



**Physics Department**

**College of Science**

**Salahaddin University**

**Subject: FIBER OPTIC COMMUNICATION  
SYSTEMS**

**Course Book – (Year 3 – Applied Physics,  
Communication Branch)**

**Lecturer's name ABDULLAH O HAMZA**

**Academic Year: 2022-2023**

# Course Book

<b>1. Course name</b>	<b>Optical Fiber Communication Systems</b>
<b>2. Lecturer in charge</b>	<b>ABDULLAH OTHMAN HAMZA</b>
<b>3. Department/ College</b>	<b>PHYSICS/SCIENCE</b>
<b>4. Contact</b>	<b>e-mail: abdulla.hamza@su.edu.krd</b>
<b>5. Time (in hours) per week</b>	<b>Theory: 3 Practical: 0</b>
<b>6. Office hours</b>	<b>3</b>
<b>7. Course code</b>	<b>MP</b>
<b>8. Teacher's academic profile</b>	<p>I've been working for Salahaddin University since November 2003 when I got the position of an assistant physics in physics department. I've taught many physics courses for undergraduate students including: General Physics, Electricity and Magnetism, Mathematical Physics and recently Laser &amp; optical communication systems. In parallel I've supervised laboratories and scientific projects of graduate Bachelor students.</p> <p><b>B.Sc. Physics 2003/Salahaddin University Erbil</b>  <b>M.Sc. Solid state electronics 2007/ Salahaddin University Erbil</b>  <b>PhD Nanophotonics 2019/ University of Hull-UK</b></p>
<b>9. Keywords</b>	<b>Optical Fibers, the structure and working of Optical Fibers , Optical Fibers communication systems, Application of Optical fibers . . . .</b>
<b>10. Course overview:</b>	<p>this course will provide a general understanding and principles of the fibre optic communication systems in more depth and also deals with the propagation of the optical signals in fibre and signal degradation effects. This part mainly covers the general Optical Fiber communication system, advantages of optical fiber communications. Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays. Cylindrical fibers- Modes Fiber materials, Fiber fabrication techniques, fiber optic cables, Classification of Optical fibers . . . . .</p>
<b>11. Course objective:</b>	<p>The aim of this course is to provide students with a working knowledge optical communication systems, students should realise the physical significance of the optical communication systems and understand the design and properties of the optical fibers. Furthermore, After completing the course, the student is able to describe and understand different kind of losses as well as design and optimisation of the optical systems.</p>

## **12. Student's obligation**

Students should have a Basic knowledge of optics, electromagnetism waves and quantum mechanics. A list of useful examples and problems will be given to help the students feel more comfortable with the subject and to improve their problem solving skills. The students are required to do these problems as well as to do at least two exams during two semesters besides other assignments.

## **13. Forms of teaching**

The lectures are presented via data show on a screen while the solved problems and examples are done on a white board.

## **14. Assessment scheme**

Students must do at least two exams; the marks are added and divided by two to give an average mark representing the overall contribution and skill of the students. This step has got 40% of the total mark and a final exam is going to hold the rest (60%)

## **15. Student learning outcome:**

In general, After completing this module, student should. Understand basic physical principles of the optical fibers and describe the advantages and technical issues of the optical communication systems.

## **16. Course Reading List and References:**

### **Text book:**

- 1- Optical Fiber Communications – Gerd Keiser, Tata Mc Graw-Hill International edition, 4th Edition, 2008.
- 2- 2. Optical Fiber Communications – John M. Senior, PHI, 2nd Edition, 2002.

### **REFERENCE BOOKS:**

1. Fiber Optic Communications – D.K. Mynbaev , S.C. Gupta and Lowell L. Scheiner, Pearson Education, 2005.
2. Text Book on Optical Fibre Communication and its Applications – S.C.Gupta, PHI, 2005.
3. Fiber Optic Communication Systems – Govind P. Agarwal , John Wiley, 3rd Edition, 2004.
4. Fiber Optic Communications – Joseph C. Palais, 4th Edition, Pearson Education, 2004.

