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 2023-24 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 2023-24 and onwards)

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	

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CURRICULUM - PROGRAMME NAME–M.Sc. Computer Science (2023 Batch)

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
First Semester										
234CS2A1CA	Core - I	Advanced Data Structures	4	-	-	3	25	75	100	4
234CS2A1CB	Core - II	Advanced Java	4	-	-	3	25	75	100	4
234CS2A1CC	Core - III	Information Security	5	-	-	3	25	75	100	5
234CS2A1CD	Core - IV	Software Project Management	4	-	-	3	25	75	100	4
234CS2A1CP	Core Practical I	Advanced Data Structures	-	-	4	3	40	60	100	2
234CS2A1CQ	Core Practical II	Advanced Java	-	-	4	3	40	60	100	2
234CS2A1DA		Digital Image Processing								
234CS2A1DB		Advanced Data Mining								
234CS2A1DC	DSE -I	Computer Communication Networks	5	-	-	3	25	75	100	5
		Total	22		8				700	26

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

BoS-	AC -	GB -
10.6.23	14.7.23	5.8.23

APPROVED

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Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Second Semester										
234CS2A2CA	Core - V	Advanced Python Programming	4	-	-	3	25	75	100	4
234CS2A2CB	Core - VI	Advanced Relational Data Management Systems	4	-	-	3	25	75	100	4
234CS2A2CC	Core - VII	Neural Networks and Fuzzy Logic	4	-	-	3	25	75	100	4
232MT2A2ED	EDC	Advanced Operations Research	5	-	-	3	25	75	100	5
234CS2A2CP	Core Practical - III	Advanced Python Programming	-	-	4	3	40	60	100	2
234CS2A2CQ	Core Practical - IV	Advanced Relational Data Management Systems	-	-	4	3	40	60	100	2
234CS2A2DA		Deep Learning	5	-	-	3			100	5
234CS2A2DB		Predictive Analytics								
234CS2A2DC	DSE -II	Advanced Networks					25	75		
		Total	22		08				700	26

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Third Semester										
234CS2A3CA	Core - VIII	Data Science Essentials	4	-	-	3	25	75	100	4
234CS2A3CB	Core - IX	Advanced Operating Systems	4	-	-	3	25	75	100	4
234CS2A3CC	Core - X	Distributed Computing	4	-	-	3	25	75	100	4
234CS2A3CD	Core - XI	Research Methodology	5	-	-	3	25	75	100	5
234CS2A3CP	Core Practical - V	Data Science Essentials	-	-	4	3	40	60	100	2
234CS2A3CQ	Core Practical - VI	Advanced Operating Systems	-	-	4	3	40	60	100	2
234CS2A3TA	IT	Internship	-	-	-	3	40	60	100	2
234CS2A3DA		Natural Language Processing								
234CS2A3DB		Business Analytics								
234CS2A3DC	DSE -III	Network Security	5	-	-	3	25	75	100	5
		Total	22		08				800	28

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Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Fourth Semester										
234CS2A4CV	Core	Project Work	-	-	-	3	80	120	200	12
		Total							200	12
		*Grand Total							**2400**	**92**

Theory   : CIA 25 : ESE 75
Practical/ IT   :   CIA 40 : ESE 60
Project   :   CIA 100: ESE 100

*Total Credits does not exceed 92 credits

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.	234CS2A1DA	Digital Image Processing
2.	234CS2A1DB	Advanced Data Mining
3.	234CS2A1DC	Computer Communication Networks

Semester II (Elective II)
List of Elective Courses

S. No.	Course Code	Name of the Course
1.	234CS2A2DA	Deep Learning
2.	234CS2A2DB	Predictive Analytics
3.	234CS2A2DC	Advanced Networks

Semester III (Elective III)
List of Elective Courses

S. No.	Course Code	Name of the Course
1.	234CS2A3DA	Natural Language Processing
2.	234CS2A3DB	Business Analytics
3.	234CS2A3DC	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	234CS2ASSA	IPR and Entrepreneurship
2	234CS2ASSB	Organizational Behavior

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M.Sc. Computer Science (Students admitted during the AY 2023-24)

PG REGULATION (R5)

(2023-24 and onwards)
(OUTCOME BASED EDUCATION WITH CBCS)

Effective from the academic year 2023-24 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, Cognitive Systems, Artificial Intelligence and Machine Learning and Cyber Security and Data Analytics 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 2023–2025 refers to students belonging to a 2-year Degree programme admitted in 2023 and completing in 2025.

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)Internship/Industrial Training (IT)

Students must undertake industrial / institutional training for a minimum of 15 days during the II semester summer vacation. The students will submit the report for evaluation during III semester.

e) 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.

f) 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.

g) 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 University/ 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,

Mark distribution for Theory Courses

Continuous Internal Assessment (CIA) : 40 Marks

End Semester Exams (ESE)   : 60 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)	5
2	Model (All 5 Units) (On completion of 85th working day)	5
3	Attendance	05
4	Library Usage	05
5	Skill Enhancement *	05
	Total	25

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.

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M.Sc. Computer Science (Students admitted during the AY 2023-24)

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 and Assignment.

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

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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
13	Assignment	- Content and Style - Spelling and Grammar - References

ii) Distribution of External Marks

Total	:	75
Written Exam	:	75

Marks Distribution for Practical course

Total	:	100
Internal	:	40
External	:	60

i) **Distribution of Internals Marks**

S. No.	Particulars	Distribution of Marks
1	Experiments/Exercises	15
2	Test 1	10
3	Test 2	10
4	Observation Notebook	05
	Total	40

ii) **Distribution of Externals Marks**

S.No.	Particulars	External Marks
1	Practical	40
2	Record	10
3	Viva- voce	10
	Total	60

Practical examination shall be evaluated jointly by Internal and External Examiners.

