Dr. N.G.P. ARTS AND SCIENCE COLLEGE

(An Autonomous Institution, Affiliated to Bharathiar University, Coimbatore
Approved by Government of Tamilnadu and Accredited by NAAC with 'A++' Grade (3rdCycle)
Dr. N.G.P.- Kalapatti Road, Coimbatore-641048, Tamilnadu, India
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REGULATIONS 2022-23 for Post Graduate Programme

(Outcome Based Education model with Choice Based Credit System)

M.Sc. Computer Science Degree

(For the students admitted during the academic year 2022-23)

Programme: M.Sc. Computer Science

Eligibility

Candidates for admission to the first year course leading to the Degree of Master of Science (COMPUTER SCIENCE) will be required to possess a pass in B.Sc. Computer Science / B.C.A. /B.Sc. Computer Technology / B.Sc. Information Technology /B.Sc. Information Sciences/B.Sc. Information Systems/ B.Sc. Software Systems/B.Sc. Software Sciences / B.Sc. Applied Sciences (Computer Science/Computer Technology) / B.Sc. Electronics of any University in Tamil Nadu or an Examination accepted as equivalent thereto by the Academic Council, subject to such conditions as may be prescribed thereto are permitted to appear and qualify for the M.Sc. Computer Science Examination of this College after the programme of study of two academic years.

Programme Objectives

The Curriculum is designed to attain the following learning goals which students shall accomplish by the time of their graduation:

1. To embrace future developments and professional relevance in Computer Science.
2. To attain agility in advanced programming languages and software building for wide area of applications.
3. To explore with applications of Internet Technologies in the related profession with social and ethical responsibilities.
4. To handle the current techniques, skills and tools necessary for computing practice.
5. To engage in research-oriented activities and life-long learning for continuing professional development.

PROGRAMME OUTCOMES

On the successful completion of the program, the following are the expected outcomes.

PO Number	PO Statement
PO1	The ability to identify and analyze the requirements of Computer Science problems.
PO2	The understanding of professional and ethical responsibility in the field of computer science and to communicate effectively.
PO3	The ability to implement algorithms and paradigms with modern software tools.
PO4	The ability to function effectively on multi-disciplinary projects and problems.
PO5	The ability to recognize and respond towards research areas of computer science and the need for lifelong learning.

TOTAL CREDIT DISTRIBUTION

Part	Subjects	No. of Papers	Credit	Semester No.
III	Core	11	9X4=36 2X5=10	I to III
	Core Practical	6	12	I to III
	Extra Departmental Course (EDC)	1	5	II
	Discipline Specific Elective (DSE)	3	3 x 5=15	I to III
	Internship	1	2	III
	Project Work	1	12	IV
TOTAL CREDITS			**92**	

CURRICULUM

M.Sc. COMPUTER SCIENCE

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
First Semester										
224CS2A1CA	Core I	Advanced Data Structures	4	-	-	3	50	50	100	4
224CS2A1CB	Core II	Advanced Java	4	-	-	3	50	50	100	4
224CS2A1CC	Core III	Information Security	5	-	-	3	50	50	100	5
224CS2A1CD	Core IV	Software Project Management	4	-	-	3	50	50	100	4
224CS2A1CP	Core Practical I	Advanced Data Structures	-	-	4	3	50	50	100	2
224CS2A1CQ	Core Practical II	Advanced Java	-	-	4	3	50	50	100	2
224CS2A1DA	DSE –I	Digital Image Processing	5	-	-	3	50	50	100	5
224CS2A1DB		Advanced Data Mining								
224CS2A1DC		Computer Communication Networks								
		Total	**22**	**-**	**08**	**-**	**-**	**-**	**700**	**26**

29/7/22

BoS Chairman/HoD
Department of Computer Science
Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

Dr.N.G.P. Arts and Science College
APPROVED
13th 29-7-22 | AC - 13th 6-9-22 | GB - 18th 10-9-22

Academic Council
Dr. V. Rajendran
CHAIRMAN
Dr.N.G.P. Arts and Science College

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Second Semester										
224CS2A2CA	Core V	Advanced Python Programming	4	-	-	3	50	50	100	4
224CS2A2CB	Core VI	Advanced Relational Database Management Systems	4	-	-	3	50	50	100	4
224CS2A2CC	Core VII	Neural Networks and Fuzzy Logic	4	-	-	3	50	50	100	4
222MT2A2ED	EDC	Advanced Operations Research	5	-	-	3	50	50	100	5
224CS2A2CP	Core Practical III	Advanced Python Programming	-	-	4	3	50	50	100	2
224CS2A2CQ	Core Practical IV	Advanced Relational Database Management Systems	-	-	4	3	50	50	100	2
224CS2A2DA	DSE -II	Deep Learning	5	-	-	3	50	50	100	5
224CS2A2DB		Predictive Analytics								
224CS2A2DC		Advanced Networks								
		Total	22	-	08	-	-	-	700	26

29/11/22

BoS Chairman/HoD
Department of Computer Science
Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

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BoS- 14th	AC - 14th	GB - 19th
29.11.2022	19.01.23	30.01.23

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Dr.N.G.P. Arts and Science College

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Third Semester										
224CS2A3CA	Core - VIII	Data Science Essentials	4	-	-	3	50	50	100	4
224CS2A3CB	Core - IX	Advanced Operating Systems	4	-	-	3	50	50	100	4
224CS2A3CC	Core - X	Distributed Computing	4	-	-	3	50	50	100	4
224CS2A3CD	Core - XI	Research Methodology	5	-	-	3	50	50	100	5
224CS2A3CP	Core Practical - V	Data Science Essentials	-	-	4	3	50	50	100	2
224CS2A3CQ	Core Practical - VI	Advanced Operating Systems	-	-	4	3	50	50	100	2
224CS2A3TA	IT	Internship	-	-	-	3	50	50	100	2
224CS2A3DA	DSE -III	Natural Language Processing	5	-	-	3	50	50	100	5
224CS2A3DB		Business Analytics								
224CS2A3DC		Network Security								
		Total	**22**		**08**				**800**	**28**

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10.6.23	14.7.23	5.9.23

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Fourth Semester										
224CS2A4CV	Core	Project Work	-	-	-	3	100	100	200	12
		Total	-	-	-	-	-	-	**200**	**12**
		***Grand Total**							**2400**	**92**

16/10/23

BoS Chairman/HoD
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Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

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BoS - 16th	AC - 16th	GB - 21st
16/10/23	13/12/23	05/01/24

Academic Council
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DISCIPLINE SPECIFIC ELECTIVE

Students shall select the desired course of their choice in the listed elective course during Semesters I, II and III

Semester I (Elective I)
List of Elective Courses

S. No.	Course Code	Name of the Course
1.	224CS2A1DA	Digital Image Processing
2.	224CS2A1DB	Advanced Data Mining
3.	224CS2A1DC	Computer Communication Networks

Semester II (Elective II)
List of Elective Courses

S. No.	Course Code	Name of the Course
1.	224CS2A2DA	Deep Learning
2.	224CS2A2DB	Predictive Analytics
3.	224CS2A2DC	Advanced Networks

Semester III (Elective III)
List of Elective Courses

S. No.	Course Code	Name of the Course
1.	224CS2A3DA	Natural Language Processing
2.	224CS2A3DB	Business Analytics
3.	224CS2A3DC	Network Security

EXTRA CREDIT COURSES

The following are the courses offered under self study to earn extra credits:

Semester III

S. No.	Course Code	Name of the Course
1	224CS2ASSA	IPR and Entrepreneurship
2	224CS2ASSB	Organizational Behavior

PG REGULATION (R4)

(Students Admitted in the AY 2022-23)

(OUTCOME BASED EDUCATION WITH CBCS)

Effective from the academic year 2022-23 and applicable to the students admitted to the Degree of Master of Arts/Commerce/Management/Science.

1.NOMENCLATURE

1.1 Faculty: Refers to a group of programmes concerned with a major division of knowledge. Eg. Faculty of Computer Science consists of Programmes like Computer Science, Information Technology, Computer Technology, Computer Applications etc.

1.2 Programme: Refers to the Master of Arts/Management/Commerce/Science Stream that a student has chosen for study.

1.3 Batch: Refers to the starting and completion year of a programme of study. Eg. Batch of 2022–2024 refers to students belonging to a 2-year Degree programme admitted in 2022 and completing in 2024.

1.4 Course: Refers to component of a programme. A course may be designed to involve lectures / tutorials / laboratory work / seminar / project work/ practical training / report writing / Viva voce, etc or a combination of these, to effectively meet the teaching and learning needs and the credits may be assigned suitably.

a) Core Courses A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

b) Extra Departmental Course (EDC): A course chosen generally from a related discipline/subject, with an intention to seek exposure in the discipline relating to the core domain of the student.

c) Discipline Specific Elective Course (DSE): Elective courses are offered under main discipline/ subject of study.

d) Project Work: It is considered as a special course involving application of knowledge in problem solving/analyzing/exploring a real-life situation. The Project work will be given in lieu of a Core paper.

e) Extra credits Extra credits will be awarded to a student for achievements in co-curricular activities carried out outside the regular class hours. The guidelines for the award of extra credits are given in section two, these credits are not mandatory for completing the programme.

f) Advanced Learner Course (ALC): ALC is doing work of a higher standard than usual for students at that stage in their education. Research work / internships carried out in Universities/ Research Institutions/ Industries of repute in India or abroad for a period of 15 to 30 days.

2. STRUCTURE OF PROGRAMME

- Core Course
- Extra Departmental Course (EDC)
- Discipline Specific Elective (DSE)
- Industrial Training (IT)
- Project

3. DURATION OF THE PROGRAMME

M.Sc. /M.Com. / M.A. Programme must be completed within 2 Years (4 semesters) and maximum of 4 Years (8 semesters) from the date of acceptance to the programme. If not, the candidate must enroll in the course determined to be an equivalent by BoS in the most recent curriculum recommended for the Programme.

4. REQUIREMENTS FOR COMPLETION OF A SEMESTER

Every student shall ordinarily be allowed to keep terms for the given semester in a program of his/ her enrolment, only if he/ she fulfills at least seventy five percent (75%) of the attendance taken as an average of the total number of lectures, practicals, tutorials, etc. wherein short and/or long excursions/field visits/study tours organised by the college and supervised by the faculty as envisaged in the syllabus shall be credited to his attendance. Every student shall have a minimum of 75% as an overall attendance.

5. EXAMINATIONS

The end semester examinations shall normally be conducted after completing 90 working days for each semester. The maximum marks for each theory and practical course as follows,

a) Mark distribution for Theory Courses

Continuous Internal Assessment (CIA)	: 50 Marks
End Semester Exams (ESE)	: 50 Marks
Total	: 100 Marks

i) Distribution of Internal Marks

S.No.	Particulars	Distribution of Marks
1	CIA I (2.5 Units) (On completion of 45th working day)	15
2	Model (All 5 Units) (On completion of 85th working day)	15
3	Assignment	05
4	Attendance	05
5	Library Usage	05
6	Skill Enhancement *	05
	Total	**50**

Assignment Rubric
(Maximum -20 marks converted to 5 marks)

Criteria	4 marks	3 Marks	2 Marks	1 MArk
Language	Excellent spelling and Grammar	Good spelling and Grammar	Reasonable spelling and Grammar	Bad spelling and Grammar
Style	Outstanding style beyond usual college level	Attains College level style	Approaches College level style	Elementary form with little or no variety in sentence structure
Referencing	Good use of wide range of reference sources	Moderate use of suitable reference materials	Shows signs of plagiarism & using sources without referencing	No reference material used
Development	Main points well developed with high quality and quantity support	Main points developed with quality and quantity supporting details	Main points are present with limited details and development	Main points lack detailed development
Critical thinking/Problem solving	Advanced attempt to interpret the process, content/	Proficient attempt to interpret the process, content/	Adequate attempt to interpret the process, content/	Limited attempt to interpret the process, content/

	analyse and solve the problem	analyse and solve the problem	analyse and solve the problem	analyse and solve the problem

Breakup for Attendance Marks:

S.No	Attendance Range	Marks Awarded
1	95% and Above	5
2	90% - 94%	4
3	85% - 89%	3
4	80% - 84%	2
5	75% - 79%	1

Note:
Special Cases such as NCC, NSS, Sports, Advanced Learner Course, Summer Fellowship and Medical Conditions etc. the attendance exemption may be given by principal and Mark may be awarded.

Break up for Library Marks:

S.No	Attendance Range	Marks Awarded
1	10h and above	5
2	9h– less than 10h	4
3	8h – less than 9h	3
4	7h - less than 8h	2
5	6h – less than 7h	1

Note:
In exception, the utilization of e-resources of library will be considered.

***Components for "Skill Enhancement" may include the following:**

Class Participation, Case Studies Presentation/Term paper, Field Study, Field Survey, Group Discussion, Term Paper, Presentation of Papers in Conferences, Industry Visit, Book Review, Journal Review, e-content Creation, Model Preparation & Seminar.

