KSIT BANGALORE

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

COURSE FILE

NAME OF THE STAFF	**:**	**Dr. DINESH KUMAR D S**
SUBJECT CODE/NAME	**:**	**21EC72/Optical & Wireless communication**
SEMESTER/YEAR	**:**	**VII/IV**
ACADEMIC YEAR	**:**	**2024 – 2025**
BRANCH	**:**	**ECE**

COURSE IN-CHARGE **HOD**

K. S. INSTITUTE OF TECHNOLOGY

VISION

" To impart quality technical education with ethical values, employable skills and research to achieve excellence".

MISSION

- To attract and retain highly qualified, experienced & committed faculty.
- To create relevant infrastructure.
- Network with industry & premier institutions to encourage emergence of new ideas by providing research & development facilities to strive for academic excellence.
- To inculcate the professional & ethical values among young students with employable skills & knowledge acquired to transform the society.

K.S. INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

VISION:

"To achieve excellence in academics and research in Electronics & Communication Engineering to meet societal need".

MISSION:

- To impart quality technical education with the relevant technologies to produce industry ready engineers with ethical values.
- To enrich experiential learning through active involvement in professional clubs &societies.
- To promote industry-institute collaborations for research &development.

K.S. INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES (PEO'S)

PEO1: To Excel in professional career by acquiring domain knowledge

PEO2: To pursue higher Education & research by adopting technological innovations by continuous learning through professional bodies and clubs.

PEO3: To inculcate effective communication, team work, ethics, entrepreneurship skills and leadership qualities..

PROGRAM SPECIFIC OUTCOMES (PSO'S)

PSO1: Graduate should be able to understand the fundamentals in the field of Electronics & Communication and apply the same to various areas like Signal processing, embedded systems, Communication & Semiconductor technology.

PSO2: Graduate will demonstrate the ability to design, develop solutions for Problems in Electronics & Communication Engineering using hardware and software tools with social concerns.

K S INSTITUTE OF TECHNOLOGY

PROGRAM OUTCOMES (PO'S)

Engineering Graduates will be able to:

PO1 :**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 : **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 : **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 : **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 : **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 : **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 : **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 : **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 :**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 :Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 ;Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

K.S. INSTITUTE OF TECHNOLOGY, BANGALORE - 560109
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
ACADEMIC YEAR 2024-2025 ODD SEMESTER

CO-PO MAPPING WITH JUSTIFICATION

Course: Optical & Wireless communication	**Course Code:21EC72**	**Type: CORE**
Course Incharge : Dr. Dinesh Kumar D S		

No of Hours per week			
Theory (Lecture Class)	Practical/Field Work/Allied Activities	Total/Week	Total teaching hours
3	1	4	51
Marks			
Internal Assessment	Examination	Total	Credits
50	50	100	2

Aim/Objective of the Course:

This Course will enable students to:

- Learn the basic principle of optical fiber communication with different modes of light propagation and Understand the transmission characteristics and losses in optical fiber.
- Study of optical components and its applications in optical communication networks.
- Understand the concepts of propagation over wireless channels from a physics standpoint
- Understand the multiple access techniques used in cellular communications standards.
- Application of Communication theory both Physical and networking to understand GSM systems that handle mobile telephony

Course Learning Outcomes: After completing the course, the students will be able to,		**Bloom's Level**
21EC72.1	To **make use of** ray theory, **Identify** and explain different fibers and losses in optical fibers.	**Applying (L3)**
21EC72.2	To **make use of** optical communication link and **construct** optical sources and detectors.	**Applying (L3)**
21EC72.3	To **examine** the concept of propagation mechanisms and **Analyze** cellular communication.	**Applying (L4)**
21EC72.4	To **classify** different multiple access techniques and **utilize** basic cellular system.	**Applying (L3)**
21EC72.5	To **make use of** GSM architecture and **examine** the frame structure	**Applying (L3)**

Syllabus Content:	COs, POs and PSOs mapping
Module 1	**CO1** 10hrs PO1-3 PO2-2 POS1-3 POS2-1
Optical Fiber Structures: Optical Fiber Modes and Configurations, Mode theory for circular waveguides, Single mode fibers, Fiber materials.	
Attenuation and Dispersion: Attenuation, Absorption, Scattering Losses, Bending loss, Signal Dispersion: Modal delay, Group delay, Material dispersion.	
[Text1 : 3.1, 3.2, 2.3[2.3.1 to 2.3.4], 2.4[2.4.1, 2.4.2],2.5, 2.7].	
LO: At the end of this session the student will be able to, 1. Examine the ray theory concept 2. Examine the different fibers 3. Examine different losses in fibers	
Module2	**CO2**
Optical Sources and detectors: Light Emitting Diode: LED Structures, Light source materials, Quantum efficiency and LED power, Laser Diodes: Modes and threshold conditions, Rate equations, External quantum efficiency, Resonant frequencies, Photodetectors: The pin Photodetector, Avalanche Photodiodes.	10hrs
WDM Concepts: Overview of WDM, Isolators and Circulators, Fiber grating filters, Dielectric thin-film filters, Diffraction Gratings. [Text1: 4.2 ,4.3, 6.1, 10.1, 10.3, 10.4, 10.5, 10.7]	PO1-3 PO2-2 POS1-3 POS2-1
LO: At the end of this session the student will be able to, 1. Construct LED,LASER and photo diodes 2. Utilize Passive and active components 3. Understand the concept of WDM	
Module 3	**CO3** 10hrs PO1-3 PO2-2 POS1-3 POS2-1
Mobile Communication Engineering: Wireless Network generations, Basic propagation Mechanisms, Mobile radio Channel.	
Principles of Cellular Communications: Cellular terminology, Cell structure and Cluster, Frequency reuse concept, Cluster size and system capacity, Frequency Reuse Distance, Cochannel Interference and signal quality. [Text2: 1.4, 2.4, 2.5, 4.1 to 4.4, 4.6, 4.7]	
LO: At the end of this session the student will be able to, 1. Examine the propagation mechanisms 2. Examine the concept of cellular communication	
Module 4	CO4 10hrs PO1-3 PO2-2 POS1-3 POS2-1
Multiple Access Techniques: FDMA, TDMA, CDMA, SDMA, Hybrid Multiple Access Techniques, Multicarrier Multiple Access Schemes.	
A Basic Cellular System: A basic cellular system connected to PSTN, Parts of basic cellular system, Operation of a cellular system. [Text2: 8.2, 8.3, 8.4.5, 8.5, 8.6, 8.10, 9.2.2, 9.2.3, 9.3]	

LO: At the end of this session the student will be able to, 1. Utilize the concept of multiple access techniques 2. Utilize the concept of cellular sysytem Identify the different antenna for the specific applications	
Module 5:	CO5 10hrs PO1-3 PO2-2 POS1-3 POS2-1
Global System for Mobile (GSM): GSM Network Architecture, GSM signalling protocol architecture, Identifiers used in GSM system, GSM Channels, Frame structure for GSM, GSM Call procedures, GSM hand-off Procedures, GSM Services and features. [Text2: 11.1, 11.2,11.3,11.4, 11.5, 11.8, 11.9. 11.10]	
LO: At the end of this session the student will be able to, 1. Utilize the concept of GSM 2 Utilize frame sturucture,services and features of GSM	

Text Books

1. Gerd Keiser, Optical Fiber Communication, 5th Edition, McGraw Hill Education (India) Private Limited, 2016. ISBN:1-25-900687-5.
2. T L Singal, Wireless Communications, McGraw Hill Education (India) Private Limited, 2016, ISBN:0- 07-068178-3.

Reference Books

1. John M Senior, Optical Fiber Communications, Principles and Practice, 3rd Edition, Pearson Education, 2010, ISBN:978-81-317-3266-3
2. Theodore Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Prentice Hall Communications Engineering and Emerging Technologies Series, 2002, ISBN 0-13-042232-0.

1. Gary Mullet, Introduction to Wireless Telecommunications Systems and Networks, First Edition, Cengage Learning India Pvt Ltd., 2006, ISBN - 13: 978-81-315-0559-5.

Teaching and Learning Methods:

1. Lecture class
2. Self-study
3. Paper presentation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CO - PO MAPPING

PO1: Science and engineering Knowledge	**PO6:** Engineer & Society
PO2: Problem Analysis	**PO7:** Environment and Sustainability
PO3: Design & Development	**PO8:** Ethics
PO4: Investigations of Complex Problems	**PO9:** Individual & Team Work
PO5: Modern Tool Usage	**PO10:** Communication
	PO11: Project Management & Finance
	PO12: Life long Learning

PSO1: Graduate should be able to understand the fundamentals in the field of Electronics & Communication and apply the same to various areas like Signal processing, embedded systems, Communication & Semiconductor technology.

PSO2: Graduate will demonstrate the ability to design, develop solutions for Problems in Electronics& Communication Engineering using hardware and software tools with social concerns.

CO PO Mapping details for Academic Syllabus

CO 21EC62	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12	PSO 1	PSO 2
21EC62.1	L3	3	2	-	-	-	-	-	-	-	-	-	-	3	2
21EC62.2	L3	3	2	-	-	-	-	-	-	-	-	-	-	3	2
21EC62.3	L4	3	2	2	-	-	-	-	-	-	-	-	-	3	2
21EC62.4	L3	3	2	2	-	-	-	-	-	-	-	-	-	3	2
21EC62.5	L3	3	2	-	-	-	-	-	-	-	-	-	-	3	2
21EC62 (before CBS)		**3**	**2**	-	-	-	-	-	-	-	-	-	-	**3**	**2**

CO PO Mapping details with Content Beyond Syllabus

CO 21EC72	Bloom's Level	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12	PSO 1	PSO 2
21EC72.1	L3	3	2	-	-	-	-	-	2	2	2	-	2	3	2
21EC72.2	L3	3	2	-	-	-	-	-	2	2	2	-	2	3	2
21EC72.3	L4	3	2	2	-	-	-	-	2	2	2	-	2	3	2
21EC72.4	L3	3	2	2	-	-	-	-	2	2	2	-	2	3	2
21EC72.5	L3	3	2	-	-	-	-	-	2	2	2	-	2	3	2
21EC72 (after CBS)		3	2	2	-	-	-	-	2	2	2	-	2	3	2

Sl. No	Gap Identification	Activity planned to fill the gap	CO	Relevant PO mapping and Justification
1	PO3 TO PO12	Literature survey	CO1 to CO5	PO8, PO9,PO10 and PO12

JUSTIFICATION FOR CO - PO & PSO MAPPING

CO-PO MAPPING Justification Table				
Sl No.	CO	PO	Number Of Key Elements of PO Mapped To CO	Justification
CO1: To **make use of** ray theory, **Identify** and explain different fibers and losses in optical fibers.				
1.		PO1	**The students will be able to** • Classify types of optical fibers • Identify the materials used • Identify different losses	3
2		PO2	**The students will be able to** • Interpret ray theory for propagation of light • synthesis of the information	2
3		PSO1	**The students will be able to understand the fundamentals of Electronics & Communication Engineering which can be used in** • Research • Innovations • Design	3

4		PSO2	**The students will have the ability to** • Develop solutions with new technology	2
CO2: To **make use of** optical communication link and **construct** optical sources and detectors.				
5.		PO1	**The students will be able to** • Classify types of optical sources and detectors • Make use of WDM technique • Identify passive and active devices	3
6.		PO2	**The students will be able to** • Interpret working principle and applications of sources and detectors • synthesis of the information	2
7.		PSO1	**The students will be able to understand the fundamentals of Electronics & Communication Engineering which can be used in** • Research • Innovations • Design	3
8.		PSO2	**The students will have the ability to** • Develop solutions with new technology	2
CO3: To **examine** the concept of propagation mechanisms and **Analyze** cellular communication.				
9.		PO1	**The students will be able to** • Identify the Basic propagation Mechanisms • Analyze cell structure and frequency reuse concept	3
10		PO2	**The students will be able to** • analysis and interpretation of cellular communication • synthesis of the information	2
11		PO3	**The students will be able to** • Design and analyses of cell structure	2
12		PSO1	**The students will be able to understand the fundamentals of Electronics & Communication Engineering which can be used in** • Research • Innovations • Design	3
13		PSO2	**The students will have the ability to** • Develop solutions with new technology	2
CO4: To **classify** different multiple access techniques and **utilize** basic cellular system.				
14		PO1	**The students will be able to** • Identify multiple access techniques • Analyze PSTN architecture • Analyze the electric dipole antenna	3
15		PO2	**The students will be able to** • analysis and interpretation of data • synthesis of the information	2

17		PSO1	**The students will be able to understand the fundamentals of Electronics & Communication Engineering which can be used in** • Research • Innovations • Design	3
18		PSO2	**The students will have the ability to** • Develop solutions with new technology	2
CO5: To **make use of** GSM architecture and **examine** the frame structure				
17.		PO1	**The students will be able to** • Make use of GSM arechitecture • Identify the call procedure • Identify the GSM services and features	3
18		PO2	**The students will be able to** • analysis and interpretation of GSM architecture • synthesis of the information	2
19		PSO1	**The students will be able to understand the fundamentals of Electronics & Communication Engineering which can be used in** • Research • Innovations • Design	3
20		PSO2	**The students will have the ability to** • Develop solutions with new technology	2

Signature of Course In-charge **Signature of Module Coordinator** **Signature of HOD ECE**

K. S. INSTITUTE OF TECHNOLOGY, BENGALURU-560109

TENTATIVE CALENDAR OF EVENTS: VII ODD SEMESTER (2024-2025)

SESSION: SEP 2024 TO DEC 2024

Week No.	Month	Day						Days	Activities
		Mon	Tue	Wed	Thu	Fri	Sat		
1	SEP 2024	9*	10	11	12	13	14	6	9* - Commencement of VII sem 14- Wednesday Time Table
2	SEP	16 H	17	18	19	20	21 H	4	16- Eid Milad
3	SEP	23	24	25	26	27	28	6	28- Monday Time Table
4	SEP/OCT	30	1	2 H	3	4TA	5 H	4	2- Gandhi Jayanthi / Mahalaya Amavasya
5	OCT	7T1	8T1	9T1	10	11 H	12 H	4	11- Maha Navami & Ayuda Pooja 12 - Vijayadashami
6	OCT	14	15BV	16ASD	17 H	18	19 H	4	17- Valmiki Jayanathi
7	OCT	21	22	23*FFB1	24	25	26	6	23- First Faculty Feed Back 26 - Friday Time Table
8	OCT/NOV	28	29	30	31H	1 H	2 H	3	31- Naraka Chaturdashi 1 - Rajyotsava Day 2 - Balipadyami
9	NOV	4	5	6	7	8	9TA	6	9- Thursday Time Table
10	NOV	11T2	12T2	13T2	14	15	16 H	5	
11	NOV	18 H	19	20BV	21ASD	22	23	5	18 - Kanakadasa Jayanthi 23 - Monday Time Table
12	NOV	25	26	27	28	29	30	6	30- Wednesday Time Table
13	DEC	2	3	4	5	6 TA	7*H	5	
14	DEC	9	10	11*FFB2	12T3	13T3	14T3	6	11- Second Faculty Feed Back
15	DEC 2024	16LT	17LT	18LT	19LT	20 ASD	21*H	5	21* - Last working Day

Total No of Working Days : 75

Total Number of working days (Excluding holidays and Tests)=62

H	Holiday
BV	Blue Book Verification
T1,T2	Tests 1,2
ASD	Attendance & Sessional Display
DH	Declared Holiday
LT	Lab Test
TA	Test attendance

Monday	12
Tuesday	12
Wednesday	13
Thursday	12
Friday	13
Total	**62**

PRINCIPAL
K.S. INSTITUTE OF TECHNOLOGY
BENGALURU - 560 109.

K. S INSTITUTE OF TECHNOLOGY, BENGALURU-560109

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

TENTATIVE CALENDAR OF EVENTS: VII ODD SEMESTER (2024-2025)

SESSION: SEP 2024 TO DEC 2024

Week No.	Month	Day						Days	Activities	Department Activities Tentative Dates
		Mon	Tue	Wed	Thu	Fri	Sat			
1	SEP 2024	9*	10	11	12	13	14	6	**9* - Commencement of VII sem** 14- Wednesday Time Table	13th September 1day Workshop Under ISTE , IEEE, IETE, IEI
2	SEP	16 H	17	18	19	20	21 H	4	16- Eid Milad	
3	SEP	23	24	25	26	27	28	6	28- Monday Time Table	
4	SEP/OCT	30	1	2 H	3	**4 TA**	5 H	4	2- Gandhi Jayanthi / Mahalaya Amavasya	4th October Tech-Tron 2k24 Under IEEE
5	OCT	**7 T1**	**8 T1**	**9 T1**	10	11 H	12 H	4	11- Maha Navami & Ayuda Pooja 12 - Vijayadashami	
6	OCT	14	15 BV	16 ASD	17 H	18	19 H	4	17- Valmiki Jayanathi	
7	OCT	21	22	23* FFB1	24	25	26	6	23- First Faculty Feed Back 26 - Friday Time Table	
8	OCT/ NOV	28	29	30	31 H	1 H	2 H	3	31- Naraka Chaturdashi 1 - Rajyotsava Day 2 - Balipadyami	28th October Guest Lecture Under IETE, ISTE, IEI, IEEE
9	NOV	4	5	6	7	8	9 TA	6	9- Thursday Time Table	
10	NOV	**11 T2**	**12 T2**	**13 T2**	14	15	16 H	5		14th November Tecknical Talk Under IETE, ISTE, IEI, IEEE
11	NOV	18 H	19	20 BV	21 ASD	22	23	5	18 - Kanakadasa Jayanthi 23 - Monday Time Table	23rd November Tecknical Talk Under IETE, ISTE, IEI, IEEE
12	NOV	25	26	27	28	29	30	6	30- Wednesday Time Table	
13	DEC	2	3	4	5	6 TA	7 H	5	No Holi	
14	DEC	9	10	11* FFB2	**12 T3**	**13 T3**	**14 T3**	6	11- Second Faculty Feed Back	
15	DEC 2024	16 LT	17 LT	18 LT	19 LT	20 ASD	21* H	5	**21* - Last working Day**	
Total No of Working Days : 75										

Total Number of working days (Excluding holidays and Tests) = 62

H	Holiday
BV	Blue Book Verification
T1,T2, T3	Tests 1,2, 3
ASD	Attendance & Sessional Display
DH	Declared Holiday
LT	Lab Test
TA	Test attendance

Monday	12
Tuesday	12
Wednesday	13
Thursday	12
Friday	13
Total	**62**

HEAD OF THE DEPARTMENT

K.S.INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGG.
LIST OF STUDENTS STUDYING IN VII SEMESTER
FOR THE ACADEMIC YEAR - 2024 (ODD SEMESTER)

SECTION : B

SL.NO	USN	NAME OF THE STUDENT
1	1KS21EC062	PRAJWAL D
2	1KS21EC063	PRAJWAL G V
3	1KS21EC064	PRAJWAL H S
4	1KS21EC065	PRAJWAL R
5	1KS21EC066	PRATHAM R SHANBHAG
6	1KS21EC067	PRAYAG SINGH S
7	1KS21EC068	PREETHAM M
8	1KS21EC069	PREKSHA S
9	1KS21EC070	PUNITH M
10	1KS21EC071	RAGHAVENDRA NARAYAN PUJAR
11	1KS21EC072	RAKSHITH S
12	1KS21EC073	RAKSHITHA M R
13	1KS21EC074	RAYADURG JOISH SHRIYA
14	1KS21EC075	REHAMAN SHARIFF
15	1KS21EC076	RITESH KUMAR SINHA
16	1KS21EC077	RITHIKA M
17	1KS21EC078	S HARI DHANUSH
18	1KS21EC080	S SHAJITH ALI
19	1KS21EC081	SAGAR G S
20	1KS21EC082	SAI RAHUL N
21	1KS21EC083	SAMHITHA PRAKASH
22	1KS21EC084	SANJANA V
23	1KS21EC085	SANJAY G
24	1KS21EC086	SANJAY N
25	1KS21EC087	SANJAY P
26	1KS21EC088	SATHYAM KUMAR MANDAL S
27	1KS21EC089	SHAIK ARFATH
28	1KS21EC090	SHASHANK C U
29	1KS21EC091	SHREYAS RAGHAVENDRA V
30	1KS21EC092	SHWETHA V
31	1KS21EC093	SINDHU M NIMBAL
32	1KS21EC095	SPOORTHY M U
33	1KS21EC096	SRILAKSHMI G
34	1KS21EC097	SRIPRIYA H G
35	1KS21EC098	SUMUKH P
36	1KS21EC099	SUNEETHA
37	1KS21EC100	SUNEHA S
38	1KS21EC101	SUPREETH A
39	1KS21EC102	SURABHI K R
40	1KS21EC103	SUSHEN KRISHNAPUR
41	1KS21EC104	TARUN M
42	1KS21EC105	TEJASHREE N
43	1KS21EC106	THARUN K V
44	1KS21EC107	THEJAS H V
45	1KS21EC108	THUSHAR CHERIAN
46	1KS21EC109	UDAYA KUMAR S R
47	1KS21EC110	VAISHNAVI B A
48	1KS21EC111	VARSHA JAYAKUMAR
49	1KS21EC112	VARSHA S DAVASKAR
50	1KS21EC113	VARSHITH S
51	1KS21EC114	VEERESH K N
52	1KS21EC115	VIDYA I
53	1KS21EC116	VIDYA RAWAL D
54	1KS21EC117	VIDYASHREE R
55	1KS21EC118	VIJAY YADAV R
56	1KS21EC120	VYSHAK G R
57	1KS21EC121	YASHWANTH.M
58	1KS22EC407	PRAJWAL PATIL B S
59	1KS22EC408	SANGEETHA H M
60	1KS22EC409	SOUNDARYA S
61	1KS22EC410	SOWMYA A M
62	1KS22EC411	SUDEEP P

K.S.INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGG.
LIST OF STUDENTS STUDYING IN VII SEMESTER
FOR THE ACADEMIC YEAR - 2024 (ODD SEMESTER)

