Decompositions, Binary Space Partitions, Diameter of a Point Set, Random Sampling, Liner Programming

UNIT-V

Online Algorithms: Online Paging Problem, Adversary models, Paging against an Oblivious Adversary, Adaptive Online Adversary, The k-server problem.

Distributed Algorithms: Symmetry Breaking problems like leader election, Byzantine agreement, maximal independent set, and colouring; Algorithms for dynamic networks; the k-machine model for processing large graphs.

Streaming Algorithms: The streaming model, approximate counting, reservoir sampling, AMS sketching.

References and Text Books:

1. Rajeev Motwani and Prabhakar Raghavan, "Randomized Algorithms", Cambridge University Press, 1995
2. Michael Mitzenmacher and Eli Upfal, "Probability and Computing:Randomized Algorithms and Probabilistic Analysis", Cambridge University Press, 2005

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSE53	**ED**	**AUGMENTED REALITY**	**3**	**0**	**2**	**4**	**15**	**15**	**40**	**15**	**15**	**Computer vision,**

COURSE OUTCOMES

1. Describe how AR systems work and list the applications of AR.
2. Understand and analyses the hardware requirement of AR..
3. Use computer vision concepts for AR and describe AR techniques.
4. Analyze and understand the working of various state of the art AR devices.
5. Acquire knowledge of mixed reality.

COURSE CONTENTS

UNIT-1 Introduction to Augmented Reality (A.R)

What Is Augmented Reality - Defining augmented reality, history of augmented reality, The Relationship Between Augmented Reality and Other Technologies-Media, Technologies, Other Ideas Related to the Spectrum Between Real and Virtual Worlds, applications of augmented reality Augmented Reality Concepts- How Does Augmented Reality Work? Concepts Related to Augmented Reality, Ingredients of an Augmented Reality Experience.

UNIT-2 Augmented Reality Hardware

Augmented Reality Hardware – Displays – Audio Displays, Haptic Displays, Visual Displays, Other sensory displays, Visual Perception , Requirements and Characteristics, Spatial Display Model. Processors – Role of Processors, Processor System Architecture, Processor Specifications. Tracking & Sensors - Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion.

UNIT-3 Computer Vision for Augmented Reality & A.R. Software
Computer Vision for Augmented Reality - Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Simultaneous Localization and Mapping, Outdoor Tracking

Augmented Reality Software - Introduction, Major Software Components for Augmented Reality Systems, Software used to Create Content for the Augmented Reality Application.

UNIT-4 AR Techniques- Marker based & Markerless tracking

Marker-based approach- Introduction to marker-based tracking, types of markers, marker camera pose and identification, visual tracking, mathematical representation of matrix multiplication Marker types- Template markers, 2D barcode markers, imperceptible markers. Marker-less approach- Localization based augmentation, real world examples Tracking methods- Visual tracking, feature based tracking, hybrid tracking, and initialization and recovery

UNIT-5 AR Devices & Components

AR Components – Scene Generator, Tracking system, monitoring system, display, Game scene AR Devices – Optical See- Through HMD, Virtual retinal systems, Monitor bases systems, Projection displays, Video see-through systems

List of some Suggested Practicals:

1. Study of different game engines
2. Implementation on Video/ Feature Viewing
3. Implementation on Virtual tour
4. Implementation on material animation
5. Implementation to show portal planets
6. Explore projects in Unity 2D and 3D
7. Creating a virtual environment in Unity
8. Explore UI interactions; Interactive media elements
9. Placing object at correct place using interactions in VR
10. Changing a 360 panorama using VR
11. Explore locomotion in VR by creating tunnel vision
12. Creating a VR environment for Picking up items and manipulating it.
13. Implement Basic concepts of 3D modelling
14. Implementing an experimental means of reducing motion sickness
15. Mini Project on Augmented Reality or Virtual Reality

SUGGESTED READINGS

1. Allan Fowler-AR Game Development‖, 1st Edition, A press Publications, 2018, ISBN 978-1484236178
2. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016),ISBN-10: 9332578494
3. Designing for Mixed Reality, Kharis O'Connell Published by O'Reilly Media, Inc., 2016, ISBN: 9781491962381
4. Sanni Siltanen- Theory and applications of marker-based augmented reality. Julkaisija – Utgivare Publisher. 2012. ISBN 978-951-38-7449-0

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSE54	ED	Knowledge Based System	3	1	0	4	25	25	50			DAA, Artificial Intelligence

COURSE OUTCOMES

1. Develop a general understanding of A. I. concepts and KBS and use the various search mechanisms to solve a problem.
2. Understand knowledge acquisition techniques and use knowledge representation methods.
3. Use inference techniques to improve prediction and decision support.
4. Apply artificial intelligence methods such as fuzzy learning, Bayes' method etc., to handle uncertainty.
5. To utilize the system for solving real time problems.

