NPR College of Engineering & Technology
NPR Nagar, Natham, Dindigul - 624401, Tamil Nadu, India.
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An ISO 9001:2015 Certified Institution.
Phone No: 04544- 246 500, 246501, 246502.
Website : www.nprcolleges.org, www.nprcet.org, Email:nprcetprincipal@nprcolleges.org

CRITERION 2 TEACHING – LEARNING AND EVALUATION

KEY INDICATOR 2.2 CATERING TO STUDENT DIVERSITY

Metric No 2.2.1 The institution assesses the learning levels of the students and organises special Programmes for advanced learners and slow learners (2021-22).

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PRINCIPAL
Dr. J.SUNDARARAJAN,
B.E., M.Tech., Ph.D.,
Principal
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ACADEMIC YEAR

2021-22

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VISION AND MISSION

OF

THE INSTITUTION

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VISION AND MISSION OF THE INSTITUTE

VISION

"To develop students with intellectual curiosity and technical expertise to meet the global needs"

MISSION

M1: To achieve academic excellence by offering quality technical education using best teaching techniques.

M2: To improve Industry – Institute interactions and expose industrial atmosphere.

M3: To develop interpersonal skills along with value-based education in a dynamic learning environment.

M4: To explore solutions for real time problems in the society.

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INSTITUTION PROFILE

NPR College of Engineering & Technology is one of the premier institutions in South Tamil Nadu situated near Natham in Dindigul District. The institution was established in 2008 by Titan Educational Trust with an exalted aim of uplifting the rural students to excel in the field of Engineering and Technology. It is approved by AICTE and affiliated to Anna University, Chennai. The institution encompasses a lush green environment with lawns and gardens in pristine surroundings conducive for learning. The institution offers 8 Under Graduate courses in Engineering and 1 Post graduate course in Engineering as well as Management studies. Our college is an institutional life member of various professional bodies like ICI, ISTE, IETE, and CSI. Our institution has Centre of Excellence in CISCO, IIC, Red Hat Academy, Rural Entrepreneurship Development Cell and local chapter of NPTEL. College has a vibrant Placement Cell, Women Development Cell, Industry – Institute Interaction Cell, Internal Quality Assurance Cell and signed MoUs with leading National and International engineering industries. Being the green campus, our college is honored with IGEN Award and JAL SAKTHI award for Clean and Smart campus by AICTE in 2019.

The institution has an appealing infrastructure with 7 seminar halls, 1 fully air-conditioned seminar hall, 4 drawing halls, smart class room in each department, a digital library, computer Centre and 100 Mbps Wi-Fi connectivity available throughout the campus. The institution has well-furnished and sophisticated hostel facilities with indoor gym separately for boys and girls and mess providing hygienic food varieties as per the choice of students. The institution has a hygienic mega cafeteria, ATM Centre, Ambulance facility, medical Centre and well-connected transport facility covering nearby districts.

Beyond academics, the institution instills self-discipline among students, motivates them to participate in the various club activities, sports, games and especially in cricket. The institution has a turf cricket ground with international standards approved

NPR COLLEGE OF ENGG. & TECH. NATHAM

by BCCI where Ranji Trophy, Tamil Nadu Premiere League (TNPL) and many first class matches are conducted.

The institute is certified with ISO 9001:2015 quality management systems to meet the needs and expectations of the students, leading to better learning outcomes with the support of the dedicated faculty members and in turn to cater the needs of the global industries.

The institution has the motto 'Reach the star' and strives hard to develop the students' employability skills through placement training programmes to get placed in reputed engineering industries, promote innovative thinking and emphasis life-long learning to face the challenges in their career.

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POLICY
ON
SLOW LEARNERS
AND
ADVANCED LEARNERS

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POLICY ON SLOW LEARNERS AND ADVANCED LEARNERS

This policy paper is conceded as the "Policy on Slow Learners and Advanced Learners" of NPR College of Engineering and Technology, Natham, Dindigul. By virtue of this Policy the College pronounces its assurance to the proper counsel for the enhancement of the slow learners to be better on their way of academic and personal life and advanced learners to be extraordinary in the academic and other extracurricular activities.

Categorization of New Budding Engineers

We organized bridge course to familiarize the basic fundamentals and we also conducted one day Motivational Program for all the new budding engineers to expose the opportunities available in the field of Engineering.

The students belonging to first years are taxonomies as Tamil Medium Students / Poor Cut off marks in XII Standard / Poor Knowledge in computing skills.

The purpose of assessment of the learning levels of the students and conduction of activities for them is to help them out for improvement in their academics.

Methods to identify Advanced Learners and Slow Learners

Each and Every faculty must deal with different categories of students; some are very intelligent who learn very fast and some are quite weak who learn very slowly. Therefore, it is required to determine the abilities of the students in the class. Based on the ability determined, some students need only guidance and some students need a hard work and regular attention.

A good teaching methodology helps a lot to make either an advanced learner to get more connected with the class or a slow learner he/she may not get away from the concentration.

A student may have his/her own way of getting knowledge and standing with what they had learnt. It varies from one to the other.

1. To validate a student's capacity, he/she will be assessed by daily class tests, internal exam and practical sessions as a whole right from first to the final year, which will be taken for grading their internal marks as well.

2. Slow learner and advanced learners would be identified for each subject separately by respective faculty members for all the semesters.

3. The student as an individual is identified as Advanced learners if he/she scores equal to or greater than 60% [>=60%] of marks in his/her internal exams and the students scored less than 60% [<60%] are identified as Slow learners.

SLOW LEARNERS

The slow learners are always lagging in academic performance. They may fail in exams or score poor marks. They need more attention towards their studies to enhance and endure their level of grade.

Methodologies to Support Slow Learners

- Remedial are conducted with appropriate focus on the subject/topic codes in which the students are found to be slow learners
- Individual academic counseling is done by concerned subject faculty.

POLICY GUIDELINES FOR SLOW LEARNERS

- Remedial Course for slow learners, absentees and students involved in sports activities which help slow learners to improve subject knowledge with the result of catching up with their peers.
- Bridge Course for first year students.
- Orientation and Induction Programme at College and departmental level for freshers.
- Conduct additional classes for the difficult subjects (based on the previous semester university results) in the curriculum.

- Special attention is given to the students in the remedial classes, who are identified as the slow learners.
- Slow learners are specially advised and counseled by a staff mentor and the subject expert.
- The students are given with training on communication skills, personality development, time management and motivational sessions.
- Academic and personal counseling are given to the slow learners by the mentor.
- Bilingual explanation and discussions are imparted to the slow learners after the class hours for better understanding.
- Provision of simple and standard lecture notes/course materials and special preparation for the exams will be good.
- Getting the support of the advanced learners to the slow learners in making their learning process more participatory and interesting.
- Encouraging the group learning activities and practical will be useful to the slow learners.

ADVANCED LEARNERS

The Advanced learners are those who can grab concepts faster than others and can make best outputs on various tests they go through. They take into themselves greater responsibilities, by showing interests on both Academic and extracurricular activities.

Methodology to encourage Advanced Learners

1. Advanced learners are motivated to strive for higher goals. They are encouraged to organize as well as to participate in Symposium, Workshop, various technical competitions and Seminar to gain Knowledge.
2. Helping them to participate in group discussions, technical quizzes to develop analytical and problem-solving abilities in them and thereby, to improve their presentation skills.
3. Regular Motivation is given to the students to prepare for the Placement, Competitive Exams and Entrepreneurship.

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POLICY GUIDELINES FOR ADVANCED LEARNERS

- ✓ Advanced learners are motivated to strive for higher goals. They are provided with additional inputs for better career planning and growth through offering special coaching for higher level competitive examinations
- ✓ Encouragement to identify and utilize the web learning resources
- ✓ Motivation to participate in interactive activities like debates, group discussion on and out of the syllabi contents and participation in various cultural, extra-curricular and research competitions in and out of the college.
- ✓ To provide need-based facility in departments and library to advanced learners.
- ✓ Personal Counseling as and when the students turn up for the guidance
- ✓ Arrangement of Guest lectures.
- ✓ Students enrolled into SWAYAM Courses
- ✓ Students are engaged in ICT enabled teaching learning and LMS with considerable responses.
- ✓ They are made the supporters to the average and the slow learners.

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CATEGORIZATION

OF

NEW BUDDING ENGINEERS

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DEPARTMENT OF SCIENCE AND HUMANITIES

CATEGORIZATION OF NEW BUDDING ENGINEERS

Tamil Medium Students in XII

- Development of Literacy Skills
- Development of Communication Skills

Low Cut off in XII Examination

- Improving Mathematical Skills
- Basic Aptitude Questions

Bio - Maths Students in XII

- Basic Computer skills
- Basic Programming Languages(C, Python)

NPR COLLEGE OF ENGG. & TECHNOLOGY * NATHAM

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NPRCET/S&H/2021 - 2022 **18.11.2021**

CIRCULAR

The Special coaching classes will be conducted for first-year students those who have from Tamil medium, Biology students, and those who are poor in Mathematics subject in XII Standard from 22.11.2021 to 24.11.2021. The students are advised to make use of these special coaching classes successfully.

Copy to

1. Office
2. Department notice board
3. File

N.P.R. COLLEGE OF ENGG & TECH. NATHAM-624 401

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DEPARTMENT OF SCIENCE AND HUMANITIES

THE FACULTY NAME LIST FOR THE SPECIAL COACHING CLASSES

S. NO	NAME OF THE FACULTY	SUBJECT
1	1.Mrs. V. Sujitha, AP/CSE 2. Mrs. J. Prisca Mary, AP/CSE 3. Mrs. C. Kalpana. AP/CSE	Basic Computer Skills & Basic Programming Languages.
2.	1. Mrs.D.Lakshmi, AP/Maths 2. Mr. U. Vijayanarayanan, AP/ Maths 3. Mr. K.Yogunath, AP/Maths	Basic Mathematical Skills and Aptitude.
3.	1. Mrs. K. Kavitha, AP/English 2. Mr. K. Murali, AP/ English 3. Ms. A.Rubini, AP/English	Development of Literacy and Communication Skills.

HOD
(Dr.T.Piya)

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DEPARTMENT OF SCIENCE & HUMANITIES (2021 - 2022)

ENGLISH COACHING CLASS

DEVELOPMENT OF LITERACY & COMMUNICATION SKILLS

SYLLABUS

- Listen to simple conversations in everyday contexts and respond.
- Practice production of stress, intonation and problem sounds.
- Listen to lectures, presentations and other suitable listening materials from electronic media, and take notes.
- Listen to telephone calls and respond; keep notes while listening.
- Use conversation starters: introducing oneself; introducing others; small talk: family, friends, hobbies, profession, studies etc.
- Pronunciation practice: Stress and syllables; word stress; contracted forms; utterance stress; uses of a dictionary for pronunciation practice.
- Congratulate people on their success, Apologize.
- Skimming through reading texts and determine two or more main ideas or themes.
- Scanning through reading texts to understand and explain how key details support the main ideas or themes.
- Nouns Verbs Adverbs Adjectives Prepositions Pronouns Conjunctions Interjections, Be Forms Of Modals Be Forms –Auxillaries WH Questions Tenses Negatives Word Building Reading Enhancement Vocabulary LSRW Revision
- Negatives, Word Building, Word Games, Reading Enhancenent, Vocabulary.
- Listening Skills, Speaking Skills, Reading Skills, Writing Skills
- Conclusion.

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DEPARTMENT OF SCIENCE & HUMANITIES

DEVELOPMENT OF LITERACY & COMMUNICATION SKILLS

TIME TABLE

Period	1		2	3	4		5	6		7	8
Hour →	09.00 to 09:50	9.50 to 10.15	10.15 to 11.05	11.05 to 11.55	11.55 to 12.45	12.45 to 1.20	01.20 to 2.05	02.05 to 02.50	02.50 to 3.00	3.00 to 03.45	03.45 to 04.30
22.11.2021	K.K	BREAK	K.K	A.R		LUNCH	K.M		BREAK	K.K	
23.11.2021	A.R		A.R	K.M			K. K			A.R	
24.11.2021	K.M		K.M	K. K			A.R			K.M	

Subject Name	Faculty	
Development Of Literacy & Communication Skills	1. Mrs. K. Kavitha	K.K
	2. Mrs. A. Rubini	A.R
	3. Mr. K. Murali	K.M

C. Yogitha
TIME TABLE INCHARGE
[Mrs. Yogitha C]

T.R.
HOD
(Dr. T. Raja)

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DEPARTMENT OF SCIENCE & HUMANITIES (2021-2022)

DEVELOPMENT OF LITERACY & COMMUNICATION SKILLS

STUDENTS ATTENDANCE

Branch: CIVIL

S.No	Name	22.11.2021	23.11.2021	24.11.2021
1	Bharath Kumar S	/	/	/
2	Muthuarivu K	A	/	/
3	Subanu M	/	/	A
4	Syed Ali Fathima K	/	/	/
5	Veeramari S	/	/	/

Branch: CSE

S.No	Name	22.11.2021	23.11.2021	24.11.2021
1	Shanmugapriya V	/	A	/
2	Baby Shalini C	/	/	/
3	Mousook Rahman S	/	/	/
4	Jothi Mani P	/	/	/
5	Jothiprakash M	/	/	A
6	Gantha Raja M	/	A	/
7	Karthikeyan M	/	/	/
8	Madhesh G	/	/	/
9	Madhumitha J	A	/	/
10	Naveen S	/	/	/
11	Pavithra J	/	/	/
12	Phavaneswar K	/	/	/
13	Ragul R	/	A	/
14	Rathis Kanna R	/	/	/
15	Sankaradinesh A	/	/	/
16	Shaul Hameed U	/	/	/
17	Sheeba V	A	A	/
18	Sheik Abdul Basith S	/	/	/
19	Shriharini V	/	/	/
20	Sibidharani K	/	/	/

Branch: EEE

S.No	Name	22.11.2021	23.11.2021	24.11.2021
1	Anbarasan P	/	/	/
2	Jeyavarthini	/	A	/
3	Ramya M	/	/	/
4	Santhosh Kumar R	/	/	/
5	Srisaisakthi R	/	/	/

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Branch: ECE

S.No	Name	22.11.2021	23.11.2021	24.11.2021
1	Ragul M	/	/	/
2	Sivabalaji M	/	/	/
3	Vignesh R	/	A	/
4	Partha Sarathi K	A	/	A
5	Sathasivam M	/	/	/
6	Sabari Prasath P	/	/	/
7	Vignesh K	A	/	/
8	Ponraj H	/	/	/
9	Thoufik Raja S	/	/	/
10	P. Alagupandi	A	/	A
11	Ramji M	A	/	/
12	Premkumar G	A	/	/
13	Ravikumar S	/	/	/
14	Nithishkumar K	/	/	/
15	Prathisha P	/	/	/
16	Aakash R	/	/	A
17	Aashiga Begam N	/	/	/
18	Abdul Rahman A	A	A	/
19	Abhishek S	/	/	/
20	Abirami.S	/	/	/
21	Kansa shereen. J	/	/	/
22	Naveenkumar S	/	/	/
23	Pommendran R	/	/	/
24	Vinoth Kumar K	/	A	A
25	Pugalenthi K	/	/	/
26	Mohamed Baruk S	/	/	/
27	Mohamed Imthiyas K	A	/	/
28	Mohammed Hissam R	/	/	/
29	Mokesh Nandhu P	/	A	/
30	Mukesh Varma M	/	/	/
31	Nachammai C	/	/	/
32	Nadhira Banu N	/	/	/

