Department of Electronics and Communication Engineering

Course File

WIRELESS COMMUNICATION AND NETWORKS
(Course Code: EC863PE)

IV B.Tech II Semester

2023-24

Dr. Inumula Veeraraghava Rao
Associate Professor

Anurag ENGINEERING COLLEGE
(An Autonomous Institution)
Ananthagiri, Kodad, Telangana 508 206, India.

Department of Electronics and Communication Engineering

WIRELESS COMMUNICATION AND NETWORKS

Check List

S.No	Name of the Format	Page No.
1	Syllabus	1
2	Timetable	3
3	Program Educational Objectives	4
4	Program Objectives	4
5	Course Objectives	5
6	Course Outcomes	5
7	Guidelines to study the course	6
8	Course Schedule	7
9	Course Plan	10
10	Unit Plan	14
11	Lesson Plan	19
12	Assignment Sheets	41
13	Tutorial Sheets	46
14	Evaluation Strategy	51
15	Assessment in relation to COb's and CO's	53
16	Mappings of CO's and PO's	53
17	Rubric for course	55
18	Mid-I and Mid-II question papers	56
19	Mid-I mark	60
20	Mid-II mark	61
21	Sample answer scripts and Assignments	62
22	Course materials like Notes, PPT's, etc.	63

UNIT IV:

Equalization and diversity: Introduction, fundamentals of equalization, training a generic adaptive equalizer, equalizer in a communication receiver, linear equalizers, nonlinear equalization, decision-feedback equalization (DFE) CDMA Packet and frame formats in IS-95, polarization diversity, frequency diversity, Time diversity, RAKE Receiver

(PROFESSIONAL ELECTIVE-VI)

Int. Marks: 25   Ext. Marks: 75   Total Marks:100

UNIT I:

The cellular concept system design fundamentals: Introduction, Frequency reuse, channel assignment strategies, hand off strategies-prioritizing hand offs, practical hand off considerations, interference and system capacity-co channel interference and system capacity, channel planning for wireless systems, adjacent channel interference, power control for reduced interference, trunking and grade off service, improving coverage capacity in cellular systems-cell splitting, sectoring.

UNIT II:

Large scale path loss: Introduction to radio wave propagation, free space propagation model. the 3 basic propagation mechanisms, reflections from dielectric, Brewster angle, reflection from prefect conductors, ground reflection(two ray)model, diffraction-Fresnel zone geometry, knife edge diffraction model, multiple knife edge diffraction, scattering, outdoor propagation models-longley-ryce models, okamura model, hata model, indoor propagation model-partition losses same floor, partition losses between floor, long distance path loss model, signal penetration into buildings, retracing and sight specific modeling.

UNIT III:

Small scale fading and multipath: Small scale multipath propagation, factors influencing small scale fading, Doppler shift, impulse response model of a multipath channel. Introduction to multiple access, FDMA, TDMA, spread spectrum multiple access, space division multiple access, fading characteristics, Rayleigh fading model

Department of Electronics and Communication Engineering

UNIT V:

Wireless Networks: Introduction to wireless networks, Advantages and disadvantages of wireless LAN, wireless LAN topologies, wireless LAN standard IEEE802.11. IEEE802.11 medium access control, comparison of IEEE802.11 a,b,g and n standard, IEEE802.16 and its enhancements wireless pans, hyper LAN, WLL.

TEXT BOOKS:
1. Theodore s Rappaport," Wireless Communication and Applications." Pearson Education -2002.
2. Upen Datal," Wireless Communications," camebride University Press,2005.
3. Mobile cellular communications – gottapushashibhushanrao,person education 2012.

REFERENCES:
1. P.Nicopolitidies, M.SObaidat,G.I.Papadimitria, A.S. Pomportsis,"Wireless Networks", Jhon Wiley & Sons, 2003.
2. X. Wang and H.V.poor, "Wireless Communication Systems," Pearson education, 2004.
3. Dr. Sunil Kumar S. Manavi, Mahaballeshwar S. Kakasageri,"Wireless and Mobile Networks: concepts and protocols,"Wiley India,2010.
4. Jhon W.Mark and WeilhuaZhqung,"Wireless Communiation and Networking,"PHI, 2005.
5. Jochen Schiller, "Mobile Communications," Pearson Education,2nd Edition,2003.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	PO12
CO1	H	L	L				L			H		L
CO2	M			H			M			H		M
CO3		H	M		M					H		
CO4		H			H		H			H		H
CO5				M	H					H		

H-HIGH   **M-MEDIUM**   **L-LOW**

Department of Electronics and Communication Engineering

Timetable

IV B.Tech. II Sem –WCN (A&B Sec)

Day/Hour	9.40-10.30	10.30-11.20	11.20-12.00	12.00-12.55	12.55-1.50	1.50-2.45	2.45-3.50
Monday	WCN-A	WCN-B					
Tuesday	WCN-A		WCN-B				
Wednesday			WCN-B	WCN-A			
Thursday		WCN-A					
Friday		WCN-B					
Saturday	WCN-B		WCN-A				

Department of Electronics and Communication Engineering

Vision of the Institute

To be a premier Institute in the country and region for the study of Engineering, Technology and Management by maintaining high academic standards which promotes the analytical thinking and independent judgment among the prime stakeholders, enabling them to function responsibly in the globalized society.

Mission of the Institute

To be a world-class Institute, achieving excellence in teaching, research and consultancy in cutting-edge Technologies and be in the service of society in promoting continued education in Engineering, Technology and Management.

Quality Policy

Department of Electronics and Communication Engineering Quality policy is to ensure and maintain a low risk status from planned monitoring, maintenance and improvement of the institutes Quality Framework.

Vision of the Department

Our vision is to develop the department into a full-fledged centre of learning in various fields of Electronics & Communication Engineering keeping in view the latest developments.

Mission of the Department

- The Mission of the department is to turn out full-fledged Engineers in the field of Electronics Communication Engineering with an overall background suitable for making a successful career either in industry/research or higher education in India and abroad.