COURSE CONTENTS

UNIT-1

Introduction to Intelligence and Artificial Intelligence, Overview of Artificial Intelligence, History of Artificial Intelligence, Characteristics of AI Programs, Symbolic processing, Knowledge Representation, Search, Heuristics, Applications of Artificial Intelligence
Search: Process of Searching, Representing search problems, Search strategies, Uninformed (blind) search, Informed (heuristic) search

UNIT-2

Introduction to Knowledge Based System: Data, Information and knowledge, Types of knowledge, Types of knowledge based systems. Knowledge Representation: Definition, Knowledge representations schemes, Logic Representation, Prepositional logic, Predicate logic, Logic Programming, Introduction to PROLOG, Semantic networks, Frames

UNIT-3

Productions and Rule based systems: Architecture of a Production System, Execution in a Production System, Comparison of the Various Knowledge Schemes
Knowledge Acquisition: Sources of Knowledge, Categories of Knowledge Acquisition Methods, Top-Down Methods and Bottom-Up Methods, Knowledge Acquisition Modes
Base techniques of knowledge-based systems: rule-based techniques, inductive techniques, hybrid techniques, symbol-manipulation techniques, case-based techniques

UNIT-4

Expert Systems: Definition, Structure of An Expert System, A methodology for the development of expert system, Expert System Shells, Case-based reasoning (CBR), Case, Case – indexing
Main components of case-based systems
Inference: Definition, Inference Strategies in Artificial Intelligence Applications
Rule-based inference controls: Forward chaining, Backward chaining

UNIT-5

Knowledge Based Systems Software Lifecycles: Software Life Cycles, Characteristics of KBS Projects, Commonalities in KBS, The Waterfall Model, KADS Methodology
Uncertainty: AI classification of uncertainty, Handling Uncertainty, Confidence/Certainty Factors, Bayes' Theorem

SUGGESTED READINGS

1. Gonzalez, A. J. and Dankel, D. D. The Engineering of Knowledge-based Systems. Prentice Hall, 1993. ISBN-10: 0132769409, ISBN-13: 978-0132769402.
2. Durkin, J., Expert Systems: Design and Development. Prentice Hall, New York, NY, 1994. ISBN-10: 0023309709, ISBN-13: 978-0023309700.
3. Russell, S. and Norvig, P. Artificial Intelligence: A Modern Approach. Third edition. Prentice Hall. 2010. ISBN-10: 0136042597, ISBN-13: 978-0136042594.
4. Puppe, F. Systematic Introduction to Expert Systems: Knowledge Representations and Problem-Solving Methods. Springer. 2011. ISBN-10: 3642779735, ISBN-13: 978-3642779732.
5. Mitchell, T. Machine Learning. McGraw-Hill. 1997. ISBN-10: 0070428077, ISBN-13: 978-0070428072.

Course No.	Type	Subject	L	T	P	Credits	TCA	TMS	TES	Pre-requisites
CACSE55	**ED**	**Human Computer Interface**	**3**	**1**	**0**	**4**	**25**	**25**	**50**	**Computer Architecture, Computer Graphics**

COURSE OUTCOMES

1. To be able to understand the importance of designing interactive products those are usable.
2. To be able to communicate effectively about requirements, design, and evaluation activities related to interactive products.
3. To be able to evaluate an interactive product using suitable techniques.
4. To be able to incorporate the convenient user interfaces in different devices.
5. To be able to understand the emerging technology in hardware and their usages

COURSE CONTENTS

UNIT-1

Importance of user Interface – definition, importance of good design. Benefits of good design. A brief history of Screen design.

The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, characteristics, Web user – Interface popularity, characteristics- Principles of user interface.

UNIT-2

Design process – Human interaction with computers, importance of human characteristics human consideration, human interaction speeds, understanding business junctions.

UNIT-3

Screen Designing : Design goals – Screen planning and purpose, organizing screen elements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition – amount of information – focus and emphasis – presentation information simply and meaningfully – information retrieval on web – statistical graphics – Technological consideration in interface design.

UNIT-4

Windows – New and Navigation schemes selection of window, selection of devices based and screen based controls. Components – text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors.

UNIT-5

Software tools – Specification methods, interface – Building Tools. Interaction Devices – Keyboard and function keys – pointing devices – speech recognition digitization and generation – image and video displays – drivers. Guidelines for project based work: Semester long projects/presentations/ research work/ term papers based on the above topics.