SECTION : A

SLNO	USN	NAME OF THE STUDENT
1	1KS21EC001	AADHYA B N
2	1KS21EC002	ABHIJITH R
3	1KS21EC003	ABHISHEK H C
4	1KS21EC004	ABHISHEK T S
5	1KS21EC005	AISHWARYA A
6	1KS21EC006	AKSHAY C
7	1KS21EC007	AKSHAY M S
8	1KS21EC008	ANAGHA PRAKASH
9	1KS21EC009	ANIRUDHA R BHAT
10	1KS21EC010	ARCHANA G M
11	1KS21EC011	ARCHANA M
12	1KS21EC013	ASHCHARYA N B
13	1KS21EC014	ASHWIN S R
14	1KS21EC015	B N JEEVAN
15	1KS21EC017	B S BHARGAV
16	1KS21EC018	BHAVYA K
17	1KS21EC019	BHUVANA H
18	1KS21EC020	BINDUSHREE S
19	1KS21EC021	CHINTAN D S
20	1KS21EC023	CHIRANTH V V
21	1KS21EC024	DAGGUPATI CHARITHA
22	1KS21EC025	DAMINI S
23	1KS21EC026	DEEKSHA H K
24	1KS21EC027	DEEPIKA D
25	1KS21EC028	GAGAN V
26	1KS21EC029	GAGANA SINDHU N
27	1KS21EC031	GURUSHANKARA M
28	1KS21EC032	HARINI L
29	1KS21EC033	HEMANTH D R
30	1KS21EC035	KAMBHAMPATI VIVEK
31	1KS21EC036	KARAN S
32	1KS21EC037	KEERTHANA S
33	1KS21EC038	KOMALA N
34	1KS21EC039	KUSHAL GOWDA U
35	1KS21EC040	KUSUMA M S
36	1KS21EC041	LIKITHA L
37	1KS21EC042	LOHIT S HOOLAGERI
38	1KS21EC043	LOHITH B
39	1KS21EC044	LOHITH S
40	1KS21EC045	MANOJ T V
41	1KS21EC046	MEGHANA N
42	1KS21EC047	MISBA M
43	1KS21EC048	MITHUN C
44	1KS21EC049	MONISHA D
45	1KS21EC050	MUTTHULURU SAI HIMAJA
46	1KS21EC051	NANDAN K
47	1KS21EC053	NARAHARI N JOSHI
48	1KS21EC054	NAVEEN S
49	1KS21EC055	NAYANA J
50	1KS21EC056	NAYANA S
51	1KS21EC058	OMKAR N BHUJARKAR
52	1KS21EC059	PAVAN M PAI
53	1KS21EC060	POLURU MANJUNATH
54	1KS21EC061	POOJA R
55	1KS22EC400	ADITHYA D
56	1KS22EC401	APOORVA B
57	1KS22EC402	B SREEPADREDDI H BULLANGOUDAR
58	1KS22EC403	CHAITRA N
59	1KS22EC404	GONUGUNTLA SHRUJANA
60	1KS22EC405	HEMA K
61	1KS22EC406	PAVANGOWDA H P

K.S. INSTITUTE OF TECHNOLOGY, BANGALORE -109
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
INDIVIDUAL TIME TABLE FOR THE YEAR - 2024 (ODD SEMESTER)

W.E.F. : 19/8/2024

NAME OF THE FACULTY : Dr. DINESH KUMAR D S **DESIGNATION: ASSOCIATE PROFESSOR**

PERIOD	1	2	10.20 AM 10.35 AM	3	4	12.25 PM 1.15 PM	5	6	7
TIME / DAY	8.30 AM 9.25 AM	9.25 AM 10.20 AM		10.35 AM 11.30 AM	11.30 AM 12.25 PM		1.15 PM 2.10 PM	2.10 PM 3.05 PM	3.05 PM 4.00 PM
MON		O&WC (21EC72) -A	TEA BREAK		O&WC (21EC72) -B	LUNCH BREAK	← A& DSD Lab (BECL305) - A1 →		
TUE	O&WC (21EC72) -B			O&WC (21EC72) -A					
WED	O&WC (21EC72) -A			O&WC (21EC72) -B			← A& DSD Lab (BECL305) - A2 →		
THU		O&WC (21EC72) -B			O&WC (21EC72) -A				
FRI	← A& DSD Lab (BECL305) - A3 →								

	Subject Code	Subject Name	Sem	Section	Work Load
Subject 1	21EC72	Optical & Wireless Communication	7th	A&B	8
Lab	BECL305	Analog and Digital Systems Design Lab	3rd	A	9
Mini project	BEC586	Mini Project (Guide)	5th		2
Project	21ECP75	Project work (Guide)	7th		2
ADDITIONAL WORK: MENTORING AND OTHERS					
TOTAL LOAD= 21 Hrs/Week					

Time Table Co-ordinator

HOD

HEAD OF THE DEPARTMENT
Dept. of Electronics & Communication Engg
K.S. Institute of Technology
Bengaluru - 560 109.

Principal

PRINCIPAL
K.S. INSTITUTE OF TECHNOLOGY
BENGALURU - 560 109.

K.S. INSTITUTE OF TECHNOLOGY, BANGALORE -109

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

VII SEMESTER TIME TABLE FOR THE YEAR 2024 (ODD SEMESTER)

W.E.F. : 9/9/2024

SEC : 'A'

CLASS TEACHER : Dr. Saleem S Tevaramani

CLASS ROOM : NB LH 302

PERIOD	1	2	10.20 AM 10.35 AM	3	4	12.25 PM 1.15 PM	5	6	7
TIME DAY	8.30 AM 9.25 AM	9.25 AM 10.20 AM		10.35 AM 11.30 AM	11.30 AM 12.25 PM		1.15 PM 2.10 PM	2.10 PM 3.05 PM	3.05 PM 4.00 PM
MON	AI&ML (21CS752) / DS (21CS754)	O&WC (21EC72)	TEA BREAK	NS (21EC732)	AVLSI (21EC71)	LUNCH BREAK	← Research Internship/ Industry Internship (21INT82) →		
TUE	DIP (21EC722)	AVLSI (21EC71)		O&WC (21EC72)	AI&ML (21CS752) / DS (21CS754)		← Research Internship/ Industry Internship (21INT82) →		
WED	O&WC (21EC72)	AVLSI (21EC71)		NS (21EC732)	DIP (21EC722)		← Research Internship/ Industry Internship (21INT82) →		
THU	AI&ML (21CS752) / DS (21CS754)	NS (21EC732)		DIP (21EC722)	O&WC (21EC72)		← Research Internship/ Industry Internship (21INT82) →		
FRI	DIP (21EC722)	NS (21EC732)		AVLSI (21EC71)	AI&ML (21CS752) / DS (21CS754)		← Research Internship/ Industry Internship (21INT82) →		

Sub-Code	Subject Name	Faculty Name
21EC71	Advanced VLSI	Mrs. Shubha Kulkarni
21EC72	Optical & Wireless Communication	Dr. Dinesh Kumar D S
21EC732	Digital Image Processing (Professional elective Course-II)	Dr. Saleem S Tevaramani
21EC742	Network Security (Professional elective Course-III)	Mr. Naveen Kumar S
21CS752	Introduction to AI and ML (Open elective Course-II)	Mrs. Pragathi P
21CS754	Introduction to Data Science (Open elective Course-II)	Dr. Electa Alice Jayarani A
21EC76	Project work	Dr. Devika B , Dr. Bharathi Gururaj

Time Table Co-ordinator

HOD

Principal

K.S. INSTITUTE OF TECHNOLOGY, BANGALORE -109

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

VII SEMESTER TIME TABLE FOR THE YEAR 2024 (ODD SEMESTER)

W.E.F. : 9/9/2024

SEC : 'B'

CLASS TEACHER : Dr. Dinesh Kumar D S

CLASS ROOM : NB SH 303

PERIOD	1	2		3	4		5	6	7
TIME DAY	8.30 AM 9.25 AM	9.25 AM 10.20 AM	10.20 AM 10.35 AM	10.35 AM 11.30 AM	11.30 AM 12.25 PM	12.25 PM 1.15 PM	1.15 PM 2.10 PM	2.10 PM 3.05 PM	3.05 PM 4.00 PM
MON	AI&ML (21CS752) / DS (21CS754)	AVLSI (21EC71)	TEA BREAK	DIP (21EC722)	O&WC (21EC72)	LUNCH BREAK	← Research Internship/ Industry Internship (21INT82) →		
TUE	O&WC (21EC72)	NS (21EC732)		DIP (21EC722)	AI&ML (21CS752) / DS (21CS754)		← Research Internship/ Industry Internship (21INT82) →		
WED	NS (21EC732)	DIP (21EC722)		O&WC (21EC72)	AVLSI (21EC71)		← Research Internship/ Industry Internship (21INT82) →		
THU	AI&ML (21CS752) / DS (21CS754)	O&WC (21EC72)		AVLSI (21EC71)	NS (21EC732)		← Research Internship/ Industry Internship (21INT82) →		
FRI	AVLSI (21EC71)	DIP (21EC722)		NS (21EC732)	AI&ML (21CS752) / DS (21CS754)		← Research Internship/ Industry Internship (21INT82) →		

Sub-Code	Subject Name	Faculty Name
21EC71	Advanced VLSI	Mrs. Shubha Kulkarni
21EC72	Optical & Wireless Communication	Dr. Dinesh Kumar D S
21EC732	Digital Image Processing (Professional elective Course-II)	Dr. Saleem S Tevaramani
21EC742	Network Security (Professional elective Course-III)	Mr. Naveen Kumar S
21CS752	Introduction to AI and ML (Open elective Course-II)	Mrs. Pragathi P
21CS754	Introduction to Data Science (Open elective Course-II)	Dr. Electa Alice Jayarani A
21EC76	Project work	Dr. Devika B , Dr. Bharathi Gururaj

Time Table Co-ordinator HOD Principal

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
B.E: Electronics & Communication Engineering / B.E: Electronics & Telecommunication Engineering
NEP, Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021 – 22)

VII Semester

Optical & Wireless Communication			
Course Code	**21EC72**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:0:0:1	SEE Marks	50
Total Hours of Pedagogy	30	Total Marks	100
Credits	2	Exam Hours	3
Non-MCQ pattern of CIE and SEE			

Course objectives:

This course will enable students to:

- Learn the basic principle of optical fiber communication with different modes of light propagation.
- Understand the transmission characteristics and losses in optical fiber.
- Study of optical components and its applications in optical communication networks.
- Understand the concepts of propagation over wireless channels from a physics standpoint
- Understand the multiple access techniques used in cellular communications standards.
- Application of Communication theory both Physical and networking to understand GSM systems that handle mobile telephony.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Optical Fiber Structures: Optical Fiber Modes and Configurations, Mode theory for circular waveguides, Single mode fibers, Fiber materials.

Attenuation and Dispersion: Attenuation, Absorption, Scattering Losses, Bending loss, Signal Dispersion: Modal delay, Group delay, Material dispersion.

[Text1 : 3.1, 3.2, 2.3[2.3.1 to 2.3.4], 2.4[2.4.1, 2.4.2],2.5, 2.7].

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-2

Optical Sources and detectors: Light Emitting Diode: LED Structures, Light source materials, Quantum efficiency and LED power, Laser Diodes: Modes and threshold conditions, Rate equations, External quantum efficiency, Resonant frequencies, Photodetectors: The pin Photodetector, Avalanche Photodiodes.

WDM Concepts: Overview of WDM, Isolators and Circulators, Fiber grating filters, Dielectric thin-film filters, Diffraction Gratings. [Text1: 4.2 ,4.3, 6.1, 10.1, 10.3, 10.4, 10.5, 10.7]	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-3	
Mobile Communication Engineering: Wireless Network generations, Basic propagation Mechanisms, Mobile radio Channel. **Principles of Cellular Communications:** Cellular terminology, Cell structure and Cluster, Frequency reuse concept, Cluster size and system capacity, Frequency Reuse Distance, Cochannel Interference and signal quality. [Text2: 1.4, 2.4, 2.5, 4.1 to 4.4, 4.6, 4.7]	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-4	
Multiple Access Techniques: FDMA, TDMA, CDMA, SDMA, Hybrid Multiple Access Techniques, Multicarrier Multiple Access Schemes. **A Basic Cellular System:** A basic cellular system connected to PSTN, Parts of basic cellular system, Operation of a cellular system. [Text2: 8.2, 8.3, 8.4.5, 8.5, 8.6, 8.10, 9.2.2, 9.2.3, 9.3]	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Global System for Mobile (GSM): GSM Network Architecture, GSM signalling protocol architecture, Identifiers used in GSM system, GSM Channels, Frame structure for GSM, GSM Call procedures, GSM hand-off Procedures, GSM Services and features. [Text2: 11.1, 11.2,11.3,11.4, 11.5, 11.8, 11.9. 11.10]	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Classification and characterization of optical fibers with different modes of signal propagation.
2. Describe the constructional features and the characteristics of optical fiber and optical devices used for signal transmission and reception.
3. Understand the essential concepts and principles of mobile radio channel and cellular communication.
4. Describe various multiple access techniques used in wireless communication systems.
5. Describe the GSM architecture and procedures to establish call set up, call progress handling and call tear down in a GSM cellular network.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE will be the same as other core theory courses.

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination (SEE):

For non-MCQ pattern of CIE and SEE

Continuous Internal Evaluation (CIE):

At the beginning of the semester, the instructor/faculty teaching the course has to announce the methods of CIE for the course.

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books

1. Gerd Keiser, Optical Fiber Communication, 5th Edition, McGraw Hill Education (India) Private Limited, 2016. ISBN:1-25-900687-5.
2. T L Singal, Wireless Communications, McGraw Hill Education (India) Private Limited, 2016, ISBN:0-07-068178-3.

Reference Books

1. John M Senior, Optical Fiber Communications, Principles and Practice, 3rd Edition, Pearson Education, 2010, ISBN:978-81-317-3266-3
2. Theodore Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Prentice Hall Communications Engineering and Emerging Technologies Series, 2002, ISBN 0-13-042232-0.
3. Gary Mullet, Introduction to Wireless Telecommunications Systems and Networks, First Edition, Cengage Learning India Pvt Ltd., 2006, ISBN - 13: 978-81-315-0559-5.

KS INSTITUTE OF TECHNOLOGY BANGALORE-560109

DEPARTMENT OF ELECRONICS & COMMUNICATION ENGINEERING

NAME OF THE STAFF : Dr.Dinesh Kumar D S

SUBJECT CODE/NAME :21EC72/OPTICAL & WIRELESS COMMUNICATION

SEMESTER/YEAR/SEC : VII/ IV/A

ACADEMIC YEAR : 2024-25

Sl. No.	Topic to be covered	Mode of Delivery	Teaching Aid	No. of Periods	Cumulative No. of Periods	Proposed Date (B)
	MODULE 1: Optical Fiber Structures					
1	**Introduction to optical fibers**	L	BB+P	1	1	9/9/24
2	Optical Fiber Modes and Configurations	L	BB+P	1	2	10/9/24
3	Mode theory for circular waveguides	L	BB+P	1	3	11/9/24
4	Single mode fibers, Fiber materials.	L	BB+P	1	4	12/9/24
5	Attenuation	L	BB+P	1	5	17/9/24
6	Absorption, Scattering losses	L	BB+P	1	6	18/9/24
7	Bending loss	L	BB+P	1	7	19/9/24
8	Signal Dispersion	L	BB+P	1	8	23/9/24
9	Modal delay	L	BB+P	1	9	24/9/24
10	Group delay, Material dispersion	L	BB+P	1	10	25/9/24
	MODULE 2: Optical Sources and detectors					
11	Light Emitting Diode	L	BB+P	1	11	26/9/24
12	LED Structures	L	BB+P	1	12	30/9/24

13	Quantum efficiency and LED power	L	BB+P	1	13	1/10/24
14	Laser Diodes	L	BB+P	1	14	3/10/24
15	Photodetectors	L	BB+P	1	15	10/10/24
16	Overview of WDM	L	BB+P	1	16	14/10/24
17	Isolators and Circulators	L	BB+P	1	17	15/10/24
18	Fiber grating filters	L	BB+P	1	18	16/10/24
19	Dielectric thin-film filters	L	BB+P	1	19	21/10/24
20	Diffraction Gratings	L	BB+P	1	20	22/10/24
	MODULE 3: Mobile Communication Engineering					
21	Wireless Network generations	L	BB+P	1	21	23/10/24
22	propagation Mechanisms	L	BB+P	1	22	24/10/24
23	Mobile radio Channel	L	BB+P	1	23	28/10/24
24	Cellular terminology	L	BB+P	1	24	29/10/24
25	Cell structure and Cluster	L	BB+P	1	25	30/10/24
26	Frequency reuse concept	L	BB+P	1	26	4/11/24
27	Cluster size and system capacity	L	BB+P	1	27	5/11/24
28	Frequency Reuse Distance	L	BB+P	1	28	6/11/24
29	Problems on frequency reuse	L	BB+P	1	29	7/11/24
30	Cochannel Interference	L	BB+P	1	30	14/11/24
	MODULE 4: Multiple Access Techniques					
31	FDMA	L	BB+P	1	31	19/11/24
32	TDMA	L	BB+P	1	32	20/11/24
33	CDMA	L	BB+P	1	33	21/11/24
34	SDMA	L	BB+P	1	34	25/11/24
35	Hybrid Multiple Access Techniques	L	BB+P	1	35	26/11/24
36	Multicarrier Multiple Access Schemes	L	BB+P	1	36	27/11/24
37	A basic cellular system connected to PSTN	L	BB+P	1	37	28/11/24
38	Parts of basic cellular system	L	BB+P	1	38	2/12/24
39	Operation of a cellular system	L	BB+P	1	39	3/12/24

MODULE 5: Global System for Mobile (GSM)						
40	GSM Network Architecture	L	BB+P	1	40	4/12/24
41	GSM signalling protocol architecture	L	BB+P	1	41	5/12/24
42	Identifiers used in GSM system	L	BB+P	1	42	9/11/24
43	GSM Channels	L	BB+P	1	43	10/11/24
44	Frame structure for GSM	L	BB+P	1	44	11/12/24
45	GSM Call procedures	L	BB+P	1	45	16/12/24
46	GSM hand-off Procedures	L	BB+P	1	46	17/12/24
47	GSM Services and features.	L	BB+P	1	47	18/12/24
48	Revision of vtu question papers	L	BB+P	1	48	19/12/24

Dineel

Signature of Course Incharge

Dineel

Signature of Module Coordinator

Signature of HOD

KS INSTITUTE OF TECHNOLOGY BANGALORE-560109

DEPARTMENT OF ELECRONICS & COMMUNICATION ENGINEERING

NAME OF THE STAFF : **Dr.Dinesh Kumar D S**

SUBJECT CODE/NAME :**21EC72/OPTICAL & WIRELESS COMMUNICATION**

SEMESTER/YEAR/SEC : **VII/ IV/B**

ACADEMIC YEAR : **2024-25**

Sl. No.	Topic to be covered	Mode of Delivery	Teaching Aid	No. of Periods	Cumulative No. of Periods	Proposed Date (B)
	MODULE 1: Optical Fiber Structures					
1	**Introduction to optical fibers**	L	BB+P	1	1	9/9/24
2	Optical Fiber Modes and Configurations	L	BB+P	1	2	10/9/24
3	Mode theory for circular waveguides	L	BB+P	1	3	11/9/24
4	Single mode fibers, Fiber materials.	L	BB+P	1	4	12/9/24
5	Attenuation	L	BB+P	1	5	17/9/24
6	Absorption, Scattering losses	L	BB+P	1	6	18/9/24
7	Bending loss	L	BB+P	1	7	19/9/24
8	Signal Dispersion	L	BB+P	1	8	23/9/24
9	Modal delay	L	BB+P	1	9	24/9/24
10	Group delay, Material dispersion	L	BB+P	1	10	25/9/24
	MODULE 2: Optical Sources and detectors					
11	Light Emitting Diode	L	BB+P	1	11	26/9/24
12	LED Structures	L	BB+P	1	12	30/9/24
13	Quantum efficiency and LED power	L	BB+P	1	13	1/10/24

14	Laser Diodes	L	BB+P	1	14	3/10/24
15	Photodetectors	L	BB+P	1	15	10/10/24
16	Overview of WDM	L	BB+P	1	16	14/10/24
17	Isolators and Circulators	L	BB+P	1	17	15/10/24
18	Fiber grating filters	L	BB+P	1	18	16/10/24
19	Dielectric thin-film filters	L	BB+P	1	19	21/10/24
20	Diffraction Gratings	L	BB+P	1	20	22/10/24
	MODULE 3: Mobile Communication Engineering					
21	Wireless Network generations	L	BB+P	1	21	23/10/24
22	propagation Mechanisms	L	BB+P	1	22	24/10/24
23	Mobile radio Channel	L	BB+P	1	23	28/10/24
24	Cellular terminology	L	BB+P	1	24	29/10/24
25	Cell structure and Cluster	L	BB+P	1	25	30/10/24
26	Frequency reuse concept	L	BB+P	1	26	4/11/24
27	Cluster size and system capacity	L	BB+P	1	27	5/11/24
28	Frequency Reuse Distance	L	BB+P	1	28	6/11/24
29	Problems on frequency reuse	L	BB+P	1	29	7/11/24
30	Cochannel Interference	L	BB+P	1	30	14/11/24
	MODULE 4: Multiple Access Techniques					
31	FDMA	L	BB+P	1	31	19/11/24
32	TDMA	L	BB+P	1	32	20/11/24
33	CDMA	L	BB+P	1	33	21/11/24
34	SDMA	L	BB+P	1	34	25/11/24
35	Hybrid Multiple Access Techniques	L	BB+P	1	35	26/11/24
36	Multicarrier Multiple Access Schemes	L	BB+P	1	36	27/11/24
37	A basic cellular system connected to PSTN	L	BB+P	1	37	28/11/24
38	Parts of basic cellular system	L	BB+P	1	38	2/12/24
39	Operation of a cellular system	L	BB+P	1	39	3/12/24

MODULE 5: Global System for Mobile (GSM)						
40	GSM Network Architecture	L	BB+P	1	40	4/12/24
41	GSM signalling protocol architecture	L	BB+P	1	41	5/12/24
42	Identifiers used in GSM system	L	BB+P	1	42	9/11/24
43	GSM Channels	L	BB+P	1	43	10/11/24
44	Frame structure for GSM	L	BB+P	1	44	11/12/24
45	GSM Call procedures	L	BB+P	1	45	16/12/24
46	GSM hand-off Procedures	L	BB+P	1	46	17/12/24
47	GSM Services and features.	L	BB+P	1	47	18/12/24
48	Revision of vtu question papers	L	BB+P	1	48	19/12/24

Signature of Course Incharge **Signature of Module Coordinator** **Signature of HOD**

K. S. INSTITUTE OF TECHNOLOGY, BANGALORE – 560109

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

2024 – 25 ODD SEMESTER

I ASSIGNMENT

Academic Year	2024-2025		
Batch	2021 - 2025		
Year/Semester/section	IV/VII/A & B		
Subject Code-Title	21EC72-Optical and Wireless Communication		
Name of the Course Incharge	Dr. Dinesh Kumar D. S	Dept	ECE

Assignment No: 1 **Total marks: 6**

Date of Issue: 26th Sept 2024 **Date of Submission: 3rd Oct 2024**

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Question	K Level	CO	Marks
1	Derive an expression for maximum acceptance angle and numerical aperture for step index fiber	L3	1	1
2	Identify and Expalin different attenuation mechanisms with relevant expressions	L3	1	1
3	Explain different fiber materials used in optical fibers	L2	1	1
4	Make use of single mode and multimode step index fibers and mulltimode GIF with their dimension with advantages	L3	1	1
5	Explain different types of LED with neat diagrams	L2	2	1
6	Explain different types of photodiodes with neat diagrams	L2	2	1

Course In charge

HOD ECE

K.S. INSTITUTE OF TECHNOLOGY, BANGALORE - 560109

2024 - 25 ODD SEMESTER

ASSIGNMENT SCHMEME AND SOLUTION - 1

Degree	:	B.E	Semester	:	VII
Branch	:	ECE	Course Code	:	21EC72
Course Title	:	Optical and Wireless Communication	Max Marks	:	6

Q.NO.	POINTS	MARKS
1	Expression for N.A NA :- It is the light collecting ability of the fiber. which gives relation b/w angle of acceptance & RI of core & cladding $NA = \sqrt{n_1^2 - n_2^2}$ $\theta_a = \sin^{-1} NA$ or $NA = n_1\sqrt{2\Delta}$	Col
2.	Attenuation :- fiber loss or Signal loss with respect to fiber at a distance. 3 mechanisms 1. Absorption - Intrinsic Extrinsic 2. Scattering 3. Radiation losses.	Col

3. optical fibers are made up of Glass & plastic.