Branch: Mechanical

S.No	Name	22.11.2021	23.11.2021	24.11.2021
1.	Aravinth B	/	/	/
2.	Anbuselvam I	A	/	/
3.	Arikaran N	/	/	/
4.	Chinnaiya N	/	/	/
5.	Dhamotharan V	/	/	/
6.	Dhayal Priyadharshan	/	/	/
7.	Gokul M	/	/	/
8.	Kesavapommaiah T	/	/	/
9.	Manoharan K	A	/	/

10.	Santhosh Kumar P	✓	✓	✓
11.	Sivaprakash P	✓	✓	✓

HOD
(Dr.T.Priya)

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DEPARTMENT OF SCIENCE & HUMANITIES

SPECIAL COACHING CLASS FOR FIRST YEAR

Name of the Student : D. Aathiraja

Year/Sem/Department : I - yr - CIVIL

1. Rate your knowledge level before you taking this course?

Below Average	Average	Above Average
✓		

2. How do you feel the improvement of your knowledge or skills after taking this class?

Below Average	Average	Above Average
	✓	

3. How would you rate your overall learning experience?

Below Average	Average	Above Average
		✓

4. Are you satisfied with course Duration & Timings?
   Yes or No

5. Do you feel that this course training is more effective?
   Yes or No

6. Name the topics you enjoyed the most in this course.
   Mathematics : Differentiation
   Computer Skills : Basic
   Communication Skills : Speaking Skills

7. Is the Content of the course useful for your further studies?
   Yes or No

8. Rate the content Delivery of the Course by the Staff?

Excellent	Good	Satisfactory
		✓

9. Any other specific topic do you want to learn? Yes
10. Do you prefer more lecture hours? Yes

NATHAM

Student's Signature

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DEPARTMENT OF SCIENCE & HUMANITIES

SPECIAL COACHING CLASS FOR FIRST YEAR

Name of the Student : V. Sumithra

Year/Sem/Department : I st year CSE

1. Rate your knowledge level before you taking this course?

Below Average	Average	Above Average
	✓	

2. How do you feel the improvement of your knowledge or skills after taking this class?

Below Average	Average	Above Average
	✓	

3. How would you rate your overall learning experience?

Below Average	Average	Above Average
	✓	

4. Are you satisfied with course Duration & Timings?
   Yes or No

5. Do you feel that this course training is more effective?
   Yes or No

6. Name the topics you enjoyed the most in this course.
   Mathematics : Matrices / Integration
   Computer Skills : Basic
   Communication Skills : Conversation starters.

7. Is the Content of the course useful for your further studies?
   Yes or No

8. Rate the content Delivery of the Course by the Staff?

Excellent	Good	Satisfactory
	✓	

9. Any other specific topic do you want to learn? No

10. Do you prefer more lecture hours? Yes -

Student's Signature

NPR College of Engineering & Technology
NPR Nagar, Natham, Dindigul - 624401, Tamil Nadu, India.
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DEPARTMENT OF SCIENCE & HUMANITIES

SPECIAL COACHING CLASS FOR FIRST YEAR

Name of the Student : C. Baby Shalini

Year/Sem/Department : I st year CSE

1. Rate your knowledge level before you taking this course?

Below Average	Average	Above Average
	✓	

2. How do you feel the improvement of your knowledge or skills after taking this class?

Below Average	Average	Above Average
✓		

3. How would you rate your overall learning experience?

Below Average	Average	Above Average
✓		

4. Are you satisfied with course Duration & Timings?
   Yes or No

5. Do you feel that this course training is more effective?
   Yes or No

6. Name the topics you enjoyed the most in this course.
   Mathematics : Application of partial fractions
   Computer Skills : Basic computer
   Communication Skills : pronuncation practice

7. Is the Content of the course useful for your further studies?
   Yes or No

8. Rate the content Delivery of the Course by the Staff?

Excellent	Good	Satisfactory
✓		

9. Any other specific topic do you want to learn? No

10. Do you prefer more lecture hours? Yes

NPRC COLLEGE OF ENGG & TECHNOLOGY NATHAM

C. Baby

Student's Signature

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DEPARTMENT OF SCIENCE & HUMANITIES (2021 - 2022)

BASIC MATHEMATICAL SKILLS AND APTITUDE

SYLLABUS

- Matrices, Basic needs of matrices - Physical interpretation of matrices - Types of matrices - Operations on matrices.
- Properties of matrices - Determinants - Relation between matrices and determinants - Properties of determinants.
- Applications of partial fractions - Importance of partial fractions - Types.
- Differential Calculus Limits and continuity - Concepts of continuity - Derivatives of a function - Differentiation rules - Derivatives of trigonometric function. Chain rule - Techniques of differentiation - Total and partial derivatives. (2 Hours) Theory of equations - Relation between roots and coefficients - Expressions - Equations and factors.
- Integral Calculus Applications of integration - Definite and indefinite integrals - Proper and improper integrals - Techniques of integration.
- Integration by substitution - Integration by parts - Bernaulli"s formula (2 Hours) Integration by using partial fractions.
- Differential Equations ODE - PDE - Applications of ODE & PDE - Formation of ODE & PDE Order - Degree - Need of differential equations & importance.

N.P.R. COLLEGE OF ENGG & TECHNOLOGY NATHAM

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NPR College of Engineering & Technology

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DEPARTMENT OF SCIENCE & HUMANITIES

BASIC MATHEMATICAL SKILLS AND APTITUDE

TIME TABLE

Period	1		2	3	4		5	6		7	8
Hour →	09.00 to 09:50	9.50 to 10.15	10.15 to 11.05	11.05 to 11.55	11.55 to 12.45	12.45 to 1.20	01.20 to 2.05	02.05 to 02.50	02.50 to 3.00	3.00 to 03.45	03.45 to 04.30
22.11.2021	K.Y	BREAK	K.Y	U.VN		LUNCH	D.L		BREAK	K.Y	
23.11.2021	U.VN		U.VN	D.L			K.Y			U.VN	
24.11.2021	D.L		D.L	K.Y			U.VN			D.L	

Subject Name	Faculty	
Basic Mathematical Skills and Aptitude	1. Mr. K. Yogunath	K.Y
	2. Mr. U. Vijayanarayanan	U.VN
	3. Mrs. D. Lakshmi	D.L

TIME TABLE INCHARGE
[Mrs. C. YOGITHA]

HOD
[Dr. T. Prita]

PRINCIPAL
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Department of Science & Humanities (2021-2022)

BASIC MATHEMATICAL SKILLS AND APTITUDE

STUDENTS ATTENDANCE

Branch: CIVIL

S.No	Name	22.11.2021	23.11.2021	24.11.2021
1	Dinakaran K	/	/	/
2	Kirthikananth M	/	/	/
3	Mohammed Abdula S	/	/	/
4	Sanjay Yukendra M	/	/	/
5	Ajai S	A	A	A
6	Praveen C	A	A	A

Branch: CSE

S.No	Name	22.11.2021	23.11.2021	24.11.2021
1	Sumitha V	/	/	/
2	Dharshini M	/	/	/
3	Aarif H	/	/	/
4	Ajay Kumar K	/	/	/
5	Apsara Jasmine S	/	/	/
6	Bharathi J	/	/	/
7	Anbulingam E	/	/	/
8	Bhuvaneshwaran S	/	/	/
9	Devadharshini R S	/	/	/
10	Dhanush M	/	/	/
11	Dharani T	/	/	/
12	Dharinish K	A	/	/
13	Durga Ghana Devi S	/	A	A
14	Fahmitha Sirin N	/	/	/
15	Frossekhan M	/	/	/
16	Gokulapriyan R	/	/	/
17	Harish T	/	/	/
18	Jayasurya S A	/	/	/
19	Karthikeyan Dk	/	/	/

Branch: EEE

S.No	Name	22.11.2021	23.11.2021	24.11.2021
1.	Ashok Viswanath M	/	/	/
2.	Jeffry Edilbert J	/	/	/
3.	Logesh Kumar B	/	/	/
4.	Muralitharan A	/	/	/
5.	Naresh Karthik M S	/	/	/

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6.	Praveen Kumar U	/	/	/
7.	Santhosh A	/	/	/
8.	Sudharsan M	/	/	/
9.	Vasanth Prabakaran R	/	/	/
10.	Vikram J	/	/	/
11.	Vinoth K	/	/	/
12.	Vishal Ganesh J	A	/	/
13.	Visvanathan M	/	/	/

Branch: ECE

S.No	Name	22.11.2021	23.11.2021	24.11.2021
1	Vibhu Vishwa Deep B K	/	/	A
2	Vijaya Shree R	/	/	/
3	Vigneshwaran T	/	/	/
4	Tharun M	/	/	/
5	Thirumalaikarthick M	/	/	/
6	Neha A	/	/	/
7	Pavithra K	/	/	/
8	Shanofar Begum S	A	/	/
9	Soundharya R	/	/	/
10	Varsha V S	/	/	/
11	Veera Lakshmi	/	/	/
12	Subash Chandra Bose S	/	/	/
13	Sarathi R	A	/	/
14	Tamilarasi C	/	/	/
15	Shanmuganathan C	/	/	/
16	Sakthi Prasanna M	/	/	/
17	Prasanna Kumar V	/	/	/
18	Dhananjeyan M	/	/	/
19	Dharani R	A	/	/
20	Dharshini B	/	/	/
.21	Divya Dharsini G	/	/	/
22	Durga S	/	/	/
23	Ganesan M	A	A	A
24	Gopinath S	/	/	/
25	Hareshkumar K	/	/	/
26	Hariharan R	/	/	/
27	Harishbalaji E	/	/	/
28	Harshinipriya R	/	/	/
29	Hemanth Bala M	/	/	/
30	Imrana Y	/	A	/
31	Janani M	/	/	/
32	Jaya Surya S	/	/	/

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Branch: MECHANICAL

S.No	Name	22.11.2021	23.11.2021	24.11.2021
1	Aathiraja D	/	/	A
2	Brithiv Kumar K	/	/	/
3	Alagarsamy T	/	/	/
4	Deepak Kumar S	/	/	/
5	Guruprasanna S	/	/	/
6	Hariharan D	/	/	/
7	Jeevanantham B	/	/	/
8	Kannan S	/	/	/
9	Karthick B	/	/	/
10	Manoj Kumar R	A	A	/
11	Nazeerkhan B	/	/	/
12	Neethirajan R	/	/	/
13	Santhoshkumar K	/	/	/
14	Vidhya Shankar P	/	/	/
15	Yogaraja S	/	/	/

HOD
(Dr. T. Priya)

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DEPARTMENT OF SCIENCE & HUMANITIES

SPECIAL COACHING CLASS FOR FIRST YEAR

Name of the Student : B. Harishbalaji

Year/Sem/Department : I/II ECE

1. Rate your knowledge level before you taking this course?

Below Average	Average	Above Average
	✓	

2. How do you feel the improvement of your knowledge or skills after taking this class?

Below Average	Average	Above Average
	✓	

3. How would you rate your overall learning experience?

Below Average	Average	Above Average
		✓

4. Are you satisfied with course Duration & Timings?
   Yes or No

5. Do you feel that this course training is more effective?
   Yes or No

6. Name the topics you enjoyed the most in this course.
   Mathematics : Canonical form
   Computer Skills : basic
   Communication Skills : listening

7. Is the Content of the course useful for your further studies?
   Yes or No

8. Rate the content Delivery of the Course by the Staff?

Excellent	Good	Satisfactory
	✓	

9. Any other specific topic do you want to learn? No

10. Do you prefer more lecture hours? Yes

NPR COLLEGE OF ENGG. & TECHNOLOGY NATHAM

B. Harishbalaji
Student's Signature

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DEPARTMENT OF SCIENCE & HUMANITIES

SPECIAL COACHING CLASS FOR FIRST YEAR

Name of the Student : Ramya M

Year/Sem/Department : 1st EEE

1. Rate your knowledge level before you taking this course?

Below Average	Average	Above Average
	✓	

2. How do you feel the improvement of your knowledge or skills after taking this class?

Below Average	Average	Above Average
		✓

3. How would you rate your overall learning experience?

Below Average	Average	Above Average
	✓	

4. Are you satisfied with course Duration & Timings?
Yes or No

5. Do you feel that this course training is more effective?
Yes or No

6. Name the topics you enjoyed the most in this course.
Mathematics : Operations on matrices
Computer Skills : Basic computer
Communication Skills : Pronounciation practice

7. Is the Content of the course useful for your further studies?
Yes or No

8. Rate the content Delivery of the Course by the Staff?

Excellent	Good	Satisfactory
	✓	

9. Any other specific topic do you want to learn? Yes
10. Do you prefer more lecture hours? Yes

COLLEGE OF ENGG & TECH NATHAM

M. Ramya
Student's Signature

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DEPARTMENT OF SCIENCE & HUMANITIES

SPECIAL COACHING CLASS FOR FIRST YEAR

Name of the Student : G. Divya Dharshini

Year/Sem/Department : 1st Yr - ECE

1. Rate your knowledge level before you taking this course?

Below Average	Average	Above Average
	✓	

2. How do you feel the improvement of your knowledge or skills after taking this class?

Below Average	Average	Above Average
		✓

3. How would you rate your overall learning experience?

Below Average	Average	Above Average
	✓	

4. Are you satisfied with course Duration & Timings?
   Yes or No

5. Do you feel that this course training is more effective?
   Yes or No

6. Name the topics you enjoyed the most in this course.
   Mathematics : Properties of matrices.
   Computer Skills : Basic Computer
   Communication Skills : Pronounciation Practice

7. Is the Content of the course useful for your further studies?
   Yes or No

8. Rate the content Delivery of the Course by the Staff?

Excellent	Good	Satisfactory
	✓	

9. Any other specific topic do you want to learn? yes

10. Do you prefer more lecture hours? yes

G. Divya Dharshini
Student's Signature

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DEPARTMENT OF SCIENCE & HUMANITIES

SPECIAL COACHING CLASS FOR FIRST YEAR

Name of the Student : S. Jeevakumar

Year/Sem/Department : IST MECH

1. Rate your knowledge level before you taking this course?

Below Average	Average	Above Average
	✓	

2. How do you feel the improvement of your knowledge or skills after taking this class?

Below Average	Average	Above Average
	✓	

3. How would you rate your overall learning experience?

Below Average	Average	Above Average
	✓	

4. Are you satisfied with course Duration & Timings?
Yes or ~~No~~

5. Do you feel that this course training is more effective?
~~Yes~~ or No

6. Name the topics you enjoyed the most in this course.
Mathematics : TRIGNOMETRY /INTEGRATION
Computer Skills : Basic computer
Communication Skills : use conversation statement

7. Is the Content of the course useful for your further studies?
Yes or ~~No~~

8. Rate the content Delivery of the Course by the Staff?

Excellent	Good	Satisfactory
	✓	

9. Any other specific topic do you want to learn? No

10. Do you prefer more lecture hours? Yes

COLLEGE OF ENGG & TECH NATHAM

S. Jeevakumar
Student's Signature

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DEPARTMENT OF SCIENCE & HUMANITIES (2021 - 2022)

BASIC COMPUTER SKILLS & BASIC PROGRAMMING LANGUAGES CLASS (FOR BIOLOGY STUDENTS)
SYLLABUS

CHAPTER-1. Operating Computer using GUI Based Operating System: What is an Operating System; Basics of Popular Operating Systems; The User Interface, Using Mouse; Using right Button of the Mouse and Moving Icons on the screen, Use of Common Icons, Status Bar, Using Menu and Menu-selection.