Components for Skill Enhancement
Any one of the following should be selected by the course coordinator

S.No.	Skill Enhancement	Description
1	Class Participation	• Engagement in class • Listening Skills • Behaviour
2	Case Study Presentation/ Term Paper	• Identification of the problem • Case Analysis • Effective Solution using creativity/imagination
3	Field Study	• Selection of Topic • Demonstration of Topic • Analysis & Conclusion
4	Field Survey	• Chosen Problem • Design and quality of survey • Analysis of survey
5	Group Discussion	• Communication skills • Subject knowledge • Attitude and way of presentation • Confidence • Listening Skill
6	Presentation of Papers in Conferences	• Sponsored • International/National • Presentation • Report Submission
7	Industry Visit	• Chosen Domain • Quality of the work • Analysis of the Report • Presentation
8	Book Review	• Content • Interpretation and Inferences of the text • Supporting Details • Presentation
9	Journal Review	• Analytical Thinking • Interpretation and Inferences • Exploring the perception if chosen genre • Presentation
10	e-content Creation	• Logo/ Tagline • Purpose • Content (Writing, designing and posting in Social Media) • Presentation
11	Model Preparation	• Theme/ Topic • Depth of background Knowledge

		• Creativity • Presentation
12	Seminar	• Knowledge and Content • Organization • Understanding • Presentation

ii) Distribution of External Marks

Total	**:**	**50**
Written Exam	**:**	**50**

Marks Distribution for Practical course

Total	**:**	**100**
Internal	**:**	**50**
External	**:**	**50**

i) Distribution of Internals Marks

S. No.	Particulars	Distribution of Marks
1	Experiments/Exercises	15
2	Test 1	15
3	Test 2	15
4	Observation Notebook	05
	Total	**50**

ii) Distribution of Externals Marks

S.No.	Particulars	External Marks
1	Materials and methods/ Procedures/Aim	10
2	Experiment/ Performance/ Observations/ Algorithm	10
3	Results/ Calculations/ Spotters/ Output	10
4	Inference/Discussion/ Presentation	10
5	Record	6
6	Viva- voce	4
	Total	**50**

A) Mark Distribution for Project

Total	**:**	**200**
Internal	**:**	**100**
External	**:**	**100**

i) Distribution of Internal Marks

S.No.	Particulars	Internal Marks
1	Review I	40
2	Review II	40
3	Attendance	20
	Total	**100**

ii) Distribution of External Marks

S.No	Particulars	External Marks
1	Project Work & Presentation	80
2	Viva –voce	20
	Total	**100**

Evaluation of Project Work shall be done jointly by Internal and External Examiners.

6 . Credit Transfer

a. Upon successful completion of 1 NPTEL Course (4 Credit Course) recommended by the department, during Semester I to II, a student shall be eligible to get exemption of one **4 credit course** during the 3rd or 4th semester. The proposed NPTEL course should cover content/syllabus of exempted core paper in 3rd or 4th semester.

S. No.	Course Code	Course Name	Proposed NPTEL Course	Credit
1			Option – 1 Paper title	4
			Option – 2 Paper title	
			Option – 3 Paper title	

b. Upon successful completion of **2 NPTEL Courses** (2 Credit each) recommended by the department, during Semester I to II, a student shall be eligible to get exemption of **one 4 credit course** during the 3rd or 4th semester. Out of 2 NPTEL proposed courses, **at least 1 course** should cover content/syllabus of exempted core paper in 3rd or 4th semester.

Mandatory

The exempted core paper in the 3rd or 4th semester should be submitted by the students for approval before the end of 2nd semester

Credit transfer will be decided by equivalence committee

S. No.	Course Code	Course Name	Proposed NPTEL Course	Credit
1			Option – 1 Paper title	2
			Option – 2 Paper title	
			Option – 3 Paper title	
2			Option – 1 Paper title	2
			Option – 2 Paper title	
			Option – 3 Paper title	

NPTEL Courses to be carried out during semester I – II.

S. No.	Student Name	Class	Proposed NPTEL Course		Proposed Course for Exemption
			Course I	Option 1- Paper Title Option 2- Paper Title Option 3- Paper Title	Any one Core Paper in 3rd or 4th Semesters
			Course II	Option 1- Paper Title Option 2- Paper Title Option 3- Paper Title	

Class Advisor **HoD** **Dean**

7. Internship/Industrial Training

Students must undertake industrial / institutional training for a minimum of 15 days and not exceeding 30 days during the II semester summer vacation. The students will submit the report for evaluation during III semester.

Mark Distribution for industrial / institutional training

Total	**:**	**100**
Internal	**:**	**50**
External	**:**	**50**

i) Distribution of Internal Marks

S.No.	Particulars	Internal Marks
1	Review I	20
2	Review II	20
3	Attendance	10
	Total	**50**

ii) Distribution of External Marks

S.No	Particulars	External Marks
1	Internship /Industrial training Presentation	40
2	Viva –voce	10
	Total	**50**

Evaluation of Internship /Industrial training Presentation shall be done jointly by Internal and External Examiners.

8. Extra Credits: 10

Earning extra credit is not essential for programme completion. Student is entitled to earn extra credit for achievement in Curricular/Co-Curricular/ Extracurricular activities carried out other than the regular class hours.

A student is permitted to earn a maximum of 10 extra Credits during the programme period. A maximum of 1 credit under each category is permissible.

Category	Credit
Self study Course	1
CA/ICSI/CMA (Foundations)	1
CA/ICSI/CMA (Inter)	1
Sports and Games	1
Publications / Conference Presentations (Oral/Poster)/Awards	1
Innovation / Incubation / Patent / Sponsored Projects / Consultancy	1
Representation in State / National level celebrations	1
Awards/Recognitions/Fellowships	1
Advanced Learner Course (ALC)*	2

Credit shall be awarded for achievements of the student during the period of study only.

GUIDELINES

Self study Course

A pass in the self study courses offered by the department.

The candidate should register the self study course offered by the department only in the III semester.

CA/ ICSI/ CMA (Foundations)

Qualifying foundation in CA/ICSI/CMA / etc.

CA/ICSI/ CMA (Inter)

Qualifying Inter in CA/ICSI/CMA / etc.

Sports and Games

The Student can earn extra credit based on their Achievement in sports in University/ State / National/ International.

Publications / Conference Presentations (Oral/Poster)

Research Publications in Journals

Oral/Poster presentation in Conference

Innovation / Incubation / Patent / Sponsored Projects / Consultancy

Development of model/ Products /Prototype /Process/App/Registration of Patents/ Copyrights/Trademarks/Sponsored Projects /Consultancy

Representation in State/ National level celebrations

State / National level celebrations such as Independence day, Republic day Parade, National Integration camp etc.

Awards/Recognitions/Fellowships

Regional/ State / National level awards/ Recognitions/Fellowships

***Advanced Learner Course (ALC):**

ALC is doing work of a higher standard than usual for students at that stage in their education.

Research work/internships carried out in Universities/ Research Institutions/ Industries of repute in India or abroad for a period of 15 to 30 days will be considered as Advanced Learners Course.

QUESTION PAPER PATTERN

CIA Test I: [1½ Hours-2.5 Units] - 25 Marks

SECTION	MARKS	DESCRIPTION	TOTAL	Remarks
Section – A	8 x 0.5= 04 Marks	MCQ	25 Marks	Marks secured will be converted To 15 mark
Section - B	3 x 2 = 06 Marks	Answer ALL Questions Either or Type ALL Questions Carry Equal Marks		
Section - C	3 x 05 = 15 Marks	Answer ALL Questions Either or Type ALL Questions Carry Equal Marks		

CIA Test II/ Model [3 Hours-5 Units] - 50 Marks

SECTION	MARKS	DESCRIPTION	TOTAL	Remarks
Section – A	10 x 1 = 10 Marks	MCQ	50 Marks	Marks secured will be converted To 15 mark
Section - B	5 x 6 = 30 Marks	Answer ALL Questions (Either or Type Questions) Each Questions Carry Equal Marks		
Section - C	1 x 10 = 10 Marks	Compulsory Question		

End Semester Examination [3 Hours-5 Units] - 50 Marks

SECTION	MARKS	DESCRIPTION	TOTAL
Section – A	10 x 1 = 10 Marks	MCQ	50 Marks
on - B	5 x 6 = 30 Marks	Answer ALL Questions (Either or Type Questions) Each Questions Carry Equal Marks	
Section - C	1 x 10 = 10 Marks	Compulsory Question	

Course Code	Course Name	Category	L	T	P	Credit
224CS2A1CA	ADVANCED DATA STRUCTURES	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- Operations of elementary data structures
- The Tree data structure and Hashing for a specified application.
- Various priority queues and disjoint sets

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the operations of data structures Stack, Queues and Linked List.	K1
CO2	The functionalities and applications of Tree data structures.	K2
CO3	Demonstrate Hash functions and applications	K3
CO4	Apply the operations of Priority Queues and Heaps.	K4
CO5	Applying knowledge about disjoint sets.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓		✓	
CO4	✓	✓	✓	✓	
CO5	✓	✓	✓		✓

✓	Skill Development		Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

224CS2A1CA	ADVANCED DATA STRUCTURES	SEMESTER 1

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Elementary Data Structures — 10 h

Abstract Data Types (ADTs) - The List ADT - Simple Array Implementation of Lists - Simple Linked Lists - Implementation of list - Applications of Lists - Doubly Linked List - Circular Linked List - The Stack ADT - Stack Model - Implementation of Stacks - Applications - Queue ADT - Queue Model - Array Implementation of Queues - Applications of Queues

Unit II Trees — 9 h

Trees - Tree Traversals with an Application - Binary Trees - Implementation - The Search Tree ADT — Binary Search Trees - AVL Trees: Single Rotation - Double Rotation - Splay Trees - B-Trees - Red-Black Trees - Sets and Maps in the Standard Library - Sets - Maps - Implementation of set and map

Unit III Hashing — 9 h

Hash Functions - Separate Chaining - Hash Tables without Linked Lists - Linear Probing - Quadratic Probing - Double Hashing - Rehashing

Unit IV Priority Queues — 10 h

Binary Heap - Structure Property - Heap-Order Property - Basic Heap Operations - Other Heap Operations - Applications of Priority Queues - The Selection Problem - Heaps - Skew Heaps - Binomial Queues

Unit V The Disjoint Sets — 10 h

Equivalence Relations - The Dynamic Equivalence Problem - Smart Union Algorithms - Path Compression - Worst Case for Union-by-Rank and Path Compression - Slowly Growing Functions - An Analysis by Recursive Decomposition

Case Study: Data structures used in Web graph and Google maps

Text Books

1 Data Structures and Algorithm Analysis in C++, Mark Allen Weiss, 4th Edition, 2014, Pearson

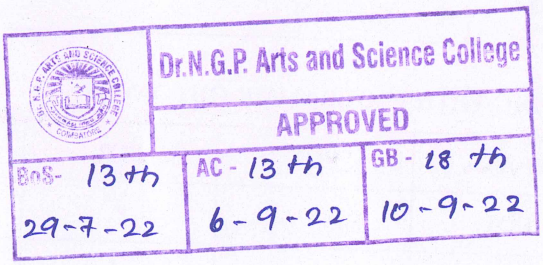
References

1 S.Sahni, 2018,"Data structures, Algorithms and Applications in C++, 2nd edition, University Press (India) Pvt. Ltd.

2 Lipschutz, 2016,"Data Structures", 3rd Edition, Tata McGraw Hills

3 Michael T.Goodrich, R.Tamassia and Mount, 2017."Data structures and Algorithms in C++", 3rd Edition, Wiley student edition, John Wiley and Sons.

4 R.G. Dromey, 2016, "How to solve it by Computers", 8th Edition, Pearson Education.



Course Code	Course Name	Category	L	T	P	Credit
224CS2A1CB	ADVANCED JAVA	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- Advanced Java concepts to develop applications
- The Concepts of Java Beans and Swing
- Database Connectivity using JDBC and Embedded SQL

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand about Java beans and Swing	K2
CO2	Understand the life cycle of Java Servlet	K2
CO3	Develop and apply events in JSP and RMI	K3
CO4	Learn the architecture and design of Enterprise Java Bean	K2
CO5	Design applications implementing Database Connectivity using JDBC and Embedded SQL.	K6

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓		
CO2	✓	✓	✓		
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓		
CO5	✓	✓	✓	✓	✓

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

224CS2A1CB	ADVANCED JAVA	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Java Beans and Swing — 10 h

Introduction: Advantages – Design patterns for Properties – Events – Methods and Design Patterns - Java Beans API – Swing : Introduction – Swing Is Built on the AWT - Two Key features of Swing – MVC Connections – Components and Containers – The Swing Packages – Simple Swing Applications - Exploring Swing

Unit II Java Servlet — 10 h

Introduction: Background - The life cycle of a Servlet – Using Tomcat for Servlet development – A Simple Servlet – The Javax.Servlet Packages – Reading Servlet Parameters – The javax.servlet.http packages – Handling Http request and responses – cookies - Session Tracking

Unit III Java Server Pages, Remote Method Invocation — 8 h

Java Server Pages- Introduction - Tags: Variable Objects - Request String: Parsing Other Information - User Session - Cookies- Session objects. Java Remote method Invocation: Remote Interface- Passing Objects- RMI Process - Server side- Client side

Unit IV Enterprise Java Bean — 10 h

Enterprise Java Beans : The EJB Container – EJB Classes - EJB Interfaces – Deployment Descriptors : Referencing EJB - Sharing Resources - Security Elements - Query Elements - Assembly Elements - Session Java Bean: Stateless and Stateful - Creating a Session Java Bean - Entity Java Bean - Message -Driven Bean

Unit V Database Connectivity — 10 h

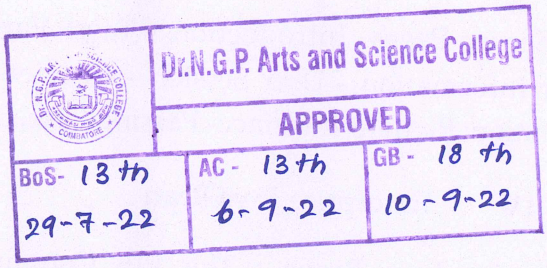
JDBC Objects : The Concept of JDBC - JDBC Driver types –JDBC Packages – Database Connection – Statement Objects – ResultSet – Transaction Processing - JDBC and Embedded SQL : Tables and Indexing - Inserting, Selecting and Updating Data

Text Books

1. Herbert Schildt, 2018, "Java The Complete Reference", 10th Edition, Tata McGraw Hill (Unit I-II)
2. Jim Keogh, 2002, "J2EE: The Complete Reference", McGraw Hill Education (Unit III - V)

References

1. Herbert Schildt, 2018, "Java, A Beginners Guide", 8th Edition, Oracle Press
2. Bert Bates, Karthy Sierra, Eric Freeman, Elisabeth Robson, 2009, "Head First Design Patterns", 1st Edition, O'Reilly
3. Robert Pattinson, 2018, "The Ultimate Beginners Guide for Advance Java", First Edition, Amazon Digital Services LLC
4. E Ramaraj P Geetha S Muthukumaran, 2018, "Advanced JAVA Programming", First Edition, Pearson, Noida.