Active glass:- They are made from pure silica. SiO_2

Dopants are added to change RI difference. CO1

plastic:- These fibers are made from polymethyl metha crylate.

These fiber are tough & durable.

4. Single Mode step index fibers.

In SIF, RI of Core is Uniform & NA remains Same. CO1

Multimode Graded index fibers

In GIF, RI of Core is Varies @

5. LED:- it is a Foreward biased PN junction device which emits light when a current is passing through it. CO2

1. Surface emitter LED
2. Edge Emitter LED

6. photodetector is a reverse biased P.N junction device which accepts light & produces photo current. CO2

1. PIN photo diode.
2. Avalanche photo diode

Course Incharge

H.OD ECE

K. S. INSTITUTE OF TECHNOLOGY, BANGALORE – 560109

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

2024 – 25 ODD SEMESTER

II ASSIGNMENT

Academic Year	2024-2025		
Batch	2021 - 2025		
Year/Semester/section	IV/VII/A & B		
Subject Code-Title	21EC72-Optical and Wireless Communication		
Name of the Course Incharge	Dr. Dinesh Kumar D. S	Dept	ECE

Assignment No: 2 **Total marks: 8**

Date of Issue: 30th Oct 2024 **Date of Submission: 7th Nov 2024**

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Question	K Level	CO	Marks
1	Explain the concept of WDM with neat diagram	L2	2	1
2	Identify and Expalin different passive devices such as isolator and circulator used in WDM	L3	2	1
3	Explain diffraction mechanism w.r.t cellular communication	L2	3	1
4	Explain reflection mechanism w.r.t cellular communication	L2	3	1
5	Identify and Explain different types small scale fading	L3	3	1
6	Explain scattering mechanism w.r.t cellular communication	L2	3	1
7	Explain TDMA concept used in cellular communication	L2	4	1
8	Illustrate FDMA FDD concept w.r.t AMPS system	L2	4	1

Course In charge

HOD ECE

K.S. INSTITUTE OF TECHNOLOGY, BANGALORE - 560109
2024 - 25 ODD SEMESTER

ASSIGNMENT SCHMEME AND SOLUTION – 2

Degree : B.E
Branch : ECE
Course Title : Optical and Wireless Communication
Semester : VII
Course Code : 21EC72
Max Marks : 6

Q.NO.	POINTS	MARKS
1.	WDM :- It is a technique of combining several optical signals & using LED or LASER & transmits these signals over a single optical channel. Adv :- system capacity increases	CO2
2.	passive devices 1. Isolator 2. circulator Isolator is a device which allow signals in forward direction & prevent reflected signal in reverse direction.	CO2
3.	Diffraction :- In cellular communication the signal emitted from Tx will undergo different ways to reach receiver. When there is no line of sight path Diffraction occurs when there is an obstacle. The signal is reflected from edge of the obstacle called diffraction	CO3

4.	Reflection occurs when incident EM waves are partially reflected when they impinge on obstructions of different electrical properties. The EM waves get reflected from tall buildings structures	CO3
5.	fading :- rapid fluctuations in time 1. Large scale fading 2. Small scale fading. Rayleigh fading :- occurs when no LOS. path.	CO3
6.	Scattering Special case of reflection caused by irregular objects such as walls with rough surfaces / vehicles.	CO3
7.	TDMA → It is a multiple access where the users are allocated in definite time intervals.	CO4
8.	FDMA → It is a multiple access technique where the Bandwidth is divided into number of frequency slots & assigned to the user. There is a guard band is required b/w each channel in order to avoid interference	CO4

Dinl
Course Incharge

HOD ECE

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
FIRST INTERNAL TEST QUESTION PAPER 2024-25 ODD SEMESTER

SET: A

USN | | | | | | | | | | |

Degree : B.E
Branch - Stream : ECE
Course Title : Optical & Wireless Communication
Duration : 1 Hr (60 minutes)

Semester : VII
Course Type / Code : 21EC72
Date : 07/10/2024
Max Marks : 20

Note: Answer **ONE full** question from each Module.

L-Bloom's Level: L1-Remebering, L2-Understanding, L3-Applying, L4-Analyzing, L5-Evaluating, L6-Creating

Q No.	Questions	Marks	CO	L
	Module-1			
1(a)	**Explain** scattering mechanism with relevant expressions	4	CO1	L2
(b)	Consider a multimode silica fiber that has a core RI of 1.48 and a cladding RI of 1.46.**Solve** i) Critical angle ii) Numerical aperture iii) Acceptance angle	4		L3
(c)	**Develop** an expression for numerical aperture (NA) in terms of maximum acceptance angle and Δ for step index fibers	4		L3
	OR			
2(a)	**Explain** different fiber materials used in optical fiber with their composition	4	CO1	L2
(b)	**Develop** an expression for material dispersion in fiber starting from group delay	4		L3
(c)	**Construct** single mode and multimode SIF and multimode GIF with neat diagram	4		L3
	Module-2			
3(a)	**Construct** Fabry Perot resonator cavity LASER with neat diagram	4	CO2	L3
(b)	A double hetero junction InGaAsP LED emitting at a peak wavelength of 1310nm has radiative recombination times of 30 and 100ns respectively with drive current 40mA. **Solve** (i) the bulk recombination lifetime (ii) internal quantum efficiency (iii) internal power level.	4		L3
	OR			
4(a)	**Construct** GaAlAs double hetero junction LED structure with neat diagram	4	CO2	L3
(b)	**Construct** PIN photodiode with neat diagram and explain its working	4		L3

Name & Signature of Course In charge:

Name & Signature of Module Coordinator:

HOD ECE

Principal

Selected

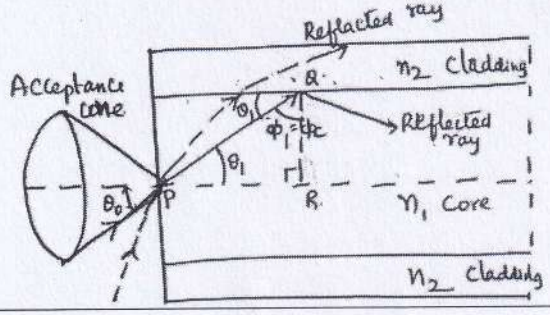
K.S. INSTITUTE OF TECHNOLOGY, BENGALURU-560109

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

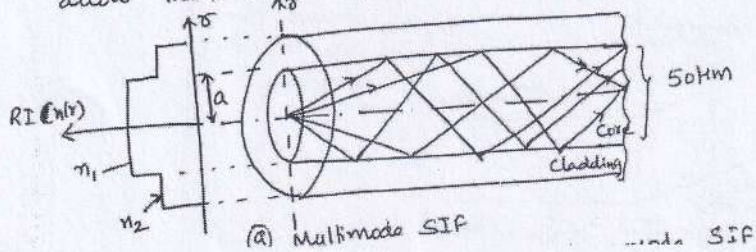
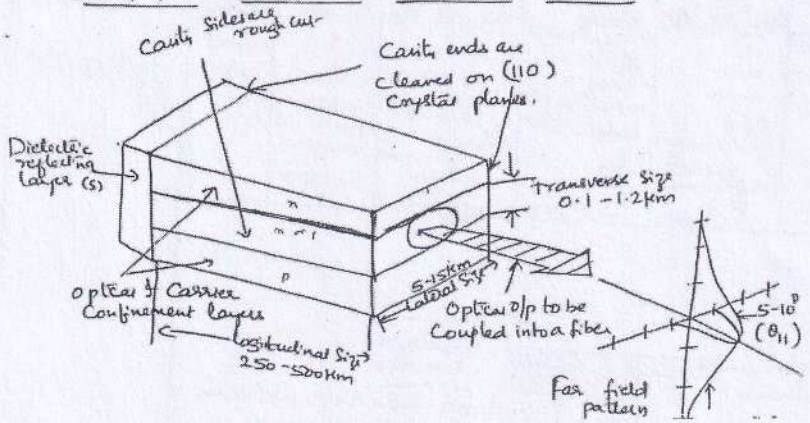
SESSION: 2024-2025 (ODD SEMESTER)

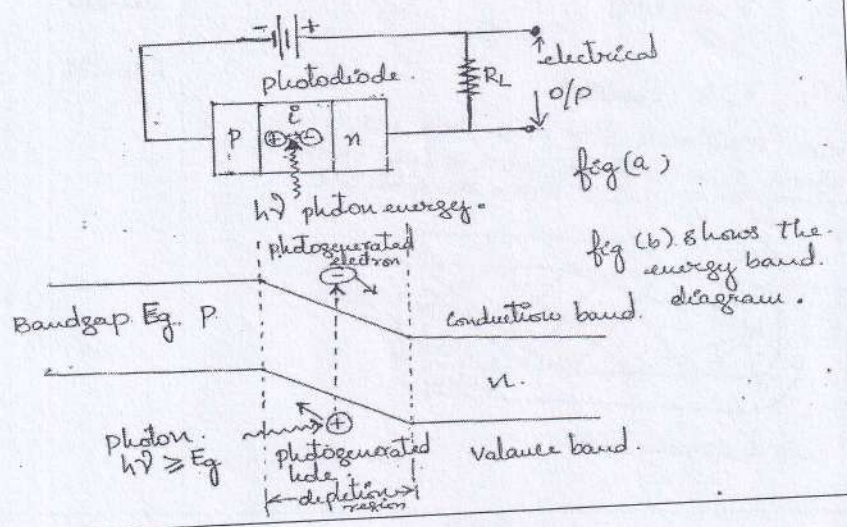
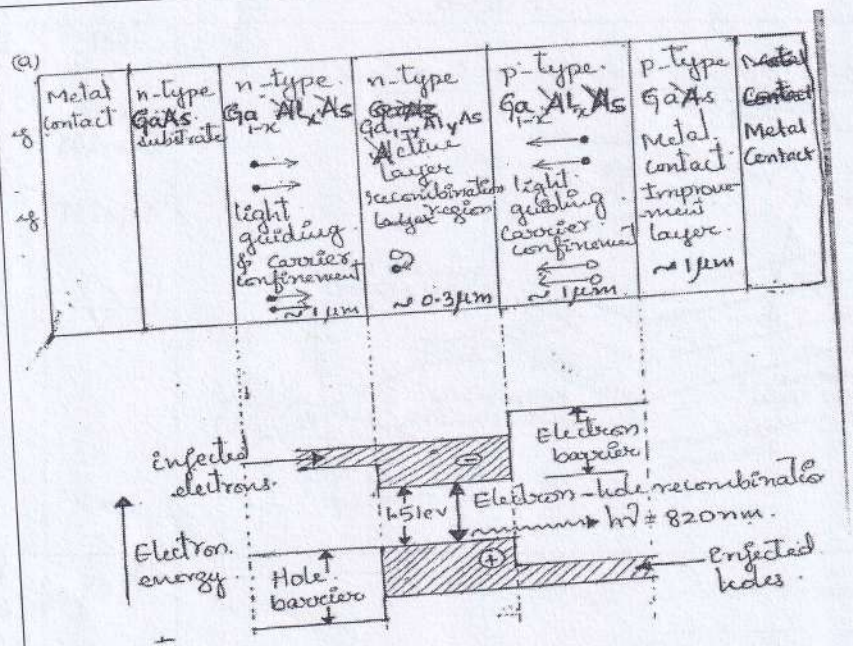
SUB: Optical & Wireless Communication -21EC72

FIRST SESSIONAL TEST SCHEME & SOLUTION-SET-A

Q. No.	Scheme and Solution	Marks	L Level	CO
	PART-A			
1(a)	Scattering loss is due to Variation in ① material density ② compositional fluctuations ③ defects during Manufacturing for Single component glass $\alpha_{scat} = \frac{8\pi^3}{3\lambda^4}(n^2-1)^2 K_B T_f \beta_T$ nepers.	4M	L2	CO1
1(b)	ⓐ W.K.T Critical angle $= \sin^{-1}\frac{n_2}{n_1} = \sin^{-1}\frac{1.46}{1.48} = 80.5^0$ ⓑ $NA = \sqrt{n_1^2 - n_2^2} = \sqrt{1.48^2 - 1.46^2} = 0.242$ ⓒ $\theta_a = \sin^{-1} NA = \sin^{-1}(0.242) = 14^0$	4M	L3	CO1
1(c)	Expression for Numerical aperture for Step index fibers Consider a meridional ray for a step index fiber as shown in Fig ⓐ 	4M Dia-1M Exp-3M	L3	CO1

	$\sin\theta_{0max} = N.A = \sqrt{n_1^2 - n_2^2}$ —(5) or $\theta_a = \theta_{0max} = \sin^{-1}(N.A)$ —(6)			
	OR			
2(a)	Active glass fibers: These fibers are made from rare earth elements & have optical & magnetic properties. These properties allow the material to perform amplification, attenuation & phase retardation on the light passing through it. two commonly used materials are erbium & neodymium. plastic optical fibers The core of these febers is either polymethylmethacrylate or a perfluorinated polymer. These fibers are refered to as PMMA POF & PF_POF.	4M	L3	CO1
2(b)	Material dispersion: pulse broadening due to material dispersin results from different group velocities of the various & Spectral Components of launched into the fiber from the optical Source. It occurs when the phase velocity of a plane wave plopagating in the dielettric medium varies non-linearly with wavelength (λ) & $\frac{d^2n}{d\lambda^2} \neq 0$. The pulse Spread due to material dispersion maybe obtained by considering the group delay τ_g. where $\tau_g = \frac{1}{V_g} = \frac{d\beta}{d\omega} = \frac{1}{c}\left(n_1 - \lambda\frac{dn_1}{d\lambda}\right)$ —(1)	4M	L3	CO1

2(c)	**Step Index fibers:** In SIF, The R.I is Uniform throughout The Core & The RI plotile is defined as $n(r) = \begin{cases} n_1 & r < a \text{ (core)} \\ n_2 & r \geq a \text{ (cladding)} \end{cases}$ —① Fig ⓐ Shows multimode Step index fibers with a core diameter of around 50 km or greater, which is large enough to allow the plopagation of modes within the fiber core.  ⓐ Multimode SIF	4M Dia-2M Exp-2M	L3	CO1
	PART-B			
3(a)	**Fabry-perot Resonator Cavity for a laser Diode**  	4M Dia- 2M Exp-2M	L3	CO2
3(b)	1> Bulk recombination lifetime $\frac{1}{\tau} = \frac{1}{\tau_r} + \frac{1}{\tau_{nr}}$. $= \frac{1}{30} + \frac{1}{100}$. $\tau = 23.07$ nsec. 2> $\eta_{ext} = \frac{\tau}{\tau_r}$. $= \frac{23.07}{30}$. $= 0.769$ or 77%. $P_{ext} = \eta_{ext} \frac{hcI}{q\lambda}$ $= 0.769 \left[\frac{(6.625 \times 10^{-34} \times 3 \times 10^8 \times 0.04)}{(1.602 \times 10^{-19})(1.31 \times 10^{-6})} \right]$ check $P_{int} = \frac{29.13}{0.769} = 37.88$ mW	4M Dia-2M Exp-2M	L3	CO2

	OR			
4(a)		4M Dia-2M Exp-2M	L3	CO2
4(b)		4M Dia-2M Exp-2M	L3	CO2

Course In charge

HOD ECE

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
FIRST INTERNAL TEST QUESTION PAPER 2024-25 ODD SEMESTER

SET: B

USN										

Degree : **B.E** | **Semester** : **VII**
Branch - Stream : **ECE** | **Course Type / Code** : **21EC72**
Course Title : **Optical & Wireless Communication** | **Date** : **07/10/2024**
Duration : **1 Hr (60 minutes)** | **Max Marks** : **20**

Note: Answer **ONE full** question from each Module.

L-Bloom's Level: L1-Remebering, L2-Understanding, L3-Applying, L4-Analyzing, L5-Evaluating, L6-Creating

Q No.	Questions	Marks	CO	L
	Module-1			
1(a)	**Explain** fiber bending losses with relevant diagram	4	CO1	L2
(b)	Consider a multimode silica fiber that has a core RI of 1.50 and a cladding RI of 1.47.**Solve** i) Critical angle ii) Numerical aperture iii) Acceptance angle	4		L3
(c)	**Identify** and explain different attenuation mechanisms in optical fibers	4		L3
	OR			
2(a)	Explain Mode field diameter for single mode fiber with diagrams	4	CO1	L2
(b)	**Develop** an expression for the delay difference due to intermodal dispersion in Multimode Step index fiber.	4		L3
(c)	Make use of the following terms w r t optical fibers i.Critical angle ii. Acceptance angle iii. Numerical aperture	4		L3
	Module-2			
3(a)	**Derive an** expression for efficiency and internal power for LED	4	CO2	L3
(b)	A PIN photodiode on avg generates one E-H pair for two incident photons at a wavelength of 0.75μm .**Solve** I.quantum efficiency ii.bandgap energy iii.mean photo current if the incident power is 20μw	4		L3
	OR			
4(a)	**Construct** Surface emitter LED with neat diagram and explain its working	4	CO2	L3
(b)	**Solve** the energy in electron volt for the following wavelengths i.eye response-550nm ii.CO_2 LASER wavelemgth-10.6μm	4		L3

Name & Signature of Course In charge: | **Name & Signature of Module Coordinator:** | **HOD ECE** | **Principal**

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU-560109

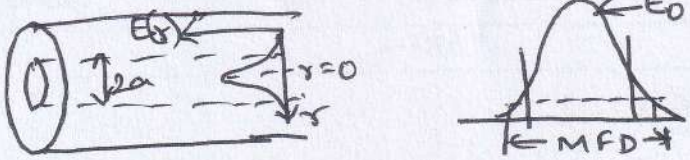
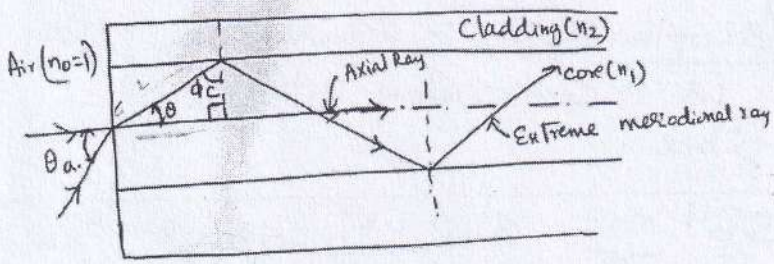
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

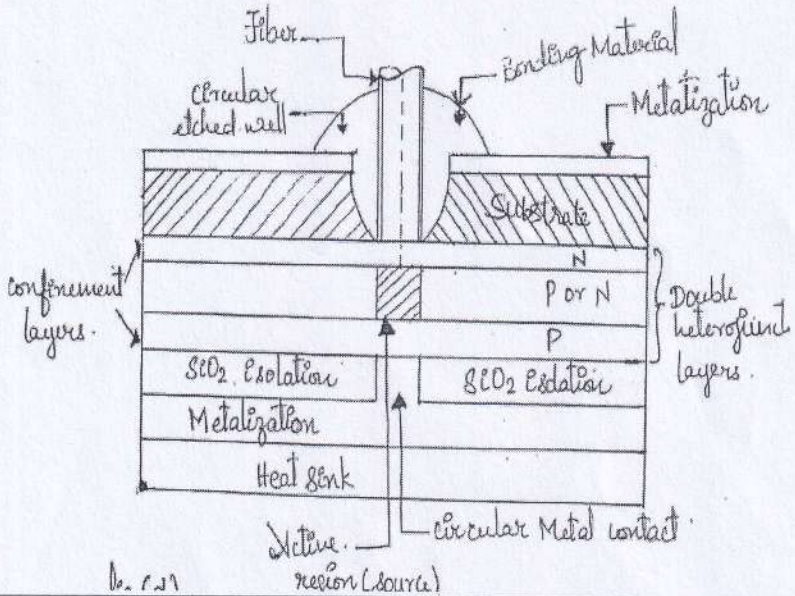
SESSION: 2024-2025 (ODD SEMESTER)

SUB: Optical & Wireless Communication -21EC72

FIRST SESSIONAL TEST SCHEME & SOLUTION-SET-B

Q. No.	Scheme and Solution	Marks	L Level	CO
	PART-A			
1(a)	Bending losses :- When a fiber is bend, radius of curvature varies 1. Macroscopic bends → occurs when a fiber is bend towards corner 2. Microscoping bends :- occurs when a fiber is incorsporated into other fiber.	4M	L2	CO1
1(b)	i. $\phi_c = \sin^{-1}\frac{n_2}{n_1} = \sin^{-1}\frac{1.47}{1.50} = 78.5^0$ ii. $NA = \sqrt{n_1^2 - n_2^2} = \sqrt{(1.5)^2 - (1.47)^2}$ $= 0.30$ iii. $\theta_a = \sin^{-1} NA = \sin^{-1} 0.3 = 17.4^0$	4M	L3	CO1
1(c)	Attenuation is a loss of Signal strengths when the information is transmitted for a longer distance. 3 Mechanisms 1. Absorption 2. Scattering 3. Radiation	4M	L3	CO1

	OR			
2(a)	Mode field diameter is the key palameter for SMF & is a function of 1. Wavelength 2. Core radius & 3. RI profile of the fiber. 	4M	L3	CO1
2(b)	Multimode Step-index fiber :- Using the ray theory model, the fastest & slowest modes propagating in the SIF maybe represented by the axial ray & the extreme meridional ray respectively as shown in fig@ 	4M	L3	CO1
2(c)	Critical angle: Minimum angle at which TIR occurs $\phi_c = \sin^{-1}\frac{n_2}{n_1}$ NA: Light collecting ability of fiber $NA = \sqrt{n_1^2 - n_2^2}$ acceptance angle:- Maximum angle at which TIR occurs $\theta_a = \sin^{-1} NA$	4M Dia-2M Exp-2M	L3	CO1

	PART-B			
3(a)	$\eta_{int} = \frac{R_r}{R_r + R_{nr}}$ $\frac{1}{\tau} = \frac{1}{\tau_r} + \frac{1}{\tau_{nr}}$ or $\frac{\tau}{\tau_r} = \eta_{int}$ $R_r + R_{nr} = I/Q$ $P_{int} = \eta_{int} \frac{hcI}{Q\lambda}$	4M Dia- 2M Exp-2M	L3	CO2
3(b)	i. $\eta = \frac{1}{2} = 50\%$ ii. $E_g = \frac{hc}{\lambda} = 1.65 eV$ iii. $I_p = R P_{in} = 6.037 KA$	4M ~~Dia-2M~~ ~~Exp-2M~~	L3	CO2
	OR			
4(a)		4M Dia-2M Exp-2M	L3	CO2

		4M	L3	CO2
4(b)	i. $E = \frac{1.24}{\lambda(\mu m)}$ $\lambda = 550nm = 0.55\mu m$ $= 2.25eV$ ii. $E = \frac{1.24}{\lambda(\mu m)} = \frac{1.24}{10.6}$ $= 0.1169 eV$	~~Dia-2M~~ ~~Exp-2M~~		

Course In charge

HOD ECE

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
SECOND INTERNAL TEST QUESTION PAPER 2024-25 ODD SEMESTER

SET: A

USN										

Degree : **B.E**
Branch - Stream : **ECE**
Course Title : **Optical & Wireless Communication**
Duration : **1 Hr (60 minutes)**

Semester : **VII**
Course Type / Code : **Core/21EC72**
Date : **08/11/2024**
Max Marks : **20**

Note: Answer **ONE full** question from each Module.