- To inculcate professional behavior, strong ethical values, innovative research capabilities and leadership abilities in the young minds so as to work with a commitment to the progress of the nation

Department of Electronics and Communication Engineering

Program Educational Objectives (B.Tech. – ECE)
Graduates will be able to
PEO1: Excel in professional career & higher education, by acquiring knowledge in related fields of Electronics & Communication Engineering.
PEO2: Exhibit leadership in their profession, through technological ability and contemporary knowledge for solving the real life problems appropriately that are technically sound, economically feasible & socially acceptable.
PEO3: Adapt to the emerging technologies for sustenance by exhibiting professionalism, ethical attitude & communication skills in their relevant areas of interest by engaging in lifelong learning.

Program Outcomes (B.Tech. – ECE)
At the end of the Program, a graduate will have the ability to

PO 1: An ability to apply knowledge of mathematics, science, fundamentals of engineering to solve electronics and communication engineering problems.

PO 2: An ability to identify, formulate and analyze and solve complex electronics and communication Engineering using the first principles of mathematics and engineering sciences.

PO 3: An ability to develop solutions to electronics and communication systems to meet the specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PO 4: An ability to design and perform experiments of electronic circuits and systems, analyze and interpret data to provide valid conclusions.

PO 5: An ability to learn, select and apply appropriate techniques, resources and modern engineering tools including prediction and modeling, to complex electronics and communication systems.

PO 6: An ability to assess the knowledge of contemporary issues to the societal responsibilities relevant to professional practice.

PO 7: An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge for the need of sustainable development.

PO 8: An ability to demonstrate the understanding of professional, ethical responsibilities and norms of engineering practice.

PO 9: An ability to function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.

PO 10: An ability to communicate effectively with the engineering community and with society at large.

PO 11: An ability to demonstrate knowledge and understanding of engineering and management principles and apply these to manage projects.

PO 12: An ability to recognize the need for, and engage in lifelong learning in the broadest context of technological change.

Department of Electronics and Communication Engineering

COURSE OBJECTIVES

On completion of this Subject/Course the student shall be able to:

S.No	Objectives
1	To Provide the Students with the fundamental treatment about many
2	Practical and theoretical concepts.
3	To equip the students with various kinds of wireless networks and its operations.
4	To prepare students to understand the concept of frequency reuse techniques.
5	To prepare students to understand various modulation schemes and multiple access techniques.
6	To improve an analytical perspective on the design and analysis of the traditional and emerging wireless networks.
7	To train students to understand architecture and operation of various wireless wide area networks such as GSM, GPRS and SMS.
8	To train students to understand wireless LAN architecture and operation.
9	To prepare students to understand the emerging technique OFDM and its importance in the wireless communications.

COURSE OUTCOMES

The expected outcomes of the Course/Subject are:

S.No	Outcomes
1.	Understand the Principles of wireless communications and fundamentals of wireless networking
2.	Analyze various multiple access schemes used in wireless communication
3.	Understand wireless wide area network and their performance analysis.
4.	Familiar with some of the existing and emerging wireless standards.
5.	Understand the concept of orthogonal frequency division multiplexing.

Signature of faculty

Note: Please refer to Bloom's Taxonomy, to know the illustrative verbs that can be used to state the outcomes.

Department of Electronics and Communication Engineering

GUIDELINES TO STUDY THE COURSE / SUBJECT

Course Design and Delivery System (CDD):

- The Course syllabus is written into number of learning objectives and outcomes.
- Every student will be given an assessment plan, criteria for assessment, scheme of evaluation and grading method.
- The Learning Process will be carried out through assessments of Knowledge, Skills and Attitude by various methods and the students will be given guidance to refer to the text books, reference books, journals, etc.

The faculty be able to –

- Understand the principles of Learning
- Understand the psychology of students
- Develop instructional objectives for a given topic
- Prepare course, unit and lesson plans
- Understand different methods of teaching and learning
- Use appropriate teaching and learning aids
- Plan and deliver lectures effectively
- Provide feedback to students using various methods of Assessments and tools of Evaluation
- Act as a guide, advisor, counselor, facilitator, motivator and not just as a teacher alone

Signature of HOD   Signature of faculty

Date: Date:

Department of Electronics and Communication Engineering

COURSE SCHEDULE
The Schedule for the whole Course / Subject is:

S. No.	Description	Duration (Date) From	To	Total No. of Periods
1.	**UNIT-I: The cellular concept system design fundamentals:** Introduction, Frequency reuse, channel assignment strategies, hand off strategies-prioritizing hand offs, practical hand off considerations, interference and system capacity-co channel interference and system capacity, channel planning for wireless systems, adjacent channel interference, power control for reduced interference, trunking and grade off service, improving coverage capacity in cellular systems-cell splitting, sectoring.	15.11.2023	16.12.2023	14
2.	**UNIT-II: Large scale path loss:** Introduction to radio wave propagation, free space propagation model. the 3 basic propagation mechanisms, reflections from dielectric, Brewster angle, reflection from prefect conductors, ground reflection(two ray)model, diffraction-Fresnel zone geometry, knife edge diffraction model, multiple knife edge diffraction, scattering, outdoor propagation models-longley-ryce models, okamura model, hata model, indoor propagation model-partition losses same floor, partition losses between floor, long distance path loss model, signal penetration into buildings, retracing and sight specific modeling.	07.12.2023	29.12.2023	16
3.	**UNIT-III:** **Small scale fading and multipath:** Small scale multipath propagation, factors influencing small scale fading, Doppler shift, impulse response model of a multipath channel. Introduction to multiple access, FDMA, TDMA, spread spectrum multiple access, space division multiple access, fading characteristics, Rayleigh fading model	30.12.2023	01.02.2024	16
4.	**UNIT-IV:** **Equalization and diversity:** Introduction, fundamentals of equalization, training a generic adaptive equalizer, equalizer in a communication receiver, linear equalizers, nonlinear equalization, decision-feedback equalization (DFE) CDMA Packet and frame formats in IS-95, polarization diversity, frequency diversity, Time diversity, RAKE Receiver	02.02.2024	02.03.2024	17
5.	**UNIT-V:** **Wireless Networks:** Introduction to wireless networks, Advantages and disadvantages of wireless LAN, wireless LAN topologies, wireless LAN standard IEEE802.11. IEEE802.11 medium access control, comparison of IEEE802.11 a,b,g and n standard, IEEE802.16 and its enhancements wireless pans, hyper LAN, WLL.	04.03.2024	04.04.2024	20