Course Code	Course Name	Category	L	T	P	Credit
224CS2A1CC	INFORMATION SECURITY	CORE	5	-	-	5

PREAMBLE

This course has been designed for students to learn and understand

- The crucial concepts of information systems security.
- The best security practices and ethics.
- The design and implementation of secure systems.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Apply Basic Crypto and Symmetric Key Crypto.	K4
CO2	Demonstrate the Public Key Crypto.	K3
CO3	Understand the Advanced Cryptanalysis Concepts.	K2
CO4	Understand Authentication and Authorization.	K2
CO5	Apply Authentication Security Protocols.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
✓	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

224CS2A1CC	INFORMATION SECURITY	SEMESTER 1

Total Credits: 5

Total Instruction Hours: 60 h

Syllabus

Unit I Crypto and symmetric key crypto 12 h

Crypto Basics: Classic Crypto-Modern Crypto - Taxonomy of Cryptography and Cryptanalysis - Symmetric Key Crypto: Stream Ciphers - A5/1 - RC4 - Block Ciphers - DES - Triple DES - AES - Block Cipher Modes - Integrity.

Unit II Public key Crypto 12 h

RSA - Diffie Hellman - Elliptic Curve Cryptography - Public Key Notation - Uses for Public Key Infrastructure - Hash Functions: Cryptographic Hash Functions - Non Cryptographic Hashes - Uses for Hash Functions.

Unit III Advanced Cryptanalysis 12 h

Enigma: Enigma Cipher Machine - Enigma Key Space - Rotors - Enigma Attack - RC4 in WEP: RC4 Algorithm - RC4 Cryptanalytic Attack - Preventing Attacks on RC4 - Linear and Differential Cryptanalysis: Tiny DES - Differential Cryptanalysis of TDES - Linear Cryptanalysis of TDES - RSA Timing Attack.

Unit IV Authentication and Authorization 12 h

Authentication: Authentication Methods - Passwords - Biometrics - Two Factor Authentication - Single Sign-On and Web Cookies - Authorization: Evolution of Authorization - Access Control Matrix - Multilevel Security Models - Firewalls - Intrusion Detection Systems.

Unit V Authentication and Real-World Security Protocols 12 h

Authentication protocols: Simple Security Protocols - Authentication Protocols - Authentication using Symmetric and Public Keys - Session Keys - Authentication and TCP - Zero Knowledge Proofs - Real World Security Protocols: SSH - SSL - IPSec.

Case Study: Security Issues issues in Internet of Things (IoT) based Applications

Text Books

1 Mark Stamp, 2018," Information Security: Principles and Practice", Wiley Publications, Second Edition).

References

1 Kim, David, Solomon, Michael G, 2018, "Fundamentals of information systems security", Jones & Bartlett Learning.

2 Jason Andress, 2019, "Foundations of Information Security: A Straightforward Introduction", No Starch Press

3 Andrej Volchkov, 2019, "Information Security Governance Framework and Toolset for CISOs and Decision Makers", Auerbach Publications.

4 Nina Godbole, 2017, "Information Systems Security, 2ed: Security Management, Metrics, Frameworks and Best Practices", Second Edition, Wiley

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Course Code	Course Name	Category	L	T	P	Credit
224CS2A1CD	SOFTWARE PROJECT MANAGEMENT	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- Theoretical and methodological aspects in software project management.
- Numerous process models for choosing the appropriate projects.
- The required skills for managing projects, project teams, and stakeholder.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Remember the process of Software Project Management.	K1
CO2	Identify the theoretical and methodological issues involved in modern Software Project Management.	K1
CO3	Prepare the activity planning and evaluate the risks involved in it	K3
CO4	Analyze project monitoring activities	K3
CO5	Develop quality products by working as a team.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	
CO5	✓	✓	✓		✓

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

224CS2A1CD	SOFTWARE PROJECT MANAGEMENT	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Importance of SPM 10 h

Definition of Project - Software Project Vs Other Types of Project - Contract Management and Technical Project Management – Activities Covered by SPM - Plans, Methods and Methodologies - Some Ways of Categorizing Software Projects – Stakeholders - Setting Objectives -Information and Control in an organization

Unit II Methodologies and Technologies 10 h

Choice of Process Models – The Waterfall Model - The Spiral Model - Software Prototyping - Agile Methods -Extreme Programming (XP) - Selecting the Most Appropriate Process Model. The Rapid Application Development – The V – Process Model - Software Effort Estimation: The Basis for Software Estimating - Software Effort Estimation Techniques - Bottom-up Estimating - The Top-down Approach and Parametric Models - Estimating by Analogy - COCOMO Parametric Productivity Model. Resource Allocation: The Nature of Resources - Identifying Resource Requirements - Scheduling Resources - Creating Critical Paths

Unit III Activity Planning 8 h

Project Schedules - Projects and Activities -Sequencing and Scheduling Activities - Network Planning Model - Formulating a Network Model – The Forward Pass – The Backward Pass - Identifying the Critical path - Activity Float – Shortening the Project Duration - Identifying Critical Activities - Activity-on-Arrow Networks. Risk Management: Definition of Risk -Categories of Risk - Risk Identification - Risk Assessment - Risk Planning – Risk Management - Evaluating Risks to the Schedule - Applying the PERT Technique -Critical Chain Concepts.

Unit IV Creating the Framework 10 h

Collecting the Data - Visualizing Progress – Cost Monitoring - Earned Value Analysis - Prioritizing Monitoring - Getting the Project Back to Target - Change Control. Managing Contracts: Types of Contract - Stages in Contract Placement - Typical Terms of a Contract – Contract Management -Acceptance. Managing People in Software Environments: Understanding Behavior- Organization Behavior: A Background - Selecting the Right Person for the Job -Instruction in the Best Methods - Motivation - The Oldham-Hackman Job Characteristics Model -

Stress - Health and Safety - Some Ethical and Professional Concerns.

Unit V Working in Teams 10 h

Becoming a Team - Decision Making – Organizational Structures - Coordination Dependencies - Dispersed and Virtual Teams -Communication Genres - Communication Plans - Leadership. Software Quality: The Place of Software Quality in Project Planning - The Importance of Software Quality - Defining Software Quality - Product versus Process Quality Management- Quality Management Systems - Process Capability Models - Techniques to Help - Enhance Software Quality – Testing - Quality Plans - Acquisition Planning – Procurement – Case Study: Approaches to Software Life Cycle

Text Books

1 Bob Hughes, Mike Cotterell, Rajib Mall, 2017 , "Software Project Management", 6th Edition, Tata McGraw Hill

References

1 Adolfo Villafiorita, 2018, "Introduction to Software Project Management", CRC Press.

2 S.A. Kelkar, 2016, "Software Project Management A Concise Study", 3rd Edition,PHI Learning Private Limited.

3 Bharat Bhushan Agarwal, Shivangi Dhall, Sumit Prakash Tayal, 2016, "Software Project Management", 1st Edition, University Science Press Pvt. Ltd.

4 Ian Sommerville, 2017, "Software Engineering", 1st Edition, Person India Pvt, Ltd

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224CS2A3CP	CORE PRACTICAL : ADVANCED DATA STRUCTURES	SEMESTER I

Total Credits: 2
Total Instructions Hours: 48 h

S.No	Contents
1	Program that implements stack (its operations) using i) Arrays ii) Linked list (Pointers).
2	Program that implements Queue (its operations) using i) Arrays ii) Linked list (Pointers).
3	Program to implement Doubly Linked List and Circularly Linked List.
4	Program to perform the operations Insert, Delete, Search for a key element in a binary search tree.
5	Program to implement the tree traversal methods
6	Program to perform the operations Insert, Delete, Search for a key element in an AVL tree.
7	Program to implement Hash Tables using Linked List.
8	Program to Implement Hashing by using any one collision technique.
9	Program to Implement of Heap Operations.
10	Program to Implement of Heaps using Priority Queues.
11	Program to implement Dynamic Equivalence.
12	Program to implement Recursive Decomposition.

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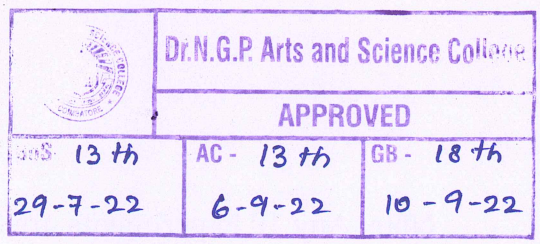
Note: Any 10 Experiments are Mandatory

224CS2A1CQ	CORE PRACTICAL : ADVANCED JAVA	SEMESTER I

Total Credits: 2
Total Instructions Hours: 48h

S.No	List of Programs
1	Programs using Java control statements.
2	Programs to implement the Collection with Iterator.
3	Programs to create applet incorporating features such as images, shapes, background, and foreground color.
4	Create applications using simple GUI.
5	Programs to perform some applications using Java Bean.
6	Create applications using Swing.
7	Programs to demonstrate AWT Components with Event Handling.
8	Programs to perform Session Tracking.
9	Java servlet programs to implement sendredirect() Method (using Http servlet class).
10	Servlet programs using HTTP Servlet.
11	Create web applications using JSP.
12	Programs with JDBC to interact with database.

Note: Ten Programs are mandatory.



Course Code	Course Name	Category	L	T	P	Credit
224CS2A1DA	DIGITAL IMAGE PROCESSING	CORE	5	-	-	5

PREAMBLE

This course has been designed for students to learn and understand

- The concepts of image sensing and acquisition.
- The Image enhancement operations.
- The Image filtering, compression and segmentation.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Grasp image processing techniques and image sensing.	K1
CO2	Understand image enhancement operations.	K2
CO3	Gain knowledge on filtering and restoration.	K3
CO4	Understand image segmentation.	K3
CO5	Identify image compression and watermarking.	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	
CO4	✓			✓	
CO5	✓	✓	✓	✓	✓

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

224CS2A1DA	DIGITAL IMAGE PROCESSING	SEMESTER I

Total Credits: 5

Total Instruction Hours: 60 h

Syllabus

Unit I Digital Image Processing 12 h

Origins - Example Fields - Steps in digital image processing - elements of visual perception - light and electromagnetic spectrum - image sensing and acquisition - image sampling and quantization - relationship between pixels.

Unit II Intensity Transformation and Spatial Filtering 12 h

Intensity Transformation Function - Histogram Processing - Fundamentals of Spatial Filtering - Smoothing Spatial Filters - Sharpening Spatial Filters -Low Pass Filters - Combining Spatial Enhancement methods -Filtering in the Frequency Domain-Selective Filtering - Fast Fourier Transform.

Unit III Image Restoration and Reconstruction 12 h

A model of the image degradation /restoration process - Noise models - Restoration in the presence of Noise only-Spatial Filtering - Periodic noise reduction using Frequency Domain Filtering - Estimating the Degradation Function - Wiener Filtering-Constrained Least Squares Filtering - Geometric Mean Filter.

Unit IV Image Segmentation 12 h

Point, Line and Edge Detection – Thresholding – Segmentation by Region Growing and Splitting and Merging – Super pixels – Region segmentation using Graph Cuts – Segmentation using Morphological Watersheds – The use of Motion in segmentation.

Unit V Image Compression and Watermarking 12 h

Fundamentals – Huffman coding – Golomb Coding – Arithmetic Coding – LZW Coding – Run – length coding – Symbol based coding – Bit-plane coding – Block Transform coding – predictive coding- Wavelet coding.

Case Study: Image Security: Steganography-Watermarking

Text Books

1 Rafael C. Gonzalez, Richard E. Woods, 2020,"Digital Image Processing ",, Fourth Edition, Pearson.

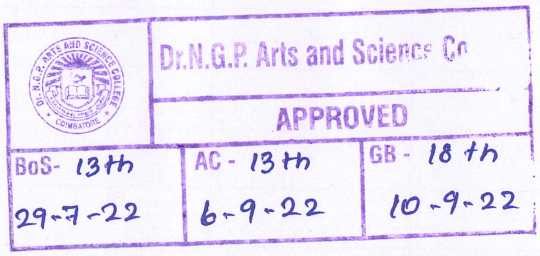
References

1 Anil K Jain, 2015,"Fundamentals of Digital Image. Processing", Fourth Edition, Pearson Education..

2 Sanjay Sharma, 2015,"Fundamentals of Digital Image Processing", 5th edition, SK Kataria and Sons..

3 Castleman, 2016, "Digital Image Processing ", First Edition , Pearson.

4 Dr. Shashidhar Sonnad, Dr.Vybhav.K, Dr.P.Joel Josephson , Dr. Kapil Joshi, 2022, "Digital Image Processing ", First Edition, Book Rivers.