CHAPTER-2. Viewing of File, Folders and Directories, Creating and Renaming of files and folders, Opening and closing of different Windows; Using help; Creating Short cuts.

CHAPTER-3. Using Spread Sheet: Basics of Spreadsheet; Manipulation of cells; Formulas and Functions; Editing of Spread Sheet, printing of Spread Sheet, Tables Charts, Formatting Charts, Outline, Sort, Filter, and Subtotal

CHAPTER-4. Making Small Presentation: Basics of presentation software; Creating Presentation; Preparation and Presentation of Slides; Slide Show; Taking printouts of presentation / handouts, Applying Themes and Layouts to Slides, Inserting Pictures, Graphics, Shapes, and Other Things, Charts

N.P.R. COLLEGE OF ENGG. & TECH. NATHAM-624 401

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DEPARTMENT OF SCIENCE & HUMANITIES

BASIC COMPUTER SKILLS AND BASIC PROGRAMMING LANGUAGES

TIME TABLE

Period	1		2	3	4		5	6		7	8
Hour →	09.00 to 09:50	9.50 to 10.15	10.15 to 11.05	11.05 to 11.55	11.55 to 12.45	12.45 to 1.20	01.20 to 2.05	02.05 to 02.50	2.50 to 3.00	3.00 to 03.45	03.45 to 04.30
22.11.2021	V. S	BREAK	V. S	J. PM		LUNCH	C.K		BREAK	V. S	
23.11.2021	J. PM		J. PM	C.K			V. S			J. PM	
24.11.2021	C.K		C.K	V.S			J. PM			C.K	

Subject Name	Faculty	
Basic Computer Skills And Basic Programming Languages	1. Mrs. V. Sujitha	V.S
	2. Mrs. J. Prisca Mary	J.PM
	3. Mrs. C. Kalpana	C.K

TIME TABLE INCHARGE
[MRS. C YOGITHA]

HOD

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Department of Science & Humanities (2021-2022)

BASIC COMPUTER SKILLS AND BASIC PROGRAMMING LANGUAGES

STUDENTS ATTENDANCE

Branch: CIVIL

S.No	Name	22.11.2021	23.11.2021	24.11.2021
1	Elambarathi B	/	/	/
2	Raghul S P	/	/	/
3	Ritika S A	/	/	/

Branch: CSE

S.No	Name	22.11.2021	23.11.2021	24.11.2021
1	Roobala V	/	/	/
2	Arusha Banu A	/	A	/
3	Madhumitha J	/	/	/
4	Natchathira M	/	/	/
5	Sri Sudharsana Lakshmi D	/	/	/
6	Keerthi Haran R	/	/	/
7	Surya Prakash M	A	/	/
8	Bellarmine Joshi	/	/	/
9.	Anbarasu S	/	/	/
10	Pranov M	/	/	/
11	Bhuvaneshwaran S	/	/	/
12	Arasuthangapandi M	/	/	/
13	Sivakumar R	/	/	/
14	Sivasubramanian N	/	/	/
15	Sowmiya S	/	/	/
16	Suresh Kannan.M	A	/	/
17	Susmitha N	/	/	/
18	Vimalroja N	/	/	/
19	Yuvashri A	/	/	/
20	Anbarasan P	/	/	/

Branch: EEE

S.No	Name	22.11.2021	23.11.2021	24.11.2021
1	Jeevadharani P	/	/	/
2	Keerthika P	/	/	/
3	Laaradolly S	/	/	/
4	Logesh S	/	/	/
5	Logeshwaran S	/	/	/
6	Mohamed Thoufeek	A	/	/
7	Nandha Kumar M	/	A	/
8	Sivanesan D	/	/	/
9	Sujindran S	/	A	/

Branch: ECE

NPR COLLEGE OF ENGG. & TECHNOLOGY * NATHAM

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S.No	Name	22.11.2021	23.11.2021	24.11.2021
1	Nadhiya M	P	P	P
2	Pothini M	P	P	P
3	Nithyasri R	P	P	P
4	Priya Dharshini S	A	P	P
5	Saranya	P	P	P
6	Subamozhi P	P	P	P
7	Sudhishree J J	P	P	P
8	Sushmitha M P	P	P	P
9	Swathi	P	P	P
10	Tamilarasi C	P	P	P
11	Sangili Perumal M	P	P	P
12	Siva Balan S	P	P	P
13	Amrutha Shopiga C	P	P	P
14	Ashok Kumar S	A	P	P
15	Babitha J	P	P	P
16	Bala Subhanu B	P	P	P
17	Balurathinam B T	P	P	P
18	Bhuvaneshwaran B	P	P	P
19	Buvaneshwari P	P	P	P
20	Chinraman V	A	P	A
21	Jeeva Bharathi M	P	P	A
22	Jeyasurya S	P	A	P
23	Joseph Samuel M	P	A	A
24	Kaleeshwaran M	P	P	P
25	Kansa Shereen J	P	P	P
26	Karthick B	P	P	P
27	Lakshmanadhasan S	P	P	P
28	Lakshmanan K	P	P	P
29	Manikandan G	P	P	P
30	Manikandan N	P	P	A
31	Manoj Kumar S	P	A	P
32	Melvin Mecvaan J	P	P	P

Branch: MECHANICAL

S.No	Name	22.11.2021	23.11.2021	24.11.2021
1	Balaji K	P	P	P
2	Deepak Kumar S	P	P	P
3	Gunapathi V	P	P	P
4	Venkat Arjun A	P	P	P
5	Nithish P	P	P	P
6	Poovarasan R	P	P	P
7	Jeevakumar S	P	P	P

HOD
(Dr. T. Rita)

COLLEGE OF ENGG. & TECHNOLOGY NATHAM

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DEPARTMENT OF SCIENCE & HUMANITIES

SPECIAL COACHING CLASS FOR FIRST YEAR

Name of the Student : Dhakaran . k

Year/Sem/Department : 1st year Civil

1. Rate your knowledge level before you taking this course?

Below Average	Average	Above Average
✓		

2. How do you feel the improvement of your knowledge or skills after taking this class?

Below Average	Average	Above Average
	✓	

3. How would you rate your overall learning experience?

Below Average	Average	Above Average
		✓

4. Are you satisfied with course Duration & Timings?
   Yes or No

5. Do you feel that this course training is more effective?
   Yes or ~~No~~

6. Name the topics you enjoyed the most in this course.
   Mathematics : Differential calculus limits and Continuity
   Computer Skills : Basic Computer
   Communication Skills : Use Conversation starters

7. Is the Content of the course useful for your further studies?
   Yes or No

8. Rate the content Delivery of the Course by the Staff?

Excellent	Good	Satisfactory
	✓	

9. Any other specific topic do you want to learn? No

10. Do you prefer more lecture hours? NO.

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Student's Signature

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DEPARTMENT OF SCIENCE & HUMANITIES

SPECIAL COACHING CLASS FOR FIRST YEAR

Name of the Student : Subamozhi P

Year/Sem/Department : ECE 1st year

1. Rate your knowledge level before you taking this course?

Below Average	Average	Above Average
	✓	

2. How do you feel the improvement of your knowledge or skills after taking this class?

Below Average	Average	Above Average
		✓

3. How would you rate your overall learning experience?

Below Average	Average	Above Average
		✓

4. Are you satisfied with course Duration & Timings?
   Yes or No ✓

5. Do you feel that this course training is more effective?
   ✓ Yes or No

6. Name the topics you enjoyed the most in this course.
   Mathematics : Application of Partial fractions
   Computer Skills : Basic Computer
   Communication Skills : Speaking activities

7. Is the Content of the course useful for your further studies?
   Yes or No

8. Rate the content Delivery of the Course by the Staff?

Excellent	Good	Satisfactory
✓		

9. Any other specific topic do you want to learn? Yes
10. Do you prefer more lecture hours? Yes

NPR COLLEGE OF ENGG & TECHNOLOGY NATHAM

Student's Signature

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DEPARTMENT OF SCIENCE & HUMANITIES

SPECIAL COACHING CLASS FOR FIRST YEAR

Name of the Student : Subanu. M

Year/Sem/Department : I st Year Civil

1. Rate your knowledge level before you taking this course?

Below Average	Average	Above Average
	✓	

2. How do you feel the improvement of your knowledge or skills after taking this class?

Below Average	Average	Above Average
		✓

3. How would you rate your overall learning experience?

Below Average	Average	Above Average
		✓

4. Are you satisfied with course Duration & Timings?
   ✓Yes or No

5. Do you feel that this course training is more effective?
   ✓Yes or No

6. Name the topics you enjoyed the most in this course.
   Mathematics : Properties of matrices
   Computer Skills : Basic computer
   Communication Skills : Reading

7. Is the Content of the course useful for your further studies?
   Yes or ✓No

8. Rate the content Delivery of the Course by the Staff?

Excellent	Good	Satisfactory
	✓	

9. Any other specific topic do you want to learn? Yes

10. Do you prefer more lecture hours? Yes

M Subanu.
Student's Signature

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DEPARTMENT OF SCIENCE AND HUMANITIES

CATEGORIZATION OF NEW BUDDING ENGINEERS

SPECIAL COACHING CLASSES

Basic mathematical skills and aptitude

Development of literacy and communication skills

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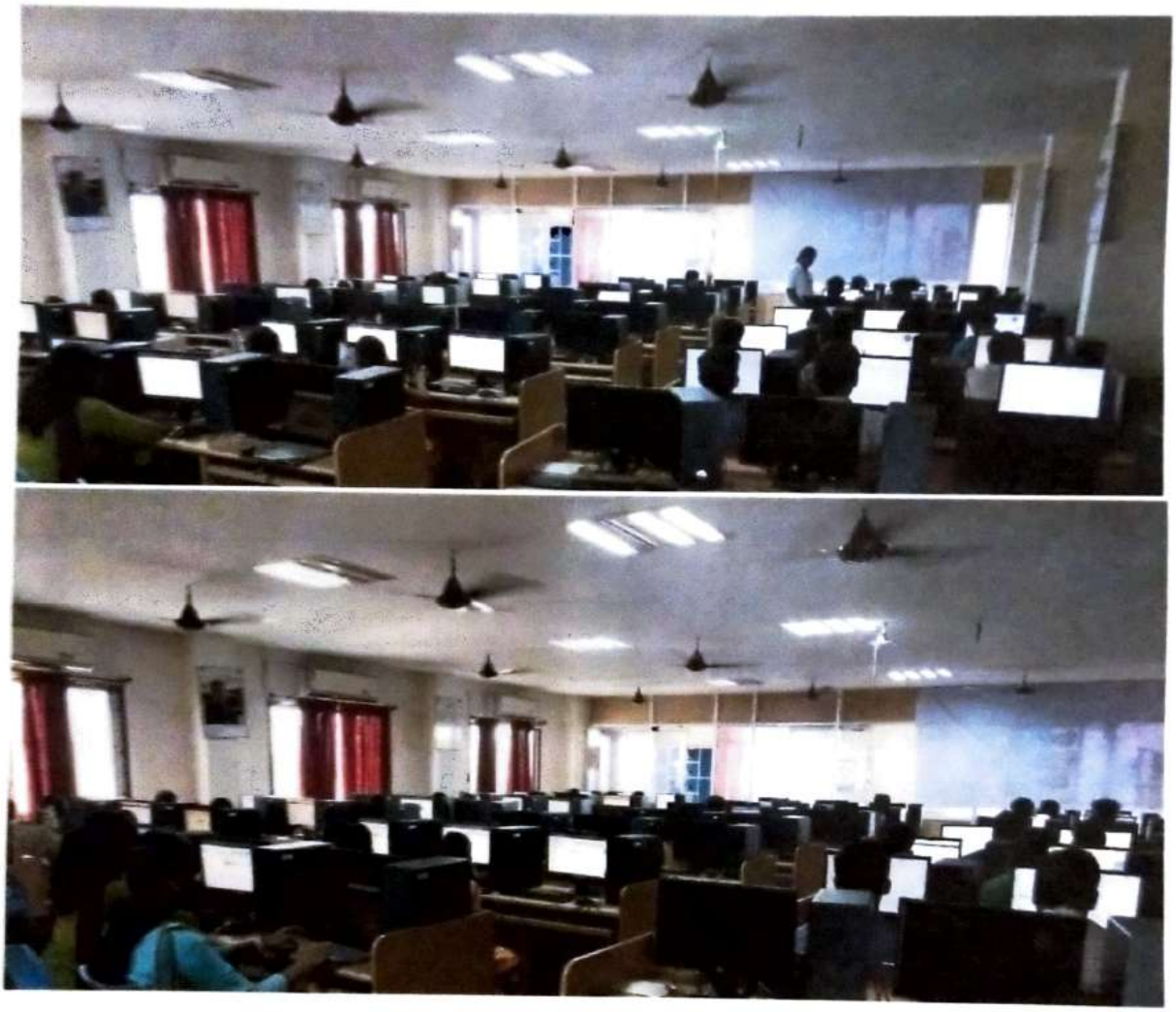
DEPARTMENT OF SCIENCE AND HUMANITIES

CATEGORIZATION OF NEW BUDDING ENGINEERS

SPECIAL COACHING CLASSES



Basics of computer skills & presentation skills

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INSTITUTION ASSESSMENT LEARNING LEVEL

Student

Internal Examination

Result Analysis

Internal Marks >=60

Advanced Learners

- ✓ Utilizing the Web Learning Resources
- ✓ Enrollment of SWAYAM Courses
- ✓ Placement Training Class
- ✓ Personal Counseling
- ✓ Carrier Planning and Special Coaching for Higher level competitive examinations
- ✓ Participation of various technical competitions.
- ✓ Supporters to the average and the slow learners.
- ✓ Coordinators of Symposium, Workshops and Guest Lectures.

Outcome

- ✓ Placement
- ✓ Higher Studies in reputed institution.
- ✓ Entrepreneurs

Internal Marks <60

Slow Learners

- ✓ Remedial Class
- ✓ Bridge Course for first year students
- ✓ Motivational Program
- ✓ Academic and Personal Counseling by Mentor
- ✓ Bilingual explanation and discussions after the class hours for better understanding.
- ✓ Simplified Lecture Notes
- ✓ Training on communication skills, personality development, time management.
- ✓ Group learning activities.

Outcome

- ✓ Slow learners become advanced learners.
- ✓ Improved subject knowledge with the result of catching up with their peers.
- ✓ Placement
- ✓ Continuous improvement in University Examinations

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Ref: NPRCET/ECE/REMEDIAL/2021-2022/ODD

DATE: 04.10.2021

CIRCULAR

This is to inform that Remedial classes will be conducted for the slow learners of III year, Electronics and communication engineering students to improve their learning skills and academic performance. The slow learners were identified based on the performance of the **First Internal Test**. The students concerned are advised to attend the remedial classes from 05.10.2021 onwards at 4.30 pm to 5.30 pm. The Remedial Class Schedule will be displayed in the Department Notice Board.