Total No. of Instructional periods available for the course: 83 Hours

Department of Electronics and Communication Engineering

SCHEDULE OF INSTRUCTIONS - COURSE PLAN

Unit No.	Lesson No.	Date	No. of Periods	Topics / Sub-Topics	Objectives & Outcomes Nos.	References (Textbook, Journal)
1.	1	15.11.2023	1	**The cellular concept** system design fundamentals: Introduction	1,2 1	Rappaport Wireless Comm. and Applications
	2	16.11.2023	1	Frequency reuse, channel assignment strategies	1,2 1	Rappaport Wireless Comm. and Applications
	3	17.11.2023	1	Hand off strategies	1,2 1	Rappaport Wireless Comm. and Applications
	4	18.11.2023	1	Prioritizing hand offs,	1,2 1	Rappaport Wireless Comm. and Applications
	5	20.11.2023	1	Practical hand off considerations,	1,2 1	Rappaport Wireless Comm. and Applications
	6	22.11.2023	1	Interference and system capacity	1,2 1	Rappaport Wireless Comm. and Applications
	7	23.11.2023	1	Co channel interference and system capacity,	1,2 1	Rappaport Wireless Comm. and Applications
	8	24.11.2023	1	Channel planning for wireless systems,	1,2 1	Rappaport Wireless Comm. and Applications
	9	25.11.2023	1	Adjacent channel interference,	1,2 1	Rappaport Wireless Comm. and Applications
	10	28.11.2023	1	Power control for reduced interference,	1,2 1	Rappaport Wireless Comm. and Applications
	11	02.12.2023	1	Trunking and grade off service	1,2 1	Rappaport Wireless Comm. and Applications
	12	04.12.2023	1	Improving coverage capacity in cellular systems	1,2 1	Rappaport Wireless Comm. and Applications
	13	05.12.2023	1	Cell splitting,	1,2 1	Rappaport Wireless Comm. and Applications
	14	06.12.2023	1	Sectoring.	1,2 1	Rappaport Wireless Comm. and Applications
2.	1	07.12.2023	1	**Large scale path los-** Introduction	3,4 2	Rappaport Wireless Comm. and Applications
	2	08.12.2023	1	Free space propagation model.	3,4 2	Rappaport Wireless Comm. and Applications
	3	11.12.2023	1	The 3 basic propagation mechanisms	3,4 2	Rappaport Wireless Comm. and Applications
	4	12.12.2023	1	Reflections from dielectric, Brewster angle	3,4 2	Rappaport Wireless Comm. and Applications
	5	13.12.2023	1	Reflection from prefect conductors	3,4 2	Rappaport Wireless Comm. and Applications
	6	14.12.2023	1	Ground reflection(two ray)model,	3,4 2	Rappaport Wireless Comm. and Applications
	7	15.12.2023	2	Diffraction-Fresnel zone geometry	3,4 2	Rappaport Wireless Comm. and Applications
	8	18.12.2023	1	Knife edge diffraction model, multiple knife edge diffraction	3,4 2	Rappaport Wireless Comm. and Applications

Department of Electronics and Communication Engineering

	9	19.12.2023	1	Scattering, outdoor propagation models-Longley-Ryce models	3,4 2	Rappaport Wireless Comm. and Applications
	10	21.12.2023	2	Okamura model, Hata model, Indoor propagation model	3,4 2	Rappaport Wireless Comm. and Applications
	11	22.12.2023	1	Partition losses same floor, Partition losses between floor	3,4 2	Rappaport Wireless Comm. and Applications
	12	23.12.2023	1	Long distance path loss model	3,4 2	Rappaport Wireless Comm. and Applications
	13	27.12.2023	1	Signal penetration into buildings	3,4 2	Rappaport Wireless Comm. and Applications
	14	29.12.2023	1	Retracing and sight specific modeling	3,4 2	Rappaport Wireless Comm. and Applications
3.	1	30.12.2023	1	**Small Scale Fading**- Introduction	5,6 3	Rappaport Wireless Comm. and Applications
	2	02.01.2024	1	Multipath Propagation	5,6 3	Rappaport Wireless Comm. and Applications
	3	03.01.2024	1	Factors influencing small scale fading	5,6 3	Rappaport Wireless Comm. and Applications
	4	05.01.2024	1	Doppler shift	5,6 3	Rappaport Wireless Comm. and Applications
	5	06.01.2024	1	Impulse response model of a multipath channel.	5,6 3	Rappaport Wireless Comm. and Applications
	6	08.01.2024	1	Introduction to multiple access,	5,6 3	Rappaport Wireless Comm. and Applications
	7	09.01.2024	1	FDMA	5,6 3	Rappaport Wireless Comm. and Applications
	8	17.01.2024	1	TDMA	5,6 3	Rappaport Wireless Comm. and Applications
	9	18.01.2024	1	Spread spectrum multiple access, Space division multiple access	5,6 3	Rappaport Wireless Comm. and Applications
	10	19.01.2024 & 20.01.2024	2	Fading characteristics	5,6 3	Rappaport Wireless Comm. and Applications
	11	22.01.2024 & 24.01.2024	1	Rayleigh fading model	5,6 3	Rappaport Wireless Comm. and Applications
	12	27.01.2024	1	Signal Penetration into Buildings	5,6 3	Rappaport Wireless Comm. and Applications
	13	01.02.2024 & 30.01.2024	2	Revision of Units 1,2,3	5,6 3	Rappaport Wireless Comm. and Applications
4	1	02-02-2024	1	**Equalization and Diversity**	7,8 4	Rappaport Wireless Comm. and Applications
	2	05-02-2024	1	Introduction	7,8 4	Rappaport Wireless Comm. and Applications
	3	06-02-2024	1	Fundamentals of equalization	7,8 4	Rappaport Wireless Comm. and Applications
	4	07-02-2024 & 08-02-2024	2	Training a generic adaptive equalizer	7,8 4	Rappaport Wireless Comm. and Applications
	5	12-02-2024	1	Equalizer in a communication receiver	7,8 4	Rappaport Wireless Comm. and Applications