Course Code	Course Name	Category	L	T	P	Credit
224CS2A1DB	ADVANCED DATA MINING	DSE	5	-	-	5

PREAMBLE

This course has been designed for students to learn and understand

- The concepts of data visualization techniques.
- The Genetic algorithms and web mining.
- The Support Vector Machines and text mining

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the data visualization techniques	K2
CO2	Understand the concepts of OLAP	K2
CO3	Apply various regression and clustering methods	K3
CO4	Explain the concept of mining data on web.	K4
CO5	Illustrate the role of data mining techniques with SVM	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	
CO3	✓	✓		✓	✓
CO4	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

224CS2A1DB	ADVANCED DATA MINING	SEMESTER I

Total Credits: 5

Total Instruction Hours: 60 h

Syllabus

Unit I Data Mining and Data Visualization 12 h

Data Scales-Data Categories-Databases and Data Warehouses-Data Mining-Supervised and Unsupervised Learning-Steps in Data Mining. Data Visualisation Techniques: Graphics and Visualisation- Summarisation Vs Visualisation-Graphics- One Variable Diagrams- Multi-variable diagrams- Hierarchical Charts-Data Visualisation Technology-Software for Data Visualisation.

Unit II Online Analytical Processing 12 h

OLAP - Data Cubes and Cuboids-Aggregation Measures- OLAP Schemas-OLAP Operations-OLAP Variants-Mobile OLAP-Multimedia OLAP. Decision Trees: Graph Theory-Trees-Decision Trees-Measures for Node Splitting-Induction Algorithms- Pruning Decision Trees-Applications. Association Rules: Meaning of Association Rules-Association Rule Mining-The Apriori Principle-The FP-Growth Algorithm.

Unit III Regression and Cluster Analysis 12 h

Regression - Sample Covariance-Interpretation of Correlation Coefficient-Multivariate Data-Multiple Linear Regressions. Cluster Analysis: Meaning of Clustering- Cluster Display- Dissimilarity Metrics-Clustering Algorithms-Cluster Validation Techniques.

Unit IV Genetic Algorithms and Web Mining 12 h

Genetic Algorithms: Genetic Operators-Mutation and Crossover-Implementation of GA. Web Mining: Web Search Engines-Web Mining-Implementing Web Mining-Web Structure Mining-Measures for Web Structure Mining-Page Rank Algorithm-Generalised Page Rank Algorithm- Web Query Mining-Semantic Web Mining-Image Mining-Table Mining.

Unit V Support Vector Machines and Text Mining 12 h

Binary SVM-Lagrangian Formulation-Weighted SVM- Soft-Margin SVM- Multi-class SVM-Kernels-Least Squares SVM-Nonlinear SVM-Support Vector Regression-SVM Vs Statistical Classifiers. Text Mining: Text Mining Workflow-Term by document Matrix (TD-Matrix)- Text Classification-Metrics for Text Mining-Applications of Text Mining.

Case study: Detecting Parkinson's disease

Text Books

1 Rajan Chattamvelli, 2016, "Data Mining Methods", 2nd Edition, Narosa Publishing House.

References

1 J.Han and M. Kamber, 2011, "Data Mining Concepts and Techniques", 3rd Edition, Harcourt India Pvt. Ltd, New Delhi.

2 K.P. Soman , Shyam Diwakar, V.Ajay, 2003, "Insight into Data Mining Theory and Practice ",1st Edition, Prentice Hall of India Pvt. Ltd.

3 Pang-Ning Tan, Michael Steinbach, Vipin Kumar, 2019," Introduction to Data Mining", 2nd Edition, Pearson Education.

4 Arun.K.Pujari, 2013,"Data Mining Techniques",3rd Edition, University Press India Limited.

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Course Code	Course Name	Category	L	T	P	Credit
224CS2A1DC	COMPUTER COMMUNICATION NETWORKS	DSE	5	-	-	5

PREAMBLE

This course has been designed for students to learn and understand

- the concepts of Communication Networks.
- the Networking Devices and the advanced types of Networks.
- the Network Applications and Management.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the concepts in Communication Network.	K2
CO2	Understanding the overview of Networking Devices.	K3
CO3	Impart knowledge on data link and link interfaces.	K4
CO4	Gain knowledge on VLANs and WLANs	K4
CO5	Impart Knowledge on Wide area network and Ability to apply Network Applications	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	-	✓	✓
CO4	✓	-	✓	✓	✓
CO5	✓	✓	✓	✓	✓

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

224CS2A1DC	COMPUTER COMMUNICATION NETWORKS	SEMESTER I

Total Credits: 5

Total Instruction Hours: 60 h

Syllabus

Unit I Communication Network 12 h

Packet-Switched Networks-Packet Switching Versus Circuit Switching-Data, Packets, and Frames-The Internet and ISPs-Classification of ISPs-Types of Packet-Switched Networks-Connectionless Networks-Connection-Oriented Networks-Packet Size and Optimizations-Foundation of Networking Protocols-Addressing Scheme in the Internet.

Unit II Networking Devices 12 h

Network Interface Cards (NICs)- Switching and Routing Devices-Wireless Switching and Routing Devices-Wireless Access Points and Base Stations-Wireless Routers and Switches-Antennas in Wireless Devices-Modems-Multiplexers-Frequency-Division Multiplexing (FDM)- Time-Division Multiplexing.

Unit III Data Links and Link Interfaces 12 h

Data Links-Data Link Types-Link Encoder-Error Detection and Correction on Links-Error Detection Methods-Cyclic Redundancy Check (CRC) Algorithm-Flow Control on Links-Stop-and-Wait Flow Control-Sliding-Window Flow Control-Link Access by Multiple Users-Wireless Channel Access by Multiple Users-Link Aggregation.

Unit IV Local Area Networks 12 h

Local Area Networks and Networks of LANs-LANs and Basic Topologies-LAN Protocols-Networks of LANs-MAC/IP Address Conversion Protocols-Address Resolution Protocol (ARP)- Reverse Address Resolution Protocol (RARP)-Spanning-Tree Protocol (STP)- Virtual LANs (VLANs)- Wireless LANs-IEEE 802.11 Wireless LAN Standard.

Unit V Wireless Wide Area Network and Management 12 h

Wireless Wide Area Network and LTE Technology-Infrastructure of Wireless Networks-Cellular Networks-Mobile IP Management in Cellular Networks-Home Agents and Foreign Agents-Agent Discovery Phase-Registration-Mobile IP Routing-Generations of Cellular Networks-Long-Term Evolution (LTE) Technology. Basic Network Applications and Management: Overview of the Application Layer-Domain Name System (DNS)- Electronic Mail (E-Mail)- World Wide Web (WWW).

Case study: Emerging concepts in next generation networks.

Text Books

1 Nader F. Mir, 2018, "Computer and Communication Networks", Second Edition, Pearson Education

References

1 Behrouz A. Forouzan, 2007, "Data Communications and Networking", Fourth Edition, McGraw Hill Higher Education

2 Larry L. Peterson, Bruce S. Davie, 2011,"Computer Networks: A Systems Approach", 5th Edition, Morgan Kaufmann.

3 Cory Beard, William Stallings, 2015, "Wireless Communication Networks and Systems", Pearson.

4 William Stallings, 2010, "Data and Computer Communications", 9th Edition, Pearson.

29/8/22

BoS Chairman/HoD
Department of Computer Science
Dr. N. G. P. Arts and Science College
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Course Code	Course Name	Category	L	T	P	Credit
224CS2A2CA	ADVANCED PYTHON PROGRAMMING	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- Data Manipulation using NumPy and Pandas.
- Data Visualization using Matplotlib.
- Advanced python techniques for analysis of data.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand basics of Python	K2
CO2	Apply Scientific computing using NumPy.	K5
CO3	Demonstrate theData Manipulation and Analysis using Pandas.	K3
CO4	Illustrate Visualization in python using Matplotlib.	K4
CO5	Implement Data analysis using Scikit-Learn.	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓		✓	✓
CO2	✓	✓	✓		✓
CO3		✓	✓	✓	
CO4		✓	✓		✓
CO5	✓		✓	✓	✓

COURSE FOCUSES ON

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability	✓	Innovations
✓	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

224CS2A2CA	ADVANCED PYTHON PROGRAMMING	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Data Structures in Python 9 h

Variables - Basic Program Structure - Conditional Operations - Iterative Routines - Functions and Modules - String - Tuple - List - Dictionary - Set - Operators with Sequences - Iterator - Slicing - Reversing - Sorting - Operations with Sequences - Operations with Sets - Frozensets - Operations with Dictionaries.

Unit II NumPy 10 h

Understanding Data Types in Python - The Basics of NumPy Arrays - Computation on NumPy Arrays: Universal Functions - Aggregations - Computation on Arrays: Broadcasting - Comparisons, Masks, and Boolean Logic - Fancy Indexing - Sorting Arrays - Structured Data: NumPy's Structured Arrays.

Unit III Data Manipulation with Pandas 10 h

Installing and Using Pandas - Introducing Pandas Objects - Data Indexing and Selection - Operating on Data in Pandas - Handling Missing Data - Hierarchical Indexing - Combining Datasets: Concat and Append - Combining Datasets: Merge and Join - Aggregation and Grouping - Working with Time Series.

Unit IV Visualization with Matplotlib 10 h

Importing matplotlib- Setting Styles - Simple Line Plots - Simple Scatter Plots - Visualizing Errors - Density and Contour Plots - Histograms, Binnings, and Density - Customizing Plot Legends - Customizing Color bars - Multiple Subplots - Text and Annotation - Customizing Ticks - Three-Dimensional Plotting in Matplotlib - Visualization with Seaborn.

Unit V Data Analysis with Scikit-Learn 9 h

Machine Learning - Scikit-Learn - Hyper parameters and Model Validation - Feature Engineering - Naive Bayes Classification - Linear Regression - Decision Trees and Random Forests - Principal Component Analysis - k-Means Clustering.

Case Study: A Face Detection Pipeline.

Course Code	Course Name	Category	L	T	P	Credit
224CS2A2CB	ADVANCED RELATIONAL DATABASE MANAGEMENT SYSTEMS	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The concepts, techniques and application of the database management technology.
- The techniques of database design and querying.
- The hands-on experience to use on existing database management system to develop a database application system.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Describe structure of relational databases.	K2
CO2	Apply structured query language.	K5
CO3	Design ER model.	K4
CO4	Illustrate querying and transactions.	K4
CO5	Implement Lock based protocols and Recovery System.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓			✓	✓
CO2	✓	✓	✓		✓
CO3		✓	✓	✓	✓
CO4	✓	✓	✓		✓
CO5	✓		✓	✓	✓

COURSE FOCUSES ON

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability	✓	Innovations
✓	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

Text Books

1. T.R.Padmanabhan, 2016, "Programming with Python", Springer Nature Singapore Pvt Ltd., (Unit - I).
2. Jake VanderPlas, 2017, "Python Data Science Handbook - Essential Tools for Working with Data", O' Reilly Media, Inc., (Unit - II to V).

References

1. Christian Hill, 2020,"Learning Scientific Programming with Python", Cambridge University Press.
2. Gowrishankar S., Veena A,2019, "Introduction to Python Programming", CRC Press, Taylor & Francis Group, LLC.
3. Fabio Nelli, 2018, "Python Data Analytics with Pandas, Matplotlib, and the Python Programming Language", 2nd Edition, APRESS.
4. Ashok Kamthane, Amit Kamthane, 2018, "Programming and Problem Solving with Python", McGraw Hill Education India Private Limited.

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224CS2A2CB	ADVANCED RELATIONAL DATABASE MANAGEMENT SYSTEMS	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Relational Databases 9 h

Introduction to the Relational Model - Structure of Relational Databases - Database Schema - Keys - Schema Diagrams - Relational Query Languages - Relational Operations -Introduction to SQL- Overview of the SQL Query Language-SQL Data Definition- Basic Structure of SQL Queries- Additional Basic Operations- Set Operations - Null Values - Aggregate Functions - Nested Sub queries - Modification of the Database.

Unit II Intermediate and Advanced SQL 9 h

Join Expressions -Views - Transactions - Integrity Constraints - SQL Data Types and Schemas - Authorization -Accessing SQL From a Programming Language - Functions and Procedures - Triggers - Recursive Queries- Advanced Aggregation Features-OLAP.

Unit III Database Design 10 h

Database Design and the E-R Model-Overview of the Design Process- The Entity Relationship Model - Constraints - Removing Redundant Attributes in Entity Sets - Entity-Relationship Diagrams - Reduction to Relational Schemas - Entity Relationship Design Issues - Extended E-R Features-Relational Database Design Features of Good Relational Designs - Atomic Domains and First Normal Form - Decomposition Using Functional Dependencies.

Unit IV Query Processing and Transaction Management 10 h

Query Processing - Overview - Measures of Query Cost - Selection Operation - Sorting - Join Operation - Other Operations - Evaluation of Expressions - Transactions-Transaction Concept-A Simple Transaction Model - Storage Structure - Transaction Atomicity and Durability - Transaction Isolation - Serializability Transaction Isolation and Atomicity - Transaction Isolation Levels - Implementation of Isolation Levels -Transactions as SQL Statements.

Unit V Lock-Based Protocols and Recovery 10 h

Lock-Based Protocols-Deadlock Handling-Multiple Granularity-Insert Operations, Delete Operations, and Predicate Reads-Timestamp-Based Protocol-Validation-Based Protocols-Multi version Schemes-Snapshot Isolation-Failure Classification-Storage-Recovery and Atomicity-Recovery Algorithm-Buffer Management-Recovery in Main-Memory Databases.