L-Bloom's Level: L1-Remebering, L2-Understanding, L3-Applying, L4-Analyzing, L5-Evaluating, L6-Creating

Q No.	Questions	Marks	CO	L
	Module-2			
1(a)	**Utilize** the concept of WDM in optical communication	04	CO2	L3
	OR			
2(a)	**Develop** 3 port circulator with their specifications	04	CO2	L3
	Module-3			
3(a)	Consider a single high-power transmitter that can support 40 voice channels over an area of 140 km² with the available spectrum. If this area is equally divided into seven smaller areas (cells), each supported by lower power transmitters so that each cell supports 30% of the channels. **Solve** i. coverage area of each cell ii. total number of voice channels	04	CO3	L3
(b)	**Identify** and explain different fading mechanisms	04		L3
(c)	**Make use of** the concept of clustering and cell structure used in cellular communication	04		L3
	OR			
4(a)	A cellular system of 32 cells with a cell radius of 1.6 km, a total spectrum allocation that supports 336 traffic channels, and a reuse pattern of 7. **Solve** i. The total service area covered with this configuration ii. The number of channels per cell iii. total system capacity. Assume regular hexagonal cellular topology	04	CO3	L3
(b)	**Identify** and explain IG cellular systems with their specifications	04		L3
(c)	**Make use of** frequency reuse concept for cluster size K = 7	04		L3
	Module-4			
5(a)	**Make use of** the concept of FDMA used in wireless communication	04	CO4	L3
	OR			
6(a)	A US AMPS analog cellular system is allocated 12.5 MHz for each simplex band. If the guard band at either end of the allocated spectrum is 10 kHz, and the channel bandwidth is 30 kHz. **Solve** the number of channels available in an FDMA system.	04	CO4	L3

Dineel
Name & Signature of Course In charge

Dineel
Name & Signature of Module Coordinator

HOD

Principal

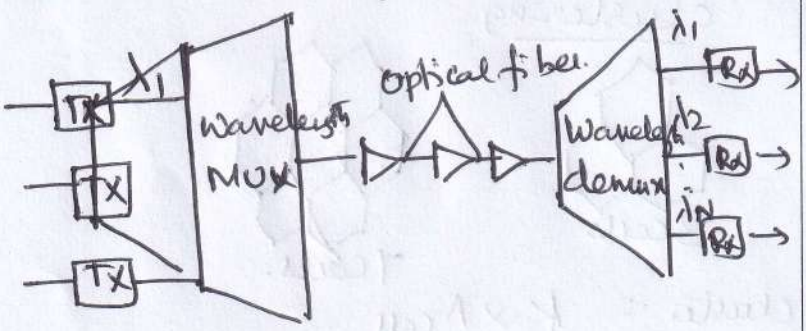
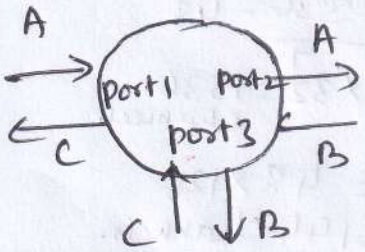
K.S. INSTITUTE OF TECHNOLOGY, BENGALURU-560109

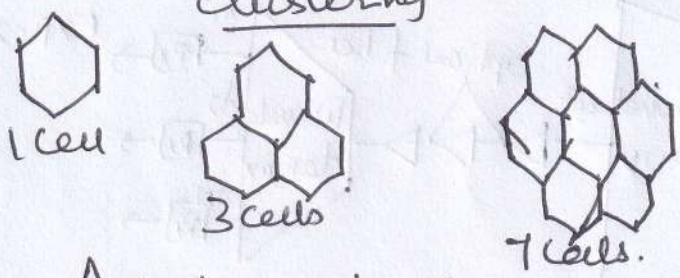
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

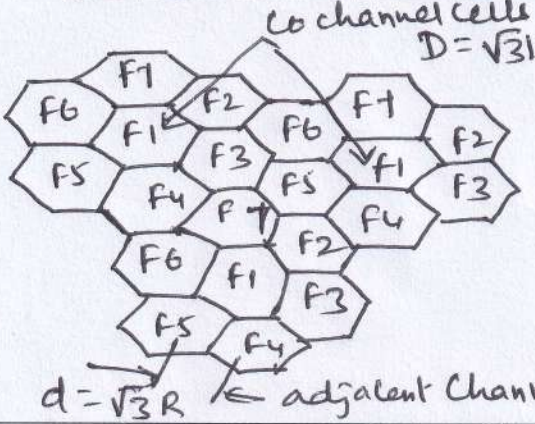
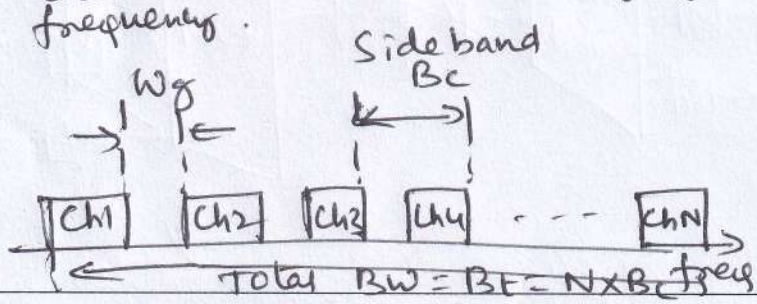
SESSION: 2024-2025 (ODD SEMESTER)

SUB: Optical & Wireless Communication -21EC72

SECOND SESSIONAL TEST SCHEME & SOLUTION-SET-A

Q. No.	Scheme and Solution	Marks	L Level	CO
	PART-A			
1(a)	WDM :- Technique of combining optical signals of different wavelengths 	4M Dia-2 Exp-2	L3	CO2
2(a)	Circulator is a non reciprocal device which allow power flow in one direction.  Size → 5.5 x 50mm Wavelength C band ⇒ 1525 - 1565nm L band ⇒ 1570 - 1610nm	4M	L3	CO2
3(a)	i) Coverage area of a cell = $\frac{140 Km^2}{7}$ = $20 Km^2$ ii) No of voice channes = 30% of original channels = 0.3 x 40 = 12 Channels. Total no of voice channels = 12 x 7 = 84 Channels.	4M	L3	CO3

3(b)	Fading Mechanisms ① flat fading → occurs when the radio channel has a constant gain & linear phase response. ② Rayleigh fading → occurs with No line of sight signal path ③ Rician fading → Small signal envelope.	4M	L3	CO3
3(c)	clustering  $A_{cluster} = K \times A_{cell}$.	4M	L3	CO3
4(a)	i) $A_{cell} = \frac{3\sqrt{3}}{2} \times R^2 = 6.65\ km^2$ No of channels per cell $= \frac{336}{7} = 48$ System Capacity $= 48 \times 32 = 1536$ channels ii) New System Capacity $= 48 \times 128$ $= 6144$ Channels.	4M	L3	CO3
4(b)	1G cellular Systems AMPS → 832 channels FDMA/FM US ETACS → 1240 channels —11— UK NMT900 → 1999 channels —11— EU JTACS 400/800 FDMA/FM → Japan	4M	L3	CO3

4(c)	Frequency Reuse Concept  	4M	L3	CO3
5(a)	FDMA → frequency division Multiple access → entire BW is divided into N-channels of different frequency.  	4M	L3	CO4
6(a)	$B_t = 12.5\,MHz$ $B_g = 10\,KHz$ $B_c = 30\,KHz$ $N = \frac{B_t - 2B_g}{B_c} = \frac{12.5\times10^6 - 2\times10\times10^3}{30\times10^3}$ $N = 416$	4M	L3	CO4

Course In charge

HOD ECE

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
SECOND INTERNAL TEST QUESTION PAPER 2024-25 ODD SEMESTER

SET: B

USN | | | | | | | | | | |

Degree : B.E
Branch - Stream : ECE
Course Title : Optical & Wireless Communication
Duration : 1 Hr (60 minutes)

Semester : VII
Course Type / Code : 21EC72
Date : 07/11/2024
Max Marks : 20

Note: Answer **ONE full** question from each Module.

L-Bloom's Level: L1-Remebering, L2-Understanding, L3-Applying, L4-Analyzing, L5-Evaluating, L6-Creating

Q No.	Questions	Marks	CO	L
	Module-2			
1(a)	Make use of the concept of Fiber Brag Grating used in WDM	04	CO2	L3
	OR			
2(a)	Construct and explain Faraday rotation isolator with neat diagram	04	CO2	L3
	Module-3			
3(a)	**Solve** the number of times the cluster of size 4 have to be replicated in order to approximately cover the entire service area of 1765 km^2 with the adequate number of uniform-sized cells of 7 km^2 each.	04	CO3	L3
(b)	**Make use of** the concept of fast fading with relevant diagram	04		L3
(c)	Identify and explain 2G cellular systems with their specifications	04		L3
	OR			
4(a)	A mobile subscriber travels at a uniform speed of 60 km/h. **Solve** the time between fades if the mobile uses i.a cellphone operating at 900 MHz ii.a PCS phone operating at 1900 MHz	04	CO3	L3
(b)	**Derive** the relationship between frequency reuse factor Q and cluster size K	04		L3
(c)	**Identify** and explain different cells used in cellular system and also illustrate a cell with a cell site and mobile	04		L3
	Module-4			
5(a)	A cellular system operator is allocated a total spectrum of 5 MHz for deployment of an analog cellular system based on the FDMA technique, with each simplex channel occupying 25 kHz bandwidth. **Solve** the number of simultaneous calls possible in the system.	04	CO4	L3
	OR			
6(a)	**Make use of** the concept of FDMA/FDD used in AMPS system	04	CO4	L3

Dinesh

Name & Signature of Course In charge

Dinesh

Name & Signature of Module Coordinator

HOD

Principal

Selected

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU-560109

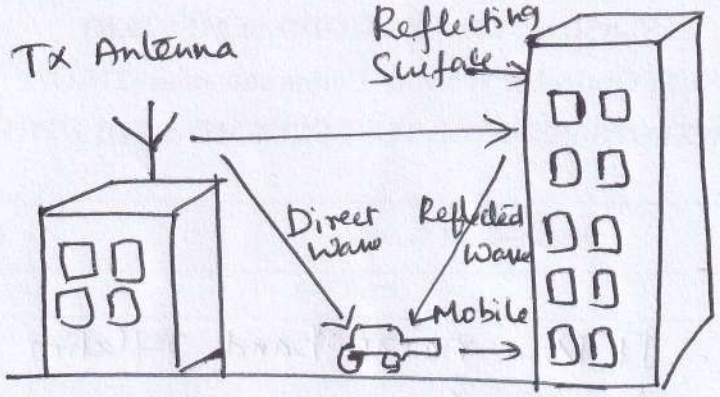
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

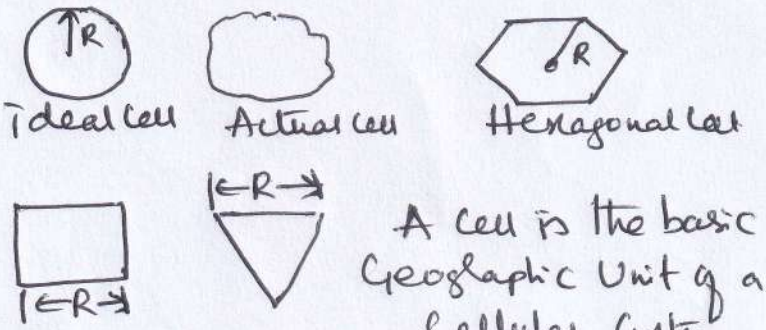
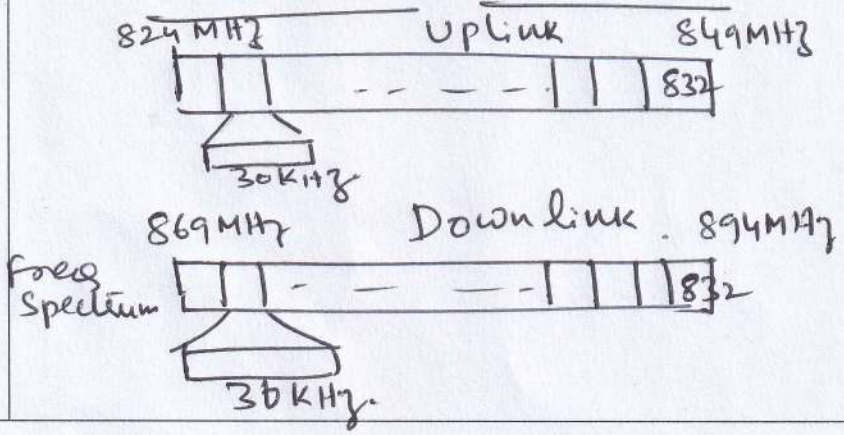
SESSION: 2024-2025 (ODD SEMESTER)

SUB: Optical & Wireless Communication -21EC72

SECOND SESSIONAL TEST SCHEME & SOLUTION-SET-B

Q. No.	Scheme and Solution	Marks	L Level	CO
	PART-A			
1(a)	FBG :- It is a narrowband reflection filter that is fabricated using a photoimplinting process. The Technique is based on the UV light It is used in WDM System for combining & seperating individual Wavelengths.	4M Dia-2 Exp-2	L3	CO2
2(a)	Isolator :- it is a non reciprocal device that allows light to pass through them in only one direction. It consists of 3 components 45° Faraday rotator & two Birefringent	4M Dia-2 Exp-2	L3	CO2
3(a)	K=4, $A_{cell} = 7 km^2$ i. Area of cluster $= K \times A_{cell}$ $= 4 \times 7 km^2$ $= 28 km^2$ No of clusters $= \frac{A_{sys}}{A_{cluster}} = \frac{1765}{28} = 64$	4M	L3	CO3

3(b)		4M DIA-2 EXP-2	L3	CO3
3(c)	2G Cellular Systems ① IS 54/136 TDMA/FDD US ② GSM TDMA/FDD Europe ③ PDC TDMA/FDD Japan ④ IS-95 CDMA/FDD US/ASIA	4M	L3	CO3
4(a)	ii) $V_m = 60\text{kmph} = \frac{60\times10^3}{3600} = 16.67\text{m/s}$ i) $T_f = \frac{c}{2f_c V_m} = \frac{3\times10^8}{2\times900\times10^6\times16.7}$ $= 10\text{msec}$ ii) $T_f = \frac{c}{2f_c V_m} = \frac{3\times10^8}{2\times1900\times10^6\times16.7} = 4\text{msec}$	4M	L3	CO3
4(b)	$D^2 = (i\times d)^2 + (j\times d)^2 - 2\times(i\times d)(j\times d)\cos120^\circ$ $D^2 = d^2(i^2+j^2+i\times j)$ But $d = \sqrt{3}R$ $\therefore D^2 = 3R^2\times K$ $\frac{D^2}{R^2} = 3K$ $\frac{D}{R} = \sqrt{3K} = Q.$	4M	L3	CO3

4(c)	Types of Cells.  A cell is the basic Geographic Unit of a Cellular System	4M	L3	CO3
5(a)	(i) No of Simplex Channels = $\frac{5\times10^6}{25\times10^3}$ $= 200$ (ii) No of duplex channels = $\frac{200}{2} = 100$ ∴ 100 Simultaneous Calls are possible.	4M	L3	CO4
6(a)	FDMA FDD in AMPS System  	4M	L3	CO4

Course In charge

HOD ECE

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
THIRD INTERNAL TEST QUESTION PAPER 2024-25 ODD SEMESTER

SET: A

USN										

Degree : B.E
Branch - Stream : ECE
Course Title : Optical and Wireless Communication
Duration : 1 Hr (60 minutes)

Semester : VII
Course Type / Code : Core /21EC72
Date : 12/12/2024
Max Marks : 20

Note: Answer **ONE full** question from each Module.

L-Bloom's Level: L1-Remebering, L2-Understanding, L3-Applying, L4-Analyzing, L5-Evaluating, L6-Creating

Q No.	Questions	Marks	CO	L
	Module-4			
1(a)	**Make use of** the concept of TDMA with relevant diagram	04	CO4	L3
(b)	**Identify** and explain the different parts of a cellular system	04		L3
	OR			
2(a)	**Utilize** the concept of CDMA with relevant diagram	04	CO4	L3
(b)	**Make use of** the concept of hybrid TDMA /FDMA used in IS-136 cellular system with frame format	04		L3
	Module-5			
3(a)	**Make use of** GSM architecture with neat diagram and briefly explain main components	04	CO5	L3
(b)	**Identify** and explain different broadcast control channels used in GSM	04		L3
(c)	The GSM system uses the GMSK modulation scheme. **Solve** the bandwidth efficiency of the standard GSM system.	04		L3
	OR			
4(a)	**Identify** and explain GSM traffic channels with frame structure	04	CO5	L3
(b)	**Identify** and explain different GSM handoffs used in cellular communication	04		L3
(c)	GSM uses a frame structure where each frame consists of 8 time slots, and each time slot contains 156.25 bits and data is transmitted over a channel at 270.833 kbps. **Solve** i. Time duration of a bit ii. Time duration of a time slot iii. Time duration of a TDMA frame.	04		L3

Name & Signature of Course In charge:

Name & Signature of Module Coordinator:

HOD

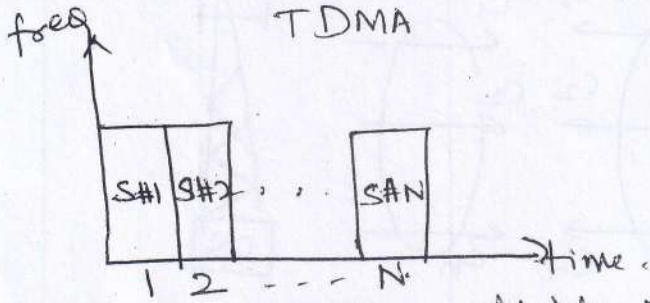
Principal

Selected.

K.S. INSTITUTE OF TECHNOLOGY, BANGALORE - 560109
THIRD INTERNAL TEST QUESTION PAPER 2024 – 25 ODD SEMESTER

SCHEME AND SOLUTION (SET A)

Degree	:	B.E	Semester	:	VII
Branch	:	ECE	Course Code	:	21EC72
Course Title	:	Optical and Wireless Communication	Max Marks	:	20

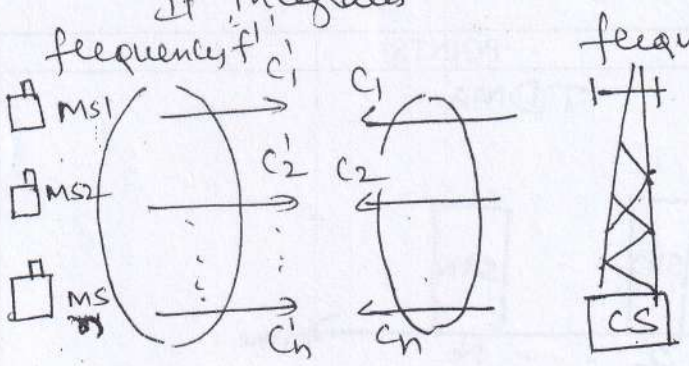
Q.NO.	POINTS	MARKS
1a)	TDMA  TDMA systems divide the available radio spectrum into N. timeslots $N = \frac{\{m \times (B_t - 2B_g)\}}{B_c}$	Dia-2M Exp-2M
1b)	Parts of a cellular System 1. cell site Equipment 2. MTSO 3. MSU CSE: A CS is a fixed base station used for wireless comm'n. It consists of Cell Site Tranceiver cell site controller MTSO → It is the central coordinating System MSU → It comprises of a single antenna, tranceiver & microprocessor based control CKt	Dia-2M Exp-2M

2a) CDMA ⇒ code division Multipleaceas.

It Uses Spread Spectrum Modulation Technique

Dia-2M
Exp-2M.

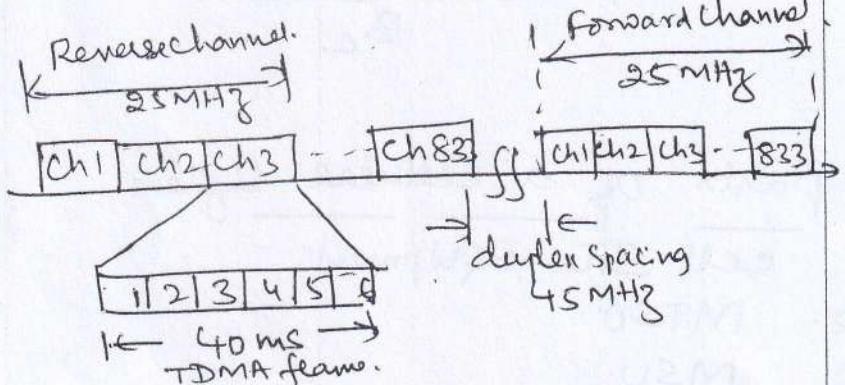
It integrates Voice & data



2b) Hybrid TDMA/FDMA in IS-136 System

It combines both TDMA & FDMA

Dia-2M
Exp-2M



3a) GSM:- Global System for Mobile

It Uses 2 frequency bands of 25MHz each. With

Uplink frequency 890MHz - 915MHz

& down link frequency 935MHz - 960MHz

Dia-2M
Exp-2M

It has 4 components

① MS
② BSC - Base Station Controller
③ MSC → Mobile station Controller
④ OMC → operation & Maintanance Centre.

3b) **Broad cast channels**

1. BCCH → Broadcast Control channel.
2. FCCH → frequency correction Control Channel
3. SCH → Synchronization Channel. — Exp-4M

BCCH → Used by BTS to broadcast
1. frequency of operation
2. Operator identifiers
3. Cell ID

FCCH → Used by the BTS to correct 148 bits length data

SCH → Used by BTS to synchronize 64bit length data.