Department of Electronics and Communication Engineering

	6	13-02-2024 & 16-02-2024	2	Linear equalizers	7,8 4	Rappaport Wireless Comm. and Applications
	7	17-02-2024	1	Non-linear equalizers	7,8 4	Rappaport Wireless Comm. and Applications
	8	20-02-2024	1	Decision-feedback equalization (DFE)	7,8 4	Rappaport Wireless Comm. and Applications
	9	21-02-2024	1	CDMA Packet	7,8 4	Rappaport Wireless Comm. and Applications
	10	22-02-2024	1	Frame formats in IS-95	7,8 4	Rappaport Wireless Comm. and Applications
	11	26-02-2024	1	Polarization diversity	7,8 4	Rappaport Wireless Comm. and Applications
	12	27-02-2024	1	Frequency diversity	7,8 4	Rappaport Wireless Comm. and Applications
	13	28-02-2024	1	Time diversity	7,8 4	Rappaport Wireless Comm. and Applications
	14	01-03-2024	2	RAKE Receiver	7,8 4	Rappaport Wireless Comm. and Applications
5	1	04-03-2024	1	**Wireless Networks**	9 5	Rappaport Wireless Comm. and Applications
	2	05-03-2024	1	Introduction to wireless networks	9 5	Rappaport Wireless Comm. and Applications
	3	06-03-2024	1	Advantages and Disadvantages	9 5	Rappaport Wireless Comm. and Applications
	4	07-03-2024	1	Wireless LAN	9 5	Rappaport Wireless Comm. and Applications
	5	09-03-2024	1	Wireless LAN topologies	9 5	Rappaport Wireless Comm. and Applications
	6	12-03-2024	1	Wireless LAN standard	9 5	Rappaport Wireless Comm. and Applications
	7	13-03-2024	1	IEEE802.11	9 5	Rappaport Wireless Comm. and Applications
	8	14-03-2024 & 18-03-2024	2	Medium Access Control	9 5	Rappaport Wireless Comm. and Applications
	9	19-03-2024 & 20-03-2024	2	Comparison of IEEE 802.11 a,b,g and n standard	9 5	Rappaport Wireless Comm. and Applications
	10	22-03-2024	1	IEEE802.16 Introduction	9 5	Rappaport Wireless Comm. and Applications
	11	23-03-2024	1	IEEE802.16 Enhancements	9 5	Rappaport Wireless Comm. and Applications
	12	26-03-2024 & 27-03-2024	2	Wireless PANs	9 5	Rappaport Wireless Comm. and Applications
	13	28-03-2024	1	Hyper LAN	9 5	Rappaport Wireless Comm. and Applications
	14	01-04-2024 & 02-04-2024	2	Wireless Local Loop (WLL)	9 5	Rappaport Wireless Comm. and Applications
	15	03-04-2024	1	Revision of Unit IV & V		

Department of Electronics and Communication Engineering

	16	04-04-2024	1	Old Question Paper Discussions	1, 2, 3, 4, 5,6,7,8,9 1, 2, 3, 4, 5	

Signature of HOD   Signature of faculty

Date: Date:

Note:
1. Ensure that all topics specified in the course are mentioned.
2. Additional topics covered, if any, may also be specified in bold.
3. Mention the corresponding course objective and outcome numbers against each topic.

Department of Electronics and Communication Engineering
LESSON PLAN (U-I)

Lesson No: 01, 02   Duration of Lesson: 1hr 10 min

Lesson Title: The cellular concept system design fundamentals, Introduction, Frequency Reuse

Instructional / Lesson Objectives:

- To make students understand Cellular Concept
- To familiarize students on Cellular Fundamentals and frequency reuse
- To understand students the concept of cellular system design.
- To provide information on channel assignment strategies with help of frequency reuse .

Teaching AIDS   : PPTs, Digital Board
Time Management of Class   :

10 mins for taking attendance
90 min for the lecture delivery
10 min for doubts session

Assignment / Questions:
Define Handoff and list the types of Handoffs (Obj:-1, Out:-1)

Refer assignment – I & tutorial-I sheets

Signature of faculty

Department of Electronics and Communication Engineering

LESSON PLAN (U-I)

Lesson No: 07, 08   Duration of Lesson: 1hr 10 min

Lesson Title: co channel interference and system capacity, channel planning for wireless systems

Instructional / Lesson Objectives:

- To make students understand Interference Concept
- Planning of Wireless Channel
- To understand students on deriving of System Capacity.

Teaching AIDS   : PPTs, Digital Board
Time Management of Class   :

10 mins for taking attendance
90 min for the lecture delivery
10 min for doubts session

Assignment / Questions:
What is Co Channel interference and system capacity (Obj:-2, Out:-1)

Refer assignment – I & tutorial-I sheets

Signature of faculty

Department of Electronics and Communication Engineering

LESSON PLAN (U-II)

Lesson No: 03, 04   Duration of Lesson: 1hr 10 min

Lesson Title: The 3 basic propagation mechanisms, reflections from dielectric, Brewster angle

Instructional / Lesson Objectives:

- To make students understand Propagation Mechanism
- To familiarize students on Reflection from dielectric materials
- To provide information Hoe Brewster Angle useful in estimation of Propagation .

Teaching AIDS   : PPTs, Digital Board
Time Management of Class   :

10 mins for taking attendance
90 min for the lecture delivery
10 min for doubts session

Assignment / Questions:
Define Brewster Angle (Obj:-3, Out:-2)

Refer assignment – I & tutorial-I sheets

Signature of faculty

Department of Electronics and Communication Engineering
LESSON PLAN (U-II)

Lesson No: 01, 02   Duration of Lesson: 1hr 10 min

Lesson Title: scattering, outdoor propagation models-Longley-Ryce models, Okamura model, Hata model
Instructional / Lesson Objectives:

- To make students understand Scattering Concept
- To familiarize students on Practical Propagation Models like
    o Longley-Ryce models,
    o Okamura model,
    o Hata model

Teaching AIDS   : PPTs, Digital Board
Time Management of Class   :

10 mins for taking attendance
90 min for the lecture delivery
10 min for doubts session

Assignment / Questions:
What is Scattering and list the sources of Scattering (Obj:-4, Out:-2)

Refer assignment – I & tutorial-I sheets

Signature of faculty

Department of Electronics and Communication Engineering

LESSON PLAN (U-III)

Lesson No: 01, 02   Duration of Lesson: 1hr 10 min

Lesson Title: Small scale fading and multipath: Small scale multipath propagation

Instructional / Lesson Objectives:

- To make students understand Fading Concept
- To familiarize students on Fading and Propagation difference
- Classification of Fading.