Text Books

1 Abraham Silberchatz, Henry F.Korth, S.Sudharshan, 2019 "Database System Concepts", 7th Edition, McGraw Hill..

References

1 Jan L. Harrington,2016, "Relational Database Design and Implementation: Clearly Explained",4th Edition, Morgan Kaufmann Publisher.

2 Walter Shields,2019 ,"SQL QuickStart Guide: The Simplified Beginner's Guide to Managing, Analyzing, and Manipulating Data With SQL", Illustrated edition , Clyde Bank Media LLC.

3 Joel Murach, 2019,"Murach's MySQL", 3rd edition, Mike Murach & Associates publisher.

4 C. J. Date, 2019, "Database Design and Relational Theory: Normal Forms and All That Jazz" 3rd edition, Apress Publisher.

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Course Code	Course Name	Category	L	T	P	Credit
224CS2A2CC	NEURAL NETWORKS AND FUZZY LOGIC	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The Neural Networks and Fuzzy Logic Control
- The concepts of fuzzy logic and artificial neural networks.
- The Analysis and design the various intelligent control.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Familiarize the concepts of feed forward neural networks.	K2
CO2	Understand the feedback networks.	K3
CO3	Analyze the concept of fuzziness involved in various systems.	K4
CO4	Implement fuzzy logic control and adaptive fuzzy logic	K4
CO5	Apply fuzzy logic control to real time systems.	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓		✓	✓
CO2	✓	✓	✓		✓
CO3	✓	✓	✓	✓	✓
CO4		✓	✓	✓	✓
CO5	✓			✓	✓

COURSE FOCUSES ON

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability	✓	Innovations
✓	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

224CS2A2CC	NEURAL NETWORKS AND FUZZY LOGIC	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Fundamentals of Neural Networks 9 h

Basic concepts of Neural Networks – Model of Artificial Neuron - Neural Network Architecture: Single Layer Feed Forward Network – Multilayer Feed Forward Network – Recurrent Networks – Characteristics of Neural Networks – Taxonomy of Neural Network Architectures – History of Neural Network Research – Early Neural Network Architectures - Some Application Domain.

Unit II Back Propagation Networks 9 h

Architecture of Back Propagation Network: The Perceptron Model- Single Layer Artificial Neural Network – Back Propagation Learning – Applications – Effect of Tuning Parameters of the Back propagation Neural Network- Selection of Various Parameters in BPN – Variation of standard Back Propagation Algorithm: Adaptive Back Propagation – Genetic Algorithm Based Back Propagation - Augmented BP Networks.

Unit III Adaptive Resonance Theory 10 h

Introduction: Cluster structure – Vector Quantization – Classical ART Networks - Simplified ART Architecture – ART 1: Architecture – Special Features of ART1 Models – ART 1 Algorithm – ART 2: Architecture – ART 2 Algorithm – Applications: Character Recognition Using ART1 – Classification of Soil – Prediction of Load from Yield Line Patterns - Chinese Character Recognition.

Unit IV Fuzzy Set Theory 10 h

Fuzzy versus Crisp – Crisp Sets: Operation & Properties of Crisp Sets – Fuzzy Sets: Membership Function – Fuzzy Sets and Crisp Sets- Basic Fuzzy set operations - Properties of Fuzzy Sets– Crisp Relations: Cartesian Product - Crisp Product – Operations on Relations– Fuzzy Relations: Fuzzy Cartesian Product – Operations on Fuzzy Relations.

Unit V Fuzzy Systems 10 h

Crisp Logic: Laws of Propositional Logic – Inference in Propositional Logic – Predicate Logic: Interpretations of Predicate Logic Formula – Inference in Predicate Logic – Fuzzy Logic: Fuzzy Quantifiers – Fuzzy Inference -Fuzzy Rule Based System – Defuzzification Methods – Applications: Greg Viot's Fuzzy Cruise Controller – Air Conditioner Controller.

Text Books

1 S. Rajasekaran, G.A.Vijayalakshmi Pai , 2017, " Neural Networks, Fuzzy Logic and Genetic Algorithms Synthesis and Applications" , PHI.

References

1 Simon Haykin, 2016, "Neural Networks and Learning Machines", Pearson Pvt. Ltd.

2 Sathish Kumar, 2015, "Neural Networks – A Classroom Approach", McGraw Hill Pvt. Ltd.

3 Christopher M. Bishop, 2015 "Neural Networks for Pattern Recognition", 5th Edition, Cambridge.

4 Timothy J. Ross, 2016, "Fuzzy Logic with Engineering Applications", 4th Edition, John Wiley & Sons Ltd. Publications.

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Course Code	Course Name	Category	L	T	P	Credit
222MT2A2ED	ADVANCED OPERATIONS RESEARCH	IDC	5		-	5

PREAMBLE

This course has been designed for students to learn and understand

- The number of different situations which can be characterized as sequencing problems
- The replacement of depreciable assets
- The various components of a queuing system

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the algorithm of processing n jobs through two or more machines.	K2
CO2	Analyze some equipment replacement decisions.	K3
CO3	Analyze the situations where a single and multiple channel waiting line models apply.	K3
CO4	Demonstrate the way of making decisions under certainty, uncertainty & risks.	K4
CO5	Apply business problems involving goal, integer and dynamic programming.	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓		✓	✓	
CO2		✓	✓	✓	✓
CO3	✓	✓		✓	
CO4	✓		✓		✓
CO5		✓	✓	✓	

COURSE FOCUSES ON

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability	✓	Innovations
✓	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

222MT2A2ED	ADVANCED OPERATIONS RESEARCH	SEMESTER II

Total Credits: 5

Total Instruction Hours: 60 h

Syllabus

Unit I Sequencing Problem 12 h

Notations terminology and assumptions - solution to sequencing problems: algorithm of processing n jobs through two machines - algorithm of processing n jobs through three machines - algorithm of processing n jobs through m machines - algorithm of processing 2 jobs through m machines.

Unit II Replacement Theory 10 h

Introduction - Failure mechanism of items - considerations leading to replacement - O.R. methodology of solving replacement problems - replacement policy for equipment/asset which deteriorates gradually - replacement of items that fail suddenly.

Unit III Queuing Theory 12 h

Introduction - Elementary queuing system - single server queuing model: (M/M/1):(∞/FCFS) - multiple server queuing model: (M/M/k):(∞/FCFS) - multi-phase service queuing model : (M/E_k/1):(∞/FCFS) - benefits and limitations of queuing theory.

Unit IV Decision Analysis 11 h

Introduction - few management applications - ingredients of decision problem - types of decision making environments: decision making under certainty - decision making under risk - decision making under uncertainty - Bayesian decision rule - posterior analysis - decision tree analysis.

Unit V Goal, Integer and Dynamic Programming 15 h

Concepts - goal programming model formulation - concepts of integer programming -some integer programming formulation techniques - concepts of dynamic programming - formulation and solution of dynamic programming problem.

Note: Distribution of marks 80% Problem and 20% Theory.

Text Books

1 Kapoor V.K., 2021, "OperationsResearch- Quantitative Techniques for Management", Sultan Chand & Sons, New Delhi.

References

1 Taha H.A., 2006, "Operations Research: An Introduction", 5th Edition, Prentice Hall of India Private Limited, New Delhi.

2 Gupta P.K, Hira D.S., 2021, "Operations Research", 7th Edition, S.Chand & Company Limited, New Delhi.

3 Man Mohan, Gupta. P.K, 2004, "Problems in Operations Research", 14th Edition, Sultan Chand & Sons , New Delhi.

4 Kanti Swarup, Gupta.P.K, Man Mohan., 2018, "Operations Research", 19th Edition, Sultan Chand & Sons, New Delhi.

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224CS2A2CP	ADVANCED PYTHON PROGRAMMING	SEMESTER II

Total Credits: 2
Total Instructions Hours: 48 h

S.No	Contents
1	Demonstrate Python Functions and Modules.
2	Implement a Python program to perform List, Tuple, Dictionary operations.
3	Develop a Python script to perform basic operations using NumPy.
4	Create a structured array for the student's details which includes Student id, Student name, Height, Class and perform Sorting, Grouping operations.
5	Implement Universal and Aggregate functions in NumPy.
6	Implement Pandas to demonstrate data handling, indexing and Slicing Operations.
7	Build a DataFrame and display the specific dictionary data that includes index and labels to perform: a) Display the summary details b) Count the number of rows and columns c) Select the specific rows and columns d) Count the number of rows with NaN values e) Iterate the DataFrame to display the specific rows
8	Demonstrate on how to write a Python dictionary to a CSV file. After writing the CSV file, read the CSV file, perform preprocessing and basic operations on dataframe.
9	Build a Dataset in Excel file and create a Python script to import Dataset into Pandas DataFrame and perform Read, Sort, Export operations in it.
10	Demonstrate use of Matplotlib modules in plotting.
11	Demonstrate Data Visualization using Seaborn.
12	Perform Data Analysis with Scikit-Learn.

Note: Any 10 Experiments are Mandatory

224CS2A2CQ	ADVANCED RELATIONAL DATABASE MANAGEMENT SYSTEMS	SEMESTER II

Total Credits: 2
Total Instructions Hours: 48 h

S.No	List of Experiments
1	Implement DDL, DML and TCL Commands.
2	Demonstrate Data and Built in Functions in SQL.
3	Perform Relational algebra queries for a set of relations.
4	Implement different Normalization.
5	Implementation of Views.
6	Implementation of Cursors.
7	Implementation of Triggers.
8	PL/SQL Procedures and Functions.
9	Error and Exception Handling.
10	Demonstrate E-R Diagram for Database.
11	Implementation of Transaction Management.
12	Database Connectivity.

Note: Any 10 Experiments are Mandatory

Course Code	Course Name	Category	L	T	P	Credit
224CS2A2DA	DEEP LEARNING	DSE	5	-	-	5

PREAMBLE

This course has been designed for students to learn and understand

- The basic ideas and principles of Deep Learning.
- Design and development of a Feedforward Network.
- Optimization and training data using Deep Learning algorithms.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Describe the basic deep learning algorithms and their applications.	K2
CO2	Illustrate the architectural design of Feedforward network.	K4
CO3	Identify and apply regularization techniques in deep learning algorithms.	K3
CO4	Optimize data for deep learning algorithms.	K4
CO5	Apply the Convolution Algorithms.	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓		✓	
CO2		✓	✓		
CO3	✓			✓	
CO4		✓	✓	✓	
CO5	✓		✓		✓

COURSE FOCUSES ON

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability	✓	Innovations
✓	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

224CS2A2DA	DEEP LEARNING	SEMESTER II

Total Credits: 5

Total Instruction Hours: 60 h

Syllabus

Unit I Introduction to Deep Learning] 12 h

Learning Algorithms - Capacity, Overfitting and Underfitting - Hyperparameters and Validation Sets, Maximum Likelihood Estimation- Bayesian Statistics - Supervised Learning Algorithms - Unsupervised Learning Algorithms - Stochastic Gradient Descent - Challenges Motivating Deep Learning.

Unit II Deep Feedforward Networks 12 h

Learning XOR - Gradient-Based Learning - Hidden Units - Architecture Design - Back-Propagation - Other Differentiation Algorithms.

Unit III Regularization for Deep Learning 12 h

Parameter Norm Penalties - Norm Penalties as Constrained Optimization - Regularization and Under-Constrained Problems - Dataset Augmentation - Noise Robustness - Semi-supervised learning - Multitask Learning - Early Stopping - Sparse Representations - Bagging and other Ensemble Methods.

Unit IV Optimization for Training Deep Models 12 h

Learning Differs from Pure Optimization - Challenges in Neural Network Optimization - Basic Algorithms - Parameter Initialization Strategies - Algorithms with Adaptive Learning Rates - Approximate Second-order Methods - Optimization Strategies and Meta-Algorithms.

Unit V Convolutional Networks] 12 h

The Convolution Operation - Motivation - Pooling - Convolution and Pooling as an Infinitely Strong Prior - Variants of the Basic Convolution Function - Structured Outputs - Data Types - Efficient Convolution Algorithms - Random or Unsupervised features - Convolution Networks

Text Books

1 Ian Goodfellow, YoshuaBengio and Aaron Courville, 2017, "Deep Learning", MIT Press.

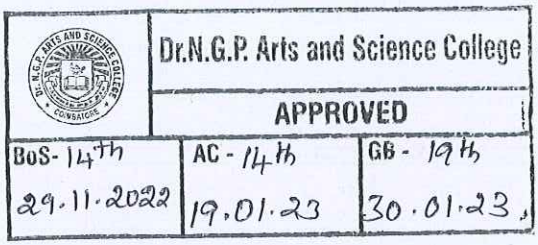
References

1 Umberto Michelicci, 2018, "Applied Deep Learning: A Case-based Approach to Understanding Deep Neural Networks", Apress..