HOD / ECE

COLLEGE OF ENGG. & TECHNOLOGY * NPR * NATHAM

Copy to

1. **The Principal**
2. **Office**
3. **Department Notice Board**
4. **IV Year ECE Classroom**

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

ACADEMIC YEAR 2021-2022 ODD

INTERNAL TEST – I REMEDIAL CLASS TIMETABLE FOR SLOW LEARNERS

Year / Sem: IV/VIII **Batch :**2018-2022

Venue : IV ECE Class Room **Time:** 4.30 pm - 5.30 pm

Date	Day	Subject Name	Faculty Name
05.10.2021	Tuesday	Antennas and Microwave Engineering	Dr.S.M.Vijaya Rajan
07.10.2021	Thursday	Embedded & Real Time Systems	Ms.S. Monika
08.10.2021	Friday	Ad hoc and Wireless Sensor	Mr.R.Naveen Kumar
09.10.2021	Saturday	Optical Communication	Mrs. C.Kannika Parameshwari
11.10.2021	Monday	Optical Communication	Mrs.C.Kannika Parameshwari
13.10.2021	Wednesday	Embedded & Real Time Systems	Ms.S.Monika
15.10.2021	Friday	Advanced Wireless Communication	Mr. S.Vinayagam
16.10.2021	Saturday	Transducer Engineering	Ms.E.Thangadeepiga
18.10.2021	Monday	Antennas and Microwave Engineering	Dr. S. M.Vijaya Rajan

Timetable In-charge **HOD**

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

ACADEMIC YEAR 2021-2022

INTERNAL TEST - I

Year / Sem/Course Code: IV/VII/ C402 **Batch:** 2018-2022

Course Code / Subject Code:C402/ EC8751 **Subject Name**: Optical Communication

S. No.	Reg. No.	NAME	INTERNAL TEST -I MARK	RETEST	WEBPORTAL MARK
1.	920818106001	ABILASHA.M	98		98
2.	920818106002	ABINAYA. S	98		98
3.	920818106004	BLESSING.X	92		92
4.	920818106005	DHARSHINI.V	90		90
5.	920818106007	DURGADEVI.B	90		90
6.	920818106008	DURGADEVI.S	98		98
7.	920818106009	HARIPRIYA.M	98		98
8.	920818106010	ILAKKIYA.B	98		98
9.	920818106011	JAYA PRATHAP.S	45	85	85
10.	920818106012	JEYARAJ.S	88		88
11.	920818106013	KIRUTHIKA.R	90		90
12.	920818106014	MANOJ PRABHAKAR.V	48	86	86
13.	920818106016	MUKESH KANNA.G	82		82
14.	920818106017	MUTHU VIGNESH.M	96		96
15.	920818106018	NISHA.M	96		96
16.	920818106019	NIVETHA.K. S	90		90
17.	920818106020	PONBHARATHI.V	86		86
18.	920818106022	PUGALARASU.S	84		84
19.	920818106023	PUSHPA PRIYADHARSHINI.R	94		94
20.	920818106024	RAJKUMAR.K	90		90
21.	920818106026	SARITHA RANI.K	96		96
22.	920818106027	SARUMATHI.R	92		92
23.	920818106028	SATHISH KUMAR.G	86		86
24.	920818106029	SEEMA FATHIMA.S	98		98
25.	920818106031	SOWMIYA.P	98		98
26.	920818106032	SREE RAGA SUDHA.K	96		96
27.	920818106033	SURYA PRAKASH.V.M	36	77	77
28.	920818106035	SWETHA.M	86		86
29.	920818106036	VARSHIINI.B	98		98
30.	920818106037	VENNILA.A	92		92
31.	920818106038	VIGNESH.R	54	90	90
32.	920818106039	VISHALINI.B	98		98
33.	920818106040	VIVEKA.S	98		98
34.	920818106302	VIGNESH.S	94		94

Faculty In-Charge

HoD

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

ACADEMIC YEAR 2021-2022

Name List for Advanced Learners for Internal Test I

Year / Sem/Course Code: IV/VII/ C402 **Batch:** 2018-2022
Course Code / Subject Code:C402/ EC8751 **Subject Name:** Optical Communication

S. No.	Reg. No.	NAME
1.	920818106001	ABILASHA.M
2.	920818106002	ABINAYA. S
3.	920818106004	BLESSING.X
4.	920818106005	DHARSHINI.V
5.	920818106007	DURGADEVI.B
6.	920818106008	DURGADEVI.S
7.	920818106009	HARIPRIYA.M
8.	920818106010	ILAKKIYA.B
9.	920818106012	JEYARAJ.S
10.	920818106013	KIRUTHIKA.R
11.	920818106016	MUKESH KANNA.G
12.	920818106017	MUTHU VIGNESH.M
13.	920818106019	NIVETHA.K. S
14.	920818106020	PONBHARATHI.V
15.	920818106018	NISHA.M
16.	920818106022	PUGALARASU.S
17.	920818106023	PUSHPA PRIYADHARSHINI.R
18.	920818106024	RAJKUMAR.K
19.	920818106026	SARITHA RANI.K
20.	920818106027	SARUMATHI.R
21.	920818106028	SATHISH KUMAR.G
22.	920818106029	SEEMA FATHIMA.S
23.	920818106031	SOWMIYA.P
24.	920818106032	SREE RAGA SUDHA.K
25.	920818106035	SWETHA.M
26.	920818106036	VARSHIINI.B
27.	920818106037	VENNILA.A
28.	920818106039	VISHALINI.B
27.	920818106040	VIVEKA.S
28.	920818106302	VIGNESH.S

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COLLEGE OF ENGG. & TECHNOLOGY * NPR * NATHAM

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
ACADEMIC YEAR 2021-2022
Name List for Slow Learners for Internal Test I

Year / Sem/Course Code: IV/VII/ C402 **Batch:** 2018-2022
Course Code / Subject Code:C402/ EC8751 **Subject Name:** Optical Communication

S. No.	Reg. No.	NAME
1.	920818106011	JAYA PRATHAP.S
2.	920818106014	MANOJ PRABHAKAR.V
3.	920818106033	SURYA PRAKASH.V.M
4.	920818106038	VIGNESH.R

Faculty In-Charge **HoD**

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

ACADEMIC YEAR 2021-2022

Attendance for Slow Learners for Internal Test – I

Year / Sem/Course Code: IV/VII/ C402
Course Code / Subject Code:C402/ EC8751

Batch: 2018-2022
Subject Name: Optical Communication

S. No.	Reg. No.	NAME	09.10.2021	11.10.2021
1.	920818106011	JAYA PRATHAP.S	/	/
2.	920818106014	MANOJ PRABHAKAR.V	/	/
3.	920818106033	SURYA PRAKASH.V.M	/	/
4.	920818106038	VIGNESH.R	/	/

DETAILS OF THE TOPIC COVERED			
S. NO.	**Name of the Faculty**	**No of times subject handled**	**Signature of the Faculty**
1	Mrs.C. Kannika Parameshwari	1	
S. NO.	**TOPICS COVERED DURING COACHING CLASS**		
1	Unit – 1 Waveguide modes		
2	Unit – 2 Polarization mode dispersion		

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

REMEDIAL CLASSES & IMPLEMENTATION

PROGRAMME : ELECTRONICS & COMMUNICATION
SEMESTER: VII

REMEDIAL CLASSES	
Subject	**OPTICAL COMMUNICATION (EC8751/C402)**
Class Involved	Semester 7
Faculty in-charge	Mrs.C. Kannika Parameshwari
Reason for arranging the remedial Class	Weak students identified after Internal test 1
Contents to be Taught	Unit 1 & 2
Date and venue of the Class	09.10.2021, 11.10.2021 & IV ECE Class room
Faculty to ensure the Class Room is free and the teaching aids are arranged for the Class	Yes
Information to all Students of the Class	Yes
HOD To Ensure there are no other Classes for the students involved on this Date/Time	No other classes
Approved by HOD	

REMEDIAL CLASSES IMPLEMENTATION	
% Attendance of the REMEDIAL Class	100%
Attendance details is forwarded to HOD	Yes
Verification by HOD	

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

ACADEMIC YEAR 2021-2022

UNIVERSITY MARKS

Year / Sem/Course Code: IV/VII
Course Code / Subject Code:C402/ EC8751

Batch: 2018-2022
Subject Name: Optical Communication

S. No.	Reg. No.	NAME	Grade	Grade Points
1.	920818106001	ABILASHA.M	A+	9
2.	920818106002	ABINAYA. S	O	10
3.	920818106004	BLESSING.X	A+	9
4.	920818106005	DHARSHINI.V	A+	9
5.	920818106007	DURGADEVI.B	O	10
6.	920818106008	DURGADEVI.S	O	10
7.	920818106009	HARIPRIYA.M	O	10
8.	920818106010	ILAKKIYA.B	O	10
9.	920818106011	JAYA PRATHAP.S	A+	9
10.	920818106012	JEYARAJ.S	A+	9
11.	920818106013	KIRUTHIKA.R	A+	9
12.	920818106014	MANOJ PRABHAKAR.V	A+	9
13.	920818106016	MUKESH KANNA.G	A+	9
14.	920818106017	MUTHU VIGNESH.M	A+	9
15.	920818106018	NISHA.M	A+	9
16.	920818106019	NIVETHA.K. S	O	10
17.	920818106020	PONBHARATHI.V	A+	9
18.	920818106022	PUGALARASU.S	A+	9
19.	920818106023	PUSHPA PRIYADHARSHINI.R	A	8
20.	920818106024	RAJKUMAR.K	A+	9
21.	920818106026	SARITHA RANI.K	A	8
22.	920818106027	SARUMATHI.R	A+	9
23.	920818106028	SATHISH KUMAR.G	A+	9
24.	920818106029	SEEMA FATHIMA.S	A+	9
25.	920818106031	SOWMIYA.P	A+	9
26.	920818106032	SREE RAGA SUDHA.K	O	10
27.	920818106033	SURYA PRAKASH.V.M	B	6
28.	920818106035	SWETHA.M	A+	9
29.	920818106036	VARSHIINI.B	O	10
30.	920818106037	VENNILA.A	A+	9
31.	920818106038	VIGNESH.R	A+	9
32.	920818106039	VISHALINI.B	A+	9
33.	920818106040	VIVEKA.S	O	10
34.	920818106302	VIGNESH.S	A+	9

Faculty In-Charge

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

ACADEMIC YEAR 2021-2022

REMEDIAL CLASS ANALYSIS FOR SLOW LEARNERS

EC8751-OPTICAL COMMUNICATION

Year / Sem: IV/VII

Batch: 2018-2022

S. No.	Reg. No.	NAME	NO. OF HOURS TAKEN	UNIVERSITY RESULT	NO. OF STUDENTS PASSED/FAILED
1.	920818106011	JAYA PRATHAP.S	2	A+	Passed: 4
2.	920818106014	MANOJ PRABHAKAR.V	2	A+	
3.	920818106033	SURYA PRAKASH.V.M	2	B	
4.	920818106038	VIGNESH.R	2	A+	

Faculty In-Charge

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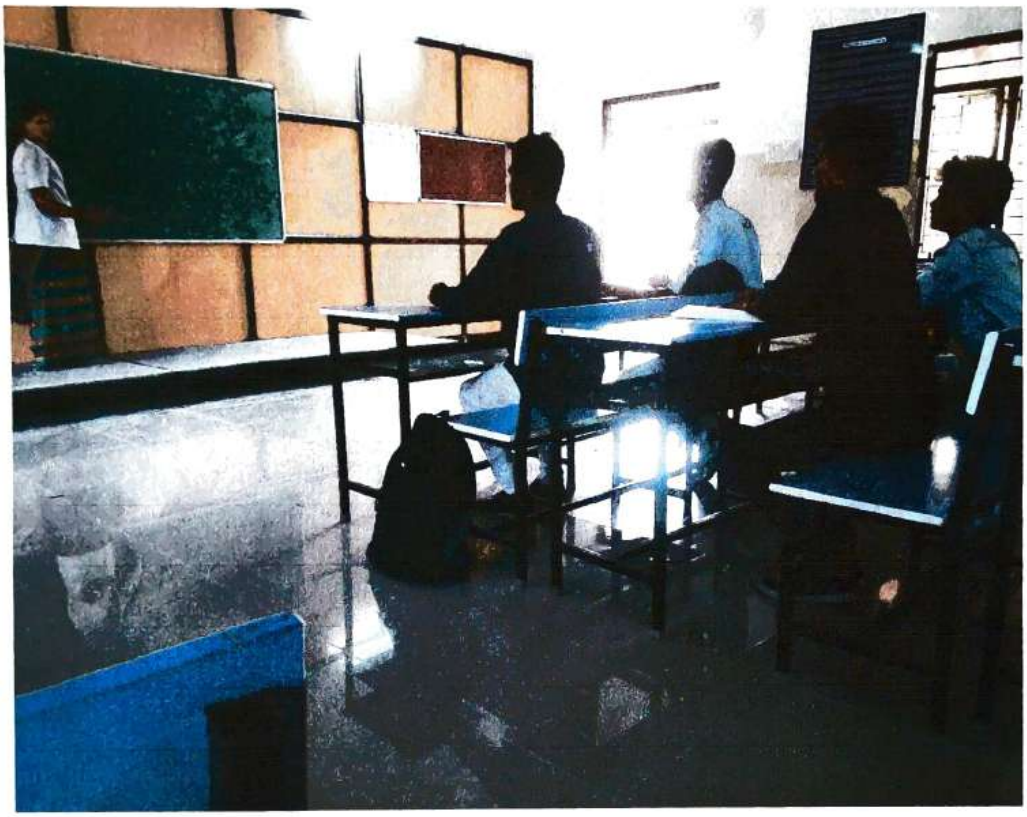
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

ACADEMIC YEAR 2021-2022

Year / Sem: IV/VII **Batch:** 2018-2022

Course Code / Subject Code:C402/ EC8751



REMEDIAL CLASS FOR SLOW LEARNERS

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SAMPLE STUDY MATERIALS
(Notes,Important Questions)

EC8751 Optical Communication

Unit-I

Introduction to optical fibers

Introduction. general optical fiber communication System, basic optical laws and definitions, optical modes and configurations, mode analysis for optical propagation through fibers, modes in planar wave guide, modes in cylindrical optical fiber, transverse electric and transverse magnetic modes, fiber materials, fiber fabrication techniques, fiber optic Cables, classification of optical fiber, Single mode fiber, graded index fiber.

Text Book: - 1. optical Fiber Communication - P. Chakrabarti
2. Optical Fiber Communication - Gred Keiser.

Introduction:-

* This channel may be viewed as a medium that links the transmitter and receiver.
* However, a similar communication link may also be established by making use of an electromagnetic carrier which belongs to the optical range of frequencies.
* The later mode of communication is generally referred to as an optical communication while the former mode is known as electrical communication.

* A fiber optic cable is essentially a light pipe that is used to carry a light beam from one place to another.
* Light is a electromagnetic signal like a radio wave. It can be modulated by an information signal and sent over the fiber optic cable.
* The frequency of light is extremely high so wider bandwidths.
* wider bandwidth, lower loss, light weight, small size, strength security, interface immunity and safety.

Spectrum of light:-

* The frequency of the optical spectrum is in the range of 3×10^{11} to 3×10^{16} Hz. This includes both infrared and ultraviolet as well as the visible parts of the spectrum.
* Light frequency spectrum
  - Infrared - 770nm to 106nm
  - visible - 390nm to 770 nm
  - ultraviolet - 10nm to 390nm.

wavelength ⇒ It is the length that one cycle of an electromagnetic wave occupies in space. It is measured in the unit of meters.

Advantages of optical fiber communication:-

1. wider Bandwidth and Greater Information Capacity
2. Lower Transmission Losses.

3. Small size and Light weight
4. Signal Security.
5. Repeaters Spacing.
6. Environmental Immunity.
7. Low cost and Ease of maintenance.
8. Electrical isolation.
9. Immunity to Interference and Crosstalk.
10. System Reliability.
11. Long Distance Transmission.
12. Safe and Easy Installation.