Teaching AIDS   : PPTs, Digital Board
Time Management of Class   :

---

10 mins for taking attendance
90 min for the lecture delivery
10 min for doubts session

Assignment / Questions:
Define Fading and Importance of Fading in Wireless Communication (Obj:-5, Out:-3)

Refer assignment – I & tutorial-I sheets

Signature of faculty

Department of Electronics and Communication Engineering
LESSON PLAN (U-III)

Lesson No: 05, 06   Duration of Lesson: 1hr 10 min

Lesson Title: FDMA, TDMA

Instructional / Lesson Objectives:

- To make students understand Multiple Access Techniques
- To Distinguish between FDMA and TDMA
- To understand the Process of Information through TDMA and FDMA.

Teaching AIDS   : PPTs, Digital Board
Time Management of Class   :

10 mins for taking attendance
90 min for the lecture delivery
10 min for doubts session

Assignment / Questions:
List the differences between TDMA and FDMA (Obj:-6, Out:-3)

Refer assignment – I & tutorial-I sheets

Signature of faculty

Department of Electronics and Communication Engineering

LESSON PLAN (U-IV)

Lesson No: 01, 02   Duration of Lesson: 1hr 10 min

Lesson Title: Equalization and diversity: Introduction, fundamentals of equalization

Instructional / Lesson Objectives:

- To make students understand process of Equalization and Diversity
- To study different types of Equalization techniques
- To familiarize students about Diversity Techniques.
- To provide information on process of Equalization and Diversity.

Teaching AIDS   : PPTs, Digital Board
Time Management of Class   :

10 mins for taking attendance
90 min for the lecture delivery
10 min for doubts session

Assignment / Questions:
What is meant by Equalization and list the types (Obj:-7, Out:-4)

Refer assignment – I & tutorial-I sheets

Signature of faculty

Department of Electronics and Communication Engineering

LESSON PLAN (U-IV)

Lesson No: 13, 14   Duration of Lesson: 1hr 10 min

Lesson Title: Time diversity, RAKE Receiver
Instructional / Lesson Objectives:

- To make students understand Architecture of RAKE Receiver and Time Diversity phenomena
- To provide information on Building Blocks of Rake Receiver .

Teaching AIDS   : PPTs, Digital Board
Time Management of Class   :

10 mins for taking attendance 90 min for the lecture delivery 10 min for doubts session

Assignment / Questions:
Write a short note on Time Diversity (Obj:-8, Out:-4)

Refer assignment – I & tutorial-I sheets

Signature of faculty

Department of Electronics and Communication Engineering

LESSON PLAN (U-V)

Lesson No: 01, 02   Duration of Lesson: 1hr 10 min

Lesson Title: Introduction to wireless networks, Advantages and disadvantages
Instructional / Lesson Objectives:

- To make students understand Wireless Networks role in Communication
- To familiarize students on Drawbacks of WN

Teaching AIDS   : PPTs, Digital Board
Time Management of Class   :

10 mins for taking attendance
90 min for the lecture delivery
10 min for doubts session

Assignment / Questions:
List the Advantages of Wireless Networks (Obj:-9, Out:-5)

Refer assignment – I & tutorial-I sheets

Signature of faculty

Department of Electronics and Communication Engineering

LESSON PLAN (U-V)

Lesson No: 10, 11   Duration of Lesson: 1hr 10 min

Lesson Title: The IEEE802.16 and its enhancements

Instructional / Lesson Objectives:

- To make students understand IEEE802.16 Architecture
- To familiarize students on IEEE802.16 Standards
- To understand students the concept of Medium Access Control for Data Frame.

Teaching AIDS   : PPTs, Digital Board
Time Management of Class   :

10 mins for taking attendance
90 min for the lecture delivery
10 min for doubts session

Assignment / Questions:
List the IEEE802.16 Standards (Obj:-9, Out:-5)

Refer assignment – I & tutorial-I sheets

Signature of faculty

Department of Electronics and Communication Engineering

ASSIGNMENT – 1

This Assignment corresponds to Unit No. 1

Question No.	Question	Objective No.	Outcome No.
1	Describe the Channel Planning Process and how Adjacent Channel Interference can be avoided	1	1
2	Explain the Concept of Trunking and grade of Service; find the number of cells supported if frequency reuse factor of 4 and system has 100 channels	2	1
3	What are the Different Strategies for Improving Coverage Capacity in Cellular System	2	1

Signature of HOD   Signature of faculty

Date: Date:

Department of Electronics and Communication Engineering

ASSIGNMENT – 2

This Assignment corresponds to Unit No. 2

Question No.	Question	Objective No.	Outcome No.
1	What is Scattering, explain about Hata model for path loss prediction	3	2
2	A wireless system operates at 5GHz and is used to provide coverage in suburban area. If system has 1W of transmission power and the area divided in to 100 cells, each cell radius of 1 Km, calculate the maximum number of users supported by system if user requires 1Mbps Bandwidth	3	2
3	Describe Knife Edge Diffraction model and how it is useful in path loss estimation	4	2

Signature of HOD   Signature of faculty

Date: Date:

Department of Electronics and Communication Engineering

ASSIGNMENT – 3

This Assignment corresponds to Unit No. 3

Question No.	Question	Objective No.	Outcome No.
1	Derive the Change of Frequency in Doppler Shift Analysis	5	3
2	Write a Short note on Impulse Response model of multipath channel	5	3
3	List the Advantages and Disadvantages of Different Multiple Access Techniques	6	3

Signature of HOD   Signature of faculty

Date: Date:

Department of Electronics and Communication Engineering

ASSIGNMENT – 4

This Assignment corresponds to Unit No. 4

Question No.	Question	Objective No.	Outcome No.
1	Explain the Decision Feedback Equalization and list the Advantages and Disadvantages of DFE	7	4
2	Explain about Polarization, Frequency and Time Diversities	7	4
3	Explain the Operation of RAKE Receiver and how it improve the quality of received signal	8	4

Signature of HOD   Signature of faculty

Date: Date:

Department of Electronics and Communication Engineering

ASSIGNMENT – 5

This Assignment corresponds to Unit No. 5

Question No.	Question	Objective No.	Outcome No.
1	Discuss the Security challenges associate with wireless LANs and issues including with Authentication, Encryption and Privacy	9	5
2	Write a short note on WLL and Wireless Networks	9	5
3	Explain about Hyper LAN in Wireless Communications	9	5

Signature of HOD   Signature of faculty

Date: Date:

Department of Electronics and Communication Engineering

TUTORIAL – 1

This tutorial corresponds to Unit No. 1 (Objective Nos.: 1, Outcome Nos.: 1)

Q1. The region where a particular charge exerts a force on any other charge located in that region is called
a) Electric Filed   b) Coulomb Law   c) Potential   d) Force

Q2. Volume charge density is expressed in
a) C/m^3 b) C/m^2 c) C/m d) $C-m^2$

Q3. For free space or vacuum, the relative permittivity $\varepsilon_r =$
a) 1   b) 2   c) 3   d) 4

Q4. Define Coulomb's Law.