2 Charu C. Aggarwal, 2018, "Neural Networks and Deep Learning", Springer.

3 Seth Weidman, 2019, "Deep Learning From Scratch: Building with Python from First Principles", O'Reiley.

4 Josh Patterson, 2017, "Deep Learning: A Practitioner's Approach", PACKET.



Course Code	Course Name	Category	L	T	P	Credit
224CS2A2DB	PREDICTIVE ANALYTICS	DSE	5	-	-	5

PREAMBLE

This course has been designed for students to learn and understand

- The models of neural networks, decision trees, logistic regression, support vector machines and Bayesian network.
- The use of binary classifier and numeric predictor nodes to automate model selection.
- The purpose of all models and to combine models to improve prediction.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand process of data collection, preparation, design, build, and evaluate models.	K2
CO2	Compare predictive modeling techniques.	K3
CO3	Analyze different algorithms of Predictive Analytics.	K4
CO4	Apply machine learning model for predictive analytics.	K5
CO5	Implement Predictive Analytics on Big Data.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓		✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓		✓		✓
CO4	✓	✓	✓	✓	
CO5	✓	✓	✓		✓

COURSE FOCUSES ON

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability	✓	Innovations
✓	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

224CS2A2DB	PREDICTIVE ANALYTICS	SEMESTER II

Total Credits: 5

Total Instruction Hours: 60 h

Syllabus

Unit I Analytics and Data Mining 12 h

Introduction to Analytics - Application areas of analytics - challenges and longitudinal view of analytics. Introduction to predictive analytics and data mining: Most common data mining applications - Kind of patterns data mining can discover - popular data mining tools.

Unit II Standardized process for predictive analytics 12 h

KDD process - CRISP-DM Cross-Industry standard process for data mining - SEMMA. Data and Methods for predictive Analytics: Nature of data in data analytics - Preprocessing of Data for Analytics - Data Mining Methods - Prediction - Classification - Decision Tree - Cluster Analysis for Data Mining - K-Means Clustering Algorithm - Association - Apriori Algorithm - Data mining and predictive analytics misconceptions and realities.

Unit III Algorithms for Predictive Analytics 12 h

Naive Bayes - Nearest Neighbor - Similarity Measure - Distance Metric - Artificial Neural Network - Support Vector Machine - Linear and logistic regression - time - series forecasting.

Unit IV Predictive Modeling 12 h

Model Ensembles - Bias variance trade – off in predictive analytics - Imbalanced data problems in predictive analytics - Explain ability of machine learning model for predictive analytics.

Unit V Big data for predictive analytics 12 h

Fundamental concepts of bigdata - Business problems that big data Analytics addresses - Big data technologies. Deep learning and Cognitive Computing: Introduction - Elements of Artificial Neural Network - Deep Neural networks - Convolutional Neural Network - Cognitive computing.

Text Books

1 Dursun Delen, 2021, "Predictive Analytics: Data Mining, Machine Learning and Data Science for Practitioners", 2nd Edition, Pearson Education, Inc.

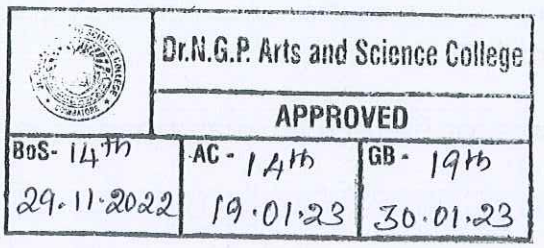
References

1 Anasse Bari, Mohamed Chaouchi, Tommy Jung, 2017, "Predictive Analytics for dummies",Second Edition,John Wiley & Sons.

2 John D. Kelleher (Author), Brian Mac Namee , 2020, "Fundamentals of Machine Learning for Predictive Data Analytics," 2nd Edition, The MIT Press.

3 Trevor Hastie, Robert Tibshirani, Jerome Friedman,2009, "The Elements of Statistical Learning-Data Mining, Inference, and Prediction", 2nd Edition, Springer Verlag

4 Subhashini Chellappan, Seema Acharya, 2019, "Big Data and Analytics", 2ndEdition, Wiley.



Course Code	Course Name	Category	L	T	P	Credit
224CS2A2DC	ADVANCED NETWORKS	DSE	5	-	-	5

PREAMBLE

This course has been designed for students to learn and understand

- The resource sharing, availability and reliability
- The increased storage capacity, streamlined collaboration and communication.
- Reduction of errors and secured remote access.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the Network Edge, Network Core and Protocol Layers and their Service Models	K2
CO2	Illustrate the Application Layer , Transport Layer and The Network Layer	K3
CO3	Apply the Data Link Layer and Mobile Networks	K5
CO4	Analyze the Security in Computer Networks	K4
CO5	Analyze the Multimedia Networking	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓		✓
CO2		✓		✓	✓
CO3	✓		✓	✓	✓
CO4	✓		✓	✓	✓
CO5	✓	✓	✓		✓

COURSE FOCUSES ON

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability	✓	Innovations
✓	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

224CS2A2DC	ADVANCED NETWORKS	SEMESTER II

Total Credits: 5

Total Instruction Hours: 60 h

Syllabus

Unit I Basics of Computer Networks 12 h

The Network Edge: Access Networks - Physical Media -The Network Core: Packet Switching - Circuit Switching- A Network of Networks -Delay, Loss, and Throughput in Packet-Switched Networks-Protocol Layers and their Service Models: Layered Architecture - Encapsulation -Networks under Attack

Unit II Application Layer, Transport Layer and Network Layer 12 h

Application Layer: The Web and HTTP- Video Streaming and Content Distribution Networks- Socket Programming: Creating Network Applications- Transport Layer:Connectionless Transport UDP - Principles of Reliable Data Transfer-Connection-Oriented Transport TCP- Principles of Congestion Control-The Network Layer:Routing Algorithms - Intra-AS Routing in the Internet OSPF - Routing Among the ISPs- The SDN Control Plane

Unit III The Data Link Layer and Mobile Networks 12 h

The Data Link Layer: Error-Detection and -Correction Techniques-Multiple Access Links and Protocols-Data Center Networking- Mobile Networks: WiFi- Cellular Internet Access- Mobility Management: Principles- Mobile IP- Managing Mobility in Cellular Networks- Wireless and Mobility: Impact on Higher-Layer Protocols

Unit IV Security in Computer Networks 12 h

Principles of Cryptography - Message Integrity and Digital Signatures- End-Point Authentication- Securing E-Mail- Securing TCP Connections SSL-Network-Layer Security: IPsec and Virtual Private Networks- Securing Wireless LANs- Operational Security: Firewalls and Intrusion Detection Systems

Unit V Multimedia Networking 12 h

Multimedia Networking Applications - Streaming Stored Video- Voice-over-IP-Protocols for Real-Time: RTP - SIP Conversational Applications- Network Support for Multimedia: Dimensioning Best-Effort Networks- Providing Multiple Classes of Service-Diffserv- Per Connection Quality-of-Service Guarantees: Resource Reservation and Call Admission

Text Books

1 James F. Kurose and Keith W. Ross, 2017, "Computer Networking", 7th Edition, Pearson Publication.

References

1 Savo G. Glisic, 2016, "Advanced Wireless Networks", 3rd Edition, John Wiley and sons.

2 Jeffrey S.Beasley and Piyasatnilkaew, 2018, "A Practical Guide to Advanced Network", 3rd Edition, Pearson Publisher.

3 Behrouz A. Forouzan, 2019, "Data Communications and Networking 5E", McGraw Hill Education Edition.

4 Sanjay Kumar Biswash and Sourav Kantiaddya,2021,"Cloud Network Management", 1st Edition, CRC Press.

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Course Code	Course Name	Category	L	T	P	Credit
224CS2A3CA	DATA SCIENCE ESSENTIALS	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The essential concepts of Data Science
- The R environment
- The concept of machine learning and its applications.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the Data Science Process and the types of data.	K2
CO2	Advantages and Disadvantages of R and their basic concepts.	K3
CO3	Impart knowledge on control statements and various built-in functions.	K3
CO4	Visualize the data in different forms of chart.	K4
CO5	Apply the concepts of machine learning algorithms.	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	
CO2		✓		✓	✓
CO3			✓		✓
CO4	✓	✓		✓	
CO5	✓		✓	✓	✓

COURSE FOCUSES ON

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability	✓	Innovations
✓	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

224CS2A3CA	DATA SCIENCE ESSENTIALS	**SEMESTER III**

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Data Science in Big Data World 9 h

Benefits and uses of Data Science and Big Data- Facets of Data- The Data Science Process - The Big Data Ecosystem and Data Science. Overview of the Data Science Process- Defining research goals and creating a project charter- Retrieving Data- Cleansing, Integrating and transforming Data- Exploratory Data Analysis- Build the models.

Unit II The R Environment 9 h

History, Features and Importance of R- Advantages and Disadvantages of R- Applications of R-The R Script File-Comments-Operators-Variables-Basic Data types-Data Structures-Vector-List- Matrices.

Unit III Data Structures and Control Statements, Files 9 h

Data Frames- Factors- Arrays-The if, if...else, if...else ladder-Basic Loop Structures-The Break, Next and Repeat Loop-R Functions-The return Function- Built in Functions-Variable Scope and Lifetime- Recursive Functions - Reading and Writing Data into Files - Reading Data from Excel - Reading HTML and XML Files.

Unit IV Plotting Graphs in R 9 h

Plotting a Histogram- Plotting a Bar Graph- Plotting a Line Chart- Plotting a Scatter Plot- Plotting Boxplot Graphs- Density Plots- Saving a plot in R- Customising Text in a Graph- Advanced plots with ggplot

Unit V Machine Learning Algorithms 12 h

Simple Linear Regression-k- Nearest Algorithm - Decision Trees - K-means Algorithm- Naïve Bayes Classification - Support Vector Machine.

Case Study: Facebook Mining and Web Scraping

Text Books

1 Davy Cielen, Arno D.B. Meysman, Mohamed Ali, 2016," Introducing Data Science", Manning Publications Co, New York. (Unit I)

Reema Thareja, 2021, "Data Science and Machine Learning with R", McGraw Hill Education, India. (Unit II to V)

References

1 Rafael A. Irizarry, 2019, "Introduction to Data Science: Data Analysis and Prediction Algorithms with R", CRC Press.

2 B. Uma Maheswari, R. Sujatha, 2021, "Introduction to Data Science: Practical Approach with R and Python", Wiley.

3 Jared P. Lander, 2018, "R for Everyone: Advanced Analytics and Graphics", 2nd Edition, Pearson Education.

4 Chantal D. Larose, Daniel T. Larose, 2019, "Data Science Using Python and R", 1st Edition, Wiley.

Course Code	Course Name	Category	L	T	P	Credit
224CS2A3CB	ADVANCED OPERATING SYSTEMS	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- To learn the fundamentals of Operating Systems
- To gain knowledge on Distributed operating system concepts that includes architecture, Mutual exclusion algorithms, Deadlock detection algorithms
- To gain insight on the distributed resource management components viz. the algorithms for implementation of distributed shared memory, recovery and commit protocols

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the concepts of various synchronization, scheduling and memory management issues	K2
CO2	Understand the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system	K3
CO3	Identify the different features of real time and mobile operating systems.	K3
CO4	Install and use available open source kernel	K4
CO5	Modify existing open source kernels in terms of functionality or features used	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓			✓	✓
CO2		✓			
CO3	✓	✓		✓	
CO4			✓		
CO5	✓	✓			✓

COURSE FOCUSES ON

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability	✓	Innovations
✓	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

224CS2A3CB	ADVANCED OPERATING SYSTEMS	**SEMESTER III**

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I FUNDAMENTALS OF OPERATING SYSTEMS 8 h

Overview – Functions of Operating Systems - Design Approaches - Types of Operating Systems - Synchronization Mechanisms – Concept of a Process - Concurrent Process -Semaphores -Processes Deadlocks: Preliminaries - Models of Deadlocks -Deadlock Detection-Deadlock Prevention-Deadlock Avoidance

Unit II DISTRIBUTED OPERATING SYSTEMS 10 h

Issues in Distributed Operating System – Architecture – Communication Primitives –Lamport's Logical clocks – Causal Ordering of Messages – Distributed Mutual Exclusion Algorithms – Centralized and Distributed Deadlock Detection Algorithms – Agreement Protocols.

Unit III DISTRIBUTED RESOURCE MANAGEMENT 10 h

Distributed File Systems – Design Issues - Distributed Shared Memory: Algorithms for Implementing Distributed Shared memory–Issues in Load Distributing – Components Load Distributing Algorithm– Fault Tolerance: Two-Phase Commit Protocol – Nonblocking Commit Protocol

Unit IV PROTECTION &DATA SECURITY 10 h

Introduction - Preliminaries - The Access Matrix Model - Implementation ofAccess Matrix Model- Advanced Models of Protection - A Model of Cryptography - Private Key Cryptography: Data Encryption Standard - Public Key Cryptography- Multiple Encryption - Authentication in Distributed Systems

Case Studies : The UNIX Operating System - Hydra Kernel - Amoeba

Unit V MULTI PROCESSOR OPERATING SYSTEMS 10 h

Multiprocessor System Architectures- Basics of Multi Processor Architecture Systems - Interconnection Networks for Multiprocessor Systems - Caching - Multiprocessor Operating Systems - Operating Systems Design Issues - Threads - Process Synchronization - Process Scheduling - Memory Management.

Text Books

1 Mukesh Singhal and Niranjan G. Shivaratri, 2019, "Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems", Second Edition, Tata McGraw-Hill.