SUGGESTED READINGS

1. Galitz, W. O. 2007. The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques. 3rd Edition, Wiley.
2. Dix, A. Finlay, J., Abowd, G. and Beale, R. 2004. Human-Computer Interaction, 3rd Edition, Prentice Hall.
3. Preece, J., Sharp, H. and Rogers, Y. 2015. Interaction Design: Beyond HumanComputer Interaction, 4th Edition, Wiley.
4. Shneiderman, B., Plaisant, C., Cohen, M. S., Jacobs, S., Elmqvist, N., & Diakopoulos, N. 2016. *Designing the user interface: strategies for effective human-computer interaction*. Pearson.
5. MacKenzie, I. S., & Tanaka-Ishii, K. 2010. *Text entry systems: Mobility, accessibility, universality*. Elsevier.

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSE56	**ED**	**Pattern Processing using AI**	**3**	**0**	**2**	**4**	**15**	**15**	**40**	**15**	**15**	**Python, Machine Learning**

COURSE OUTCOMES

1. Apply pattern recognition techniques to real-world problems such as document analysis and recognition. 2. Apply neural networks to pattern classification and regression problems.
2. To apply knowledge representation and reasoning techniques
3. To understand the design principles of pattern recognition with estimation and apply classification technique.
4. Implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.
5. To apply algorithms in real time problems.

COURSE CONTENTS

UNIT-1

Introduction to Pattern Recognition: Fundamental concepts and blocks of a typical pattern recognition system. Decision functions- role and types, pattern and weight space, properties and implementation of decision functions.

UNIT-2

Basics of Probability, Random Processes and Linear Algebra: Probability: independence of events, conditional and joint probability, Bayes' theorem; Random Processes: Stationary and nonstationary processes, Expectation, Autocorrelation, Cross-Correlation, spectra; Linear Algebra: Inner product, outer product, inverses, eigen values, eigen vectors.

Bayes Decision Theory: Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, discrete features

UNIT-3

Parameter Estimation Methods: Maximum-Likelihood estimation: Gaussian case; Maximum a Posteriori estimation; Bayesian estimation: Gaussian case

Unsupervised learning: Criterion functions for clustering; Algorithms for clustering: K-Means, Hierarchical and other methods; Cluster validation; Gaussian mixture models; Expectation-Maximization method for parameter estimation; Maximum entropy estimation

UNIT-4

Sequential Pattern Recognition: Hidden Markov Models (HMMs); Discrete HMMs; Continuous HMMs

Nonparametric techniques for density estimation: Parzen-window method; K-Nearest Neighbour method

Dimensionality reduction: Fisher discriminant analysis; Principal component analysis; Factor Analysis

UNIT-5

Linear discriminant functions: Gradient descent procedures; Perceptron; Support vector machines

Non-metric methods for pattern classification: non-numeric data or nominal data; Decision trees: CART

List of Practicals:

1. Write a python program to implement simple Chatbot.
2. Write a program to implement k-means clustering from scratch.
3. Generating samples of Gaussian (normal) distributions and plotting them for visualization
4. Projects based on Fingerprint Pattern Recognition
5. Project based on Handwritten Word Recognition
6. Implement Decision Tree algorithms.
7. Implement SVM.
8. Implement Principal component analysis and use it for unsupervised learning
9. Implement Maximum-Likelihood estimation.
10. Implement agglomerative Hierarchical clustering.

SUGGESTED READINGS

1. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001

2. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009
3. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006
4. S. Russel and P. Norvig, "Artificial Intelligence – A Modern Approach", Second Edition, Pearson Education
5. Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press. 1995.

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSE57	**ED**	**Responsible AI**	**3**	**1**	**0**	**4**	**25**	**25**	**50**			**Artificial Intelligence**

COURSE OUTCOMES

1. Describe the reasons for an ethical analysis applied to AI.
2. Use critical skills in clarifying and ethically analysing AI in different domains of life.
3. Identify the ethical and social impacts and implications of AI.
4. Critically analyse the current policies for AI and use ethical and socially responsible principles in your professional life.
5. To utilize the system in real time problems.

COURSE CONTENTS

UNIT-1 Introduction, What Is Artificial Intelligence: - Introduction, The Background of AI Autonomy Adaptability, Interaction .

Ethical Decision-Making: - Introduction Ethical Theories Values Ethics in Practice. Implementing Ethical Reasoning.

UNIT-2 Taking Responsibility: Introduction Responsible Research and Innovation, The ART of AI: Accountability, Responsibility, Transparency, Design for Values

Can AI Systems Be Ethical: Introduction What Is an Ethical Action? Approaches to Ethical Reasoning by AI, Designing Artificial Moral Agents, Ethical Deliberation, Levels of Ethical Behavior, The Ethical Status of AI Systems.