Signature of HOD   Signature of faculty

Date: Date:

Department of Electronics and Communication Engineering

TUTORIAL – 2

This tutorial corresponds to Unit No. 2 (Objective Nos.: 2, Outcome Nos.: 2)

Q1. Rate of flow of charge at a specified point is called
a) Electric Current   b) Potential   c) Gradient   d) Intensity

Q2. The current passing through the unit surface area, when the surface is held normal to the direction of the current is
a) Current Density b) Current Intensity c) Flux Density d) Flux Intensity

Q3. Point for of Ohms Law
a) $J = \sigma E$ b) $E = \sigma J$ c) $J = \sigma/E$ d) $E = \sigma/J$

Signature of HOD   Signature of faculty

Date: Date:

Department of Electronics and Communication Engineering

TUTORIAL SHEET – 3

This tutorial corresponds to Unit No. 3 (Objective Nos.: 3, Outcome Nos.: 3)

Q1. A _____ has an large quantity of charge that is free to move

a) Conductor   b) Dipole   c) Insulator   d) Force

Q2 Inside a conductor
a) $E = 0$, $\rho_V = 0$, $V_{ab} = 0$ b) $E = V$, $\rho_V = 0$, $V_{ab} = 0$
c) $E = V$, $\rho_V = 0$, $V_{ab} = \infty$ d) $E = 0$, $\rho_V = \infty$, $V_{ab} = \infty$

Q3. According to Ampere's Circuit Law, line integral of magnetic field intensity H around a closed path is _____ to the direct current enclosed by that path
a) Equal   b) Greater   c) Lesser   d) Linear

Signature of HOD   Signature of faculty

Date: Date:

Department of Electronics and Communication Engineering

TUTORIAL – 4

This tutorial corresponds to Unit No. 4 (Objective Nos.: 3, Outcome Nos.: 3)

Q1. The time varying fields are produced due to the _____
a) Time varying currents   b) Time varying EMF
c) Time invariable currents   d) Time invariable EMF

Q2. According to Lenz's law, the induced e.m.f. acts to produce an ____ flux
a) Opposing   b) Same   c) Normal   d) Tangential

Q3. When an e.m.f. is induced in a stationary closed path due to the time varying B field, the e.m.f. is called or transformer e.m.f.
a) statically induced e.m.f.   b) dynamically induced e.m.f.   c) motional e.m.f.
d) mutual e.m.f

Signature of HOD   Signature of faculty

Date: Date:

Department of Electronics and Communication Engineering

TUTORIAL SHEET – 5

This tutorial corresponds to Unit No. 5 (Objective Nos.: 5, Outcome Nos.: 5)

Q1. The _____ theorem is based on law of conservation of energy in electromagnetism
a) Poynting   b) Lorentz   c) Faraday's   d) Gauss

Q2. The equations describing relationships between time varying electric and magnetic fields are known as _____ equations.

a) Maxwell's   b) Lorentz   c) Lenz's   d) Faraday's

Q3. Ratio of the total flux linkage to the current flowing through the circuit is called _____
a) Inductance   b) Capacitance   c) EMF   d) Resistance

Signature of HOD   Signature of faculty

Date: Date:

Department of Electronics and Communication Engineering

EVALUATION STRATEGY

Target (s)

    a.   Percentage of Pass   : 95%

Assessment Method (s) (Maximum Marks for evaluation are defined in the Academic Regulations)

    a.   Daily Attendance

    b.   Assignments

    c.   Online Quiz (or) Seminars

    d.   Continuous Internal Assessment

    e.   Semester / End Examination

List out any new topic(s) or any innovation you would like to introduce in teaching the subjects in this semester

Case Study of any one existing application

Signature of HOD   Signature of faculty

Date: Date:

Department of Electronics and Communication Engineering

COURSE COMPLETION STATUS

Actual Date of Completion & Remarks if any

Units	Remarks	Objective No. Achieved	Outcome No. Achieved
Unit 1	completed on 06.12.2023	1,2	1
Unit 2	completed on 29.12.2023	3,4	2
Unit 3	completed on 30.01.2024	5,6	3
Unit 4	completed on 01.03.2024	7,8	4
Unit 5	completed on 04.04.2024	9	5

Signature of HOD

Date:

Signature of faculty

Date:

Department of Electronics and Communication Engineering

Mappings

1. **Course Objectives-Course Outcomes Relationship Matrix**
   (Indicate the relationships by mark "X")

Course-Outcomes / Course-Objectives	1	2	3	4	5
1	H		M		
2		H			
3			H		
4				H	
5					H

2. **Course Outcomes-Program Outcomes (POs) & PSOs Relationship Matrix**
   (Indicate the relationships by mark "X")

P-Outcomes / C-Outcomes	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
1	H			M									H	
2		M	H			M							H	H
3					H				M		M			M
4						M	H						M	
5										H				

Department of Electronics and Communication Engineering

Rubric for Evaluation

Performance Criteria	Unsatisfactory	Developing	Satisfactory	Exemplary
	1	**2**	**3**	**4**
Research & Gather Information	Does not collect any information that relates to the topic	Collects very little information some relates to the topic	Collects some basic Information most relates to the topic	Collects a great deal of Information all relates to the topic
Fulfill team role's duty	Does not perform any duties of assigned team role.	Performs very little duties.	Performs nearly all duties.	Performs all duties of assigned team role.
Share Equally	Always relies on others to do the work.	Rarely does the assigned work - often needs reminding.	Usually does the assigned work - rarely needs reminding.	Always does the assigned work without having to be reminded
Listen to other team mates	Is always talking—never allows anyone else to speak.	Usually doing most of the talking-- rarely allows others to speak.	Listens, but sometimes talks too much.	Listens and speaks a fair amount.

