

## 课程大纲 COURSE SYLLABUS

1.	课程代码/名称 Course Code/Title	现代通信光电子技术 Optical electronics in Modern Communications
2.	课程性质 Compulsory/Elective	专业课
3.	课程学分/学时 Course Credit/Hours	3/48
4.	授课语言 Teaching Language	英语
5.	授课教师 Instructor(s)	沈平
6.	是否面向本科生开放 Open to undergraduates or not	否
7.	先修要求 Pre-requisites	无
8.	教学目标 Course Objectives	<p>This course is intended to introduce to you various optical communication devices and systems, as well as advanced technologies in today's optical communications systems and networks. Upon the completion of the course, you should be able to:</p> <ol style="list-style-type: none"> <li>1. Differentiate various types of optical fibers</li> <li>2. Determine how to use active and passive optical devices in optical fiber communication systems</li> <li>3. Identify the performance issues of the most important relevant devices.</li> <li>4. Implementation of fiber optic communication systems such as an elementary WDM optical fiber system.</li> </ol> <p>本课程目标是使学生了解光通信网络系统和组成，以及现代技术的在其中的应用。完成本课程后，学生可以：</p> <ol style="list-style-type: none"> <li>1. 分辨不同种类的光纤；</li> <li>2. 了解如何在光通信网络中使用有源和无源器件；</li> <li>3. 确定最重要设备的性能问题；</li> <li>4. 完成光纤通信网络的设计如基本的波分复用光纤系统。</li> </ol>
9.	教学方法 Teaching Methods	<p>Lecture Quiz Assignment Case Study Report</p>
10.	教学内容 Course Contents	<p>(如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.)</p> <p><b>Section 1</b></p> <p>Introduction and development of optical communication systems, optical principles and fiber types, and guiding mechanism.</p> <p>1.1 Motivation of optical communication system</p> <p>1.2 Concept and key units</p> <p>1.3 Fiber types and guiding mechanism</p> <p>1.4 Fiber manufacture and performance</p> <p>光通信系统、光纤原理、类型及导波原理的介绍和发展。</p>

	<p>1.1 光通信发展的动因</p> <p>1.2 光通信概念及关键单元</p> <p>1.3 光纤类型及导波原理</p> <p>1.4 光纤制造及性能</p>
<p><b>Section 2</b></p>	<p>Signal degradation mechanisms in optical fiber, dispersion mechanisms, rise time budget, and bandwidth estimations.</p> <p>2.1 Signal degradation</p> <p>2.2 Calculation of signal distortion and dispersion</p> <p>2.3 Performance of single mode fiber</p> <p>2.4 Bandwidth estimation and rise time budget</p> <p>光纤中的信号衰减机制、色散机制、上升时间及预算和带宽估计。</p> <p>2.1 信号损耗</p> <p>2.2 信号畸变及色散计算</p> <p>2.3 单模光纤性能</p> <p>2.4 带宽估计及上升时间及预算</p>
<p><b>Section 3</b></p>	<p>Attenuation mechanisms, power budget and link budget estimations.</p> <p>3.1 Link and power budget estimation of point to point</p> <p>3.2 Power cost</p> <p>3.3 Error control</p> <p>3.4 Coherent detection</p> <p>衰减机制、链路及功率预算。</p> <p>3.1 点到点链路及功率预算</p> <p>3.2 功率代价</p> <p>3.3 差错控制</p> <p>3.4 相干检测</p>
<p><b>Section 4</b></p>	<p>Light sources and photo detectors used for optical fiber systems.</p> <p>4.1 LED and semiconductor laser</p> <p>4.2 Width and reliability analysis of light source</p> <p>4.3 Physical principle of photo detector</p> <p>4.4 Key parameters and performance analysis of photo detector</p> <p>光源和光探测器在光纤通信系统中的使用。</p> <p>4.1 发光二极管、半导体激光器</p> <p>4.2 光源线宽及可靠性分析</p> <p>4.3 光检测器物理原理</p> <p>4.4 光检测器关键参数分析及性能分析</p>
<p><b>Section 5</b></p>	<p>Linear parameters of optical fibers, budget considerations of linear fiber optics in WDM networks.</p> <p>5.1 Fiber attenuation and dispersion</p> <p>5.2 Optical fiber sistem considerations</p> <p>5.3 Budget of link power and time cost</p> <p>5.4 Basic measurement standard and equipment</p> <p>光纤线性参数及其在波分复用通信网络中的预算考虑。</p> <p>5.1 光纤损耗及色散</p> <p>5.2 系统考虑</p>