3c) **Solu:-** The channel BW = 200KHz

Channel data rate = 270.833 Kbps

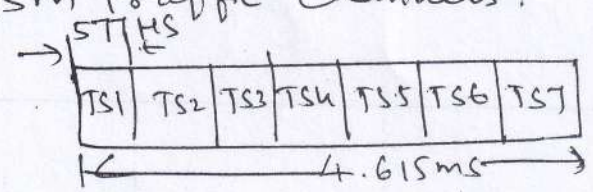
B.W efficiency = $\frac{\text{Channel data rate}}{\text{Channel BW}}$ — Solu-4M

$= \frac{270.833 \times 10^3}{200 \times 10^3}$

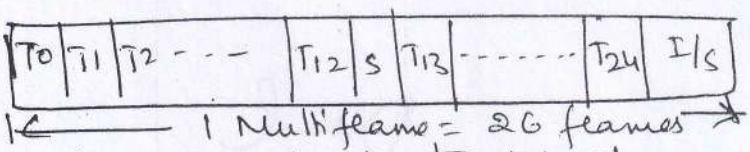
$= 1.35 \text{ bps/Hz}$

4a) **GSM Traffic Control Channels**

Voice channels are called GSM Traffic channels.



Dia-2M
Exp-2M



TCH/F → Full rate Traffic Channel

TCH/H → Half rate traffic Channel.

4b) **Handoff's Used in GSM**

1. Intra cell-cum-intra-BTS Handoff
   It is initialed by the BS.
2. Intercell-cum-intra-BSC Handoff
   This occurs b/w two cells.
3. Inter-BSC-cum Intra-MSC
   Handoff.
4. Inter-MSC-handoff → occurs b/w two cells That are in different MSC's.

4M

4c) i $R_b = 270.833$ Kbps

$T_b = \frac{1}{R_b} = \frac{1}{270.833 \times 10^3} = 3.69$ μs

ii. $T_{slot} = 156.25$ bits $\times T_b$

$= 577$ μs

iii. $T_f = $ no of Time Slots $\times T_{slot}$

$= 8 \times 577 \times 10^{-6}$

$T_f = 4.616$ ms

4M.

Course in charge

Module Coordinator

HOD ECE

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
THIRD INTERNAL TEST QUESTION PAPER 2024-25 ODD SEMESTER

SET: B

USN										

Degree : B.E
Branch - Stream : ECE
Course Title : Optical and Wireless Communication
Duration : 1 Hr (60 minutes)

Semester : VII
Course Type / Code : Core /21EC72
Date : 12/12/2024
Max Marks : 20

Note: Answer **ONE full** question from each Module.

L-Bloom's Level: L1-Remebering, L2-Understanding, L3-Applying, L4-Analyzing, L5-Evaluating, L6-Creating

Q No.	Questions	Marks	CO	L
	Module-4			
1(a)	**Make use of** the concept of OFDM used in OFDMA with relevant diagram	04	CO4	L3
(b)	**Identify** and explain the different steps used in mobile to mobile call procedures	04		L3
	OR			
2(a)	**Make use of** the concept of hybrid TDMA /FDMA used in GSM cellular system with frame format	04	CO4	L3
(b)	**Identify** any eight parameters of a GSM system	04		L3
	Module-5			
3(a)	**Make use of** GSM protocol architecture with neat diagram and explain different layers	04	CO5	L3
(b)	**Make use of** GSM super frame structure with neat diagram	04		L3
(c)	The channel data rate is 270.833 kbps in GSM standard that is 40% (say) of theoretical maximum data rate that can be supported in a 200-kHz channel bandwidth. **Solve** the corresponding theoretical S/N required.	04		L3
	OR			
4(a)	**Identify** and briefly explain GSM services	04	CO5	L3
(b)	**Identify** and explain any four identifiers used in GSM system with necessary frame formats	04		L3
(c)	**Show** that the 3-dB bandwidth for a Gaussian LPF used to produce B × Tb = 0.3 GMSK modulation in GSM standard is 81.3 kHz. The channel data rate is 270.833 kbps.	04		L3

Name & Signature of Course In charge:

Name & Signature of Module Coordinator:

HOD

Principal

K.S. INSTITUTE OF TECHNOLOGY, BANGALORE - 560109
THIRD INTERNAL TEST QUESTION PAPER 2024 - 25 ODD SEMESTER

SCHEME AND SOLUTION (SET B)

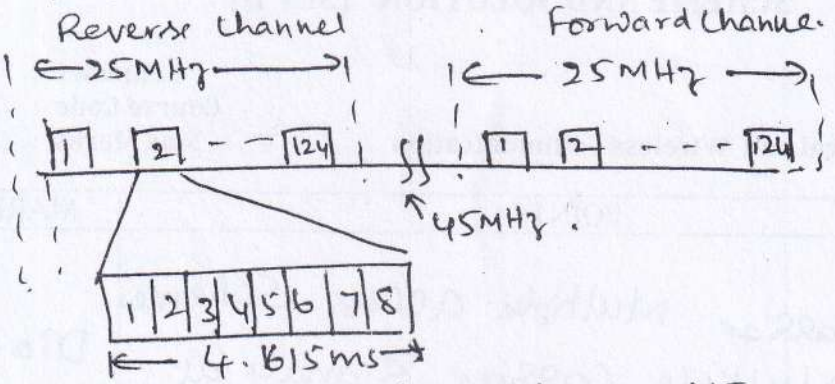
Degree : B.E
Branch : ECE
Course Title : Optical and Wireless Communication

Semester : VII
Course Code : 21EC72
Max Marks : 20

Q.NO.	POINTS	MARKS
1a)	Multicarrier Multiple access Schemes Use Multiple carrier Signals at different frequencies, Sending Some of the bits on each channel. It is Similar to FDM in concept	Dia-2M Exp-2M
1b)	Steps in Mobile-to-mobile call procedures 1. originating MS initiates the call. 2. CS receives the caller's ID number. 3. The MTSO sends a page command to all CS 4. The destination CS controller sends a page request through a forward control channel. 5. Traffic Channels are assigned 6. call progress tones are given to both calling and called mobile Subscribers	Steps 6M

2a) Hybrid TDMA/FDMA in GSM

Dia-2
Exp-2



GSM has 8 time slots with Frame duration of 4.615ms

2b) GSM parameters

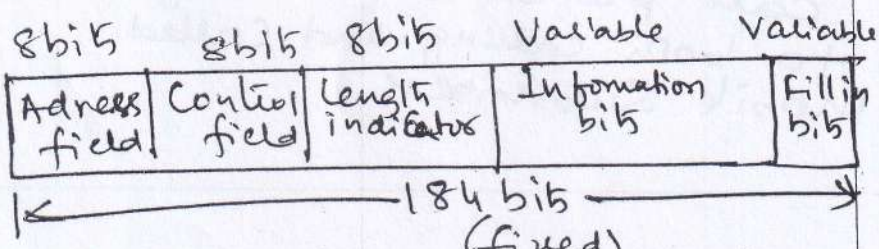
1. Freq band → 890–915 MHz Uplink
   935–960 MHz downlink
2. Spacing b/w Uplink & downlink → 45MHz
3. No of Time slots = 8
4. Duration of TDMA frame = 4.615ms
5. Duration of Time slot = 577 μs
6. Multiple access Technique TDMA/FDMA
7. Modulation Scheme — GMSK
8. Duplexing Technique - FDD

3a) GSM protocol Architecture

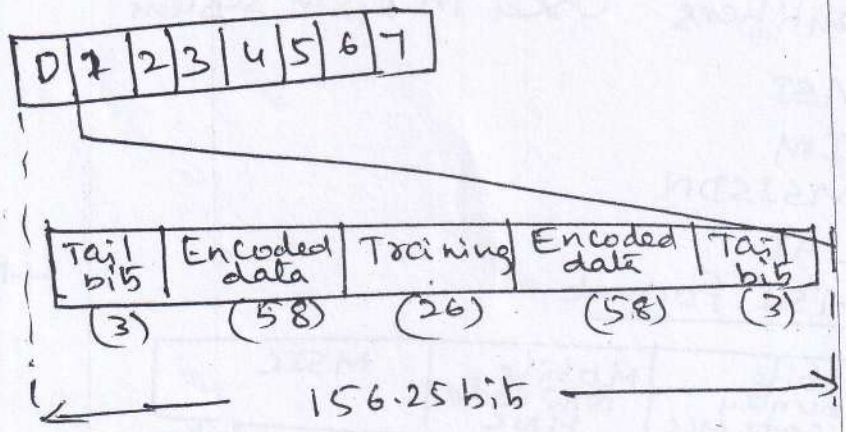
Dia-2M
Exp-2M

GSM protocol is divided into 3 layer.
1. physical layer
2. Data link layer
3. Networking layer.

LAPD is used as a protocol



3b) GSM Frame Structure



Dia-2
Exp-2

3c)

$R_b = 270.833 Kbps$

$R_b = 0.4 \times C$

$C = \frac{R_b}{0.4} = \frac{270.833 Kbps}{0.4}$

$= 677 Kbps$

4M

$B = 200 KHz$

$C = B \times \log_2(1 + S/N)$

$S/N = 9.75 dB$

GSM Services..

4a) Telephone services → Telephony voice at 13 Kbps (Full rate)
SMS :- point to point & cell broadcast types

Data or bearer services
Access to X-25 public data n/ws

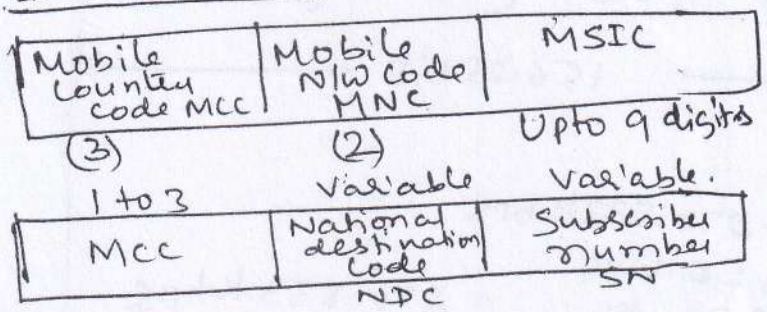
Supplementary ISDN services
Call forwarding
Call barring
Call waiting
Call holding

4M

4b) Identifiers Used in GSM System

1. IMSI
2. SIM
3. MSISDN
4. LAI

IMSI format



4M

4c)

Soln:- $R_b = 270.833 \text{ kbps}$

$T_b = \frac{1}{R_b} = 3.69 \mu s$

$B \times T_b = 0.3$

$B = \frac{0.3}{T_b} = \frac{0.3}{3.69 \times 10^{-6}}$

$= 81.3 \text{ KHz}$

4M

Course in charge

Module Coordinator

HOD_ECE

K. S. INSTITUTE OF TECHNOLOGY

#14, Raghuvanahalli, Kanakapura Main Road, Bengaluru-5600109

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

2024-25 ODD SEMESTER

List of students who are identified as slow learners and their marks in every internal

Subject and Subject Code: OPTICAL AND WIRELESS COMMUNICATION/ 21EC72

Semester and Section: VII A

Sl No.	USN	NAME	First Test Marks	Remedial Class Dates & Attendance		Improvement Test Marks	Second Test Marks	Remedial Class Dates & Attendance		Improvement Test Marks	Third Test Marks	Improvement Test Marks	FINAL (50)
				15/10/24	25/10/24			20/11/24	26/11/24				
01	1KS21EC003	ABHISHEK H C	AB	P	P	7	AB	P	P	10	6		31
02	1KS21EC005	AISHWARYA A	AB	P	P		AB	P	P	14	5		28
03	1KS21EC015	B N JEEVAN	AB	P	P	15	AB	P	P		10		32
04	1KS21EC028	GAGAN V	4	P	P		AB	P	P	15	9		30
05	1KS21EC031	GURUSHANKARA M	AB	P	P	10	7				8		31
06	1KS21EC050	SAI HIMAJA	AB	P	P	15	AB	P	P		12		33
07	1KS21EC056	NAYANA S	AB	P	P	7	AB	P	P	8	9		31
08	1KS22EC051	NANDAN K	AB	P	P	15	AB	P	P		12		33
09	1KS22EC060	POLURU MANJUNATH	AB	P	P	12	8				4		27

Signature of the Faculty

Signature of the HOD

K. S. INSTITUTE OF TECHNOLOGY

#14, Raghuvanahalli, Kanakapura Main Road, Bengaluru-5600109

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

2024-25 ODD SEMESTER

List of students who are identified as slow learners and their marks in every internal

Subject and Subject Code: OPTICAL AND WIRELESS COMMUNICATION/ 21EC72

Semester and Section: VII B

Sl No.	USN	NAME	First Test Marks	Remedial Class Dates & Attendance		Improvement Test Marks	Second Test Marks	Remedial Class Dates & Attendance		Improvement Test Marks	Third Test Marks	Improvement Test Marks	FINAL
				15/10/24	23/10/24			20/11/24	26/11/24				
03	1KS21EC078	S HARI DHANUSH	AB.	P	P		10	P	P		10		25
05	1KS21EC108	THUSHAR CHERIAN	AB	P	P	6	10	P	P		8		31
06	1KS21EC109	UDAY KUMAR S R	8	P	P		AB	P	P	8	10		32
	1KS21EC113	VARSHITH S	7	P	P		14	P	P		5		32
07	1KS22EC408	SANGEETHA H M	6	P	P		8	P	P		13		33

Signature of the Faculty

Signature of the HOD

K.S. INSTITUTE OF TECHNOLOGY, BANGALORE - 560109
DEARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
TEACHING AND LEARNING

Pedagogy Activity

Academic Year	2024-25 (Odd)
Name of the Faculty	Dr. Dinesh Kumar D S
Course Name /Code	Optical and Wireless Communication
Semester/Section	VII/A &B
Activity Name	LITERATURE SURVEY PAPER
Topic Covered	Optical and Wireless Communication Syllabus
Date	16/12/2024 to 20/12/24
No. of Participants	123
Objectives/Goals	• To improve self-learning skills of students • To improve communication skills of students • To improve writing skills of journal paper
ICT Used	Microsoft word

Appropriate Method/Instructional materials/Exam Questions

- Initially delivered lecture on given topics.
- Later students were asked to prepare a draft of the literature survey paper from different topics covering each module
- Students are given with additional information/sources from which they can prepare innovatively and submit the report as per standard format

Relevant PO's	9,10,12
Significance of Results/Outcomes	• Students tried to explore the different optical fibers and wireless communication generations, architecture ,design and Application • Improve their self-learning, communication, and project management skills as an individual and team member. • There are total 123 students and 31 teams prepared and Submitted literature review paper.
Reflective Critique	• The activity improved the self-learning of students. • The activity provided a platform for students to interact with Peers improve their communication skills; work as individuals and as team.

Proofs (Photographs/Videos/Reports/Charts/Models) :Student literature survey paper is attached

Quantum Efficiency of Quantum Dot Lasers

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Abstract—**The quantum efficiency relates the calculated to the measured external threshold current of a laser. This quantity is often estimated from the length dependence of the external differential efficiency above threshold, assuming the carrier density is pinned. Often it is also assumed that the internal current varies linearly with the external current; it is shown here this is not the case due to the effect of stimulated emission on the current-voltage relation of the active region. Furthermore, it has been observed that spontaneous emission from inhomogeneous quantum dots does not pin above threshold which questions the determination of their optical loss. This nonpinning is reproduced by a model in which the laser photon rate equation is coupled to rate equations for the occupation of dot states mediated by a thermal phonon distribution. The threshold current from this model agrees with a Fermi–Dirac calculation but the external efficiency above threshold is lower and its length dependence gives a smaller value of mode loss than the input value. The reasons for this behavior are analyzed and it is concluded that a Fermi–Dirac calculation does not represent the light–current characteristics in quantum dot lasers at room temperature.**

Index Terms—**Quantum dots, semiconductor lasers, spontaneous emission.**

I. Introduction

KNOWLEDGE of the quantum efficiency of a diode laser is necessary when making a comparison between calculated gain-current relations and experimentally measured properties particularly the threshold current. Calculations usually provide the current due to intrinsic, radiative recombination processes within the active region[1] (J_{calc}) whereas measurements on laser structures give the current supplied by an external source (J_{ext}) which includes that due to carrier leakage and recombination in other parts of the structure in addition to the active region. The relation between them is expressed as an efficiency by the deceptively simple relation $J_{ext} = J_{calc}/\eta$.

In general the relation between the external current supplied and the internal radiative recombination current is made up of two components:

1) the fraction of the external current which enters the active region termed the injection efficiency, the balance being lost by current spreading and carrier leakage, and

It has been common practice to obtain the injection efficiency from an analysis of the differential quantum efficiency above threshold for devices of different cavity length, a procedure which also provides a value for the internal optical mode loss, α_i. Setting aside uncertainty due to the scatter in data from different devices, there are two concerns with this approach. Firstly the analysis relies upon the quasi-Fermi levels (and therefore carrier density) pinning above threshold and, secondly, it is assumed that the relation between internal and external currents is linear with the same slope below and above threshold, in other words that the *differential* injection efficiency above threshold is the same as the injection efficiency at and below threshold. The purpose of this paper is to examine these assumptions with particular reference to quantum dot lasers where there is evidence that the carrier density on the dots is not pinned above threshold.

The paper begins with a general outline of the analysis of the external differential efficiency as a function of cavity length. It is shown that, due to the onset of stimulated emission above threshold, the relation between internal and external currents is not linear going above threshold therefore it is important to distinguish "overall" efficiencies and differential efficiencies. The specific implications for quantum dot lasers are examined using calculations which replicate the non-pinning above threshold in the dots, solving the single mode photon rate equation with rate equations for occupation of dot and wetting layer states mediated by a thermal phonon distribution, without prior assumption of a Fermi-Dirac distribution. The calculated light-current curves are analyzed as functions of cavity length revealing errors in the derived values of mode loss due to this behaviour.

Signature of Course In charge

Signature of HOD ECE

K.S. INSTITUTE OF TECHNOLOGY, BANGALORE - 560109
DEARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
TEACHING AND LEARNING

Content beyond Syllabus

Academic Year	2024-25 (Odd)
Name of the Faculty	Dr. Dinesh Kumar D S
Course Name /Code	Optical and Wireless Communication
Semester/Section	VII/A &B
Activity Name	LITERATURE SURVEY PAPER
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- Students are given with additional information/sources from which they can prepare innovatively and submit the report as per standard format

Relevant PO's	9,10,12
Significance of Results/Outcomes	• Students tried to explore the different optical fibers and wireless communication generations, architecture ,design and Application • Improve their self-learning, communication, and project management skills as an individual and team member. • There are total 123 students and 31 teams prepared and Submitted literature review paper.
Reflective Critique	• The activity improved the self-learning of students. • The activity provided a platform for students to interact with Peers improve their communication skills; work as individuals and as team.

Proofs (Photographs/Videos/Reports/Charts/Models) :Student literature survey paper is attached

Quantum Efficiency of Quantum Dot Lasers

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Abstract—**The quantum efficiency relates the calculated to the measured external threshold current of a laser. This quantity is often estimated from the length dependence of the external differential efficiency above threshold, assuming the carrier density is pinned. Often it is also assumed that the internal current varies linearly with the external current; it is shown here this is not the case due to the effect of stimulated emission on the current-voltage relation of the active region. Furthermore, it has been observed that spontaneous emission from inhomogeneous quantum dots does not pin above threshold which questions the determination of their optical loss. This nonpinning is reproduced by a model in which the laser photon rate equation is coupled to rate equations for the occupation of dot states mediated by a thermal phonon distribution. The threshold current from this model agrees with a Fermi–Dirac calculation but the external efficiency above threshold is lower and its length dependence gives a smaller value of mode loss than the input value. The reasons for this behavior are analyzed and it is concluded that a Fermi–Dirac calculation does not represent the light–current characteristics in quantum dot lasers at room temperature.**

Index Terms—**Quantum dots, semiconductor lasers, spontaneous emission.**

I. Introduction

KNOWLEDGE of the quantum efficiency of a diode laser is necessary when making a comparison between calculated gain-current relations and experimentally measured properties particularly the threshold current. Calculations usually provide the current due to intrinsic, radiative recombination processes within the active region[1] (J_{calc}) whereas measurements on laser structures give the current supplied by an external source (J_{ext}) which includes that due to carrier leakage and recombination in other parts of the structure in addition to the active region. The relation between them is expressed as an efficiency by the deceptively simple relation $J_{ext} = J_{calc}/\eta$.

In general the relation between the external current supplied and the internal radiative recombination current is made up of two components:

1)' the fraction of the external current which enters the active region termed the injection efficiency, the balance being lost by current spreading and carrier leakage, and

It has been common practice to obtain the injection efficiency from an analysis of the differential quantum efficiency above threshold for devices of different cavity length, a procedure which also provides a value for the internal optical mode loss, α_i. Setting aside uncertainty due to the scatter in data from different devices, there are two concerns with this approach. Firstly the analysis relies upon the quasi-Fermi levels (and therefore carrier density) pinning above threshold and, secondly, it is assumed that the relation between internal and external currents is linear with the same slope below and above threshold, in other words that the *differential* injection efficiency above threshold is the same as the injection efficiency at and below threshold. The purpose of this paper is to examine these assumptions with particular reference to quantum dot lasers where there is evidence that the carrier density on the dots is not pinned above threshold.

The paper begins with a general outline of the analysis of the external differential efficiency as a function of cavity length. It is shown that, due to the onset of stimulated emission above threshold, the relation between internal and external currents is not linear going above threshold therefore it is important to distinguish "overall" efficiencies and differential efficiencies. The specific implications for quantum dot lasers are examined using calculations which replicate the non-pinning above threshold in the dots, solving the single mode photon rate equation with rate equations for occupation of dot and wetting layer states mediated by a thermal phonon distribution, without prior assumption of a Fermi-Dirac distribution. The calculated light-current curves are analyzed as functions of cavity length revealing errors in the derived values of mode loss due to this behaviour.