Department of Electronics and Communication Engineering

ANURAG Engineering College

(An Autonomous Institution)
Ananthagiri (V&M), Suryapet (Dt), Telangana – 508206.
IV B.Tech II Semester I MID Examinations, Jan 2024

Branch: ECE		Max. Marks: 20
Date: 11.01.2024 AN	Subject: Wireless Communications & Networks	Time: 90 Min.

PART-A

Answer all the questions   **5 X 1M=5 Marks**

Q.NO	Question	Course Outcome	Bloom's Level
1.	Define Foot Print?	CO1	L1
2.	Mention the Methods of Prioritizing Handoffs?	CO1	L1
3.	What is Okamura Model	CO2	L1
4.	Differentiate Knife Edge and Multiple Knife Edge Diffraction Model	CO2	L1
5.	What is Doppler Shift	CO3	L1

PART-B

Answer the following   **3 X 5M=15 Marks**

Q.NO	Question	Course Outcome	Bloom's Level
6.	Discuss in detail about Adjacent Channel Interference?	CO1	L2
	OR		
7.	What are the Different Strategies for Improving Coverage Capacity in cellular system?	CO1	L2
8.	Discuss Hata Model and Partition model between floors?	CO2	L3
	OR		
9.	What is Scattering, explain about Hata model for path loss prediction?	CO2	L2
10.	Derive the Change of Frequency in Doppler Shift Analysis?	CO3	L3
	OR		
11.	Write a Short note on Impulse Response model of multipath channel?	CO3	L2

Department of Electronics and Communication Engineering
ANURAG Engineering College
(An Autonomous Institution)
Ananthagiri (V&M), Suryapet (Dt), Telangana – 508206.
IV B.Tech II Semester II MID Examinations, April 2024

Branch: ECE		Max. Marks: 20
Date:08-04-2024	Subject : **Wireless Communications & Networks**	Time: 90 Min.

<mark>**Instructions for preparing Question Paper:**</mark>
1. **For Each Subject you have to prepare 3 SET'S of Question paper**
2.Text Font Style : Times New Roman
3. Text Font Size : 12
4. Questions Should Not be Repeated in any 3 Sets
5. Question Paper Saving File Name format : **Example** (IV-II-I-MID-Branch Name-Subject Name-SET-A)
6.If any Additional Property Like Graphs/Sign Table/Log Tables etc. The Faculty should inform Clearly in Question paper itself

PART-A

Answer all the questions   5 X 1M=5 Marks

Q.NO	Question	Course Outcome	Bloom's Level
1.	Differentiate between TDMA and FDMA	CO3	1
2.	Define Equalization and its Importance in Wireless Communication	CO4	1
3.	What is Frequency Diversity and how can it help to mitigate the effects of fading	CO4	2
4.	Compare IEEE802.11 a, b, g and n Standards for wireless LANs	CO5	2
5.	Discuss the potential Impacts of Wireless networks on Society and Economy	CO5	2

PART-B

Answer the following   3 X 5M=15 Marks

Q.NO	Question	Course Outcome	Bloom's Level
6.	Explain About Rayleigh Fading in Wireless Communication	CO3	2
OR			
7.	List the Advantages and Disadvantages of Different Multiple Access Techniques	CO3	2
8.	Explain the Decision Feedback Equalization and list the Advantages and Disadvantages of DFE	CO4	2
OR			
9.	Explain the Operation of RAKE Receiver and how it improve the quality of received signal	CO4	2
10.	Discuss the Security challenges associate with wireless LANs and issues including with Authentication, Encryption and Privacy	CO5	2
OR			
11.	Explain about Hyper LAN in Wireless Communications	CO5	2

ANURAG Engineering College
(An Autonomous Institution)
Ananthagiri (V & M), Suryapet (Dt.), Telangana - 508206.

Electronics and Communication Engineering

IV B.Tech II Semester Mid Marks List SEC-A

Faculty: Dr.I.Veeraraghava Rao			Subject: Wireless Communications and Networks					
S.No	H.T.No.	Name of the Student	Mid - I	Assignment - I	Mid - I Total	Mid - II	Assignment - II	Mid - II Total	AVG
1	20C11A0402	AKHILA B	20	5	25	20	5	25	25
2	20C11A0403	ALEKYA AGGADI	20	5	25	19	5	24	25
3	20C11A0404	ALEKYA KOLA	20	5	25	15	5	20	23
4	20C11A0406	ARYAN MADDINENI	10	5	15	10	5	15	15
5	20C11A0407	BHAVANA KALANGI	20	5	25	14	5	19	22
6	20C11A0408	BRAMHARAJU KOLAHALAM	20	5	25	20	5	25	25
7	20C11A0409	CHANDANA THIRUMALAREDDY	18	5	23	16	5	21	22
8	20C11A0410	CHARAN SAI PONUGOTI	20	5	25	19	5	24	25
9	20C11A0411	CHARITHA CHITTURI	18	5	23	17	5	22	23
10	20C11A0412	DURGA SAI ADDANKI	8	5	13	12	5	17	15
11	20C11A0413	GANESH BHUMA	19	5	24	18	5	23	24
12	20C11A0414	GAYATHRI PRIYA POKKULA	20	5	25	20	5	25	25
13	20C11A0416	GOWTHAM VEMULA	19	5	24	20	5	25	25
14	20C11A0418	KARTHIK MUTHINENI	16	5	21	16	5	21	21
15	20C11A0419	KARTHIK THOTA	20	5	25	20	5	25	25
16	20C11A0420	KARTHIKEYA KANDE	19	5	24	20	5	25	25
17	20C11A0421	KAVYA MATHANGI	20	5	25	20	5	25	25
18	20C11A0422	KEERTHI MUDIMANIKYAM	20	5	25	19	5	24	25
19	20C11A0423	KIRANKUMAR MADHAMSHETTY	18	5	23	13	5	18	21
20	20C11A0424	LAKSHMI KRISHNA VAMSI BOMMINI	19	5	24	20	5	25	25
21	20C11A0426	LIKHITHA SATHULOORI	18	5	23	18	5	23	23
22	20C11A0428	MANOJ KUMAR KOLLU	14	5	19	11	5	16	18
23	20C11A0429	MOUNIKA PODILA	20	5	25	18	5	23	24
24	20C11A0430	NAGA GAYATHRI MUNDRA	20	5	25	19	5	24	25