	<p>5.3 链路功率及时间综合预算</p> <p>5.4 基本测试标准及设备</p>
<b>Section 6</b>	<p>Optical nonlinear effects in fibers, nonlinear effects induced limitations/applications in networks.</p> <p>6.1 Nonlinear effect</p> <p>6.2 stimulated raman scattering and self-phase modulation</p> <p>6.3 Four-wave mixing</p> <p>6.4 Limitationa and application of nonlinear effect</p> <p>光纤非线性效应及其在通信网络中的限制与应用。</p> <p>6.1 非线性效应概述</p> <p>6.2 受激拉曼散射、自相位调制</p> <p>6.3 四波混频</p> <p>6.4 非线性效应的限制及应用</p>
<b>Section 7</b>	<p>Various components for optical fiber communications.</p> <p>7.1 Passive optical coupler</p> <p>7.2 Isolator and circulator</p> <p>7.3 Filter</p> <p>7.4 Active optical device</p> <p>7.5 Tunable light source</p> <p>光纤通信系统的各种组件。</p> <p>7.1 无源光耦合器</p> <p>7.2 隔离器及环形器</p> <p>7.3 滤波器</p> <p>7.4 有源光器件</p> <p>7.5 可调谐光源</p>
<b>Section 8</b>	<p>Optical multiplexers and demultiplexers, fiber gratings and fiber-based sensors.</p> <p>8.1 Concept of optical multiplexer and demultiplexer</p> <p>8.2 Basis of optical fiber grating</p> <p>8.3 Optical fiber bragg grating</p> <p>8.4 Communication network based on optical fiber grating</p> <p>8.5 Sensing network based on optical fiber grating</p> <p>光复用器及解复用器及光纤光栅和传感的概念。</p> <p>8.1 光复用器及解复用器概念</p> <p>8.2 光纤光栅基础</p> <p>8.3 光纤布拉格光栅</p> <p>8.4 基于光纤光栅的通信网络</p> <p>8.5 基于光纤光栅的传感网络</p>
<b>Section 9</b>	<p>WDM Communication System</p> <p>9.1 Principle of WDM</p> <p>9.2 Standard of WDM</p> <p>9.3 WDM components based on phase array</p> <p>9.4 Passive WDM optical network framework</p> <p>9.5 Long-distance WDM network of wide bandwidth</p> <p>9.6 Metropolitan area WDM network of narrow bandwidth</p>

	<p>波分复用通信系统</p> <p>9.1 WDM 工作原理</p> <p>9.2 WDM 标准</p> <p>9.3 基于相位阵列的 WDM 器件</p> <p>9.4 WDM 无源光网络构架</p> <p>9.5 宽带长途 WDM 网络</p> <p>9.6 窄带城域 WDM 网络</p>
<p><b>Section 10</b></p>	<p>Optical amplifiers (SOA, EDFA, RFA and hybrid amplifier), signal regeneration.</p> <p>10.1 Basic application and classification of optical amplifier</p> <p>10.2 Semiconductor optical amplifier (SOA)</p> <p>10.3 Er-doped fiber amplifier (EDFA) and hybrid amplifier</p> <p>10.4 Amplifier noise</p> <p>10.5 Optical signal and noise ratio</p> <p>10.6 Signal regeneration and its system application</p> <p>光放大器（SOA, EDFA, RFA 和混合放大器）和信号再生</p> <p>10.1 光放大器的基本应用及分类</p> <p>10.2 半导体放大器</p> <p>10.3 掺铒光纤放大器、混合放大器</p> <p>10.4 放大器噪声</p> <p>10.5 光信噪比</p> <p>10.6 信号再生及系统应用</p>
<p><b>Section 11</b></p>	<p>Optical Communication Network.</p> <p>11.1 Network concept</p> <p>11.2 Network typology</p> <p>11.3 High-speed optical links and switching</p> <p>11.4 Passive optical network</p> <p>11.5 Optical Ethernet</p> <p>11.6 Concept and design 5G+optical network</p> <p>光通信网络。</p> <p>11.1 网络概念</p> <p>11.2 网络拓扑</p> <p>11.3 高速光链路、光交换</p> <p>11.4 无源光网络</p> <p>11.5 光以太网</p> <p>11.6 5G+光网络概念及设计</p>
<p><b>11. 课程考核</b></p> <p><b>Course Assessment</b></p> <p>( ① 考核形式 Form of examination; ②. 分数构成 grading policy; ③ 如面向本科生开放, 请注明区分内容。 If the course is open to undergraduates, please indicate the difference. )</p>	
<ol style="list-style-type: none"> <li>1. Continuous Assessment 1 (CA1): Quiz (20%)</li> <li>2. Continuous Assessment 2 (CA2): Assignment (20%)</li> <li>3. Continuous Assessment 3 (CA3): Case Study 1 Formal Report (30%)</li> <li>4. Continuous Assessment 4 (CA4): Case Study 2 (15%)</li> <li>5. Continuous Assessment 5 (CA5): Case Study 3 (15%)</li> </ol>	

12. 教材及其它参考资料

**Textbook and Supplementary Readings**

TEXTBOOKS

1. Keiser Gerd, Optical Fiber Communications, 4th Edition, McGraw Hill, 2011. (TK5103.59.K27 2011)

REFERENCES

1. Hecht Jeff, Understanding Fiber Optics, 5th Edition, Pearson/Prentice-Hall, 2006. (TA1800.H447 2006)
2. Powers John P, An Introduction to Fiber Optic Systems, 2nd Edition, Irwin, 1999. (TA1800.P888 1999)
3. Palais Joseph C, Fiber Optic Communications, 5th Edition, Pearson/Prentice-Hall, 2005. (TK5103.59.P154 2005)
4. Ramswami Rajiv and Sivarajan Kumar N, Optical Networks: A Practical Perspective, 3rd Edition, Morgan Kaufmann 2008.