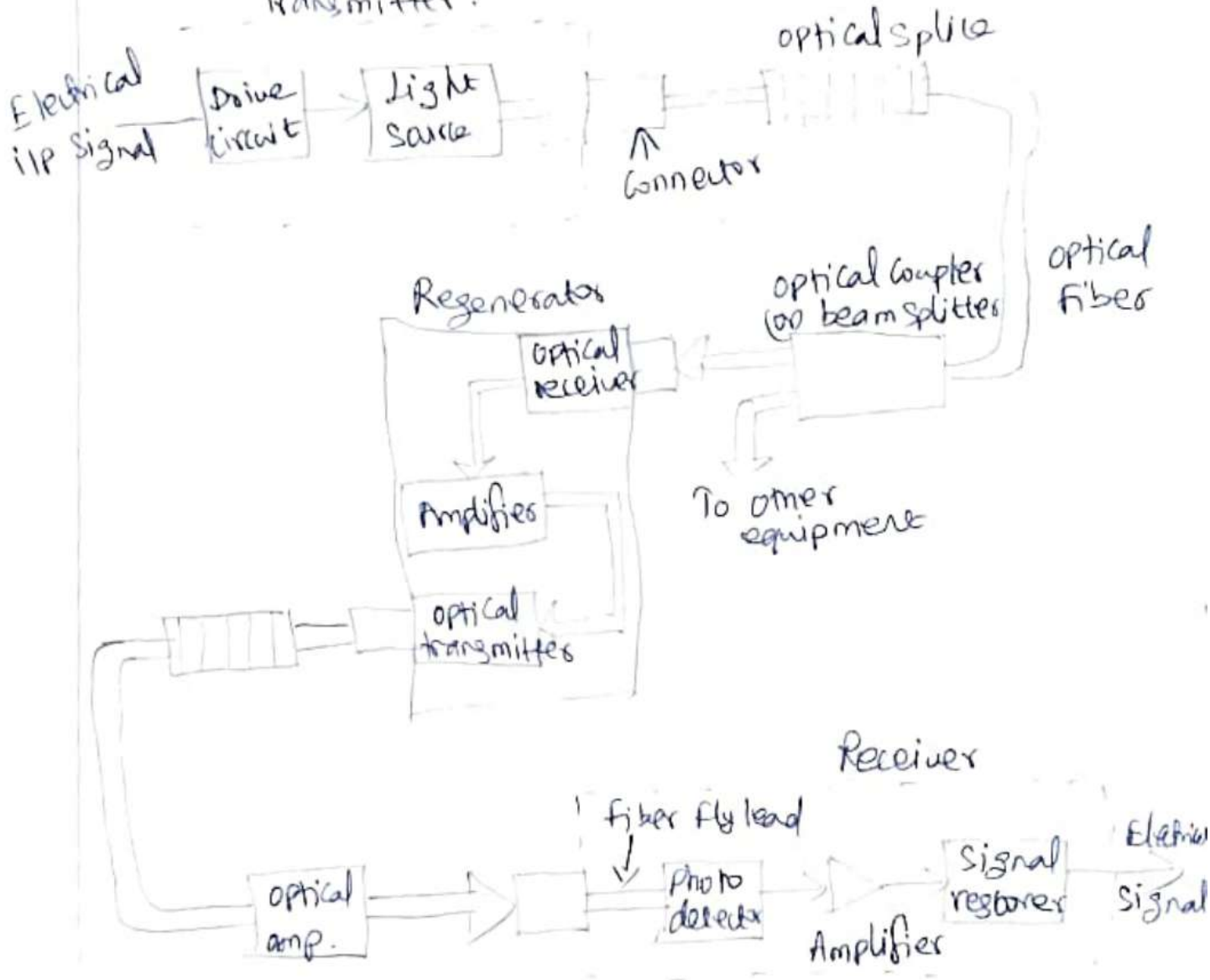
Disadvantages:-

1. High Initial Cost
2. Joining and Test process.

Evolution of fiber optic Systems:-

* First window - (800 - 90 nm)
* Second window - 1310 nm
* Third window - 1550 nm.
* LASER (Light Amplification by Stimulated Emission Radiation) ⇒ wide bandwidth
* optical sources and photo detectors - 800 nm to 1300 nm.
* single mode, multimode fibers ⇒ 1300 nm in LAN
* Erabium - Doped Fiber Amplifiers (EDFAs) ⇒ 1550 nm.
* Praseodymium - Doped Fiber Amplifiers (PDFAs) ⇒ 1300 nm.
* Wavelength Division Multiplexing (WDM) ⇒ Several independent information streams over the same fiber

General optical Fiber Communication System:-



1. Information Source ⇒ voice, video or computer data.

2. Transmitter ⇒ Drive circuit ⇒ electrical signal into light source
   ↳ Light source ⇒ generates optical signal.
   ↳ modulates information signal by using the optical signal.

3. Information channel ⇒ bridging the distance between transmitter and receiver.
   ↳ Fiber optic cables are used as channels.

4. Repeaters ⇒ optical receiver ⇒ optical signal into electrical signal.
   ↳ optical transmitter ⇒ electrical signal into optical signal.
   ↳ amplifier ⇒ ~~electrical sign~~

5. Receiver ⇒ detect the optical signal & convert them into electrical signal.

↳ photo diodes, photo transistors, photo conductors

Applications :-

1. telephone systems
2. broadcast television, Cable television, remote monitoring, Surveillance.
3. LAN, MAN, WAN.

Characteristics of Light:-

* speed of light ⇒ 300,000,000 m/s (3×10^8 m/s)

* Reflection ⇒ 

ϕ_1 ⇒ angle of incidence
ϕ_2 ⇒ angle of reflection.

↳ The Angle of incidence (ϕ_1) = Angle of reflection (ϕ_2)

* Refraction ⇒ bending of a light ray that occurs when the light rays pass from one medium to another.

Index of refraction (n) = $\frac{\text{speed of light in air (c)}}{\text{speed of light in substance (v)}}$

Basic optical Laws:-

1. Wave Theory:-

* Light is emitted in all directions as a series of waves in a medium which he termed as Luminifer-ous ether.

* The wave theory predicted that light waves could interfere with each other like sound waves.

2. maxwell's Electromagnetic Theory:-

*The plane of polarization of ~~linearity~~ linearly polarized light is rotated when the light rays travel along the direction of the magnetic field in the presence of a transparent dielectric.

*maxwell discovered that self propagating electromag-netic waves can travel through space at a constant speed.

3. Quantum Theory:-

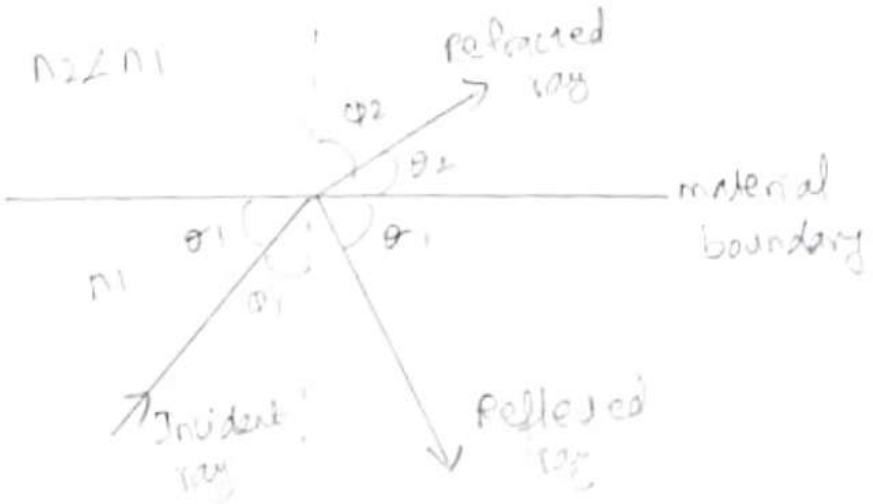
*The new form of particle theory of light supported by Einstein for explanation of photoelectric effect initially faced stiff operation from the firm believers of wave theory.

4. Ray theory:-

*This approach is based on the principles of geometrical optics allowing one to assume rectilinear propagation of light and thereby representing the path of light through a medium by straight light rays.

Total Internal Reflection →

$$n = \frac{\text{velocity of light in free space}}{\text{velocity of light in the medium}} = \frac{c}{v}$$



$$n_1 \sin\phi_1 = n_2 \sin\phi_2$$

$$\frac{\sin\phi_1}{\sin\phi_2} = \frac{n_2}{n_1}$$

$$n_1 \sin\phi_c = n_2 \qquad \phi_c = \sin^{-1}\left(\frac{n_2}{n_1}\right)$$

$\phi_c \Rightarrow$ Critical angle

Optical mode and Configurations:-

*An optical fiber is a cylindrical dielectric waveguide that confines the electromagnetic energy in the form of light and guides it in a direction parallel to its axis.

*It consists of a solid dielectric cylinder of radius, a and a refletion index of n1.

Core → The fiber which is the single solid dielectric Cylinder of radius 'a' and the index of refractions is n_1.

Cladding → The Core is usually Surrounded by a solid dielectric cladding which has a refractive index n_2 that is less than n_1. ($n_1 > n_2$).

* cladding reduces scattering loss occuring otherwise from the bare Core surface.

* It also ~~Support~~ provides a mechanical support to the fiber and protects the Core from undesirable Contain -ments.

* The materials used for making optical are usually glass and plastic.

* A plastic fiber uses polymer materials.

* Glass or silica fibers.

1. plastic Core and ~~glad~~ cladding.
2. Glass Core with plastic cladding.
3. Glass Core with Glass cladding.

Classification:-

1. Step Index (SI) } Based on index of refraction.
2. Graded - Index (GI)

1. Single mode } Based on modes.
2. multimode

Step Index

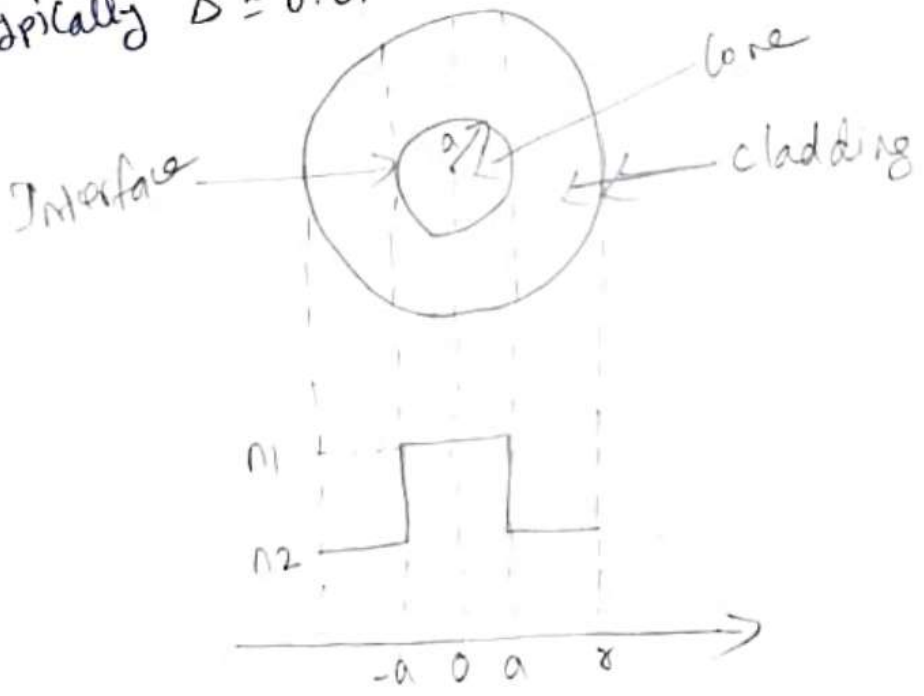
* In the core of step index fiber, the refractive index of the core is constant (n_1) and uniform throughout.
* The core refractive index undergoes an abrupt change to n_2 at the core cladding interface and remains same in the entire cladding region.

$$n(r) = \begin{cases} n_1 & \text{for } r < a \\ n_2 & \text{for } r \geq a \end{cases}$$

$$\Delta = \frac{n_1 - n_2}{n_1}$$

$\Delta \Rightarrow$ Core cladding index difference
$r \Rightarrow$ radial distance from the fiber axis
$a \Rightarrow$ Core radius.

$\Delta \Rightarrow 0.2$ to 3.
typically $\Delta = 0.01$



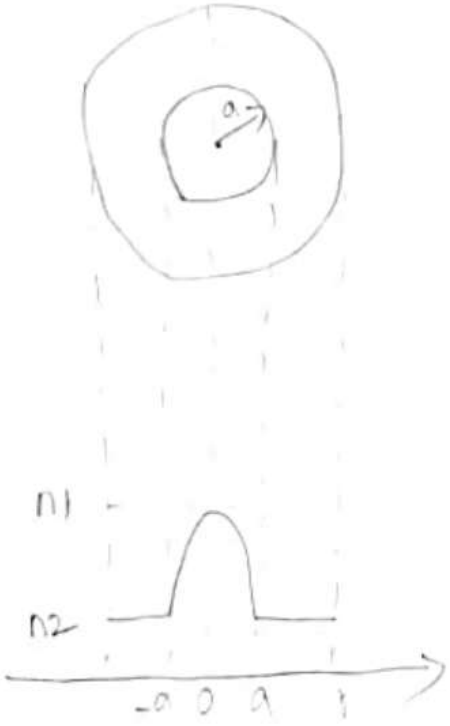
Graded Index:-

* In a graded index fiber the core refractive index is made to vary as function of the radial distance from center of the fiber core.

*The nature of shape of the variation of the refractive index of a GI fiber may range from triangular, parabolic to any higher order profile.

$$n(r) = \begin{cases} n_1\left(1 - 2\Delta\left(\frac{r}{a}\right)^{\alpha}\right)^{1/2} & r < a \\ n_1(1-2\Delta)^{1/2} \approx n_1(1-\Delta) = n_2 & r \geq a \end{cases}$$

$$\Delta = \frac{n_1^2 - n_2^2}{2n_1^2} = \frac{(n_1+n_2)(n_1-n_2)}{2n_1^2} \cong \frac{n_1 - n_2}{n_1}$$



modes of fiber:-

1. Single mode → only one mode of propagation.
2. multi mode → few modes to hundreds of modes for propagation.

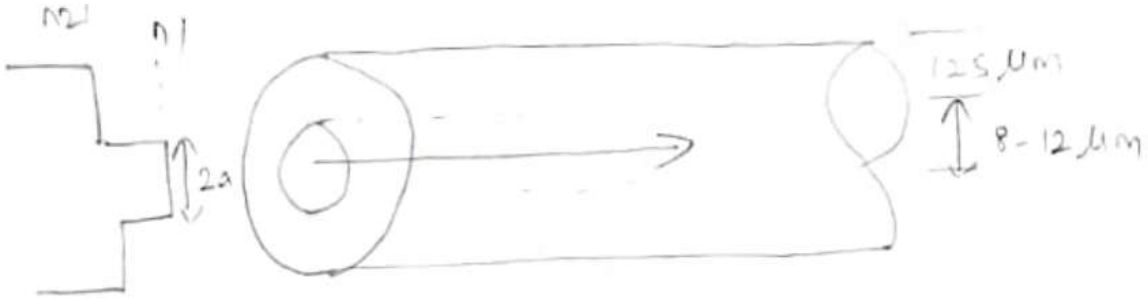
↳ $N = \left(\frac{\pi d}{\lambda}\sqrt{n_1^2 - n_2^2}\right)^2$

Optic fiber Configuration:-

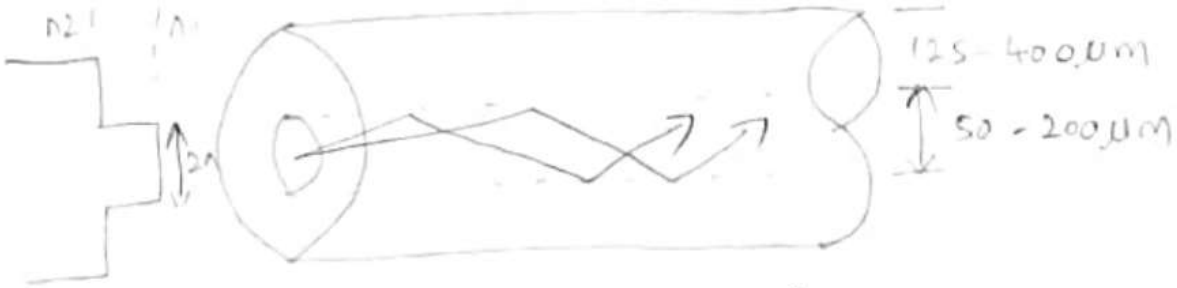
1. Single mode step index fiber
2. multimode step index fiber.
3. multimode graded index fiber.

