GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: OPTICAL COMMUNICATION
(Code: 3341103)

Diploma Programme in which this course is offered	Semester in which offered
Electronics and Communication Engineering	4th Semester

1.   RATIONALE

Optical Communication is an essential component of the modern Telecom Industry. Therefore it is desired that the diploma engineering students should be able to operate and maintain the components used in Optical communication system.

2.   COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

- **Maintain Fibre Optics Communication system**

3.   Course Outcomes

    i.   Analyse optical fibre.

    ii.   Install fibre optic cables

    iii.   Test optical driver and receiver circuits

    iv.   Identify optical components

    v.   Measure optical fiber parameters

4.   TEACHING AND EXAMINATION   SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	150
3	0	2	5	70	30	20	30	

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Legends: L - Lecture; **T -** Tutorial/Teacher Guided Student Activity; **P -** Practical;   **C -** Credit; **ESE** - End Semester Examination; **PA** - Progressive Assessment

5.   COURSE DETAILS

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit – I Light propagation in Optical Fiber	1a. Describe the phenomenon of total internal reflection.	1.1 Ray model: 1.1.1 Fundamental laws of optics : refraction, Snell's law, critical angle, total internal reflection 1.1.2 Ray propagation in step index fiber 1.1.3 Numerical Aperture and acceptance angel 1.1.4 Definition of Skew rays and Meridional rays 1.2 Wave model 1.2.1 Phase velocity and group velocity 1.3.2 Modes in optical fiber 1.3.3 V-number & normalized frequency
	1b. Classify the different types of Optical fiber used in industry.	1.3 Types of Optical Fiber: 1.3.1 SI and GI 1.3.2 SM and MM
	1c. Explain different types of losses in Optical fiber.	1.4 Attenuation: 1.4.1 Absorption losses: intrinsic and extrinsic 1.4.2 Linear scattering losses: rayleigh and mie 1.4.3 Fiber bend losses: micro and macro. 1.5 Dispersion: 1.5.1 Intermodal Dispersion in multi mode step index fiber 1.5.2 Intra-modal (Chromatic) Dispersion: material and wave guide dispersion. 1.6 Dispersion shifted and dispersion flattened fibers
	1d. Describe Fiber optics communication system with its advantages & disadvantages	1.7 General configuration of Fiber optic communication system
Unit – II Optical Fiber Cables & Connections	2a. Explain Fibre fabrication process and cabling techniques.	2.1 Fiber Fabrication: 2.1.1 Fiber Materials 2.1.2 Double crucible method 2.1.3 Vapor deposition methods: MCVD, VAD 2.1.4 Fiber drawing process 2.2 Fiber optic cables : 2.2.1 Needs of cabling 2.2.2 Fiber Cables: Slotted core, loose tube and multi-fiber ribbon
	2b. Describe splicing and joining of fibre cable	2.3 Connection losses: 2.3.1 Extrinsic Parameters: Fresnel reflection, Misalignment, and Other factors. 2.3.2 Intrinsic Parameters: NA mismatch, diameter mismatch 2.3.3 Fiber end preparation for loss minimization. 2.4 Splices: 2.4.1 Fusions Splices

Unit	Major Learning Outcomes	Topics and Sub-topics
		2.4.2 Mechanical splices: Capillary, V-grooved, Loose tube, Spring groove and elastomeric splices.
	2c. Explain the process of Connecting the fibre cable with connectors	2.5 Fiber optic connectors: Ferrule, Expanded beam.
Unit – III Optical Sources and Detectors	3a. Describe working principle of various optical Source	3.1 Basic concepts of Absorption and Emission in semiconductor 3.2 Construction and Operating Principle of LED 3.3 Heterojunction structure: SLED, EELED 3.4 Construction and Operating Principles of Semiconductor LASER Diode
	3b. Describe working principle of various optical detector	3.5 Quantum efficiency and Responsivity 3.6 p-n photodiode 3.7 p-i-n photodiode 3.8 Avalanche photo diode
	3c. Write steps for coupling : Source to fibre and fibre to detector	3.9 Coupling between fiber and source/detector
	3d. Understand driver circuits used in Optical communication system	3.10 LED driver circuit: Analog, Digital 3.11 LASER driver circuit: analog, digital 3.12 Optical receiver block diagram 3.13 Common source FET preamplifier 3.14 Regenerative repeater
Unit – IV Optical components & Integrated optics	4a. Explain the functions of various Optical Components	4.1 Optical couplers and isolators: types and functions 4.2 Optical switches 4.3 Beam splitter 4.4 Optical multiplexer and demultiplexer 4.5 Optical wavelength converter 4.6 Bragg grating
	4b. Describe working of optical amplifier 4c. Understand concept of Integrated optics	4.7 Optical Amplifiers-Semiconductor optical amplifier, EDFA, Raman amplifier 4.8 Concept of Integrated optics
Unit – V Characteriz ation & Applications	5a. Measure optical fiber parameters	5.1 fiber parameters measurement: attenuation, NA, inter modal dispersion, RI profile
	5b.Describe working principle of Optical Power Meter & OTDR	5.2 Optical power meter 5.3 Optical time domain reflectometer
	5c. Understand application of WDM in Fibre optics communication system	5.4 WDM & DWDM