Signature of Course In charge

Signature of HOD ECE

K S INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRONCS AND COMMUNICATION ENGINEERING

CBS ACTIVITY-OPTICAL AND WIRELESS COMMUNICATION-21EC72-2024-25(ODD)

Sl No	USN	Name	Team #	Topic	Section
	1KS21EC017	B S BHARGAV	1	TDMA	A
	1KS21EC021	CHINTAN D S			
	1KS21EC048	MITHUN C			
	1KS21EC041	Likitha L	2	DIFFRACTION GRATING	A
	1KS21EC001	Aadhya BN.			
	1KS21EC003	Abhishek HC.			
	1KS21EC020	BinduShree S.			
	1KS21EC047	Misba.M	3	MATERIAL DISPERSION	A
	1KS21EC049	MONISHA D			
	1KS21EC061	POOJA R			
	1KS21EC032	Harini.L	4	SCATTERING LOSSES	A
	1KS21EC006	Akshay.C			
	1KS21EC010	Archana.GM			
	1KS21EC013	Ashcharya.NB			
	1KS21EC007	Akshay M S	5	LED AND LASER	A
	1KS21EC042	Lohit SH			
	1KS21EC043	Lohith B			
	1KS21EC045	Manoj TV			
	1KS21EC023	Chiranth VV -	6	QUANTUM EFFICIENCY OF QUANTUM DOT LASER	A
	1KS21EC033	Hemanth D R			
	1KS21EC055	Nayana J -			
	1KS21EC053	Narahari N Joshi			
	1KS21EC024	D CHARITHAMUTTHULUR	7	FIBER GRATING TECHNIQUES	A
	1KS21EC050	SAI HIMAJA			
	1KS22EC404	SHRUJANA G			
	1AH21EC025	DAMINI S			
	1KS21EC015	B N Jeevan	8	CO CHANNEL INTERFERENCE	A
	1KS21EC028	Gagan V.			
	1KS21EC059	Pavan m pai			
	1KS21EC029	Gagana Sindu N			
	1KS21EC026	Deeksha	9	GSM WIRELESS COMMUNICATION SYSTEM	A
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	1KS21EC011	ARCHANA M	10	GENERATIONS OF WIRELESS NETWORKS	A&B
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	1KS22EC411	Sudeep P -			
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	1KS21EC082	Sai Rahul			
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	1KS21EC063	Prajwal G V:	14	TDMA	B
	1KS21EC081	Sagar G S			
	1KS21EC106	Tharun K V			
	1KS21EC107	Thejas H V			
	1KS21EC078	Hari Dhanush	15	GSM PROTOCOL ARCHITECTURE	B
	1KS21EC075	Rehaman Shariff-			
	1KS21EC087	Sanjay P-			
	1KS21EC089	Shaik Arfath-			
	1KS21EC098	Sumukh	16	PHOTODETECTORS	
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	1KS21EC115	Vidya I			

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	1KS21EC077	RITHIKA	23	GSM TECHNOLOGIES	
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	1KS21EC102	Surabhi.K. R -			A&B
	1KS21EC002	Abhijith R	25	EVOLUTION OF CELLULAR NETWORKS	
	1KS21EC058	Omkar N B-			
	1KS21EC095	Spoorthy M U-			
	IKS21EC036	KARAN S			A&B
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	1KS21EC120	Vyshak G R			
	1KS21EC121	Yashwanth M			
	1KS22EC400	Adithya D			A&B
	1KS21EC064	PRAJWAL HS	27	SDMA	B
	1KS21EC071	RAGHAVENDRA NARAYAN			
	1KS21EC088	SATHYAM KUMAR MANDAL S			
	1KS21EC091	V SHREYAS RAGHAVENDRA			
	1KS21EC070	Punith M	28	UOWC	
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	1KS21EC072	RAKSHITH S	29	SINGLE MODE FIBERS	
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	1KS21EC031	Gurushankara M	31	GSM	
	1KS21EC009	Anagha Prakash			
	1KS21EC008	Anirudh R Bhat			A

OPTICAL & WIRELESS COMMUNICATION

Degree	**: B.E**	**Semester**	**: VII**
Branch - Stream	**: ECE**	**Course Type / Code**	**: 21EC72**

QUESTION BANK-MODULE-1

1. classify optical fibers based index profile with core and cladding diameters

2. Define numerical aperture and obtain the expression for NA in terms of acceptance angle and RI difference

3. Explain mode field diameter w .r..t single mode fibers

4. Explain fiber materials used in optical fibers

5. Explain the following terms w.r.t. optical fibers i.critical angle ii.numerical aperture iii.acceptance angle

6. Consider a multimode silica fiber that has a core RI of 1.50 and a cladding RI of 1.47.**Solve** i) Critical angle ii) Numerical aperture iii) Acceptance angle

7. Explain different attenuation mechanisms in optical fibers

8. Explain the following lossses w.r.t optical fibersi.scattering losses ii bending losses

9. What is dispersion? Explain material dispersion with relevant expression

10. Derive an expression for delay difference in intermodal dispersion

OPTICAL & WIRELESS COMMUNICATION

Degree	**: B.E**	**Semester**	**: VII**
Branch - Stream	**: ECE**	**Course Type / Code**	**: 21EC72**

QUESTION BANK-MODULE-2

1. Explain I.surface emitter LED ii.Edge emitter LED with neat diagrams
2. Derive an expression for LED power and efficiency
3. Explain the double heterojunction structure LED with neat diagram
4. Explain fabry perot cavity LASER with neat diagram
5. Explain the working principle of PiN photodiode with neat diagram
6. Calculate the enegry in EV for the following wavelengths

i. eye response-550nm ii.CO_2 LASER wavelength -10.6μm

7. A PiN phto diode on average generates1 e-h pair for 2 incident photons at a wavelength of 0.75 μm.calculate I.quantum efficiency ii.bandgap energy iii.mean output photocurrent if the incident power is 20μw.

8. In a double heterojunction LED,the radiative & non radiative recombination lifetimes are 80ns and 100 ns respectively.calculate I.total carrier recombination life time ii.internally generated powerif emission wavelength is 0.67μm with device current of 50mA.

OPTICAL & WIRELESS COMMUNICATION

Degree	**: B.E**	**Semester**	**: VII**
Branch - Stream	**: ECE**	**Course Type / Code**	**: 21EC72**

QUESTION BANK-MODULE-3

1. **Calculate** the number of times the cluster of size 4 have to be replicated in order to approximately cover the entire service area of 1765 km^2 with the adequate number of uniform-sized cells of 7 km^2 each.
2. Identify and explain 2G cellular systems with their specifications
3. **Explain** the concept of fast fading with relevant diagram
4 A mobile subscriber travels at a uniform speed of 60 km/h. **Determine** the time between fades if the mobile uses i.a cellphone operating at 900 MHz ii.a PCS phone operating at 1900 MHzObtain the relationship between frequency reuse factor Q and cluster size K.
5. Explain frequency reuse concept for cluster size K = 7 and also mention its advantages
6. Explain 1G cellular systems with their specifications
7. A cellular system of 32 cells with a cell radius of 1.6 km, a total spectrum allocation that supports 336 traffic channels, and a reuse pattern of 7. Calculate
i. The total service area covered with this configuration ii. The number of channels per cell iii. Total system capacity. Assume regular hexagonal cellular topology
8. Explain different fading mechanisms with relevant diagrams
9. Consider a single high-power transmitter that can support 40 voice channels over an area of 140 km^2 with the available spectrum. If this area is equally divided into seven smaller areas (cells), each supported by lower power transmitters so that each cell supports 30% of the channels. Calculate i. coverage area of each cell ii. Total number of voice channels
10. **Explain** the concept of clustering and cell structure used in cellular communication
11. **Solve** the number of times the cluster of size 4 have to be replicated in order to approximately cover the entire service area of 1765 km^2 with the adequate number of uniform-sized cells of 7 km^2 each.
12. **Derive** the relationship between frequency reuse factor Q and cluster size K

OPTICAL & WIRELESS COMMUNICATION

Degree	**: B.E**	**Semester**	**: VII**
Branch - Stream	**: ECE**	**Course Type / Code**	**: 21EC72**

QUESTION BANK-MODULE-4

1. **Explain** the concept of OFDM used in OFDMA with relevant diagram
2. Explain the different steps used in mobile to mobile call procedures
3. **Explain** the concept of hybrid TDMA /FDMA used in GSM cellular system with frame format ii.IS-136 cellular system
4. **Explain** the concept of hybrid TDMA /FDMA used in GSM cellular system with frame format ii.IS-136 cellular system
5. **List** different parameters of a GSM system with their specifications
6. Explain different parts of a cellular system with neat diagram
7. Explain the different steps used in mobile to mobile call procedures
8. Explain the different steps used in mobile to landline call procedures
9. **Explain** the concept of CDMA with relevant diagram
10. **Explain** the concept of SDMA with relevant diagram

OPTICAL & WIRELESS COMMUNICATION

Degree	**: B.E**	**Semester**	**: VII**
Branch - Stream	**: ECE**	**Course Type / Code**	**: 21EC72**

QUESTION BANK-MODULE-5

1. **Explain** GSM architecture with neat diagram and briefly explain main components
2. **Explain** GSM protocol architecture with neat diagram and explain different layers
3. Explain different broadcast control channels used in GSM
4. Explain different traffic control channels used in GSM
5. Explain different identifiers used in GSM
6. Explain different handoffs used in GSM
7. Explain the different services used in GSM
8. Explain the GSM frame structure with neat diagram
9. GSM uses a frame structure where each frame consists of 8 time slots, and each time slot contains 156.25 bits and data is transmitted over a channel at 270.833 kbps. **Solve** i. Time duration of a bit ii. Time duration of a time slot iii. Time duration of a TDMA frame.
10. The GSM system uses the GMSK modulation scheme. **Solve** the bandwidth efficiency of the standard GSM system.
11. The channel data rate is 270.833 kbps in GSM standard that is 40% (say) of theoretical maximum data rate that can be supported in a 200-kHz channel bandwidth. **Solve** the corresponding theoretical S/N required.
12. **Show** that the 3-dB bandwidth for a Gaussian LPF used to produce $B \times Tb = 0.3$ GMSK modulation in GSM standard is 81.3 kHz. The channel data rate is 270.833 kbps.

Model Question Paper-1/2 with effect from 2021(CBCS Scheme)

USN | | | | | | | | | | |

7th Semester B.E. Degree Examination
OPTICAL AND WIRELESS COMMUNICATION

TIME: 03 Hours **Max. Marks: 100**

Note: 01. 02. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.
03.
04.

		Module -1	*Bloom's Taxonomy Level	COs	Marks
Q.01	a	Explain with necessary diagram the different type of fiber structure.	L2	1	6
	b	In a step index fiber if refractive index of core is 1.4 with Numerical aperture (NA) is 1.3, v=65, operating at 750nm. Calculate core size and cladding index.	L3	1	6
	c	What are the advantages, disadvantages and applications of optical fiber as compared to copper cable.	L1	1	8
		OR			
Q.02	a	Explain Intermodal dispersion for multimode step index fiber	L2	1	6
	b	Explain the three different mechanism that causes absorption of optical energy in optical fiber	L2	1	8
	c	A continuous 12km long optical fiber link has a loss of 1.5 dB/km, What is the minimum optical power level that must be launch into the fiber to maintain as optical power level of 0.3μw at the receiving end, and what is the required input power if the fiber has a loss of 2.5 dB/km.	L3	1	6
		Module-2			
Q. 03	a	An LED operating at 850nm has a spectral width of 45nm. What is the pulse spreading in ns/km due to material dispersion.	L3	2	6
	b	With a neat diagram, explain the working of an edge emitting LED. Also mention its special features and usage.	L2	2	8
	c	Explain the operation of DFB and DBR LASER	L2	2	6
		OR			
Q.04	a	Write a shot note on Avalanche photodiode.	L2	2	6
	b	With the schematic representation and energy band diagram. Explain the working of the PIN photodiode.	L2	2	8
	c	A given APD has the quantum efficiency of 65% at wavelength of 900nm. If 0.5μwatt of optical power produced a multiplied photo current of 10μA. Find the multiplication factor of M	L3	2	6
		Module-3			
Q. 05	a	Explain the evolution of wireless network	L2	3	6
	b	What are the different basic propagation mechanism used in wireless communication.Explain them briefly.	L2	3	6
	c	Define fading. Explain different types of fading in mobile radio channel.	L2	3	8
		OR			
Q. 06	a	Explain cell structure in case of wireless communication. Which type of shapes are most preferred in cell structure and why?	L2	3	6
	b	Explain Frequency reuse in detail.	L2	3	6

	c	A geographical service area of a cellular system is 4200km^2. A total of 1001 radio channels are available for handling traffic for the area of a cell is 12km^2 a) How many times would the cluster of size 7 have to be replicated in order to cover the entire service area? Calculate the number of channel per cell and the system capacity. b) If the cluster size is reduced from 7 to 4 , then dose it result into increase in system capacity	L3	3	8
		Module-4			
Q. 07	a	What do mean by multiple access. State the different types of multiple access scheme.	L1	4	6
	b	Explain FDMA with neat diagram	L2	4	6
	c	Discuss TDMA systems. Mention some salient features of TDMA	L2	4	8
		OR			
Q. 08	a	Mention and Explain different components of cellular PSTN Network	L2	4	10
	b	Explain the operation of cellular communication system	L2	4	10
		Module-5			
Q. 09	a	Explain GSM architecture in detail. Mention some salient features of GSM.	L2	5	6
	b	Discuss GSM signaling protocol in details.	L2	5	6
	c	Define physical and logical channel. Explain different channel used in GSM.	L2	5	8
		OR			
Q. 10	a	Define Handoff. Discuss different types of handoff in GSM	L2	5	6
	b	Explain GSM frame structure with neat diagram	L2	5	6
	c	What are the different services and features offered by GSM	L2	5	8

*Bloom's Taxonomy Level: Indicate as L1, L2, L3, L4, etc. It is also desirable to indicate the COs and POs to be attained by every bit of questions.

Model Question Paper-1/2 with effect from 2021(CBCS Scheme)

USN | | | | | | | | | | |

7thSemester B.E. Degree Examination

OPTICAL AND WIRELESS COMMUNICATION

TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.

		Module -1	*Bloom's Taxonomy Level	COs	Marks
Q.01	a	Explain with necessary diagram the different type of fiber structure.	L2	CO 1– PO1,2,3	6
	b	In a step index fiber if refractive index of core is 1.4 with Numerical aperture (NA) is 1.3, v=65, operating at 750nm. Calculate core size and cladding index.	L3	CO 1– PO1,2,3	6
	c	What are the advantages,disadvantages and applications of optical fiber as compared to copper cable.	L1	CO 1– PO1,2,3	8
		OR			
Q.02	a	Explain Intermodal dispersion for multimode step index fiber.	L2	CO 1– PO1,2,3	6
	b	Explain the three different mechanism that causes absorption of optical energy in optical fiber.	L2	CO 1– PO1,2,3	8
	c	A continuous 12km long optical fiber link has a loss of 1.5 dB/km, What is the minimum optical power level that must be launch into the fiber to maintain as optical power level of 0.3μw at the receiving end, and what is the required input power if the fiber has a loss of 2.5 dB/km.	L3	CO 1– PO1,2,3	6
		Module-2			
Q. 03	a	An LED operating at 850nm has a spectral width of 45nm. What is the pulse spreading in ns/km due to material dispersion.	L3	CO 2– PO1,2,3	6
	b	With a neat diagram, explain the working of an edge emitting LED. Also mention its special features and usage.	L2	CO 2– PO1,2,3	8
	c	Explain the operation of DFB and DBR LASER.	L2	CO 2– PO1,2,3	6
		OR			
Q.04	a	Write a shot note on Avalanche photodiode.	L2	CO 2– PO1,2,3	6
	b	With the schematic representation and energy band diagram. Explain the working of the PIN photodiode.	L2	CO 2– PO1,2,3	8
	c	A given APD has the quantum efficiency of 65% at wavelength of 900nm. If 0.5μwatt of optical power produced a multiplied photo current of 10μA. Find the multiplication factor of M.	L3	CO 2– PO1,2,3	6
		Module-3			
Q. 05	a	Explain the evolution of wireless network	L2	CO 3– PO1,2,3	6
	b	What are the different basic propagation mechanism used in wireless	L2	CO 3–	6

		communication. Explain them briefly.		PO1,2,3	
	c	Define fading. Explain different types of fading in mobile radio channel.	L2	CO 3– PO1,2,3	8
		OR			
Q. 06	a	Explain cell structure in case of wireless communication. Which type of shapes are most preferred in cell structure and why?	L2	CO 3– PO1,2,3	6
	b	Explain Frequency reuse in detail.	L2	CO 3– PO1,2,3	6
	c	A geographical service area of a cellular system is 4200km^2. A total of 1001 radio channels are available for handling traffic for the area of a cell is 12km^2 a) How many times would the cluster of size 7 have to be replicated in order to cover the entire service area? Calculate the number of channel per cell and the system capacity. b) If the cluster size is reduced from 7 to 4 , then dose it result into increase in system capacity.	L3	CO 3– PO1,2,3	8
		Module-4			
Q. 07	a	What do mean by multiple access. State the different types of multiple access scheme.	L1	CO 4– PO1,2,3	6
	b	Explain FDMA with neat diagram.	L2	CO 4– PO1,2,3	6
	c	Discuss TDMA systems. Mention some salient features of TDMA.	L2	CO 4– PO1,2,3	8
		OR			
Q. 08	a	Mention and Explain different components of cellular PSTN Network.	L2	CO 4– PO1,2,3	10
	b	Explain the operation of cellular communication system.	L2	CO 4– PO1,2,3	10
		Module-5			
Q. 09	a	Explain GSM architecture in detail. Mention some salient features of GSM.	L2	CO 5– PO1,2,3	6
	b	Discuss GSM signaling protocol in details.	L2	CO 5– PO1,2,3	6
	c	Define physical and logical channel. Explain different channel used in GSM.	L2	CO 5– PO1,2,3	8
		OR			
Q. 10	a	Define Handoff. Discuss different types of handoff in GSM.	L2	CO 5– PO1,2,3	6
	b	Explain GSM frame structure with neat diagram.	L2	CO 5– PO1,2,3	6
	c	What are the different services and features offered by GSM.	L2	CO 5– PO1,2,3	8

*Bloom's Taxonomy Level: Indicate as L1, L2, L3, L4, etc. It is also desirable to indicate the COs and POs to be attained by every bit of questions.

K.S.Institute of Technology,Bangalore -109

Department of Electronics and Communication Engg

7th sem Course End Survey 2024-25

Course : Optical & Wireless Communication **Course Code :21EC 72**

1. How well you are able to understand the concept of Optical fibers and attenuation losses ?
2. How well you are able to understand the operation of LED,LASER and WDM concepts?
3. How well you are able to understand the basic propagation mechanisms and frequency reuse concept in cellular system?
4. How well you are able to understand the concept of TDMA,FDMA and basic cellular system?
5. How well you are able to understand the GSM architecture and its channels?

Date	USN	Name of the Student	Faculty Name	Q1	Q2	Q3	Q4	Q5
12/19/2024	SAAJHSJA	FFGFGFG	Dr.DINESH KUMAR D S	3	2	3	3	3
12/20/2024	1KS21EC021	CHINTAN D S	Dr.DINESH KUMAR D S	3	3	3	3	3
12/21/2024	1KS21EC017	B S BHARGAV	Dr.DINESH KUMAR D S	3	2	2	2	2
12/22/2024	1KS22EC409	Soundarya S	Dr.DINESH KUMAR D S	3	3	3	3	3
12/23/2024	1KS21EC009	Anirudha R Bhat	Dr.DINESH KUMAR D S	3	3	3	3	3
12/24/2024	1KS21EC008	Anagha Prakash	Dr.DINESH KUMAR D S	3	3	3	3	3
12/25/2024	1KS21EC118	VIJAY YADAV R	Dr.DINESH KUMAR D S	3	3	3	3	3
12/26/2024	1ks21ec095	Spoorthy M U	Dr.DINESH KUMAR D S	2	2	2	2	2
12/27/2024	1KS21EC080	S Shajith Ali	Dr.DINESH KUMAR D S	2	2	2	2	2
12/28/2024	1ks22ec404	Gonuguntla Shrujana	Dr.DINESH KUMAR D S	3	3	3	3	3
12/29/2024	1KS21EC045	Manoj T V	Dr.DINESH KUMAR D S	3	3	3	3	3
12/30/2024	1KS21EC043	Lohith B	Dr.DINESH KUMAR D S	3	3	3	3	3
12/31/2024	1KS21EC071	Raghavendra N P	Dr.DINESH KUMAR D S	2	2	2	2	2
1/1/2025	1KS21EC097	Sripriya H G	Dr.DINESH KUMAR D S	3	3	3	3	3
1/2/2025	1KS21EC048	Mithun C	Dr.DINESH KUMAR D S	3	3	3	3	3
1/3/2025	1KS21EC049	MONIHSA D	Dr.DINESH KUMAR D S	3	3	3	3	3
1/4/2025	1KS21EC105	Tejashree N	Dr.DINESH KUMAR D S	3	3	3	3	3
1/5/2025	1KS21EC106	Tharun K V	Dr.DINESH KUMAR D S	3	3	3	3	3
1/6/2025	1KS21EC076	RITESH KUMAR SINHA	Dr.DINESH KUMAR D S	3	3	3	3	3
1/7/2025	1 KS22EC405	Hema k	Dr.DINESH KUMAR D S	3	3	2	3	3
1/8/2025	1KS21EC064	PRAJWAL HS	Dr.DINESH KUMAR D S	3	3	3	3	3
1/9/2025	1ks21ec109	Udaykumar s r	Dr.DINESH KUMAR D S	2	3	2	2	2
1/10/2025	1KS21RC083	Samhitha Prakash	Dr.DINESH KUMAR D S	3	3	3	3	3
1/11/2025	1KS21EC112	VARSHA S DAVASKAR	Dr.DINESH KUMAR D S	2	2	2	2	2
1/12/2025	1KS21EC011	Archana M	Dr.DINESH KUMAR D S	3	2	2	2	2
1/13/2025	1ks21ec050	Mutthuluru Sai Himaja	Dr.DINESH KUMAR D S	3	3	3	3	3
1/14/2025	1KS21EC081	Sagar GS	Dr.DINESH KUMAR D S	3	3	3	3	3
1/15/2025	1KS213C096	Srilakshmi G	Dr.DINESH KUMAR D S	3	3	3	3	3
1/16/2025	1ls21ec035	Kambhampati vivek	Dr.DINESH KUMAR D S	3	3	3	3	3
1/17/2025	1KS21EC075	Rehaman Shariff	Dr.DINESH KUMAR D S	3	3	3	3	3
1/18/2025	1KS21EC061	Pooja R	Dr.DINESH KUMAR D S	3	3	3	3	3
1/19/2025	1KS21EC003	ABHISHEK HC	Dr.DINESH KUMAR D S	3	3	3	3	3
1/20/2025	1ks21ec014	Ashwin	Dr.DINESH KUMAR D S	2	2	2	2	2
1/21/2025	1KS21EC066	Pratham R shanbhag	Dr.DINESH KUMAR D S	2	2	2	2	2
1/22/2025	1KS21EC037	Keerthana S	Dr.DINESH KUMAR D S	2	2	2	2	2
1/23/2025	1KS21EC110	Vaishnavi B A	Dr.DINESH KUMAR D S	3	3	3	3	3

3/15/2025	1KS21EC087	SANJAY P	Dr.DINESH KUMAR D S	2	2	3	3	3
3/16/2025	1KS21EC091	V Shreyas Raghavendra	Dr.DINESH KUMAR D S	3	3	3	3	3
3/17/2025	1ks21ec065	Prajwal R	Dr.DINESH KUMAR D S	2	3	3	3	3
3/18/2025	1ks21Ec072	RAKSHITH S	Dr.DINESH KUMAR D S	3	2	3	3	3
3/19/2025	1KS21EC073	Rakshitha M R	Dr.DINESH KUMAR D S	3	3	3	3	3
3/20/2025	1KS21EC114	Veeresh KN	Dr.DINESH KUMAR D S	2	3	2	3	2
3/21/2025	1KS21EC116	Vidya Rawal	Dr.DINESH KUMAR D S	3	2	3	2	3
3/22/2025	1KS21EC098	Sumukh p	Dr.DINESH KUMAR D S	3	3	3	3	3
3/23/2025	1KS21EC058	OMKAR N bhujarkar	Dr.DINESH KUMAR D S	2	2	3	3	3
3/24/2025	1KS21EC004	Abhishek T S	Dr.DINESH KUMAR D S	3	3	3	3	3
3/25/2025	1ks21ec067	Prayag Singh	Dr.DINESH KUMAR D S	3	3	3	3	3
3/26/2025	1ks21ec108	Thushar Cherian	Dr.DINESH KUMAR D S	3	3	3	3	3
3/27/2025	1ks21ec062	Prajwal d	Dr.DINESH KUMAR D S	3	3	3	3	3
3/28/2025	1KS21EC027	Deepika D	Dr.DINESH KUMAR D S	3	3	3	3	3
3/29/2025	1KS21EC089	Shaik arfath	Dr.DINESH KUMAR D S	2	2	2	2	2
3/30/2025	1KS21EC099	Suneetha	Dr.DINESH KUMAR D S	2	3	3	3	3
3/31/2025	1KS21EC078	S HARI DHANUSH	Dr.DINESH KUMAR D S	3	2	3	3	3
4/1/2025	1ks21ec006	Akshay c	Dr.DINESH KUMAR D S	3	3	3	3	3
4/2/2025	1KS21ec104	Tarun m	Dr.DINESH KUMAR D S	3	3	3	3	3
4/3/2025	1KS21EC025	Damini S	Dr.DINESH KUMAR D S	3	3	3	3	3
4/4/2025	1KS21EC031	Gurushankara M	Dr.DINESH KUMAR D S	3	3	3	3	3
			NO. OF 1S	**1**	**1**	**1**	**1**	**1**
			Total count	**107**	**107**	**107**	**107**	**107**
			Percentage	**99.1**	**99.1**	**99.1**	**99.1**	**99.1**
			Average	**99.07**				