1. Single mode step-index fiber:-

* Used in telecommunications and data networking
* Core diameter small size 8 to 12 μm
* only one path that light may take as it propagates down the cable.
* Low intermodal dispersion which is due to one mode propagation.
* Long distance transmission, maximum information content.



2. Multimode step-index fiber:-



* Its core diameter is varying from 50-200 μm and the cladding is from 125-400 μm.
* The light rays are propagated down the core in a zig-zag manner.
* It allow the propagation of a finite no. of guided modes along the channel.

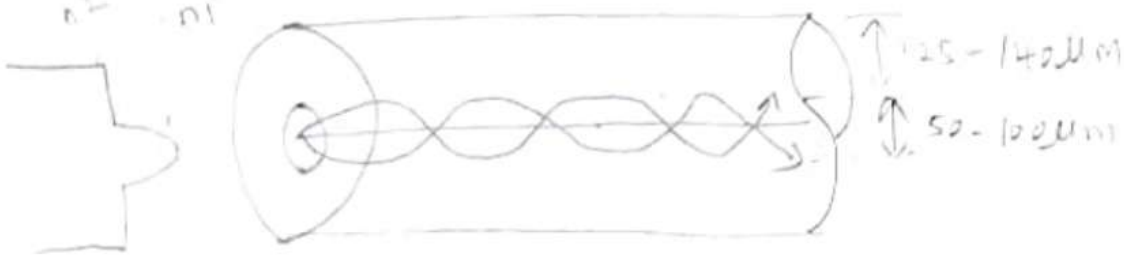
Normalized frequency (V) is used to determine the number modes a fiber can support.

$$V = \frac{2\pi}{\lambda} a n_1 (2\Delta)^{1/2}$$

$$V = \frac{2\pi}{\lambda} a (NA)$$

$$V = \frac{2\pi a}{\lambda} (n_1^2 - n_2^2)^{1/2}$$

3. Multimode Graded Index Fiber:-



* non uniform refractive index
* The index of refraction are varying continuously across the core and the light rays are bent smoothly and converge repeatedly at points along the cable.
* Less modal dispersion.
* easier to couple the light into and out of the fiber.

Optical Power:-

* flow of light energy at a given point in a specified time.

$$P = \frac{d(\text{energy})}{d(\text{time})} \qquad P = \frac{dQ}{dt}$$

dQ => Instantaneous charge (joules)
dt => Instantaneous change in time (seconds)

Numerical Aperture:-

* The Light-gathering (or) Light Collecting ability of an optical fiber.
* It is referred to as figure of merit Commonly used to measure the magnitude of acceptance angle.

$\theta_a \Rightarrow$ acceptance angle.

$$NA = \sin\theta_a$$

$$NA = \sqrt{n_1^2 - n_2^2}$$

P→1 A silica optical fiber with a core refractive index of 1.50 and a cladding refractive index of 1.47. Determine.

a) The Critical angle at the core-cladding interface.
b) the Numerical aperture for the fiber and
c) the acceptance angle in air for the fiber.

Gr.D':-

$n_1 = 1.50$

$n_2 = 1.47$

Solution:-

a) $\phi_c = \sin^{-1}\frac{n_2}{n_1} = \sin^{-1}\frac{1.47}{1.50} = \sin^{-1}(0.98)$

$$\boxed{\phi_c = 78.5^\circ}$$

b) $NA = (n_1^2 - n_2^2)^{1/2} = (1.50^2 - 1.47^2)^{1/2}$

$= (2.25 - 2.16)^{1/2} = \sqrt{0.09}$

$$\boxed{NA = 0.30}$$

c) $\theta_a = \sin^{-1} NA$

$= \sin^{-1}(0.30)$ $\boxed{\theta_a = 17.46^\circ}$

P→2 A multimode silica fiber has a core refractive index $n_1 = 1.48$ and cladding refractive index $n_2 = 1.46$. Find the numerical apertures of fiber. Ans: $\boxed{NA = 0.17}$

P→3 A step-index fiber has a normalized frequency $V = 26.6$ at a 1300 nm wavelength. If the core radius is 25mm, what is the numerical aperture? $\boxed{NA = 0.22}$

Mode Analysis for optical propagation through Fibers:-

Electromagnetic waves:-

* It Comprises of two fields, that is an electric field and a magnetic field. Both are vectors having both the direction and a magnitude.

Elatric field → x axis magnetic field → y axis

Light propagation → z axis

x-z plane → vertical polarization.

x-y plane → horizontal polarization.

Polarization → It refers to an orientation of an electromagnetic field with respect to some plane (or boundary towards which the wave advances

Linearly polarized wave

$E_x(z,t) = Re(E) = \hat{e}_x E_{0x} \cos(\omega t - \beta z)$

The general form of electric field vector is

$E(z,t) \simeq \exp[j(\omega t - \beta z)]$

$\hat{e}_x \rightarrow$ unit vector along x-direction

$\omega \Rightarrow$ Angular frequency

$\beta \Rightarrow$ z-component of the propagation constant

$E_{ox} \rightarrow$ Amplitude of electric vector along the x-direction.

$$E_y(z,t) = \hat{e}_y E_{oy} \cos(\omega t - \beta z + \delta)$$

$\hat{e}_y \rightarrow$ unit vector along y-direction.

$E_{oy} \Rightarrow$ Amplitude of electric field vector.

$\delta \rightarrow$ phase difference between the two orthogonal waves.

$$E_R(z,t) = E_x(z,t) + E_y(z,t)$$

when $\delta = 0$ or $2\pi m$, where m is an integer, then the two orthogonal waves are in phase and the resultant wave is also linearly polarized.

$$|\bar{E}| = \sqrt{E_{ox}^2 + E_{oy}^2} \qquad \theta = \tan^{-1}\left[\frac{E_{oy}}{E_{ox}}\right]$$

arbitrary values of δ.

$$\left(\frac{E_x}{E_{ox}}\right)^2 + \left(\frac{E_y}{E_{oy}}\right)^2 - 2\left(\frac{E_x}{E_{ox}}\right)\left(\frac{E_y}{E_{oy}}\right)\cos\delta = \sin^2\delta$$

when $E_{ox} = E_{oy} = E_o$, $\delta = 2\pi m \pm \frac{\pi}{2}$ $(m = 0, \pm 1, \pm 2 \cdots)$

$$E_x^2 + E_y^2 = E_o^2 \Rightarrow \text{Circularly polarized.}$$

Birefringence:-

*The circular and elliptical polarizations occur when the propagation speed of the two independent linearly polarized waves with orthogonal plane of polarizations are slightly different.

*This is usually caused by the materials which exhibit slightly different refractive index values in the two orthogonal directions.

$$B_F = \frac{(\beta_x - \beta_y)}{\left(\frac{2\pi}{\lambda}\right)}$$

$\beta_x, \beta_y \Rightarrow$ different propagation constants.

$\lambda \Rightarrow$ optical wavelength.

Electromagnetic wave Equation:-

The mode analysis is based on an electromagnetic wave equation which is derived on the basis of maxwell's equations.

electric field $\Rightarrow E$ magnetic field $\Rightarrow H$.

electric flux density $\Rightarrow D$ magnetic flux density $\Rightarrow B$

$$\left.\begin{aligned} \nabla \times E &= -\frac{\partial B}{\partial t} \\ \nabla \times H &= J + \frac{\partial D}{\partial t} \end{aligned}\right\} \text{Curl equations.}$$

$$\left.\begin{aligned} \nabla \cdot D &= \rho \\ \nabla \cdot B &= 0 \end{aligned}\right\} \text{divergence equations.}$$

$\nabla \Rightarrow$ vector operator $J = \sigma E \Rightarrow$ conduction current density

$\sigma \Rightarrow$ conductivity of the medium

$\rho \Rightarrow$ volume density of electric charge

$D = \varepsilon E \qquad B = \mu H$

* pure dielectric medium Conductivity is zero ($\sigma = 0$)

$$\nabla \times E = -\frac{\partial B}{\partial t}$$

$$\nabla \times E = -\mu \frac{\partial H}{\partial t} \quad \because B = \mu H$$

$$\nabla \times H = J + \frac{\partial D}{\partial t}$$

$$\nabla \times H = \varepsilon \frac{\partial E}{\partial t} \quad \because J = 0,\ D = \varepsilon E$$

$$\nabla \cdot E = 0$$

$$\nabla \cdot H = 0$$

$$\nabla \times E = -\mu \frac{\partial H}{\partial t}$$

taking curl on both sides.

$$\nabla \times (\nabla \times E) = -\mu \frac{\partial (\nabla \times H)}{\partial t}$$

$$\nabla \times (\nabla \times E) = -\mu \frac{\partial \left(\varepsilon \frac{\partial E}{\partial t}\right)}{\partial t} \quad \because \nabla \times H = \varepsilon \frac{\partial E}{\partial t}$$

$$\nabla \times (\nabla \times E) = -\mu \varepsilon \frac{\partial^2 E}{\partial t^2}$$

use vector identity

$$\nabla \times (\nabla \times E) = \nabla (\nabla \cdot E) - \nabla^2 (E)$$

where ∇^2 is the laplacian operator.

$$\nabla (\nabla \cdot E) - \nabla^2 (E) = -\mu \varepsilon \frac{\partial^2 E}{\partial t^2}$$

$$\nabla^2 E = \mu \varepsilon \frac{\partial^2 E}{\partial t^2}$$

similarly $\nabla^2 H = \mu \varepsilon \frac{\partial^2 H}{\partial t^2}$

$$\nabla^2 \psi = \frac{1}{v_p^2} \frac{\partial^2 \psi}{\partial t^2}$$

$\psi \rightarrow$ anyone of the components of E and H field.

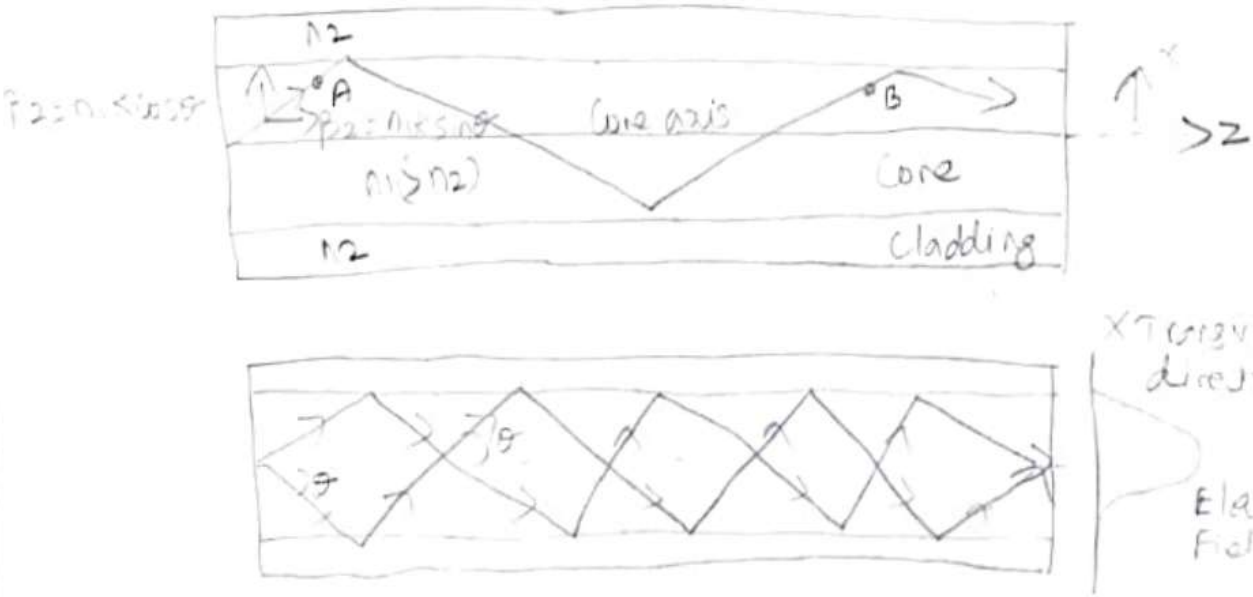
$v_p \rightarrow$ phase velocity.

$$v_p = \frac{1}{\sqrt{\mu \varepsilon}} = \frac{1}{\sqrt{\mu_0 \mu_r \varepsilon_0 \varepsilon_r}}$$

velocity of light in free space $\boxed{c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}}$

modes in a planner waveguide:-

* The planner wave guide structure consists of a dielectric slab of refractive index n_1 sandwiched between two regions of refractive index n_2 ($< n_1$).



* It associated resolved into two orthogonal component plane waves propagating in both the z and x directions

$\beta_z = n_1 K \cos\theta \rightarrow$ phase propagation constant.

$\beta_x = n_1 K \sin\theta \qquad K = \frac{2\pi}{\lambda}$

Transverse Electric (TEm) modes:-

* The elatric field is considered to be perpendicular to the direction of propagation that is, $E_z = 0$ while the magnetic field is non-zero in the z-direction.

Transverse Magnetic (TMon) modes:-

*when an elatric field is in the direction of propagation in the z direction and the magnetic field is perpendicular to the direction of propagation.

Transverse Electro magnetic (TEM) modes:-

*when $E_z = 0$ and $H_z = 0$ then the total field lines in the transverse plane and the mode is called TEm mode and they are rarely found in optical waveguides.

Modes in Cylindrical optical Fibers:-

* An optical fiber consists of a solid cylindrical core surrounded by a solid coaxial cylindrical cladding and is axially symmetric.

* The refractive index of the core (n_1) is slightly higher than that of the cladding n_2 that is ($n_2 < n_1$)

Bound or Guided modes:-

*when light propagates through an optical fiber along the axis that is, z-direction, the plane polarized electromagnetic waves get total internally reflected repeatedly from the core-cladding boundary.

*modes which are largely confined to the core and partly extending in the cladding.

*They vary harmonically in the core region and decay exponentially in the cladding region. These modes are referred to as core modes or bound modes.

Cladding modes:-

*when light is launched in an optical fiber, a fraction of the light also enters the cladding.

*This happens because some light enters beyond the fiber acceptance angle which is finally refracted out in the cladding region.

* The cladding being a dielectric medium that supports the formation of modes by the light entering into the cladding region.

* These modes are not bound in the core region but are still solutions of the boundary-value problem.