References

1 Rajib Mall, 2016, "Real-Time Systems: Theory and Practice", Second Edition, Pearson Education India.

2 Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, 2017, "Operating System Concepts", Seventh Edition, John Wiley & Sons

3 Daniel P Bovet and Marco Cesati, 2015, "Understanding the Linux kernel", 3rd edition, O'Reilly.

Course Code	Course Name	Category	L	T	P	Credit
224CS2A3CC	Distributed Computing	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- Basic concepts of Distributed Computing
- Understand networking protocols used in Distributed Computing
- Identify Applications of Distributed Computing

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the basic architecture and algorithms used in Distributed Computing	K2
CO2	Understand the basic architecture and algorithms used in Distributed Computing	K3
CO3	Utilize the modern software and technical skills in order to control concurrency in 5 distributed transactions.	K3
CO4	Develop various web applications and automate the real time problems	K4
CO5	Understand how to apply the knowledge to gain insight of Distributed System in solving 1 real world problems.	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	
CO2	✓	✓			✓
CO3		✓	✓	✓	✓
CO4	✓	✓	✓	✓	
CO5	✓		✓	✓	

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

224CS2A3CC	DISTRIBUTED COMPUTING	**SEMESTER I**

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Distributed Computing Systems 10 h

Scheduling of Divisible Loads on Heterogeneous Distributed Systems - Introduction - The System Model - Analysis of Optimal Solution - Analysis of Two-Slave System -The Sport Algorithm

Unit II Fault Tolerance Mechanisms in Distributed System 9 h

Distributed System Architecture - Fault Tolerance Systems - Basic Concept of Fault Tolerance System - Fault Tolerance Mechanism in Distributed System - Real-Time Network Simulation - Supporting Real-Time Performance - Applications and Case Studies

Unit III Software in Distributed Systems 9 h

Introduction - The Platform for Research Collaborative Computing - Prototyping Optimal Design Platform For Engineering - A Performance-Driven Approach For Restructuring Distributed Object-Oriented Software - Restructuring Scheme

Unit IV Analysis and Design of Distributed Pair Programming System 10 h

Introduction - Analysis and Interaction in DPP System - Requirements of DPP System - Design of DPP System - High Voltage Power Grid Optimization Models - An Asynchronous Distributed Algorithm for Stochastic Unit Commitment

Unit V Applications of Distributed Computing 10 h

Assigning Real-Time Tasks in Environmentally Powered Distributed Systems - Introduction - Preliminaries - ACO Solution - Cloud/Fog Computing System Architecture and Key Technologies for South-North Water Transfer Project safety

Text Books

1 Zoran Gacovski, 2019, "Parallel and Distributed Computing Applications", 2nd Edition, Arcler Press

.

References

1 Hiroyuki Takizawa, Hong Shen, Toshihiro Hanawa, 2023, "Parallel and Distributed Computing, Applications and Technologies",Springer.

2 Peter Kacsuk, Dieter Kranzlmuller, Zsolt Nemeth, Jens Volert, 2021 "Distributed and Parallel Systems Cluster and Grid Computing", 2nd Edition, Springer

3 S.K. Basu, 2016, "Parallel and Distributed Computing Architectures and Algorithms", 1st Edition, PHI

4 Kai Hwang, Geoffrey C. Fox, Jack J.Dongarra, 2012, "Distributed and Cloud Computing From Parallel Processing to the Internet of Things , Elsevier

Course Code	Course Name	Category	L	T	P	Credit
224CS2A3CD	RESEARCH METHODOLOGY	CORE	5	-	-	5

PREAMBLE

This course has been designed for students to learn and understand

- The fundamental concepts of Research Methodology.
- Learn different types of data collection methods for solving research problems.
- Emphasis on doing Research paper and Thesis Writing.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the basic concepts of research problem and research design.	K2
CO2	Understand the measurement and scaling techniques.	K3
CO3	Experiment different data collection methods for doing research process.	K3
CO4	Demonstrate Sampling and Hypothesis Testing.	K4
CO5	Develop Research Paper and Thesis Writing skills.	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓			✓	✓
CO2	✓	✓	✓		
CO3	✓	✓		✓	✓
CO4			✓		
CO5	✓	✓			✓

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability	✓	Innovations
✓	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

224CS2A3CD	RESEARCH METHODOLOGY	**SEMESTER III**

Total Credits: 5

Total Instruction Hours: 60 h

Syllabus

Unit I Introduction of Research 12 h

Meaning - Objectives - Motivation - Types - Research Approaches - Significance ofResearch - Research Methods Vs Methodology - Research and Scientific Method - Importance of Knowing How Research is Done - Research Process - Criteria ofGood Research. Defining the Research Problem: Definition - Selecting the Problem - Necessity of Defining the Problem - Technique Involved in Defining a Problem.Research Design: Meaning - Need for Research Design - Features of Good Design -Important Concepts Relating to Research Design - Different Research Designs -Basic Principles of Experimental Designs.

Unit II Sampling Design, Measurement and Scaling Techniques 12 h

Sampling Design: Census and Sample Survey - Implications of a Sample Design - Steps in Sampling Design - Criteria of Selecting a Sampling Procedure - Characteristics of a Good Sample Design - Different Types of Sample Designs. Measurement and Scaling: Measurement in Research - Measurement Scales - Sources of Error in Measurement - Tests of Sound Measurement - Technique of Developing Measurement Tools - Scaling - Meaning of Scaling - Scale Classification Bases - Important Scaling Techniques - Scale Construction Techniques.

Unit III Data Collection, Processing and Analysis 12 h

Methods of Data Collection: Collection of Primary Data - Observation Method - Interview Method - Collection of Data through Questionnaires - Collection of Data through Schedules - Difference between Questionnaires and Schedules - Some Other Methods of Data Collection - Collection of Secondary Data - Selection of Appropriate Method for Data Collection. Processing and Analysis of Data: Processing Operations - Some Problems in Processing - Elements/Types of Analysis - Statistics in Research - Measures of Central Tendency - Measures of Dispersion - Measures of Asymmetry (Skewness) - Measures of Relationship.

Unit IV Sampling, Hypothesis Testing and Chi-Square Test 12 h

Sampling Fundamentals: Need - Definitions - Important Sampling Distributions - Sampling Theory - Estimation - Estimating the Population Mean - EstimatingPopulation Proportion - Sample Size and its Determination. Testing of

Hypotheses: Definition - Basic Concepts - Procedure - Flow Diagram - Measuring the Power of a Hypothesis Test - Tests of Hypotheses - Important Parametric Tests. Chi-Square Test: Chi-square as a Test for Comparing Variance - Chi-square as a Non Parametric Test - Conditions for the application of Chi-square Test - Steps Involved in Applying Chi-Square Test - Important Characteristics of Chi-Square Test.

Unit V Preparation of Thesis and Research Papers 12 h

The IMRAD (Introduction, Materials and Methods, Results and Discussion) Structure for Research Reporting – The Structure of a Thesis – Formatting Requirements of a Thesis – Thesis Editing – Research Papers – Selecting a Journal – The Structure of a Research Paper – Other Considerations in the Preparation of Articles – Review and Peer Review – Copyediting and Proofreading – Review Papers – Conference Papers – Electronic Publications – Short notes and Other Forms of Reports – Publish and Flourish.

Text Books

1 Kothari C.R., Gaurav Garg, 2019, "Research Methodology Methods andTechniques", 4th Edition, New Age International Publishers (Unit I to UnitIV).

George Thomas C., 2015, "Research Methodology and Scientific Writing", 1st Edition, Ane Books Pvt. Ltd. (Unit V).

References

1 Dr.ShanthiBhusan Mishra, Dr.ShashiAlok, 2019, "Handbook of Research Methodology", 1stEdition, Edu creation Publishing.

2 Dr.Prabhat Pandey, Dr.Meenu Mishra Pandey, 2015, "Research Methodology:Tools and Techniques", 1st Edition, Bridge Center.

3 Ranjit Kumar, 2015, "Research Methodology - A Step by Step Guide forBeginners", 3rd Edition, Sage Publications.

4 Steven J. Taylor, Robert Bogdan, Marjorie L. DeVault, 2016, " Introduction to QualitativeResearch Methods ", 4th Edition, John Wiley & Sons.

224CS2A3CP	DATA SCIENCE ESSENTIALS	**SEMESTER III**

Total Credits: 2
Total Instructions Hours: 48 h

S.No	Contents
1	Loading a data file of different formats into R environment and perform various data processing tasks.
2	Perform various Data Exploratory Techniques on the processed data.
3	Create a simple calculator using R Operators and Variables.
4	Create a 3 X 3 matrix in R and perform various matrix operations.
5	Demonstrate reading and writing data of different file formats in R.
6	Create matrix to store the results of five players in three matches. Compare each players performance in matches played by them and find out whether their performance has improved comparing to previous matches.
7	An employee's total weekly pay is calculated by multiplying the hourly wage and number of regular hours plus any overtime pay, which in turn is calculated as total overtime hours multiplied by 1.5 times of hourly wage. Write a program that takes as input the hourly wage, total regular hours and total over time hours and prints an employee's total weekly pay.
8	Implement an R program to perform the following i. Calculate Fibonacci Series ii. Calculate the factorial of a given number. iii. Find the GCD of two numbers.
9	i. Create a stacked bar graph and a pie chart to display the marks obtained by students in different Subjects. ii. Create a stacked bar graph depicting temperature and rainfall received for five consecutive days in an area. iii. Create a data frame of random values for gender and height. Draw a density plot and a line which highlights the mean value.
10	Create a simple linear regression model using the mtcars dataset and evaluate the performance of the model using the various evaluation metrics.

11	Use the tidy verse, mlbench and caret packages to predict the diabetes from PimaIndianDiabetes dataset.
12	Download the boston.csv dataset from kaggle and create a regression tree to predict the price of a house medv.

Note: Any 10 experiments are mandatory

References

1 D. Chattopadhyay. Advanced course in practical physics, NCBA publishers.

2 Samir kumarghosh. Textbook of Advanced Practical Physics, NCBA publishers.

3 C.L. Arora. B.Sc. Practical Physics, S.Chand.

4 Sathya Prakash. Practical physics and Electronics, S.Chand

224CS2A3CQ	ADVANCED OPERATING SYSTEMS	**SEMESTER III**

Total Credits: 2
Total Instructions Hours: 48 h

S.No	Contents
1	Write programs using the following system calls of UNIX operating system: fork, exec, getpid, exit, wait, close, stat, opendir, readdir
2	Write programs using the I/O System calls of UNIX operating system (open, read, write, etc.).
3	Write C programs to simulate UNIX commands like ls, grep, etc.
4	Given the list of processes, their CPU burst times and arrival times. Display/print the Gantt chart for FCFS and SJF. For each of the scheduling policies, compute and print the average waiting time and average turnaround time.
5	Given the list of processes, their CPU burst times and arrival times. Display/print the Gantt chart for Priority and Round robin. For each of the scheduling policies, compute and print the average waiting time and average turnaround time.
6	Develop application using Inter-Process Communication (using shared memory, pipes or message queues).
7	Write a C programs to implement UNIX system calls and file management
8	To synchronize producer and consumer processes using semaphore.
9	To demonstrate communication between process using shared memory.
10	To implement demand paging for a reference string using LRU method
11	To implement file allocation on free disk space in a contiguous manner.
12	Write a C program to simulate Bankers Algorithm for Deadlock Avoidance.

Note: Any 10 Experiments are Mandatory

Course Code	Course Name	Category	L	T	P	Credit
224CS2A3DA	NATURAL LANGUAGE PROCESSING	CORE	5	-	-	5

PREAMBLE

This course has been designed for students to learn and understand

- Introduction on NLP
- The different analysis
- The machine translation and retrieval.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand Basics of Natural Language Processing	K2
CO2	Learn different types of analysis	K2
CO3	Understand discourse processing and Natural language generation	K3
CO4	Gain knowledge on machine translation	K2
CO5	Under Ascertain facts on information retrieval	K2

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓		✓	✓
CO3		✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

COURSE FOCUSES ON

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability	✓	Innovations
✓	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

224CS2A3DA	NATURAL LANGUAGE PROCESSING	**SEMESTER** III

Total Credits: 5

Total Instruction Hours: 60 h

Syllabus

Unit I NATURAL LANGUAGE PROCESSING 12 h

Origins of NLP – Language and knowledge – The Challenges of NLP – Language and Grammar– Processing Indian Language - NLP Applications – Early NLP Systems – Information Retrieval – Various Grammar–based Language Model - Statistical Language Model.

Unit II Word Level Analysis and Syntactic Analysis 12 h

Regular Expressions – Finite-State Automata - Morphological Parsing – Spelling Error Detection and Correction – Words and Word classes – Part-of-speech Tagging - Context-Free Grammar – Constituency - Parsing – Probabilistic Parsing – Indian Languages.

Unit III Discourse Processing and Natural Language Generation 12 h

Cohesion – Reference Resolution - Discourse Coherence and structure - Architectures of NLG systems – Generation Task and Representations – Applications of NLG

Unit IV Machine Translation 12 h

Problems in Machine Translation – Characteristics of Indian Languages – Machine Translation Approaches – Direct Machine Translation – Rule Based Machine Translation – Corpus-based Machine Translation – Semantic or Knowledge-based MT Systems – Translation involving Indian Languages.

Unit V Information Retrieval-I and Lexical Resources 12 h

Design Features of Information Retrieval Systems – Information Retrieval Models – Classical Information Retrieval Models – Non-Classical Models of IR – Alternative Model of IR - Evaluation of IR system -- WordNet – FrameNet – Stemmers – Part-of-Speech Tagger – Research Corpora.

Text Books

1 Tanveer Siddiqui, 2018, "Natural Language Processing and Information Retrieval", U.S. Tiwary, Sixth Impression, OXFORD University Press.