Unit	Major Learning Outcomes	Topics and Sub-topics
	5d. Classify & application of fibre optic sensors.	5.5 Fiber Sensors
	5e List application of various LASER used in industries & medical surgery.	5.6 laser Types: Concept of solid state, semi conductors & gas laser 5.7 Application of Different Lasers

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Light propagation in Optical Fiber	10	9	4	2	15
II	Optical Fiber Cables and Connections	8	10	3	2	15
III	Optical Sources and Detectors	10	8	4	3	15
IV	Optical components & Integrated optics	7	10	1	0	11
V	Applications	7	10	2	2	14
Total		42	47	14	9	70

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

Note: This specification table shall be treated as only general guideline for students and teachers. The actual distribution of marks in the question paper may vary from above table.

7. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills **(outcomes in psychomotor and affective domain)** so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

*Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.*
Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical/Exercise	Apprx. Hrs. Required
1	I	Measure N.A. of optical fiber	2
2	I	Establish Analog communication optical link	2
3	I	Establish Digital communication optical link	2
4	I	Measure attenuation of given optical fiber	2
5	I	Measure bending loss of given optical fiber	2
6	I	Demonstrate various fiber cables	2
7	II	Demonstrate fiber end preparation process.	2
8	II	Demonstrate Splicing Techniques	2
9	II	Demonstrate various connectors	2
10	III	Plot characteristics of LED	2
11	III	Plot characteristics of LASER diode	2
12	III	Plot characteristics of Photo Diode	2
13	III	Build and test LED drive circuits	2
14	IV	Demonstrate OTDR	2
15	IV	Demonstrate Optical Power Meter.	2
16	III	Build fibre optics link using PAM technique	2
17	III	Build fiber optics link using TDM technique	2
		Total	**34**

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

1. Visit nearby fiber optics industries.
2. Hands on training on fibre connecterization.
3. Arrange visit to BSNL to see live circuits and measurement of parameters
4. Collect information of transatlantic optical network used for communication.
5. Visit any Campus Wide area network which uses optical fiber .
6. Explore use of lasers in medical treatment (Eye, Kidney ,brain,ulcer,cancer etc)

9. SUGGESTED LEARNING RESOURCES

(A) List of Books:

S. No.	Title of Books	Author	Publication
1	Optical Fiber Communication	John M Senior	Pearson
2	Fiber Optics & Optoelectronics	R P Khare	Oxford
3	Fiber Optic Communication	D C Agarwal	S Chands
4	Light wave Communication Systems: A Practical Perspectives	Rajappa Papannareddy	Penram
5	Optical Fiber & Fiber Optic Communication	Subir Kumar Sarkar	S Chands

B.   List of Major Equipment/Materials

1. OTDR

2. Optical power meter

3. CRO

4. Fusion splicing machine

5. Optical fiber : Glass,Plastic

6. Semiconductor laser

C   List of Software/Learning Websites

Material / Products:
http://computer.howstuffworks.com/fiber-optic.htm
http://www.ntu.edu.sg/library/Pages/default.aspx
http://nptel.iitm.ac.in/courses/askaquestion.php?subjectId=117101002
http://www.thefoa.org/tech/
http://www.thefoa.org/fo_urls.htm
http://en.wikipedia.org/wiki/Optical_fiber
http://www.telecomramblings.com/network-maps/usa-fiber-backbone-map-resources/
http://www.foci.com.tw/pd_scw.html
Videos:
http://nptel.iitm.ac.in/courses/117101002/
http://www.youtube.com/watch?v=aqazAcE19vw
http://www.youtube.com/watch?v=pIlBlNW7sOo
http://www.youtube.com/watch?v=ASMcrcgZSrw
http://www.youtube.com/watch?v=llI8Mf_faVo
http://fiberu.org/basic/LP3.html

10.   COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics
  1.**Shri M S Dave**   Sr. Lecturer, EC Dept, Government Polytechnic, Ahmedabad.
  2.**Shri U V Buch**   Sr. Lecturer, EC Dept, Government Polytechnic, Gandhinagar.
  3.**Shri S M Gheewala,** Sr. Lecturer, EC Dept, Government Polytechnic, Valsad.

Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. (Mrs.) Anjali Potnis**, Assistant Professor, Department of Electrical and Electronics Engineering.
- **Prof. (Mrs.) Susan S. Mathew,** Associate Professor**,** Department of Electrical and Electronics Engineering.