Leaky modes:-

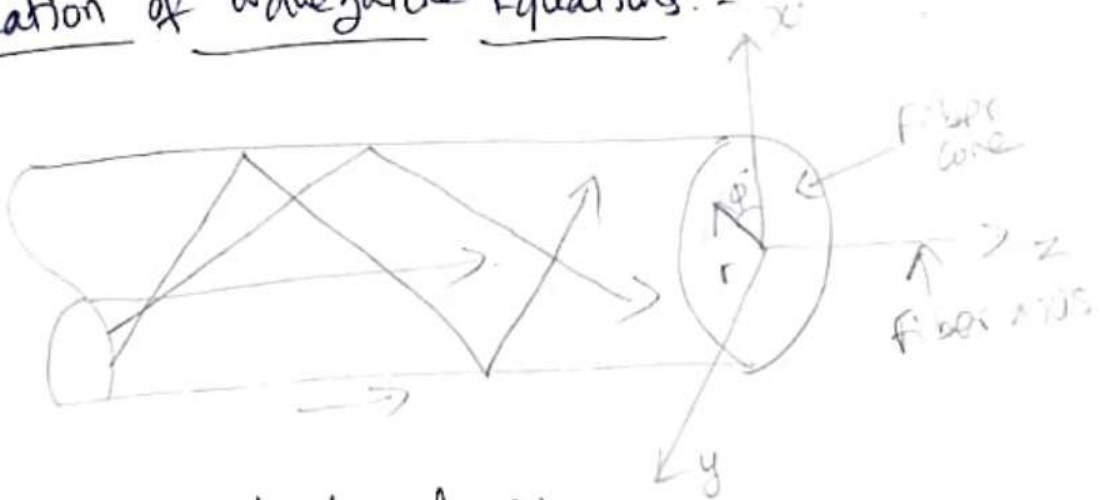
* when Light is Launched from a source into the Core of a multimode fiber that may be a few modes which do not strictly satisfy the conditions of being guided inside the Core.
* Thease modes Continuously leak power from the Core by the quantum mechanical tunnelling processes.

necessary Condition ⇒ $(n_2 k) = k_2 < \beta < k_1 (= n_1 k)$

$k = \frac{2\pi}{\lambda}$ ⇒ free space propagation constant.

Cut off Condition ⇒ $\beta = k_2 (= n_2 k)$.

Formulation of waveguide Equations:-



* Fiber is a cylindrical structure.
* Cylindrical Coordinate System $\{r, \varphi, z\}$.

$$E(r, \varphi, z, t) = E_0(r, \varphi) \exp[j(\omega t - \beta z)] \rightarrow (1)$$

$$H(r, \varphi, z, t) = H_0(r, \varphi) \exp[j(\omega t - \beta z)] \rightarrow (2).$$

here $E = \hat{r} E_r + \hat{\varphi} E_\varphi + \hat{z} E_z$ $\quad \hat{r}, \hat{\varphi}, \hat{z} \rightarrow$ unit vectors

$H = \hat{r} H_r + \hat{\varphi} H_\varphi + \hat{z} H_z$

Maxwell's Curl equations.

$$\nabla \times E = -\frac{\partial B}{\partial t}$$

$$\nabla \times H = \frac{\partial D}{\partial t}$$

$$\frac{1}{r}\left[\frac{\partial E_z}{\partial \phi} + jr\beta E_\phi\right] = -j\omega\mu H_r \rightarrow (3)$$

$$j\beta E_r + \frac{\partial E_z}{\partial r} = j\omega\mu H_\phi \rightarrow (4)$$

$$\frac{1}{r}\left[\frac{\partial (rE_\phi)}{\partial r} - \frac{\partial E_r}{\partial \phi}\right] = -j\omega\mu H_z \rightarrow (5)$$

$$\frac{1}{r}\left[\frac{\partial H_z}{\partial \phi} + jr\beta H_\phi\right] = j\omega\varepsilon E_r \rightarrow (6)$$

$$j\beta H_r + \frac{\partial H_z}{\partial r} = -j\omega\varepsilon E_\phi \rightarrow (7)$$

$$\frac{1}{r}\left[\frac{\partial (rH_\phi)}{\partial r} - \frac{\partial H_r}{\partial \phi}\right] = j\omega\varepsilon E_z \rightarrow (8)$$

from eqn (3)

$$\frac{1}{r}\frac{\partial E_z}{\partial \phi} + j\beta E_\phi = -j\omega\mu H_r \rightarrow (9)$$

$$-j\beta E_\phi - j\omega\mu H_r = \frac{1}{r}\frac{\partial E_z}{\partial \phi} \rightarrow (10)$$

from eqn (4)

$$-j\beta E_r + j\omega\mu H_\phi = \frac{\partial E_z}{\partial r}$$

from eqn (6)

$$j\omega\varepsilon E_r - j\beta H_\phi = \frac{1}{r}\frac{\partial H_z}{\partial \phi} \rightarrow (11)$$

from eqn (7)

$$j\omega\varepsilon E_\phi + j\beta H_r = -\frac{\partial H_z}{\partial r} \rightarrow (12)$$

only E_r, E_ϕ, H_r, H_ϕ

only E_r, E_ϕ, H_r, H_ϕ

* radial and the azimuthal field components of the electric and magnetic fields can be obtained in terms of the longitudinal components
* The radial components of the elatric field can be obtained by eliminating H_ϕ
* multiply eqn (10) by β and eqn (11) by $\omega\mu$ to eliminate H_ϕ and adding the consultant eqn.

$$-j\beta^2 E_r + j\omega\mu\beta H_\phi = \beta \frac{\partial E_2}{\partial r}$$

$$j\omega^2\mu\varepsilon E_r - j\omega\mu\beta H_\phi = \frac{1}{r}\omega\mu \frac{\partial H_2}{\partial \phi}$$

$$-j\beta^2 E_r + j\omega^2\mu\varepsilon E_r = \left[\beta \frac{\partial E_2}{\partial r} + \frac{\omega\mu}{r} \frac{\partial H_2}{\partial \phi}\right]$$

$$E_r\, j\left[-\beta^2 + \omega^2\mu\varepsilon\right] = \left[\beta \frac{\partial E_2}{\partial r} + \frac{\omega\mu}{r} \frac{\partial H_2}{\partial \phi}\right]$$

$$\boxed{E_r = -\frac{j}{\omega^2\mu\varepsilon - \beta^2}\left[\beta \frac{\partial E_2}{\partial r} + \frac{\omega\mu}{r} \frac{\partial H_2}{\partial \phi}\right]}$$

multiply eqn (9) by β and eqn (12) by $\omega\mu$ to eliminate H_r

$$-j\beta^2 E_\phi - j\omega\mu\beta H_r = \frac{\beta}{r} \frac{\partial E_2}{\partial \phi}$$

$$j\omega^2\mu\varepsilon E_\phi + j\omega\mu\beta H_r = -\omega\mu \frac{\partial H_2}{\partial \phi}$$

$$-j\beta^2 E_\phi + j\omega^2\mu\varepsilon E_\phi = \left[\frac{\beta}{r} \frac{\partial E_2}{\partial \phi} - \omega\mu \frac{\partial H_2}{\partial \phi}\right]$$

$$j E_\phi\left[-\beta^2 + \omega^2\varepsilon\mu\right] = \left[\frac{\beta}{r} \frac{\partial E_2}{\partial \phi} - \omega\mu \frac{\partial H_2}{\partial \phi}\right]$$

$$E_\phi = -\frac{j}{\omega^2\mu\varepsilon - \beta^2}\left[\frac{\beta}{r}\frac{\partial E_2}{\partial \phi} - \omega\mu\frac{\partial H_2}{\partial \phi}\right]$$

multiply eqn (9) by $\omega\varepsilon$ and eqn (12) by β to eliminate E_ϕ

$$-j\omega\beta\varepsilon E_\phi - j\omega^2\mu\varepsilon H_r = \frac{\omega\varepsilon}{r}\frac{\partial E_2}{\partial \phi}$$

$$+j\omega\beta\varepsilon E_\phi + j\beta^2 H_r = -\beta\frac{\partial H_2}{\partial r}$$

$$-j\omega^2\mu\varepsilon H_r + j\beta^2 H_r = \frac{\omega\varepsilon}{r}\frac{\partial E_2}{\partial \phi} - \beta\frac{\partial H_2}{\partial r}$$

$$j\omega^2\mu\varepsilon H_r - j\beta^2 H_r = -\frac{\omega\varepsilon}{r}\frac{\partial E_2}{\partial \phi} + \beta\frac{\partial H_2}{\partial r}$$

$$H_r\, j\left[\omega^2\mu\varepsilon - \beta^2\right] = \left[\beta\frac{\partial H_2}{\partial r} - \frac{\omega\varepsilon}{r}\frac{\partial E_2}{\partial \phi}\right]$$

$$H_r = -\frac{j}{\omega^2\mu\varepsilon - \beta^2}\left[\beta\frac{\partial H_2}{\partial r} - \frac{\omega\varepsilon}{r}\frac{\partial E_2}{\partial \phi}\right]$$

multiply eqn (10) by $\omega\varepsilon$ and (11) by β to eliminate E_r

$$-j\omega\varepsilon\beta E_r + j\omega^2\mu\varepsilon H_\phi = \omega\varepsilon\frac{\partial E_2}{\partial r}$$

$$j\omega\beta\varepsilon E_r - j\beta^2 H_\phi = \frac{\beta}{r}\frac{\partial H_2}{\partial \phi}$$

$$j\omega^2\mu\varepsilon H_\phi - j\beta^2 H_\phi = \omega\varepsilon\frac{\partial E_2}{\partial r} + \frac{\beta}{r}\frac{\partial H_2}{\partial \phi}$$

$$H_\phi\, j\left[\omega^2\mu\varepsilon - \beta^2\right] = \left[\frac{\beta}{r}\frac{\partial H_2}{\partial \phi} + \omega\varepsilon\frac{\partial E_2}{\partial r}\right]$$

$$H_\phi = -\frac{j}{\omega^2\mu\varepsilon - \beta^2}\left[\frac{\beta}{r}\frac{\partial H_2}{\partial \phi} + \omega\varepsilon\frac{\partial E_2}{\partial r}\right]$$

By substituting H_r and H_ϕ into eqn (8)

$$\frac{\partial}{\partial r}\left[\beta \frac{\partial H_z}{\partial \phi} + \omega \varepsilon r \frac{\partial E_z}{\partial r}\right] - \frac{\partial}{\partial \phi}\left[\beta \frac{\partial H_z}{\partial r} - \frac{\omega \varepsilon}{r}\frac{\partial E_z}{\partial \phi}\right] = -j\omega \varepsilon r E_z \times \frac{(\omega^2 \mu \varepsilon - \beta^2)}{j}$$

$$\omega \varepsilon r \frac{\partial^2 E_z}{\partial r^2} + \omega \varepsilon \frac{\partial E_z}{\partial r} + \frac{\omega \varepsilon}{r}\frac{\partial^2 E_z}{\partial \phi^2} = -\omega \varepsilon r E_z (\omega^2 \mu \varepsilon - \beta^2)$$

Divide the above eqn by $\omega \varepsilon r$, we get.

$$\frac{\partial^2 E_z}{\partial r^2} + \frac{1}{r}\frac{\partial E_z}{\partial r} + \frac{1}{r^2}\frac{\partial^2 E_z}{\partial \phi^2} + (\omega^2 \mu \varepsilon - \beta^2) E_z = 0$$

Similarly, substituting the values of E_r and E_ϕ

$$\frac{\partial^2 H_z}{\partial r^2} + \frac{1}{r}\frac{\partial H_z}{\partial r} + \frac{1}{r^2}\frac{\partial^2 H_z}{\partial \phi^2} + (\omega^2 \mu \varepsilon - \beta^2) H_z = 0$$

Wave Equations for a Step-index Fiber:-

We now use the above results to find the guided modes in a step-index fiber under the appropriate boundary conditions.

$$E_z(r, \phi, z, t) \text{ (or) } H_z(r, \phi, z, t) = C R(r) \Phi(\phi) Z(z) T(t)$$

C → arbitary constant.

$$Z(z) T(t) = \exp[j(\omega t - \beta z)]$$

$$\Phi(\phi) = \exp(jl\phi)$$

$$\Phi(\phi + 2\pi) = \exp[jl(\phi + 2\pi)] = \exp(jl\phi)$$

$$E_z(r, \phi, z, t) \text{ (or) } H_z(r, \phi, z, t) = C R(r) \exp[j(\omega t - \beta z)] \exp(jl\phi)$$

the wave equations of E_z,

$$\frac{\partial^2 R(r)}{\partial r^2} + \frac{1}{r}\frac{\partial R(r)}{\partial r} + \left(\omega^2 \mu \varepsilon - \beta^2 - \frac{l^2}{r^2}\right) R(r) = 0.$$

The above equation is a well known form of differential equation.

$$(n_2 k =) \; k_2 < \beta < k_1 \; (= n_1 k).$$

$u^2 = \omega^2 \mu \varepsilon_1 - \beta^2$ $\quad (r < a$: core region)

$w^2 = \beta^2 - \omega^2 \mu \varepsilon_2$ $\quad (r > a$: cladding region).

u^2, w^2 are the so the u and w are both real.

Substitute the values.

$$\frac{\partial^2 R(r)}{\partial r^2} + \frac{1}{r}\frac{\partial R(r)}{\partial r} + \left(u^2 - \frac{l^2}{r^2}\right) R(r) = 0.$$

$$\frac{\partial^2 R(r)}{\partial r^2} + \frac{1}{r}\frac{\partial R(r)}{\partial r} - \left(w^2 + \frac{l^2}{r^2}\right) R(r) = 0.$$

Bessel's function of the first kind of order l and argument.

$R(r) \sim J_l(ur)$ $\quad$ (for $r < a$: core)

$R(r) \sim K_l(wr)$ $\quad$ (for $r > a$: cladding)

longitudinal components of the electric and magnetic field.

$$E_z(r<a) = A J_l(ur) \exp(jl\phi) \exp[j(\omega t - \beta z)]$$

$$H_z(r<a) = B J_l(ur) \exp(jl\phi) \exp[j(\omega t - \beta z)]$$

A and B are arbitrary constants.

$$E_z(r>a) = C K_l(wr) \exp(jl\varphi) \exp[j(\omega t - \beta z)]$$
$$H_z(r>a) = D K_l(wr) \exp(jl\varphi) \exp[j(\omega t - \beta z)]$$

Cut-off Condition:-

$$u^2 + w^2 = k_1^2 - \beta^2 + \beta^2 - k_2^2$$
$$= k_1^2 - k_2^2 = k^2(n_1^2 - n_2^2)$$
$$= k^2 (NA)^2 = \text{constant}$$

Transverse Electric (TE) and Transverse Magnetic (TM) modes:-

* when $l = 0$, the mode become either transverse electric (TE$_{0m}$) or transverse magnetic (TM$_{0m}$) depanding on the condition satisfied by the characteristic equation.