<p><b>17. The Topics:</b>  <b>Note:</b>                  This syllabus is subject to further change or revision, as needed, to achieve best realize the educational goals of the course. Students get advance notes either in class or on Moodle account to any modification.</p>	<p><b>Lecturer's name</b></p>
<p><b>Unit &amp; Topic of Discussion</b></p>	
<p><b>UNIT I : OVERVIEW OF OPTICAL FIBER COMMUNICATION</b></p>	<p>Abdullah O. Hamza</p>
<ol style="list-style-type: none"> <li>1. <u>Historical development</u></li> <li>2. <u>General system</u></li> <li>3. <u>Advantages, disadvantages</u></li> <li>4. <u>Applications of optical fiber communication</u></li> <li>5. <u>Optical fiber waveguides</u></li> <li>6. <u>Ray theory, cylindrical fiber</u></li> <li>7. <u>Single mode fiber, cutoff wave length</u></li> <li>8. <u>Mode filed diameter</u></li> <li>9. <u>Optical Fibers: fiber materials</u></li> </ol>	<p>Abdullah O. Hamza</p>
<p><b>UNIT-II SIGNAL DEGRADATION IN OPTICAL FIBER</b></p>	
<ol style="list-style-type: none"> <li>1. <u>Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses.</u></li> <li>2. <u>Information capacity determination, Group delay,</u></li> <li>3. <u>Types of Dispersion - Material dispersion, Wave-guide dispersion, Polarization mode dispersion, Intermodal dispersion, pulse broadening.</u></li> </ol>	<p>Abdullah O. Hamza</p>

<p><b>4. <u>Optical fiber Connectors- Connector types, Single mode fiber connectors, Connector return loss. Introduction to Optical Fibers splicing</u></b></p>	
<p><b>Unit-III</b> <b>FIBER OPTICAL SOURCES</b></p>	<p>Abdullah O. Hamza</p>
<p><b>1. <u>Intrinsic and extrinsic material-direct and indirect band gaps-LED.</u></b>  <b>2. <u>LED structures</u></b>  <b>3. <u>LED-quantum efficiency and LED power-light source materials-modulation of LED.</u></b>  <b>4. <u>LASER diodes-</u></b>  <b>5. <u>modes and threshold conditions-Rate equations-external quantum efficiency-resonant frequencies-structures and radiation patterns-single mode laser-external modulation-temperature effects.</u></b></p>	<p>Abdullah O. Hamza</p>
<p><b>Unit-IV</b> <b>FIBER OPTICAL DETECTORS &amp; RECEIVERS</b></p>	<p>Abdullah O. Hamza</p>
<p><b>1- <u>Physical principles of PIN and APD.</u></b>  <b>2- <u>Detector response time.</u></b>  <b>3- <u>Temperature effect on Avalanche gain.</u></b>  <b>4- <u>Comparison of Photo detectors.</u></b>  <b>5- <u>Optical receiver operation- Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration.</u></b></p>	

<p style="text-align: center;"><b>UNIT V</b></p> <p style="text-align: center;"><b>OPTICAL SYSTEM DESIGN</b></p>	
<p><b>1. <u>Considerations, Component choice, Multiplexing, Point-to-point links, System considerations, Link power budget with examples. Rise time budget with examples.</u></b></p> <p><b>2. <u>Operational Principals of WDM, Solutions.</u></b></p>	
<p><b>18. Practical Topics (If there is any)</b></p>	
<p>In this section The lecturer shall write titles of all practical topics he/she is going to give during the term. This also includes a brief description of the objectives of each topic, date and time of the lecture</p>	
<p><b>19. Examinations:</b> There will be at least two midterm examinations per 40%. The rest 60% will be on Final examination.</p>	
<p><b>20. Extra notes:</b></p> <p>Here the lecturer shall write any note or comment that is not covered in this template and he/she wishes to enrich the course book with his/her valuable remarks.</p>	
<p><b>21. Peer review</b> <b>پیداچوونہوہی</b></p> <p style="text-align: center;"><b>ھاوہل</b></p> <p>This course book has to be reviewed and signed by a peer. The peer approves the contents of your course book by writing few sentences in this section. <i>(A peer is person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject).</i></p> <p>ئەم کۆرسبووکە دەبێت لەلایەن ھاوئێکی ئەکادیمیەوہ سەیر بکەیت و ناوەرۆکی بابەتەکانی کۆرسەکە پەسەند بکات و جەند ووشەیک بنووسێت لەسەر شیاوی ناوەرۆکی کۆرسەکە و واژووی لەسەر بکات.</p> <p>ھاوئێ ئەو کەسەیکە زانیاری ھەبێت لەسەر کۆرسەکە و دەبێت پلەیی زانستی لە مامۆستا کەمتر نەبێت.</p>	

Ministry of Higher Education and Scientific research <b>Salahaddin University</b>	<b>optical communication systems</b>
<b>Science College</b>	<b>Time: 3 Hours</b>
<b>Physics Dept.</b>	<b>Final Examination</b>
<b>3<sup>rd</sup> year students</b>	

Q/ Define the following parameters?

Q/ fill the following blanks with a suitable words

Q/ explain the following ( describe, list, comparison, diagram, why ... .)

Q/ Numerical Questions.