A) **Mark Distribution for Project**

Total   :   200
Internal :   80
External :   120

i) Distribution of Internal Marks

S.No.	Particulars	Internal Marks
1	Review I	30
2	Review II	40
3	Attendance	10
	Total	80

ii) Distribution of External Marks

S.No	Particulars	External Marks
1	Project Work & Presentation	100
2	Viva –voce	20
	Total	120

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 semester. The proposed NPTEL course should cover content/syllabus of exempted core paper in 3rd 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 semester. Out of 2 NPTEL proposed courses, **at least 1 course** should cover content/syllabus of exempted core paper in 3rd semester.

<u>Mandatory</u>

The exempted core paper in the 3rd 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	

S. No.	Student Name	Class	Proposed NPTEL Course		Proposed Course for Exemption
			NPTEL Courses to be carried out during semester I – II.		
			Course I	Option 1- Paper Title Option 2- Paper Title Option 3- Paper Title	Any one Core Paper in 3rd Semester
			Course II	Option 1- Paper Title Option 2- Paper Title Option 3- Paper Title	

Class Advisor

HoD

Dean

Mark Distribution for Internship/ Industrial Training

Total   :   100
Internal   :   40
External   :   60

i) Distribution of Internal Marks

S.No.	Particulars	Internal Marks
1	Review I	15
2	Review II	20
3	Attendance	5
	Total	**40**

ii) Distribution of External Marks

S.No	Particulars	External Marks
1	Internship /Industrial training Presentation	40
2	Viva –voce	20
	Total	**60**

Internship/ Industrial training shall be evaluated jointly by Internal and External Examiners.

9. 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 University/ 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		Marks secured will be converted To 5 mark
Section - B	3 x 2 = 06 Marks	Answer ALL Questions Either or Type ALL Questions Carry Equal Marks	25 Marks	
Section - C	3 x 05 = 15 Marks			

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CIA Test II/ Model [3 Hours-5 Units] - 75 Marks

SECTION	MARKS	DESCRIPTION	TOTAL	Remarks
Section – A	10 x 1 = 10 Marks	MCQ		
Section - B	5 x 3 = 15 Marks	Answer ALL Questions (Either or Type Questions) Each Questions Carry Equal Marks	75 Marks	Marks secured will be converted To 5 mark
Section - C	5 x 8 = 40 Marks			
Section - D	1 x 10 = 10 Marks	Compulsory Question		

End Semester Examination [3 Hours-5 Units] - 75 Marks

SECTION	MARKS	DESCRIPTION	TOTAL
Section – A	10 x 1 = 10 Marks	MCQ	
Section - B	5 x 3 = 15 Marks	Answer ALL Questions (Either or Type Questions) Each Questions Carry Equal Marks	75 Marks
Section - C	5 x 8 = 40 Marks		
Section - D	1 x 10 = 10 Marks	Compulsory Question	

Course Code	Course Name	Category	L	T	P	Credit
234CS2A1CA	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

234CS2A1CA	ADVANCED DATA STRUCTURES	SEMESTER 1

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

10 h

Unit I   Elementary Data Structures

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

9 h

Unit II   Trees

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

9 h

Unit III   Hashing

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

10 h

Unit IV   Priority Queues

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

10 h

Unit V   The Disjoint Sets

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 andMount,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
234CS2A1CB	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

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234CS2A1CB	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 SessionJava 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, KarthySierra, 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, Ämazon Digital Services LLC

4. E RamarajP Geetha S Muthukumaran,2018, "Advanced JAVA Programming", First Edition, Pearson,Noida.

Course Code	Course Name	Category	L	T	P	Credit
234CS2A1CC	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

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M.Sc. Computer Science (Students admitted during the AY 2023-24)

234CS2A1CC	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 Cryptanalysisof 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-WorldSecurity 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

Course Code	Course Name	Category	L	T	P	Credit
234CS2A1CD	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

234CS2A1CD	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,ShivangiDhall, 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

234CS2A1CP	CORE PRACTICAL -I : 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.

Note: Any 10 Experiments are Mandatory

234CS2A1CQ	CORE PRACTICAL-II : 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
234CS2A1DA	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

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234CS2A1DA	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 -LowPass Filters - Combining Spatial Enhancement methods -Filtering in the Frequency Domain-Selective Filtering - Fast Fourier Transform.

Unit III   Image Restorationand 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.JoelJosephson ,Dr. Kapil Joshi, 2022, "Digital Image Processing ", First Edition, Book Rivers.

Course Code	Course Name	Category	L	T	P	Credit
234CS2A1DB	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

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M.Sc. Computer Science (Students admitted during the AY 2023-24)

| 234CS2A1DB | 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-PageRank Algorithm-Generalised PageRank 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 RajanChattamvelli, 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 , ShyamDiwakar, 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.

Course Code	Course Name	Category	L	T	P	Credit
234CS2A1DC	COMPUTER COMMUNICATION NETWORKS	DSE	5	-	-	5

PREAMBLE

This course has been designed for students to learn and understand

- theconcepts 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

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M.Sc. Computer Science (Students admitted during the AY 2023-24)

234CS2A1DC	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).
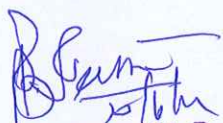
Case study:Emerging concepts in next generation networks.

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.

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