UNIT-3 Ensuring Responsible AI in Practice: Introduction, Governance for Responsible AI, Codes of Conduct, Inclusion and Diversity, The AI Narrative, Humankind's relationship with technology, AI and Society, Super-intelligence
Back boxes in AI, Biases of AI algorithm.

UNIT-4 issue and challenges: Challenges posed by automated weaponry and vehicles: risk, responsibility, and control, doping in sport, Genetic selection, enhancement, and eugenics, Technology and human relationships, robots to care work, The impact of automation on labour and inequality, The impact of technology on democracy, Pandemic ethics.

UNIT-5 Governance and policies: from AI ethics to AI governance, AI ethics principles, where ethics and regulation meet, regulating experiment vs regulating technology, policy option, fairness, accountability and transparency ,analysis in AI regulation

SUGGESTED READINGS

1. Towards a Code of Ethics for Artificial Intelligence, *by Paula Boddington*
2. AI ETHICS Paperback,mark Coelckburg
3. *Heartificial Intelligence: Embracing Our Humanity to Maximise Machines* (2016) by John C Haven
4. *Artificial Unintelligence: How Computers Misunderstand the World by* Meredith Broussard

Course No.	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CACSE58	**ED**	**Multimodal AI**	**3**	**1**	**0**	**4**	**25**	**25**	**50**			**Artificial Intelligence**

COURSE OUTCOMES

1. Understand the recent technical achievements in multimodal research.
2. Apply critical and creative thinking skills for multimodal AI.
3. Identify the future research challenges in multimodal Artificial Intelligence.
4. Deploy new research ideas in multimodal learning for real time use cases.
5. To utilize the defined AI based system in real time systems.

COURSE CONTENTS

UNIT-1

Introduction, Multimodal applications and datasets, Basic concepts: neural networks, Loss functions and neural networks, Basic concepts: network optimization, Gradients and backpropagation, Visual unimodal representations, Language unimodal representation, Multimodal representation learning, Coordinated representations, Multimodal alignment, Alignment and representation, Alignment and translation.

UNIT-2

Introduction to Computer Vision: Object recognition, semantic segmentation, face recognition, gender/age recognition, OCR (optical character recognition), image search/retrieval, predictive analytics based on image

UNIT-3

Introduction to Natural Language processing: Tokenization, POS tagging, keyword extraction, synonym/antonym detection, information extraction, relation extraction, semantic search, natural language understanding Speech Recognition Technologies: Language model extraction from Web text, acoustic model creation, hot word/trigger word detection, noise cancellation, etc

UNIT-4

Probabilistic graphical models, Dynamic Bayesian networks, Coupled and factor HMMs, Discriminative graphical models, Continuous and fully-connected CRFs, Deep Generative Models, Variational auto-encoder, Generative adversarial networks, Reinforcement learning, Markov decision process, Q learning and Deep Q learning, Multimodal RL, Policy gradients, Multimodal

applications, Fusion and co-learning, Multi-kernel learning and fusion, Few shot learning and co-learning

UNIT-5

Case Studies for various applications: Face Recognition, Counting and Statistics Platform, Speech Recognition and Synthesis, Optical Character Recognition, Predictive analytics.

SUGGESTED READINGS

1. Deep Learning, Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press, 2016.
2. The Handbook of Multimodal-Multisensor Interfaces, Sharon Oviatt, Bjoern Schuller, Philip R. Cohen, Daniel Sonntag, Gerasimos Potamianos and Antonio Kruger, Volumes 1, 2 and 3, 2017- 2019 (available through CMU Library online)
3. Machine Learning for Audio, Image and Video Analysis: Theory and Applications, Francesco Camastra and Alessandro Vinciarelli, Springer, 2008, DOI: 10.1007/978-1-84800-007-0 (freely available on SpringerLink for CMU students)
4. Multimodal Processing and Interaction, Gros, Potamianos and Maragos, SpringerLink, 2008, DOI: 10.1007/978-0-387-76316-3 (freely available on SpringerLink for CMU students)
5. Multimodal Signal Processing: Theory and applications for human-computer interaction by Jean-Philippe Thiran, Ferran Marqués and Hervé Bourlard. Academic Press, ISBN: 978-0-12-374825-6

4.5 OPEN ELECTIVE COURSES

4.5.1 LIST OF OPEN ELECTIVES

4.5.2 SYLLABI OF OPEN ELECTIVE COURSES : SCIENCES

4.5.3 SYLLABI OF OPEN ELECTIVE COURSES : HUMANITIES & SOCIAL SCIENCES

4.5.4 SYLLABI OF OPEN ELECTIVE COURSES : MANAGEMENT

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