References

1 Kibble. R, 2013, "Introduction to natural language processing" Published by: University of London ,Goldsmiths

2 Jacob Eisenstein ,2018, "Natural Language Processing", The MIT Press.

3 Ela Kumar, 2013, "Natural Language Processing Paperback", I K International Publishing House Pvt. Ltd.

4 Ashish Bansal, 2021, "Advanced Natural Language Processing with TensorFlow 2", Packt Publishing Limited..

Course Code	Course Name	Category	L	T	P	Credit
224CS2A3DB	BUSINESS ANALYTICS	CORE	5	-	-	5

PREAMBLE

This course has been designed for students to learn and understand

- The importance of business analytics
- The business analytics for decision making
- The appropriate analytics and generate solutions

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Ability to understand the role of Business Analytics in decision making	K1
CO2	Ability to apply the descriptive analytics and generate solutions	K2
CO3	Ability to apply the Predictive analytics and generate solutions	K3
CO4	Knowledge of Prescriptive Analytics and demonstrating business process improvement	K4
CO5	Apply decisions with Sample Information	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2		✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓		
CO5	✓	✓	✓		✓

COURSE FOCUSES ON

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability	✓	Innovations
✓	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

224CS2A3DB	BUSINESS ANALYTICS	**SEMESTER III**

Total Credits: 5

Total Instruction Hours: 60 h

Syllabus

Unit I Introduction to Business Analytics 12 h

Business Analytics- Impacts and Challenges- Evolution of Business Analytics- Descriptive, Predictive and Prescriptive Analytics- Data for Business Analytics.

Models in Business Analytics: Descriptive Models- Predictive Models- Prescriptive Models-Model Assumptions- Uncertainty and Risk-Problem Solving with Analytics: Recognizing a Problem- Defining the Problem- Structuring the Problem- Analyzing the Problem- Interpreting Results and Making a Decision- Implementing the Solution.

Unit II Descriptive Analytics 12 h

Data Visualization: The Value of Data Visualization- Creating Charts in Microsoft Excel-Other Excel Data Visualization Tools.

Descriptive Statistics: Metrics and Data Classification-Frequency Distributions and Histograms-Percentiles and Quartiles- Cross Tabulations- Descriptive Statistical Measures.

Unit III Predictive Analytics 12 h

Trend lines and Regression Analysis: Modeling Relationships and Trends in Data-Simple Linear Regression- Building good Regression Models.

Forecasting Techniques: Qualitative and Judgmental Forecasting- The Practice of Forecasting. Data Mining: The Scope of Data Mining.

Spreadsheet Modeling and Analysis: Analytics in Practice.

Unit IV Prescriptive Analysis 12 h

Linear Optimization: Optimization Models-Developing Linear Optimization Models- Solving Linear Optimization Models.

Integer and Nonlinear Optimization: Integer Linear Optimization Models-Nonlinear Optimization Models.

Optimization Analytics: What-If Analysis for Optimization Models. Visualization of Solver Reports.

Unit V Making Decisions 12 h

Decision Analysis: Formulating Decision Problems- Decision Strategies Without Outcome Probabilities- Decision Strategies With Outcome Probabilities- Decision Trees- Decisions with Sample Information- Utility and Decision Making.

Text Books

1 James R. Evans, 2022, "Business Analytics - Methods, Models and Decisions", Third Edition, Pearson Ed.

References

1 Christian Albright S and Wayne L. Winston, 2015, "Business Analytics - Data Analysis and Decision Making", Fifth edition, Cengage Learning.

2 Marc J. Schniederjans, Dara G. Schniederjans and Christopher M. Starkey, 2015, " Business Analytics Principles, Concepts, and Applications - What, Why, and How", Pearson Ed.

Course Code	Course Name	Category	L	T	P	Credit
224CS2A3DC	NETWORK SECURITY	CORE	5	-	-	5

PREAMBLE

This course has been designed for students to learn and understand

- The crucial concepts of network security
- The symmetric and asymmetric cryptography algorithms.
- Data integrity the and security for advanced networks

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the fundamental concepts of network security and the various attacks and threats that can compromise network security	K1
CO2	Analyze different encryption techniques and algorithms used to secure network communication	K2
CO3	Evaluate the strengths and weaknesses of different security mechanisms and protocols used to protect network communication	K3
CO4	Understand the importance of authentication, digital signatures, and hash algorithms in securing network communication	K3
CO5	Analyze the principles of intrusion detection, password management, virus protection, and firewall design, and their role in securing network communication	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓
CO3		✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability	✓	Innovations
✓	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

224CS2A3DC	NETWORK SECURITY	**SEMESTER III**

Total Credits: 5

Total Instruction Hours: 60 h

Syllabus

Unit I Computer and Network Security Concepts 12 h

Computer Security Concepts - OSI Security Architecture - Security Attacks - Security Services - Security Mechanisms - Fundamental Security Design Principles - Attack Surfaces and Attack Trees - Model for Network Security - Standards. Modular Arithmetic - Prime Numbers - Fermat's and Euler's Theorems.

Unit II Symmetric Cipher 12 h

Symmetric Cipher Model - Substitution Techniques - Transposition Techniques - Rotor Machines - Steganography - Traditional Block Cipher Structure - Data Encryption Standard - Strength of DES - Block Cipher Design Principles - Advanced Encryption Standard Finite Field Arithmetic - AES Structure - AES Transformation Functions - AES Key Expansion.

Unit III Asymmetric Cipher 12 h

Public-Key Cryptography - Principles of Public-Key Cryptosystems - RSA Algorithm - Diffie-Hellman Key Exchange - Elgamal Cryptographic System - Elliptic Curve Arithmetic - Elliptic Curve Cryptography - Pseudorandom Number Generation Based on an Asymmetric Cipher..

Unit IV Cryptographic Data Integrity Algorithms 12 h

Cryptographic Hash Functions - Applications of Cryptographic Hash Functions - Two Simple Hash Functions - Requirements and Security - Hash Functions Based on Cipher Block Chaining - Secure Hash Algorithm - SHA-3 - Message Authentication Requirements - Message Authentication Functions - Requirements for Message Authentication Codes - Security of MACs.

Unit V Security for Cloud and Advanced Networks 12 h

Network Access Control - Extensible Authentication Protocol - IEEE 802.1X Port-Based Network Access Control - Cloud Computing - Cloud Security Risks and Countermeasures - Data Protection in the Cloud -Cloud Security as a Service - Addressing Cloud Computing Security Concerns - Wireless Security - Mobile Device Security - S/MIME.

Text Books

1 Stallings, 2017, "Cryptography and Network Security Principles And Practice, Seventh Edition Global Edition", Pearson Education & Place.

References

1 Atul Kahate, 2019, "Cryptography and Network Security, 4th Edition", McGraw Hill Education.

2 Achary. R, 2021 "Cryptography and Network Security An Introduction", Mercury Learning and Information.

3 Bjarne Stroustrup, 2022, "C++ Programming Language, Fourth Edition" Pearson.

4 YashavantKanetkar, 2020, "Let Us C++", BPB Publications..

224CS2ASSA	IPR AND ENTREPRENEURSHIP	SEMESTER III

Total Credit: 1

Syllabus

Unit I Intellectual Property and World Trade Organization (WTO)

Introduction: Definition of Intellectual Property - Introduction of WTO. Agreement on TRIPS (Trade Related Intellectual Property Rights): General Provisions and Basic Principles of TRIPS - Standards Concerning the Availability, Scope and Use of Intellectual Property Rights - Enforcement of Intellectual Property Rights - Acquisition and Maintenance of Intellectual Property Rights and Related Inter-Partes Procedures - Dispute Prevention and Settlement - Transitional Arrangements- Institutional Arrangements, Final Provisions

Unit II Patent

Fundamentals of Patent: Definition - History of the Patent in India - Conditions for Grant of Patent – Inventions those are not Patentable - Process and Product Patent - Procedure for Grant of Patent – e-Filing of Patent Application - Temporal and Spatial Aspect of Patent - Opposition to Grant of Patent - Rights of Patentee - Patent Office and Register of Patents - PCT Patent - Exclusive Marketing Rights - Milestones in Indian Patent Law. Transfer and Infringement of Patent Rights: Transfer of Patent Rights - Infringement of Patent Rights - Patent Agents - Challenges in Patent.

Unit III Copyright and Trade Marks

Copyright: Definition - Meaning of Publication - Copyright Office and Copyright Board - Ownership of Copyright - The Rights of the Owner - Term of Copyright - Registration of Copyright - Infringement of Copyright - Remedies against Copyright Infringement - Internet and Copyright Issue. Trade Marks: Definition - Developing a Trade Mark - Conditions for Trade Mark Registration - Register of Trade Marks - Trends in Trade Marks Applications - Procedure for Trade Mark Registration in India - Term of Trade Mark - Certification Trade Mark - Infringement of Trade Mark - Remedies against Trade Mark Infringement.

Unit IV Significance of Entrepreneur

Basic Business Concepts for the Prospective Entrepreneur: Production Factors as Resources Needed When Starting an Enterprise - The Enterprise, Its Establishment and The Sectors- Profit and Other Objectives of an Entrepreneur - Informal and Formal Enterprises - Form of Enterprise for A Small Business - The Business Environment. Entrepreneurship and Entrepreneurial Skills: Definitions of an Entrepreneur - The Relationship between Entrepreneurship and Small Business Management - Key Characteristics of Successful Entrepreneurs - Entrepreneurial

Unit V Ideas for Start-up

The Identification of Feasible Small Business Ideas: Introduction - Cultivating a Creative Attitude - Generating Small Business Ideas: The Generation of Ideas from the Entrepreneur's Skills, Expertise and Aptitudes – Common Needs – Existing Problems – Everyday Activities – Other Sources - The Development and Evaluation of Small Business Ideas. The Business Plan: About the Business Plan – Contents of the Business Plan - The Entrepreneurial Team – Description of the Enterprise – The Objective and Strategy of the Enterprise.

Text Books

1 Neeraj Pandey, Khushdeep Dharani, 2014, "Intellectual Property Rights", PHI Learning Pvt. Ltd.

2 Nieuwenhuizen C, 2015, "Basics of Entrepreneurship", Juta Pvt. Ltd.

References

1 Deborah. E. Bouchoux, 2018, "Intellectual Property Right" 5th edition, Cengage Learning.

2 Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, 2018, "Entrepreneurship", 10th Edition, Tata McGraw Hill.

3 Prabuddha Ganguli, 2008, "Intellectual Property Right", 1st Edition, Tata McGraw Hill.

224CS2ASSB	ORGANISATIONAL BEHAVIOUR	SEMESTER III

Total Credits: 1

Syllabus

Unit I Nature and Scope of Organisation

Introduction – Concept of Organisation – Features – Types – Concepts of Organisational Typology and its Types – Significance of Organisation – Organisational Goals – Importance – Goal Formulation – Nature of Goals – Goal Changes – Individual and Organisational Goals – Conflict between Individual and Organisational Goals – Nature of Business Organization – Organisation Theory.

Unit II Organisational Behaviour]

PConcept and Meaning of Organisational Behaviour (OB) – Characteristics of OB - Key Elements / Forces of OB - Goal of OB – Philosophical Concepts of OB – Fundamental Concepts of OB – OB and Other Fields of Study – Role of OB - Historical Evolution of OB – Approaches to the Study of OB – Models of OB – Challenges and Opportunities of OB.

Unit III Individual Behaviour and Personality

Personal Factors - Environmental Factors – Organisational Factors – Models of Man / Individual Behaviour. Personality: The Meaning of Personality – Characteristics of Personality - Determinants of Personality – Development of Personality – Personality Traits – Major Traits Influencing Organisational Behaviour - Locus of Control - Matching Personality with Job Types.

Unit IV Group Functionalities

Definition of Groups – Types of Groups – Theories of Group Formation – Reasons for Group Formation – Factors Affecting Group Performance – Inter-Group Behaviour – Approaches to Inter-Group Relationship – Group Dynamic A Synoptic View. Group Decision Making: Meaning – Nature – Groups – Process – Steps – Styles – Advantages and Disadvantages.

Unit V Communication and Leadership

Communication: Definitions – Characteristics: Nature of Communication – Elements – Process – Models – Need or Purpose – Importance – Methods (Channels) – Inter Personal – Cross Cultural Communication. Leadership: Definitions – Nature and Characteristics - Leadership Vs Management –Leadership Styles - Formal and Informal Leaders – Leadership Functions – Importance of Leadership in Management – Process or Techniques of Effective Leadership.

Text Books

1 Shashi K Gopta, Rosy Joshi, 2014, "Organisational Behaviour", 9th Edition, Kalyani Publishers.

References

1 Khanka S.S., 2013, "Organisational Behaviour". 7th edition , Sultan Chand & Sons Publishing.

2 Stephen P. Robins, 2008 , "Organizational Behavior", 11th edition ,PHI Learning / Pearson Education, ,

3 Fred Luthans, 2010, "Organisational Behavior", 11th Edition, McGraw Hill.

10/6/23.

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224CS1A4CV	PROJECT WORK	SEMESTER IV

Total Credits: 12

GUIDELINES:

1. A Guide has been allotted to each student by the department. Student can select any topic in discussion with the Guide. Students should maintain a work diary were in weekly work carried out has to be written. Guide should review the work every week and put his/her signature. The work diary along with project report should be submitted at the time of viva voce.

2. CA Marks Distribution: A minimum of two reviews have to be done, one at the time finalizing the project title, second at framing questionnaire/identifying the primary data. They should be asked to present the work done to the respective guide in the two reviews. The guide will give the marks for CIA as per the norms stated below:

A) Mark Distribution for Project

Total : 200
Internal : 100
External : 100

i) Distribution of Internal Marks

S. No.	Particulars	Internal Marks
1	Review I	40
2	Review II	40
3	Attendance	20
		Total 100

ii) Distribution of External Marks

S. No.	Particulars	External Marks
1	Project Work and Presentation	80
2	Viva-Voce	20
		Total 100

Note: Evaluation of Project Work shall be done jointly by Internal and External Examiners.

16/10/23
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