Modified

CBCS SCHEME

USN | | | | | | | | | | |

21EC72

Seventh Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Optical and Wireless Communication

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Briefly explain with a neat figure the propagation mechanism of meridional rays in an ideal step index optical waveguide. **(08 Marks)**

b. Define the term attenuation in optical fibers. Explain the different attenuation mechanisms in optical fibers. **(12 Marks)**

OR

2 a. Define Dispersion. Briefly explain intermodal and intramodal dispersion effects in optical waveguide. **(10 Marks)**

b. With neat figures, discuss the structure of single mode and multimode step-index and graded index optical fibers. **(06 Marks)**

c. A multimode fiber has a core refractive index of 1.480 and a core cladding index difference of 2.0 percent. Find the numerical aperture and critical angle at the core cladding interface. **(04 Marks)**

Module-2

3 a. What are the characteristic requirements of an optical source? With the help of neat diagram, explain the constructional features and emission pattern of surface emitting LED. **(10 Marks)**

b. Define optical isolator. With a neat figure, explain the design and operation of a polarization independent isolator. **(06 Marks)**

c. A given silicon avalanche photodiode has a quantum efficiency of 65 percent at a wavelength of 900 nm. If 0.5 μw of optical power produces a multiplied photocurrent of 10 μA. What is the multiplication M? **(04 Marks)**

OR

4 a. Discuss the operation of pin photodiode with a neat circuit and energy band diagram. **(10 Marks)**

b. What is Diffraction gratings? Discuss briefly Diffraction grating techniques. **(10 Marks)**

Module-3

5 a. Explain briefly the different propagation mechanisms that influence the signal propagation in a mobile communication environment. **(10 Marks)**

b. A cellular communication service area is covered with 12 clusters having 7 cells in each cluster and 16 channels assigned in each cell. Find the number of channels per cluster and the system capacity. **(03 Marks)**

c. Explain how the concept of frequency reuse increases the spectrum efficiency that inturn increases the cellular communication system capacity. **(07 Marks)**

OR

6 a. Briefly discuss the generations of wireless communication network technology. (08 Marks)

b. Discuss the effects of co-channel interference in wireless communication in reducing the system capacity. (05 Marks)

c. Discuss the concept of multipath fading in mobile communication system. (07 Marks)

Module-4

7 a. With a neat block diagram, explain the operation of basic TDMA link. (10 Marks)

b. Explain the basic cellular system with necessary block diagram. (10 Marks)

OR

8 a. Discuss with a neat figure the call processing in a cellular system for mobile-originated calls. (12 Marks)

b. List the advantages of CDMA over TDMA and FDMA. (08 Marks)

Module-5

9 a. What is Hand off in GSM networks? Explain briefly the different handoff procedure in GSM. (10 Marks)

b. Explain the functions of data bases HLR and VLR at MSC in GSM network architecture and also explain how it is helpful in location updation in GSM networks. (10 Marks)

OR

10 a. Briefly explain the three major subsystems in GSM network architecture with a neat block diagram. (10 Marks)

b. Explain briefly the following identifiers in GSM system:
(i) SIM
(ii) Mobile system ISDN with frame format
(iii) Location Area Identify (10 Marks)

* * * * *

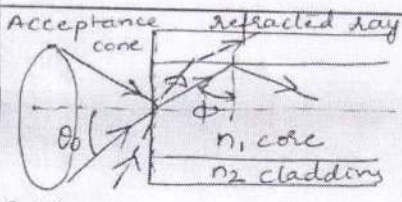
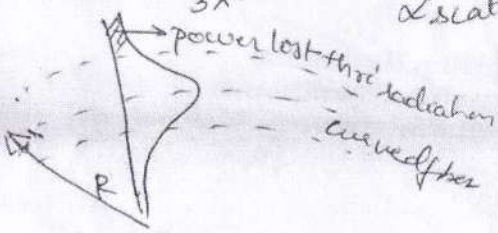
Visvesvaraya Technological University

Belagavi, Karnataka - 590 018.

Scheme & Solutions

Signature of Scrutinizer

Subject Title : Optical and wireless Communication Subject Code : 21EC72

Question Number	Solution	Marks Allocated
1 a.	 $n<n_1$ for Total internal reflection $\sin\theta_c = n_2/n_1$ angle less than θ_c reflects out of core & lost in clad. Acceptance angle θ_A $n\sin\theta_{max} = n\sin\theta_A = (n_1^2 - n_2^2)^{1/2}$ $NA = n_1\sqrt{2\Delta}$	3M(fig) 4M
b.	Attenuation: Reduction in signal strength as the light travels along the fiber is called Attenuation Three different attenuation mechanisms are absorption; caused by atomic defects in glass composition. scattering; Microscopic variations in material density & compositional fluctuations or defects Radiative loss. Bending loss whenever an optical fiber undergoes a bend of finite radius of curvature $\alpha_{scat} = \frac{8\pi^3}{3\lambda^4}(n^2-1)^2 K_B T_f \beta_T$ α_{scat} → scattering loss  Bending loss or Bending loss	1M 3M 4M 4M
2a.	Dispersion: Dispersion in an optical fiber is the spreading of light pulse as it propagates down the fiber Intramodal Dispersion: is pulse spreading that takes place within a single mode because of finite spectral width of an optical source. * It is a function of wavelength. Two types of Dispersion of Intramodal types are Material dispersion and waveguide dispersion Brief explanation of material dispersion * waveguide dispersion	1M 2M 2M 2M

Registrar (Evaluation)
Visvesvaraya Technological University
BELAGAVI - 590018

"APPROVED"

Re: 21EC72 Scheme

"Dr. Rangaraju H G" <rang_raju@yahoo.com> January 12, 2025 8:40 AM

To: boe@vtu.ac.in

Sir,

21EC72 Scheme is in order, no madifications.

Regards
Dr Rangaraju H G
Chairman, BOE-EC/TE

Yahoo Mail: Search, organise, conquer

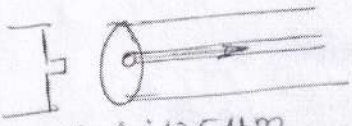
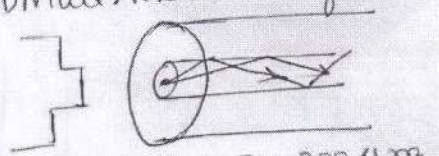
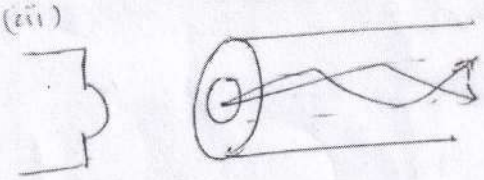
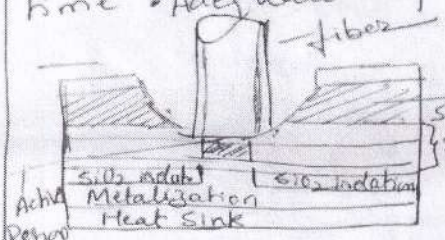
> On Fri, 10 Jan 2025 at 11:51 am, boe@vtu.ac.in <boe@vtu.ac.in> wrote:

"APPROVED"

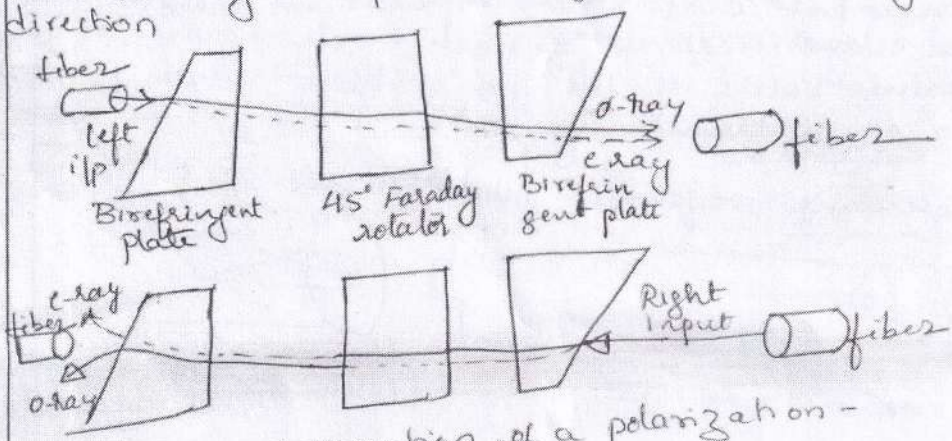
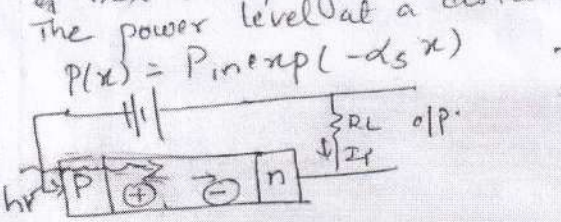
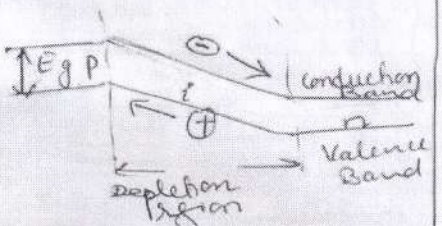
Registrar (Evaluation)
Visvesvaraya Technological University
BELAGAVI - 590018

13/1/25

Subject Title : optical & wireless communication Subject Code : 21EC72

Question Number	Solution	Marks Allocated
	Intermodal dispersion: Appears in MM fibers. Modal delay is a result of each mode having a different value of the group ~~velocity~~ velocity at a single frequency.	3M
b.	(i) Single mode SI fiber  clad : 125 μm core 8-12 μm	2M each
	(ii) Multimode SI fiber  core : 50-200 μm clad : 125-400 μm	6
	(iii)  core - 50-100 μm clad 125-140 μm.	2M
c.	$NA = n_1\sqrt{2\Delta} = 1.48(0.04)^{1/2} = 0.296$	1M
	$\phi_A = \sin^{-1}(NA) = \sin^{-1}(0.296) = 17.2^\circ$	1M 4
	$\phi_c = \sin^{-1}(n_2/n_1) = \sin^{-1}(0.980) = 78.5^\circ$	
3a.	Characteristic requirements of optical source • Narrow radiation pattern, linearity, fast response time • Adequate output power	2M
	 FIG: Surface-emitting LED	4M 10
	Explanation * Plane of active light emitting region is oriented perpendicularly to the axis of the fiber. • circular active area is 50 μm in diameter & upto 2.5 μm thick. • Emission pattern is essentially isotropic with 120° HPBW. (lambertian pattern) • Source equally bright in viewing direction but power is down to 50 percent of its peak when θ = 60° & total HPBW = 120°	4M

Subject Title : Optical & Wireless Communication Subject Code : 21EC72

Question Number	Solution	Marks Allocated
3b	Optical isolator: Optical isolators are the devices that allow light to pass through them in only one direction	1 M
		2 1/2 M
	Pic: Design & operation of a polarization-independent isolator Explanation	2 1/2 M
c.	$I_p = \mathcal{R} P_{in} = \frac{\eta q}{h\nu} P_{in} = \frac{\eta q \lambda}{hc} P_{in}$	2M
	$I_p = 0.235\ \mu A$ $M = I_M / I_p = 10\ \mu A / 0.235\ \mu A = 43$	2M
4a.	PIN photodiode: The PIN photo diode consists of P and n regions seperated by a very lightly n-doped intrinsic layer. • Sufficient large reverse bias is applied a/c the device so as to fully deplete the carriers from intrinsic region. * The penetration of photon flux ϕ is absorbed as it is progressed into the material & the power level at a distance x is given by $P(x) = P_{in} \exp(-\alpha_s x)$	3M
	 	4M
	The absorption process generates electron-hole pair as shown in fig(b) that results in primary photocurrent $I_p = \frac{q}{h\nu} P_{in}(1 - e^{-\alpha_s W})(1 - R_f)$. and Efficiency $\eta = I_p/q \,/\, (P_{in}/h\nu)$	3M

Subject Title : Optical & wireless Communication Subject Code : 21EC72

Question Number	Solution	Marks Allocated
4.b.	A diffraction grating is a conventional optical device that spatially seperates the different wavelength contained in a beam light.	2M
	The different types of Diffraction gratings are	4M
	(a) Reflection Gratings.	4M
	b) Transmission Gratings } explanation	
5a.	The various propagation mechanisms ~~that~~ makes the received signal always differ from the transmitted signal. The basic radio propagation mechanisms are	1M
	*Reflection : occurs when incident electromagnetic waves are partially reflected when they impinge on obstructions of different electrical properties that also depends on composition & surface characteristics figure	1½M 1½M } 3M
	*Diffraction : refers to the change in wave pattern caused by interference blw waves that have been reflected from a surface or a point. figure	1½M 1½M } 3M
	*Scattering ion : special case of reflection caused by irregularities in objects such as walls with rough surfaces, vehicles, foliage, traffic signs etc. figure	1½M 1½M } 3M
b.	(i) No of channels in a cluster = 7 × 16. No. of channels per cluster = 112 channels / cluster	1½M
	(ii) System capacity = {no. of cluster in a given area} × {no. of channel in a cell} = 112 × 12 = 1344 channels / system	1½M
c.	Frequency reuse concept.	
	* If a single base station serves a wireless communication sys, a high power transmitter is needed to support large no. of users. Due to availibility of limited RF spectrum, the maximum no. of simultaneous users in this sys is limited.	2M
	* If allocated RF spectrum can be reused in a given large geographical service area without increasing the interference then the service area can be divided in a no of smaller areas called cells, each allocated with a subset of frequencies. (Detailed explanation to be written)	5M

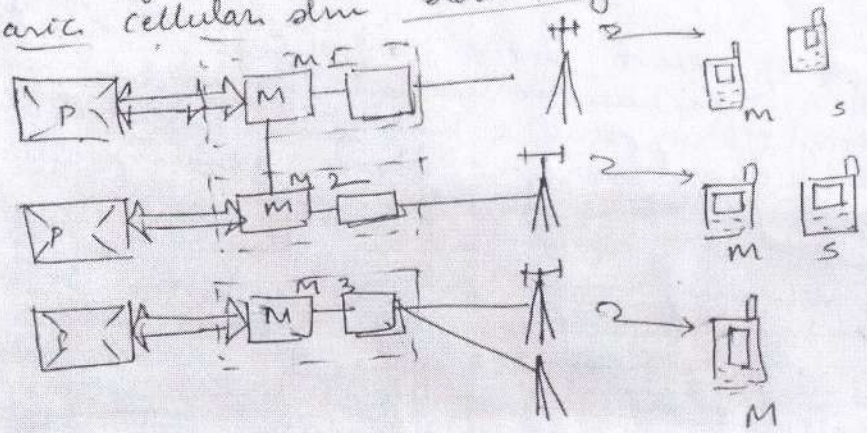
10

3

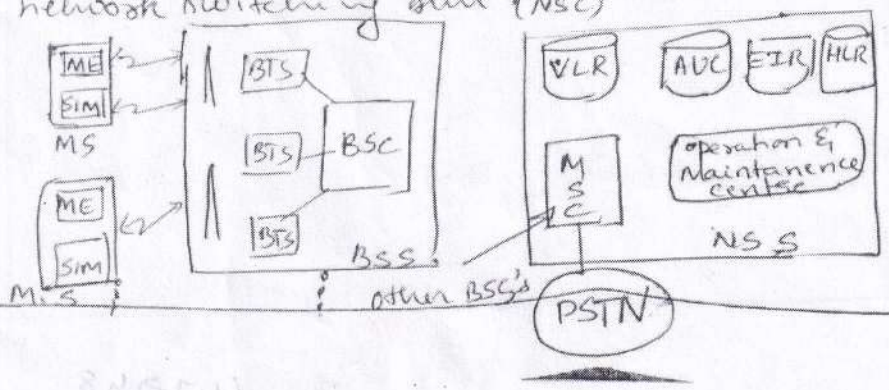
7

Subject Title : Optical & Wireless Communication Subject Code : 21EC72

Question Number	Solution	Marks Allocated
6a.	Generation of wireless comm. n/w Technology * First Generation Analog cellular sms. (transmission of speech signals) → 2M * Second Generation Digital cellular sms. → 3M * Third Generation Digital cellular sms → 3M	8
b.	Co-channel interference and signal quality co-channel interference is caused due to reuse of the same carrier frequency at different geographical locations. It may either lead to override or deteriorate the receiver and mask the desired signal. The frequency reuse method though increases the spectrum efficiency but results in cochannel interference. The received signal quality is affected by the amount of radio coverage area as well as the cochannel interference. Always carrier to interference ratio (minimum threshold should be achieved. (Detailed explation expected)	1M 4M
c.	concept of multipath fading in mobile comm system Fading of signal received by the mobile unit is an inherent problem. Reasons are because mobile unit changing in real time, multipath signal propagation between antennas Figure	4M 3M
7.a.	Operation of basic TDMA link. explanation Block Diagram of basic TDMA link	6M 4M
b.	The basic cellular sms consists of mainly three parts cell site equipment (CSE), MTSO & MSU. Explanation of each parts to be written Basic cellular sms block diagram	7M 3M



Subject Title : Optical & Wireless Communication Subject Code : 21EC72

Question Number	Solution	Marks Allocated
8a	Call processing in cellular sys for mobile originated call. → Explanation → figure	6M, 6M (12)
b.	Advantages of CDMA over TDMA * Multiple users share same frequency bands seperated by unique codes. * ~~Very high multiple users~~ * Very high spectrum efficiency. * Resistant to interference due to spread spectrum Technology * System capacity is high * used in 3G and beyond cellular nlws, GPS	8M (8)
9a.	The process of transferring an ongoing call from one cell to another without dropping the call is called Hand off.	1M
	(a) Intracell - cum - Intra BTS Hand off	2M (10)
	(b) Intercell - cum - Intra BSC Hand off	2M
	(c) Inter-BSC - cum Intra - MSC hand off	3M
	(d) Inter-MSC hand off	2M
b.	HLR & VLR data Base functions in GSM systems → Location updatation	5M → 5M (10)
10a	The three major subsystems in GSM network Architecture are Mobile station (MS), Base Station system (BSS) & network Switching sys (NSC) → Explanation	6M (10)
		4M

Subject Title : Optical & Wireless Communication subject code : 21EC72

Question number	Solution	Marks Allocated
	i) SIM : SIM stands for Subscriber Identity Module. It main advantage of SIM is that it supports roaming with or without a cell phone & can be inserted into any GSM mobile phone.	3M
	ii) Mobile system ISDN frame format MS ISDN explanation	2M 2M
	iii) Location Area Identity (LAI)	3M

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Registrar (Evaluation)
Visvesvaraya Technological University
BELAGAVI - 590018

3/12/25

647 → 48
643 → 45

K.S. INSTITUTE ECHNOLOGY, BANGALORE

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

YEAR / SEMESTER/BRANCH	SUB:OPTICAL AND WIRELESS COMMUNICATION
COURSE TITLE	SUB CODE:21EC72
COURSE CODE	SEMESTER: 7TH A&B
ACADEMIC YEAR	ACADEMIC YEAR 2024-25 (ODD)

CO Attainment	Significance
Level 3	Atleast 60% of the students should have scored >= 60% of Total marks
Level 2	Atleast 55% of the students should have scored >= 60% of Total marks
Level 1	Atleast 50% of the students should have scored >= 60% of Total marks