*when $l = 0$, the right side of the characteristics equation.

$$\left[\frac{J_l'(ua)}{u J_l(ua)} + \frac{K_l'(wa)}{w K_l(wa)}\right]\left[k_1^2 \frac{J_l'(ua)}{u J_l(ua)} + k_2^2 \frac{K_l'(wa)}{w K_l(wa)}\right] = 0$$

$$\left[\frac{J_0'(ua)}{u J_0(ua)} + \frac{K_0(wa)}{w K_0(wa)}\right] = 0 \quad \rightarrow \text{TE}_{0m}$$

$$\left[k_1^2 \frac{J_0'(ua)}{u J_0(ua)} + k_2^2 \frac{K_0'(wa)}{w K_0(wa)}\right] = 0 \quad \rightarrow \text{TM}_{0m}$$

$$A J_0(ua) - C K_0(wa) = 0$$

$$\frac{1}{u^2}\left[A w \varepsilon_1 u J_0'(ua)\right] + \frac{1}{w^2}\left[C w \varepsilon_2 w K_0'(wa)\right] = 0$$

$$C K_0(wa) = A J_0(ua)$$

$$\boxed{C = \frac{A J_0(ua)}{K_0(wa)}}$$

$$\frac{A}{} \frac{w\varepsilon_1}{u} J_0'(ua) + A J_0(ua) \frac{w\varepsilon_2}{w} \frac{K_0'(wa)}{K_0(wa)} = 0$$

$$A J_0(ua)\left[w\varepsilon_1 \frac{J_0'(ua)}{u J_0(ua)} + w\varepsilon_2 \frac{K_0'(wa)}{w K_0(wa)}\right] = 0$$

multiply $(w u)$

$$A J_0(ua)\left[k_1^2 \frac{J_0'(ua)}{u J_0(ua)} + k_2^2 \frac{K_0'(wa)}{w K_0(wa)}\right] = 0$$

$$k_1^2 = \omega^2 \mu \varepsilon_1 \qquad k_2^2 = \omega^2 \mu \varepsilon_2.$$

$$A J_0(ua) = 0$$

$$\left[k_1^2 \frac{J_0'(ua)}{u J_0(wa)} + k_2^2 \frac{K_0'(wa)}{w K_0(wa)}\right] = 0$$

For non-trivial solution,

$$\left[\frac{J_0'(ua)}{u J_0(ua)} + \frac{K_0'(wa)}{w K_0(wa)}\right] = 0$$

$$\left[k^2 \frac{J_0'(ua)}{u J_0(ua)} + \frac{2 K_0'(wa)}{k_2 w K_0(wa)}\right] \neq 0$$

$$\left[k_1^2 \frac{J_0'(ua)}{uJ_0(ua)} + k_2^2 \frac{K_0'(wa)}{wK_0(wa)}\right] \neq 0$$

$$A\, J_0(ua) = 0$$

Equivalently from the above eqns.

$$\left[\frac{J_0'(ua)}{uJ_0(ua)} + \frac{K_0'(wa)}{wK_0(wa)}\right] = 0.$$

$$A\, J_0(ua) = 0$$

this means $J_0(ua) = 0$, $E_z(r,a) = 0$.

z Component of the elastic field is zero then the corresponding mode is purely transverse elastic (TE).

Similarly Substitute $l = 0$,

$$B\, J_0(ua) - D\, K_0(wa) = 0.$$

$$\boxed{D = \frac{B J_0(ua)}{K_0(wa)}}$$

By substituting D in terms of B.

$$\frac{J_0'(ua)}{uJ_0(ua)} + \frac{K_0'(wa)}{wK_0(wa)} = 0.$$

$$B\, J_0(ua) = 0.$$

for non-trivial Case,

$$\frac{J_0'(ua)}{uJ_0(ua)} + \frac{K_0'(wa)}{wK_0(wa)} \neq 0.$$

$$k_1^2 \frac{J_0(ua)}{uJ_0(ua)} + k_2^2 \frac{K_0'(wa)}{wK_0(wa)} = 0.$$

$H_2(0<a) = 0$ since $BJ_0(ua) = 0$

$$J_1'(x) = \pm J_{l+1}(x) \mp l\frac{J_1(x)}{x}$$

$$K_1'(x) = -J_{l+1}(x) \mp l\frac{K_1(x)}{x}.$$

we obtain,

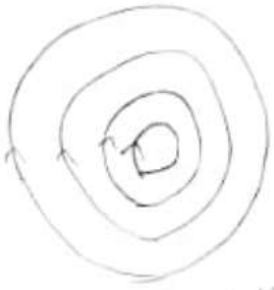
$$\frac{J_0'(ua)}{uJ_0(ua)} + \frac{K_0'(wa)}{wK_0(wa)} = \frac{J_1(ua)}{uJ_0(ua)} + \frac{K_1(wa)}{wK_0(wa)}$$

$$K_1^2\frac{J_0'(ua)}{uJ_0(ua)} + K_2^2\frac{K_0'(wa)}{wK_0(wa)} = K_1^2\frac{J_1(ua)}{uJ_0(ua)} + K_2^2\frac{K_1(wa)}{wK_0(wa)}$$

Therefore we may Summarize

$$\frac{J_1(ua)}{uJ_0(ua)} + \frac{K_1(wa)}{wK_0(wa)} = 0.$$

From modes $\rightarrow$ $K_1^2\frac{J_1(ua)}{uJ_0(ua)} + K_2^2\frac{K_1(wa)}{wK_0(wa)} = 0.$



TE01 mode

TM01 mode

mode cut-offs

$$\frac{\lambda_c}{\lambda} = \frac{V}{V_c}$$

for single mode Step index fiber $V_c = 2.405$

$$\lambda_c = \frac{V\lambda}{2.405}$$

Fiber materials:-

* Optical fibers are long, thin and flexible stands of optically transparent materials and work as optical waveguides

Silica → It has good optical transparency in the near infrared wavelength. from 0.85μm to 1.65 μm.

Glass Fiber:- → It is a Non-crystalline solid (NCS) which is made by fusing mixtures of oxides, sulfides, telluride (or) selenides.

* At room temperature glass is generally hard.
* As the temperature is increased beyond 1000°c silica glass generally sets softens and further increase in temeperature at around 1400 - 1600°c glass comes into a viscous state.

Fluoride Fiber:-

* It is based on fluoride glasses ex:- fluoroalu-minate (or) fluorozirconate glasses.
* These glasses are usually from heavy metals such as zirconium (or) lead.
* Fluorozirconate → ZrF_4
* Fluorohafnate → HfF_4

Active Glass Fiber:-

It is possible to induce new optical and magnetic properties the fiber.

* These new properties allow the material to perform amplification, attenuation, phase retardation.
* Two commonly used materials for fiber lasers are Erbium and neodymium.
* Rare earth Ions ⇒ Neodymium (Nd^{3+})
  - ↳ Erabium (Er^{3+})
  - ↳ Ytterbium (Yb^{3+})
  - ↳ Thulium (Tm^{3+})
  - ↳ Neodymium (Nd^{3+})
  - ↳ Praseodymium (Pr^{3+})
  - ↳ Holmium (Ho^{3+})

Chalcogenide Glass fibers:-

* It contain atleast one of the chalcogen elements such as S, Se or Te and typically one other element such as P, I, Cl, Br, Cd, Ba, Si or Tl for tailoring the thermal, mechanical and optical properties of the glass
* As_2S_3 ⇒ chalcogenide glasses.

Plastic optical fiber (POF)

* The core of these fibers is either polymethylmethac -rylate (PMMA) or a perfluorinated polymer (PFP)
* These fibers are referred to as PMMA POF and PFP POF respectively.

plastic clad silica (PCS) fiber:-

It is a kind of compromise between the high perform -ance silica fiber and less efficient plastic fibers.

* It consists of a core which is made of silica glass and cladding made of compatible polymer of lower refractive index.

* Commercial Plastic clad silica (PCS) fibers consist of a pure silica core, a soft silicone cladding, and a protective jacket.

fiber fabrication Techniques:-

* fiber fabrication techniques are different for both glass and plastic fibers.

* Two basic techniques are used in the fabrication of all glass optical waveguides are,

  i) Direct melt methods

  ii) vapour phase oxidation process.

Direct melt method:-

* In this method follows the traditional glass making procedures in that optical fibers are made directly from the molten state of purified components of silicate glasses.

Vapour phase oxidation Process:-

* In this process highly pure vapors of metal halides ($SiCl_4$ and $GeCl_4$) reacts with oxygen to form a white powder of SiO_2 particles.

*The particles are then collected on the surface of a bulk glass by one four different Commonly used processes and are sintered by one of a variety of techniques to form a clear glass rod ortube this rod or tube is called a preform.

1. Outside vapour phase oxidation (OVPO) or outside vapour Deposition (OVD).
2. modified chemical vapour Deposition (MCVD).
3. Vapour Axial Deposition (VAD).
4. Plasma-activated chemical Vapour Deposition (PCVD).

$SiCl_4 + O_2 = SiO_2 + 2Cl_2$ (dry oxidation)

$GeCl_4 + O_2 = GeO_2 + 2Cl_2$ (dry oxidation)

$SiCl_4 + 2H_2O$ (Steam) $= SiO_2 + 4HCl_2$ (wet oxidation)

$GeCl_4 + 2H_2O$ (Steam) $= GeO_2 + 4HCl_2$ (wet oxidation)

Vapor Phase Axial Deposition: - (VAD)

*The basic vapor phase deposition method was suitably modified for continuous production of low loss fiber in a controlled environment. this process in known as VAD technique.

Modified chemical Vapor Deposition (MCVD):-

* The soot is collected on an inner wall of the rotating silica tube.
* The rotation of the tube is necessary for cylindrical symmetry in the deposition of the soot.
* After completion of deposition of the desired thickness of soot, the flow of the reactant gases is stopped.

Plasma chemical Vapor Deposition (PCVD):-

* This method uses a non-isothermal microwave plasma which is operating at low pressure initiates the chemical reaction.
* A moving microwave resonator which is operating at a frequency of 2.45 GHz generates a plasma inside the tube in order to activate the chemical reaction.

Optical Fiber Cables:-

* The purpose of cabling is to the provide protection to fibers.

major components:-

1. Primary and secondary buffer coating of the fiber.
   A suitable strength material for core of the cable
   Additional strength members in form of steel

wires (or) organic Strength materials
4. Water blocking materials for under water Cables
5. Sheath materials.

Classification of optical fiber:-

i) Based on the index of refraction across the cross section of the cable,
   a) step index
   b) Graded index.

ii) Based on modes,
   a) mono-mode (or) single mode
   b) multimode.

Single mode fibers:-

* It allow only one mode of propagation.
* The core diameter of the single mode fiber ranges from 8-12 μm and it has a very small index differences between the core and the cladding with a normalized frequency $V = 2.405$.
* For the single mode fiber operation, only LP_{01} mode can exist, which is also known as the fundamental mode of the fiber.

$$0 \leq V < 2.405$$

Graded Index Fiber for single mode operation:-

* It may also be designed for a single mode operation and some specialist designs the fiber in order to adopt the non-step index profiles

$$V_c = 2.405 \left[1 + \frac{2}{\alpha}\right]^{1/2}$$

mode field Diameter (MFD):-

* It is an important parameter for characterizing the single mode fiber properties which takes into account the wavelength dependent electromagnetic field penetration into the fiber cladding.
* The main consideration is to approximate an electric field distribution.

$$E(r) = E_0 \exp\left[-\frac{r^2}{w_0^2}\right]$$

$r \Rightarrow$ distance measured from the centre of the core along the radius.

$E_0 \Rightarrow$ Field at zero radius

$w_0 \Rightarrow$ width of an electric field distribution.

$$MFD = 2w_0 = 2\left[\frac{2\int_0^{\alpha} r^3 E^2(r)\,dr}{\int_0^{\alpha} r E^2(r)\,dr}\right]^{1/2}$$

$E(r) \Rightarrow$ field distribution of the LP_{01} mode.

Birefringence in a single mode fibers:-

* A fiber that could maintain the state of polarization over a significant length of a fiber.

* When the polarization modes propagate with different phase velocities and the difference between their effective refractive indices is called the birefringence.

$$B_r \approx n_y - n_x$$

$n_x \Rightarrow$ Effective refractive index of horizontal mode.

$n_y \Rightarrow$ " " " vertical mode.

$$B_r = k(n_y - n_x) = \beta_y - \beta_x$$

$k = \frac{2\pi}{\lambda} \Rightarrow$ free space propagation.

Fiber Beat Length:-

* When the phase difference between the two modes is an integral multiple of 2π, the two modes will beat at this point and an i/p polarization will be reproduced. The length over which the beating occur is known as fiber beat length.

$$L_p = \frac{2\pi}{B_f} = \frac{2\pi}{\beta_x - \beta_y} = \frac{\lambda}{n_y - n_x} = \frac{\lambda}{B_f}$$

$$\phi = (\beta_x - \beta_y) L.$$

$\Rightarrow$ Length of the fiber transversed.

Graded Index fiber:-

$$n(r) = \begin{cases} n_1\left(1 - 2\Delta\left(\frac{r}{a}\right)^{\alpha}\right)^{1/2} & \text{for } 0 \le r \le a \text{ (core)} \\ n_1(1-2\Delta)^{1/2} \approx n_1(1-\Delta) = n_2 & \text{for } r \ge a \text{ (cladding)} \end{cases}$$

The index difference Δ

$$\Delta = \frac{n_1^2 - n_2^2}{2n_1^2} \simeq \frac{n_1 - n_2}{n_1}.$$

parabolic profile $\rightarrow \alpha = 2$
triangular profile $\rightarrow \alpha = 1$
} Step index

parabolic refractive index $\rightarrow \alpha = 2$.

Total no. of guided modes:-

Mode volume $M = \left(\frac{\alpha}{\alpha+2}\right)(n_1 ka)^2 \Delta$.

$$V = n_1 k a (2\Delta)^{1/2}$$

$$M_{G1} \simeq \left(\frac{\alpha}{\alpha+2}\right)\left(\frac{V^2}{2}\right).$$

$$M_{G1} = a^2 k^2 n_1^2 \Delta \left(\frac{\alpha}{\alpha+2}\right).$$

$$M_{G1} \simeq \frac{V^2}{4} \quad \because \alpha = 2$$

Numerical Aperture (NA)

$$NA(r) = \begin{cases} (n^2(r) - n_2^2)^{1/2} \simeq NA(0)\sqrt{1-(r/a)^\alpha} & \text{for } r \le a \\ 0 & \text{for } r > a \end{cases}$$

$$NA(0) = \left[n^2(0) - n_2^2\right]^{1/2} = (n_1^2 - n_2^2)^{1/2} \simeq n_1\sqrt{2\Delta}$$

PART-A

1. A step index fiber has a normalized frequency V=26.4 at a 1300nm wavelength. If the core radius is 25μm what is the numerical aperture?
2. State leaky modes in optical fiber Communication
3. What are the Advantages of optical fiber?
4. Define numerical Aperture
5. A silica optical fiber with a core refractive index of 1.5 and a cladding refractive index of 1.47. Determine the critial angle and acceptance in air for the fiber.
6. Assume that there is a glass rod of refractive index 1.5 surrounded by air find the critical angle.
7. What is total internal reflection in a fiber?
8. What is meant by linearly polarized mode?
9. List the applications of plastic fibers in POF
10. Define preform.
11. What is MFD?

12. what is fiber birefringence?
13. Define critical angle.
14. Define acceptance angle.

PART-B

1. with the neat block diagram explain the fundamental blocks of optical fiber communication.
2. Starting from maxwell's equation derive the expression for the wave equation of electromagnetic wave propagation through optical fiber.
3. write about the construction, mode field diameter and propagation modes of single mode fiber.
4. Explain about different fiber fabrication techniques in detail.
5. with neat sketch illustrate the modes in a planner wave guide.
6. Discuss in detail about fiber materials.
7. Using maxewell's equation, derive the expression for electric and magnetic field components and also derive boundary condition of a circular waveguide.