Department of Electronics and Communication Engineering

25	20C11A0431	NAGENDRABABU BADAVATH	14	5	19	14	5	19	19
26	20C11A0432	NANDHA VIHARI GUNTURU	20	5	25	19	5	24	25
27	20C11A0433	NANDHU BHARGAVI BILLUPALLY	18	5	23	10	5	15	19
28	20C11A0434	NANDINI GUDIDHI	AB	5	5	20	5	25	15
29	20C11A0435	NANDITHA POTHUGANTI	18	5	23	20	5	25	24
30	20C11A0436	NASREEN MOHAMMAD	20	5	25	19	5	24	25
31	20C11A0437	NAVEEN KUMAR VEGINATI	19	5	24	17	5	22	23
32	20C11A0438	NAVYA GUJJULA	20	5	25	20	5	25	25
33	20C11A0439	PAVAN KARISHA	11	5	16	12	5	17	17
34	20C11A0440	PAVAN KUMAR ADDANKI	5	5	10	12	5	17	14
35	20C11A0441	PRAGATHI BOWDHODI	20	5	25	19	5	24	25
36	20C11A0443	RAVICHANDRA THIPIRISETTI	20	5	25	20	5	25	25
37	20C11A0444	RENUKA GUNDEBOINA	18	5	23	19	5	24	24
38	20C11A0445	REVATHI CHERUKURI	20	5	25	20	5	25	25
39	20C11A0446	RIZWAN SHAIK	14	5	19	13	5	18	19
40	20C11A0447	SAI CHARAN KONDAGADAPA	20	5	25	19	5	24	25
41	20C11A0448	SAI NITHIN YARRABOYNA	11	5	16	12	5	17	17
42	20C11A0449	SAI TEJA KANDIBANDA	8	5	13	10	5	15	14
43	20C11A0450	SAJID SK	17	5	22	19	5	24	23

Department of Electronics and Communication Engineering

ANURAG Engineering College

(An Autonomous Institution)

Ananthagiri (V & M), Suryapet (Dt.), Telangana - 508206.

Electronics and Communication Engineering

IV B.Tech II Semester Mid Marks List SEC-B

Faculty: Dr.I.Veeraraghava Rao			Subject: Wireless Communications and Networks						
S.No	H.T.No.	Name of the Student	Mid - I	Assignment - I	Mid - I Total	Mid - II	Assignment - II	Mid - II Total	AVG
1	20C11A0451	SAMEER MOHAMMAD	AB	5	5	18	5	23	14
2	20C11A0452	SANDHYA KANAKAM	20	5	25	20	5	25	25
3	20C11A0453	SATHWIKA DEEKONDA	19	5	24	20	5	25	25
4	20C11A0455	SHAMINI PEDDOJU	19	5	24	20	5	25	25
5	20C11A0456	SHAMSHAD SHAIK	20	5	25	20	5	25	25
6	20C11A0457	SHARATH CHANDRA PILLALA	16	5	21	17	5	22	22
7	20C11A0458	SHIRISHA EEDA	20	5	25	20	5	25	25
8	20C11A0459	SHIRISHA JWALAM	20	5	25	19	5	24	25
9	20C11A0460	SHIVA KUMARI BADETI	20	5	25	18	5	23	24
10	20C11A0461	SHYAMALA GOURI THANGELLAPALLY	20	5	25	20	5	25	25
11	20C11A0462	SNEHA MALYALA	20	5	25	20	5	25	25
12	20C11A0463	SNEHA NALLA	20	5	25	20	5	25	25
13	20C11A0464	SONIYA MULAKALAPALLI	19	5	24	17	5	22	23
14	20C11A0465	SRI HARI RAJU DENUVUKONDA	8	5	13	10	5	15	14
15	20C11A0466	SRIKANTH YADAPALLI	12	5	17	10	5	15	16
16	20C11A0467	SRIYA ANNEM	19	5	24	19	5	24	24
17	20C11A0468	SUPRIYA KANTU	20	5	25	20	5	25	25
18	20C11A0469	SWATHI RAVILALA	20	5	25	20	5	25	25
19	20C11A0470	TILAK SAI NELAVELLI	12	5	17	10	5	15	16
20	20C11A0471	TIRUMALA VENU GOPAL DARAGANI	14	5	19	7	5	12	16
21	20C11A0472	TRINAINI REDDEM	18	5	23	10	5	15	19
22	20C11A0474	UPENDERA REDDY GOGIREDDY	16	5	21	11	5	16	19
23	20C11A0475	VEERAJANAKI USTHELA	20	5	25	18	5	23	24

Department of Electronics and Communication Engineering

24	20C11A0477	VINAY KUMAR DANDA	AB	AB	AB	AB	AB	AB	AB
25	20C11A0478	VINEELA PALLA	20	5	25	19	5	24	25
26	20C11A0479	YASHWANTH REDDY CHALLA	20	5	25	19	5	24	25
27	20C11A0480	YASHWITHA DONGARI	20	5	25	17	5	22	24
28	21C15A0401	DEEKSHITHA MUMMADI	20	5	25	20	5	25	25
29	21C15A0402	DIVYA JAMMALAMUDI	17	5	22	18	5	23	23
30	21C15A0403	JAYANTH GOULIKAR	20	5	25	20	5	25	25
31	21C15A0404	KULAVARDHAN REDDY SAMA	18	5	23	16	5	21	22
32	21C15A0405	LAKSHMI SOWMYA CHENNAKESHAVA	20	5	25	20	5	25	25
33	21C15A0406	MANISHA BANDI	19	5	24	20	5	25	25
34	21C15A0407	MOUNIKA VELISHALA	20	5	25	20	5	25	25
35	21C15A0408	PRUDHVI LAVUDYA	17	5	22	14	5	19	21
36	21C15A0409	RANJITH REDDY NUKALA	20	5	25	18	5	23	24
37	21C15A0410	SAI PRAKASH THANNERU	18	5	23	15	5	20	22
38	21C15A0412	SHAIK KHALID	17	5	22	19	5	24	23
39	21C15A0413	SRIYA YANNAM	20	5	25	20	5	25	25
40	21C15A0414	VENNELA KANAPARTHI	19	5	24	17	5	22	23
41	21C15A0415	YAMUNA GOVINDA	20	5	25	19	5	24	25
42	16C11A0463	PRAVALLIKA KARNATI	19	5	24	18	5	23	24