FACULTY: Dr.DINESH KUMAR D S

sl.no	USN	Name of the student	IA1			IA2				IA3			Assignment						Activity					Obtained CO wise marks					CIE	SEE
			CO1	CO2	IA1	CO2	CO3	CO4	IA2	CO4	CO5	IA3	Total	CO1	CO2	CO3	CO4	CO5	CO1	CO2	CO3	CO4	CO5	CO1	CO2	CO3	CO4	CO5		
		Max Marks	12	8	20	4	12	4	20	8	12	20	20	4	4	4	4	4	4	4	4	4	4	20	20	20	20	20	50	50
1	1KS21EC001	AADHYA B N	6	7	13	3	11	4	18	1	9	10	20	4	4	4	4	4	4	4	4	4	4	14	18	19	13	17	41	24
2	1KS21EC002	ABHIJITH R	7	2	9	3	10	4	17	3	11	14	20	4	4	4	4	4	4	4	4	4	4	15	13	18	15	19	40	20
3	1KS21EC003	ABHISHEK H C	5	2	7	6	4	0	10	0	6	6	18	3	4	4	4	3	4	4	4	4	4	12	16	12	8	13	31	24
4	1KS21EC004	ABHISHEK T S	6	4	10	0	7	3	10	0	7	7	16	3	3	3	4	4	4	4	4	4	4	13	11	14	11	15	32	26
5	1KS21EC005	AISHWARYA A	0	0	0	0	10	4	14	5	0	5	16	3	3	3	4	4	4	4	4	4	4	7	7	17	17	8	28	21
6	1KS21EC006	AKSHAY C	6	2	8	0	6	4	10	4	4	8	19	3	4	4	4	4	4	4	4	4	4	13	10	14	16	12	33	11
7	1KS21EC007	AKSHAY M S	8	1	9	0	8	4	12	3	7	10	19	3	4	4	4	4	4	4	4	4	4	15	9	16	15	15	35	22
8	1KS21EC008	ANAGHA PRAKASH	8	5	13	3	11	4	18	6	10	16	20	4	4	4	4	4	4	4	4	4	4	16	16	19	18	18	44	28
9	1KS21EC009	ANIRUDHA R BHAT	8	4	12	4	12	4	20	4	10	14	20	4	4	4	4	4	4	4	4	4	4	16	16	20	16	18	43	30
10	1KS21EC010	ARCHANA G M	8	8	16	4	7	4	15	8	11	19	20	4	4	4	4	4	4	4	4	4	4	16	20	15	20	19	45	39
11	1KS21EC011	ARCHANA M	11	4	15	1	9	4	14	3	10	13	20	4	4	4	4	4	4	4	4	4	4	19	13	17	15	18	41	19
12	1KS21EC013	ASHCHARYA N B	9	5	14	4	11	4	19	8	10	18	20	4	4	4	4	4	4	4	4	4	4	17	17	19	20	18	46	29
13	1KS21EC014	ASHWIN S R	4	6	10	0	11	4	15	2	6	8	18	3	4	4	4	3	4	4	4	4	4	11	14	19	14	13	36	15
14	1KS21EC015	B N JEEVAN	8	7	15	0	0	0	0	0	10	10	18	3	4	4	4	3	4	4	4	4	4	15	15	8	8	17	32	21
15	1KS21EC017	B S BHARGAV	11	8	19	4	12	4	20	8	12	20	20	4	4	4	4	4	4	4	4	4	4	19	20	20	20	20	50	45
16	1KS21EC018	BHAVYA K	9	4	13	3	11	4	18	3	12	15	18	3	4	4	4	3	4	4	4	4	4	16	15	19	15	19	42	24
17	1KS21EC019	BHUVANA H	4	2	6	3	12	4	19	4	12	16	20	4	4	4	4	4	4	4	4	4	4	12	13	20	16	20	41	20
18	1KS21EC020	BINDUSHREE S	8	3	11	4	10	4	18	4	8	12	20	4	4	4	4	4	4	4	4	4	4	16	15	18	16	16	41	35
19	1KS21EC021	CHINTAN D S	11	8	19	4	12	4	20	8	12	20	20	4	4	4	4	4	4	4	4	4	4	19	20	20	20	20	50	21
20	1KS21EC023	CHIRANTH V V	8	4	12	4	10	4	18	0	9	9	20	4	4	4	4	4	4	4	4	4	4	16	16	18	12	17	40	29
21	1KS21EC024	DAGGUPATI CHARITHA	12	7	19	4	12	3	19	7	12	19	20	4	4	4	4	4	4	4	4	4	4	20	19	20	18	20	49	39
22	1KS21EC025	DAMINI S	4	2	6	3	8	4	15	6	4	10	18	3	4	4	4	3	4	4	4	4	4	11	13	16	18	11	35	31
23	1KS21EC026	DEEKSHA H K	8	8	16	3	11	4	18	4	11	15	20	4	4	4	4	4	4	4	4	4	4	16	19	19	16	19	45	30
24	1KS21EC027	DEEPIKA D	8	0	8	4	9	4	17	4	12	16	20	4	4	4	4	4	4	4	4	4	4	16	12	17	16	20	41	19
25	1KS21EC028	GAGAN V	4	0	4	3	8	4	15	4	5	9	12	2	3	2	3	2	4	4	4	4	4	10	10	14	15	11	30	23
26	1KS21EC029	GAGANA SINDHU N	9	8	17	4	11	4	19	2	12	14	20	4	4	4	4	4	4	4	4	4	4	17	20	19	14	20	45	27
27	1KS21EC031	GURUSHANKARA M	6	4	10	0	3	4	7	8	0	8	16	3	3	3	4	3	4	4	4	4	4	13	11	10	20	7	31	12
28	1KS21EC032	HARINI L	12	3	15	4	10	0	14	8	12	20	20	4	4	4	4	4	4	4	4	4	4	20	15	18	16	20	45	34
29	1KS21EC033	HEMANTH D R	10	2	12	2	10	0	12	7	0	7	19	3	4	4	4	4	4	4	4	4	4	17	12	18	15	8	35	35
30	1KS21EC035	KAMBHAMPATI VIVEK	6	7	13	0	9	4	13	0	10	10	16	3	3	3	4	3	4	4	4	4	4	13	14	16	12	17	36	24
31	1KS21EC036	KARAN S	8	0	8	1	6	4	11	3	4	7	16	3	3	3	4	3	4	4	4	4	4	15	8	13	15	11	31	21
32	1KS21EC037	KEERTHANA S	4	6	10	3	12	4	19	0	7	7	19	3	4	4	4	4	4	4	4	4	4	11	17	20	12	15	38	28
33	1KS21EC038	KOMALA N	8	5	13	3	11	4	18	3	11	14	20	4	4	4	4	4	4	4	4	4	4	16	16	19	15	19	43	22
34	1KS21EC039	KUSHAL GOWDA U	8	3	11	1	5	4	10	4	8	12	20	4	4	4	4	4	4	4	4	4	4	16	12	13	16	16	37	23
35	1KS21EC040	KUSUMA M S	12	6	18	4	12	4	20	8	12	20	20	4	4	4	4	4	4	4	4	4	4	20	18	20	20	20	49	34
36	1KS21EC041	LIKITHA L	4	1	5	4	8	3	15	2	8	10	20	4	4	4	4	4	4	4	4	4	4	12	13	16	13	16	35	23
37	1KS21EC042	LOHIT S HOOLAGERI	7	4	11	2	9	4	15	6	10	16	19	3	4	4	4	4	4	4	4	4	4	14	14	17	18	18	41	23

38	1KS21EC043	LOHITH B	6	4	10	4	7	3	14	4	11	15	20	4	4	4	4	4	4	4	4	4	4	14	16	15	15	19	40	21
39	1KS21EC044	LOHITH S	7	3	10	2	8	4	14	3	8	11	19	3	4	4	4	4	4	4	4	4	4	14	13	16	15	16	37	18
40	1KS21EC045	MANOJ T V	8	3	11	3	12	4	19	4	7	11	19	3	4	4	4	4	4	4	4	4	4	15	14	20	16	15	40	22
41	1KS21EC046	MEGHANA N	6	3	9	4	8	4	16	2	12	14	20	4	4	4	4	4	4	4	4	4	4	14	15	16	14	20	40	28
42	1KS21EC047	MISBA M	11	3	14	2	11	2	15	2	8	10	20	4	4	4	4	4	4	4	4	4	4	19	13	19	12	16	40	31
43	1KS21EC048	MITHUN C	11	8	19	4	12	4	20	8	11	19	20	4	4	4	4	4	4	4	4	4	4	19	20	20	20	19	49	36
44	1KS21EC049	MONISHA D	10	7	17	4	12	4	20	8	12	20	20	4	4	4	4	4	4	4	4	4	4	18	19	20	20	20	49	30
45	1KS21EC050	MUTTHULURU SAI HIMAJA	9	6	15	0	0	0	0	5	7	12	18	3	4	4	4	3	4	4	4	4	4	16	14	8	13	14	33	20
46	1KS21EC051	NANDAN K	8	0	8	2	6	4	12	6	6	12	18	3	4	4	4	3	4	4	4	4	4	15	10	14	18	13	35	21
47	1KS21EC053	NARAHARI N JOSHI	6	3	9	2	11	4	17	2	11	13	20	4	4	4	4	4	4	4	4	4	4	14	13	19	14	19	40	19
48	1KS21EC054	NAVEEN S	8	4	12	4	11	2	17	6	12	18	19	3	4	4	4	4	4	4	4	4	4	15	16	19	16	20	43	35
49	1KS21EC055	NAYANA J	12	0	12	1	10	4	15	2	7	9	19	3	4	4	4	4	4	4	4	4	4	19	9	18	14	15	38	18
50	1KS21EC056	NAYANA S	5	2	7	3	2	3	8	4	5	9	18	3	4	4	4	3	4	4	4	4	4	12	13	10	15	12	31	23
51	1KS21EC058	OMKAR N BHUJARKAR	4	5	9	4	11	0	15	0	8	8	18	3	4	4	4	3	4	4	4	4	4	11	17	19	8	15	35	28
52	1KS21EC059	PAVAN M PAI	7	0	7	3	7	4	14	4	8	12	18	3	4	4	4	3	3	4	4	4	4	13	11	15	16	15	35	21
53	1KS21EC060	POLURU MANJUNATH	8	4	12	2	0	6	8	0	4	4	12	2	3	2	3	2	3	4	4	4	3	13	13	6	13	9	27	18
54	1KS21EC061	POOJA R	11	2	13	0	0		0	3	10	13	20	4	4	4	4	4	4	4	4	4	4	19	10	8	11	18	33	18
55	1KS21EC062	PRAJWAL D	5	4	9	3	4	4	11	4	8	12	20	4	4	4	4	4	4	4	4	4	4	13	15	12	16	16	36	23
56	1KS21EC063	PRAJWAL G V	12	8	20	4	12	4	20	6	12	18	19	3	4	4	4	4	4	4	4	4	4	19	20	20	18	20	49	36
57	1KS21EC064	PRAJWAL H S	0	7	7	0	7	4	11	4	8	12	19	3	4	4	4	4	4	4	4	4	4	7	15	15	16	16	35	18
58	1KS21EC065	PRAJWAL R	8	0	8	0	10	4	14	6	8	14	19	3	4	4	4	4	4	4	4	4	4	15	8	18	18	16	38	24
59	1KS21EC066	PRATHAM R SHANBHAG	9	4	13	3	10	3	16	2	5	7	18	3	4	4	4	3	4	4	4	4	4	16	15	18	13	12	37	30
60	1KS21EC067	PRAYAG SINGH S	5	0	5	3	7	4	14	3	8	11	19	3	4	4	4	4	4	4	4	4	4	12	11	15	15	16	35	19
61	1KS21EC068	PREETHAM M	12	8	20	4	12	4	20	8	12	20	19	3	4	4	4	4	4	4	4	4	4	19	20	20	20	20	50	37
62	1KS21EC069	PREKSHA S	8	4	12	2	11	4	17	3	12	15	19	3	4	4	4	4	4	4	4	4	4	15	14	19	15	20	42	18
63	1KS21EC070	PUNITH M	0	0	0	0	10	4	14	4	7	11	20	4	4	4	4	4	4	4	4	4	4	8	8	18	16	15	33	28
64	1KS21EC071	RAGHAVENDRA NARAYAN PUJAR	3	6	9	3	8	3	14	7	12	19	19	3	4	4	4	4	4	4	4	4	4	10	17	16	18	20	41	30
65	1KS21EC072	RAKSHITH S	11	6	17	4	12	4	20	6	6	12	20	4	4	4	4	4	4	4	4	4	4	19	18	20	18	14	45	38
66	1KS21EC073	RAKSHITHA M R	6	4	10	3	10	4	17	4	8	12	20	4	4	4	4	4	4	4	4	4	4	14	15	18	16	16	40	30
67	1KS21EC074	RAYADURG JOISH SHRIYA	12	4	16	4	12	4	20	8	12	20	20	4	4	4	4	4	4	4	4	4	4	20	16	20	20	20	48	39
68	1KS21EC075	REHAMAN SHARIFF	9	4	13	2	10	4	16	4	12	16	19	3	4	4	4	4	4	4	4	4	4	16	14	18	16	20	42	25
69	1KS21EC076	RITESH KUMAR SINHA	8	3	11	4	9	4	17	8	11	19	20	4	4	4	4	4	4	4	4	4	4	16	15	17	20	19	44	30
70	1KS21EC077	RITHIKA M	12	7	19	4	10	4	18	8	10	18	20	4	4	4	4	4	4	4	4	4	4	20	19	18	20	18	48	39
71	1KS21EC078	S HARI DHANUSH	0	0	0	0	6	4	10	4	6	10	10	2	2	2	2	2	4	4	4	4	4	6	6	12	14	12	25	18
72	1KS21EC080	S SHAJITH ALI	8	4	12	0	8	0	8	3	8	11	20	4	4	4	4	4	4	4	4	4	4	16	12	16	11	16	36	18
73	1KS21EC081	SAGAR G S	8	6	14	4	12	4	20	8	7	15	20	4	4	4	4	4	4	4	4	4	4	16	18	20	20	15	45	37
74	1KS21EC082	SAI RAHUL N	7	2	9	3	11	4	18	7	12	19	19	3	4	4	4	4	4	4	4	4	4	14	13	19	19	20	43	34
75	1KS21EC083	SAMHITHA PRAKASH	6	4	10	4	8	4	16	4	8	12	20	4	4	4	4	4	4	4	4	4	4	14	16	16	16	16	39	23
76	1KS21EC084	SANJANA V	10	4	14	4	8	4	16	4	8	12	20	4	4	4	4	4	4	4	4	4	4	18	16	16	16	16	41	22
77	1KS21EC085	SANJAY G	12	8	20	4	12	4	20	7	12	19	20	4	4	4	4	4	4	4	4	4	4	20	20	20	19	20	50	24
78	1KS21EC086	SANJAY N	8	4	12	3	11	4	18	3	11	14	20	4	4	4	4	4	4	4	4	4	4	16	15	19	15	19	42	39
79	1KS21EC087	SANJAY P	8	4	12	0	6	4	10	4	8	12	19	3	4	4	4	4	4	4	4	4	4	15	12	14	16	16	37	24
80	1KS21EC088	SATHYAM KUMAR MANDAL S	0	7	7	2	10	4	16	2	8	10	17	3	3	4	3	4	4	4	4	4	4	7	16	18	13	16	35	25
81	1KS21EC089	SHAIK ARFATH	12	7	19	3	8	4	15	4	10	14	19	3	4	4	4	4	4	4	4	4	4	19	18	16	16	18	44	19
82	1KS21EC090	SHASHANK C U	11	4	15	0	8	4	12	3	12	15	20	4	4	4	4	4	4	4	4	4	4	19	12	16	15	20	41	40
83	1KS21EC091	SHREYAS RAGHAVENDRA V	0	0	0	2	12	4	18	3	4	7	18	3	4	4	4	3	4	4	4	4	4	7	10	20	15	11	32	23
84	1KS21EC092	SHWETHA V	8	3	11	4	11	4	19	8	12	20	20	4	4	4	4	4	4	4	4	4	4	16	15	19	20	20	45	36
85	1KS21EC093	SINDHU M NIMBAL	6	1	7	2	6	0	8	2	11	13	19	3	4	4	4	4	4	4	4	4	4	13	11	14	10	19	34	20
86	1KS21EC095	SPOORTHY M U	11	7	18	3	10	4	17	5	11	16	20	4	4	4	4	4	4	4	4	4	4	19	18	18	17	19	46	28
87	1KS21EC096	SRILAKSHMI G	12	8	20	4	10	4	18	6	12	18	20	4	4	4	4	4	4	4	4	4	4	20	20	18	18	20	48	36

88	1KS21EC097	SRIPRIYA H G	11	8	19	4	12	4	[illegible]	8	12	20	20	4	4	4	4	4	4	4	4	4	4	19	20	20	20	20	50	32
89	1KS21EC098	SUMUKH P	8	3	11	3	4	4	11	3	10	13	18	3	4	4	4	3	4	4	4	4	4	15	14	12	15	17	37	33
90	1KS21EC099	SUNEETHA	4	6	10	2	8	4	14	3	8	11	20	4	4	4	4	4	4	4	4	4	4	12	16	16	15	16	38	18
91	1KS21EC100	SUNEHA S	10	0	10	3	8	4	15	0	11	11	16	3	3	3	3	4	4	4	4	4	4	17	10	15	11	19	36	32
92	1KS21EC101	SUPREETH A	12	8	20	4	8	4	16	8	10	18	20	4	4	4	4	4	4	4	4	4	4	20	20	16	20	18	47	30
93	1KS21EC102	SURABHI K R	6	6	12	0	6	4	10	5	7	12	19	3	4	4	4	4	4	4	4	4	4	13	14	14	17	15	37	25
94	1KS21EC103	SUSHÈN KRISHNAPUR	9	7	16	3	12	4	19	7	8	15	20	4	4	4	4	4	4	4	4	4	4	17	18	20	19	16	45	22
95	1KS21EC104	TARUN M	10	4	14	4	11	4	19	4	9	13	19	3	4	4	4	4	4	4	4	4	4	17	16	19	16	17	43	30
96	1KS21EC105	TEJASHREE N	11	5	16	4	12	4	20	7	12	19	20	4	4	4	4	4	4	4	4	4	4	19	17	20	19	20	48	26
97	1KS21EC106	THARUN K V	10	6	16	4	8	4	16	7	10	17	20	4	4	4	4	4	4	4	4	4	4	18	18	16	19	18	45	25
98	1KS21EC107	THEJAS H V	8	0	8	2	12	4	18	7	8	15	20	4	4	4	4	4	4	4	4	4	4	16	10	20	19	16	41	28
99	1KS21EC108	THUSHAR CHERIAN	2	4	6	2	4	4	10	0	8	8	18	3	4	4	4	3	4	4	4	4	4	9	14	12	12	15	31	18
100	1KS21EC109	UDAYA KUMAR S R	8	0	8	0	8	0	8	3	7	10	18	3	4	4	4	3	4	4	4	4	4	15	8	16	11	14	32	13
101	1KS21EC110	VAISHNAVI B A	7	7	14	3	6	4	13	5	9	14	20	4	4	4	4	4	4	4	4	4	4	15	18	14	17	17	41	21
102	1KS21EC111	VARSHA JAYAKUMAR	11	8	19	4	12	4	20	8	12	20	20	4	4	4	4	4	4	4	4	4	4	19	20	20	20	20	50	31
103	1KS21EC112	VARSHA S DAVASKAR	8	4	12	4	5	4	13	6	12	18	20	4	4	4	4	4	4	4	4	4	4	16	16	13	18	20	42	25
104	1KS21EC113	VARSHITH S	0	7	7	3	7	4	14	2	3	5	18	3	4	4	4	3	4	4	4	4	4	7	18	15	14	10	32	36
105	1KS21EC114	VEERESH K N	7	2	9	0	8	4	12	3	8	11	20	4	4	4	4	4	4	4	4	4	4	15	10	16	15	16	36	28
106	1KS21EC115	VIDYA I	11	6	17	4	12	4	20	7	8	15	20	4	4	4	4	4	4	4	4	4	4	19	18	20	19	16	46	32
107	1KS21EC116	VIDYA RAWAL D	11	8	19	3	11	4	18	5	12	17	20	4	4	4	4	4	4	4	4	4	4	19	19	19	17	20	47	41
108	1KS21EC117	VIDYASHREE R	12	8	20	4	12	4	20	8	9	17	20	4	4	4	4	4	4	4	4	4	4	20	20	20	20	17	49	42
109	1KS21EC118	VIJAY YADAV R	8	0	8	4	4	4	12	6	7	14	20	4	4	4	4	4	4	4	4	4	4	16	12	12	18	15	37	18
110	1KS21EC120	VYSHAK G R	11	4	15	4	11	4	19	6	11	17	20	4	4	4	4	4	4	4	4	4	4	19	16	19	18	19	46	41
111	1KS21EC121	YASHWANTH.M	7	7	14	4	11	4	19	3	8	11	18	3	4	4	4	3	4	4	4	4	4	14	19	19	15	15	41	26
112	1KS22EC400	ADITHYA D	12	5	17	4	11	4	19	8	11	19	20	4	4	4	4	4	4	4	4	4	4	20	17	19	20	19	48	27
113	1KS22EC401	APOORVA B	10	8	18	2	8	4	14	7	10	17	20	4	4	4	4	4	4	4	4	4	4	18	18	16	19	18	45	28
114	1KS22EC402	B SREEPADREDDI H BULLANGOUDAR	0	0	0	4	4	0	8	6	8	14	18	3	4	4	4	3	4	4	4	4	4	7	12	12	14	15	30	1
115	1KS22EC403	CHAITRA N	0	0	0	2	6	2	10	5	11	16	19	3	4	4	4	4	4	4	4	4	4	7	10	14	15	19	33	23
116	1KS22EC404	GONUGUNTLA SHRIJANA	9	6	15	4	12	4	20	8	11	19	20	4	4	4	4	4	4	4	4	4	4	17	18	20	20	19	47	37
117	1KS22EC405	HEMA K	12	4	16	4	12	4	20	8	9	17	20	4	4	4	4	4	4	4	4	4	4	20	16	20	20	17	47	29
118	1KS22EC406	PAVANGOWDA H P	10	4	14	4	10	4	18	8	12	20	20	4	4	4	4	4	4	4	4	4	4	18	16	18	20	20	46	33
119	1KS22EC407	PRAJWAL PATIL B S	5	5	10	3	7	4	14	5	8	13	18	3	4	4	4	3	4	4	4	4	4	12	16	15	17	15	38	32
120	1KS22EC408	SANGEETHA H M	4	2	6	4	0	4	8	5	8	13	18	3	4	4	4	3	4	4	4	4	4	11	14	8	17	15	33	31
121	1KS22EC409	SOUNDARYA S	11	6	17	4	12	4	20	8	12	20	20	4	4	4	4	4	4	4	4	4	4	19	18	20	20	20	49	29
122	1KS22EC410	SOWMYA A M	8	2	10	3	12	4	19	4	11	15	20	4	4	4	4	4	4	4	4	4	4	16	13	20	16	19	42	34
123	1KS22EC411	SUDEEP P	5	1	6	2	11	3	16	2	7	9	19	3	4	4	4	4	4	4	4	4	4	12	11	19	13	15	35	20

60% of Maximum marks (X)	12	12	12	12	12	30	30
No. of students above X	106	100	116	114	114	120	45
Total number of students (Y)	123	123	123	123	123	123	123
CO Percentage	86.18	81.30	94.31	92.68	92.68	97.56	36.59
CO level	03	03	03	03	03	03	00

CO	CIE	SEE	Direct Attainment in %	Direct Attainment in Level	Indirect Attainment	Final Attainment
CO1	86.2	36.6	61.4	3	3	3.00
CO2	81.3	36.6	58.9	2	3	2.10
CO3	94.3	36.6	65.4	3	3	3.00
CO4	92.7	36.6	64.6	3	3	3.00
CO5	92.7	36.6	64.6	3	3	3.00
AVERAGE						02.82

Donot delete any DIV/0 values in the cells, after entering marks, they will automatically get updated.

Co-Po Mapping Table														
CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	3	2	_	_	_	_	_	2	2	2	_	2	3	2

CO2	3	2	_	_	_	_	_	2	2	2	_	2	3	2
CO3	3	2	2	_	_	_	_	2	2	2	_	2	3	2
CO4	3	2	2	_	_	_	_	2	2	2	_	2	3	2
CO5	3	2	_	_	_	_	_	2	2	2	_	2	3	2
AVG	**3.00**	**2.00**	**2.00**	_	_	_	_	**2.00**	**2.00**	**2.00**	_	**2.00**	**3.00**	**2.00**

PO Attainment	CO Attainment	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	3.00	3.00	2.00	_	_	_	_	_	2.00	2.00	2.00	_	2.00	3.00	2.00
CO2	2.10	2.10	1.40	_	_	_	_	_	1.40	1.40	1.40	_	1.40	2.10	1.40
CO3	3.00	3.00	2.00	2.00	_	_	_	_	2.00	2.00	2.00	_	2.00	3.00	2.00
CO4	3.00	3.00	2.00	2.00	_	_	_	_	2.00	2.00	2.00	_	2.00	3.00	2.00
CO5	3.00	3.00	2.00	_	_	_	_	_	2.00	2.00	2.00	_	2.00	3.00	2.00
AVERAGE		**2.82**	**1.88**	**2**	_	_	_	_	**1.88**	**1.88**	**1.88**	_	**1.88**	**2.82**	**1.88**