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| **Modulbezeichnung:** | **Optische Kommunikationsnetze (OptK)** (Optical Communication Networks) | **2.5 ECTS** |
| Modulverantwortliche/r: | Herbert Haunstein | |
| Lehrende: | Herbert Haunstein | |

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| Startsemester: WS 2020/2021 | Dauer: 1 Semester | Turnus: jährlich (WS) |
| Präsenzzeit: 30 Std. | Eigenstudium: 45 Std. | Sprache: Deutsch oder Englisch |

**Lehrveranstaltungen:**

Optische Kommunikationsnetze (WS 2020/2021, Vorlesung, 2 SWS, Herbert Haunstein)

**Es wird empfohlen, folgende Module zu absolvieren, bevor dieses Modul belegt wird:**

Kommunikationsnetze

**Inhalt:**

Global communication between billions of subscribers utilizing a multitude of devices is accomplished over a trans-continental fiber-optic transport network. End users worldwide access this network over copper cable (xDSL, HFC), by wireless technologies like WLAN, GSM, UMTS, LTE and also via GPON, EPON and WDM-PON (PON: Passive Optical Network). After a short distance ("the last mile") data streams from many users are aggregated (e.g. by IP routers) into higher data rate transport streams, which are then carried over cost-efficient and highly reliable optical connections. Rapid increase of data traffic has quickly evolved from Gigabit Ethernet (1GbE) to 10GbE and 100GbE data rates. To operate optical networks on a global scale, standards like OTN (Optical Transport Network) have been developed to provide high capacity links by use of many wavelengths together with operations and maintenance (OAM) functions. Automated protection and restauration schemes provide a high level of availabilty and can guarantee carrier-grade Quality of Service (QoS). Future data rate increase will be driven by video streaming as well as the introduction of 5G wireless technology and the Internet of Things (IoT).

The course shall provide a fundamental understanding of modern fiber optic networks from fixed and mobile access through metropolitan area to core networks.

1) Introduction – Evolution of optical networks
2) Network layers - Internet Protocol – TCP/IP
3) Label switching – MPLS – MPLS-TP
4) Quality of Service - traffic classification – resource allocation
5) Ethernet - switching and physical transport
6) Optical Transport Network - OTN
7) Optical fiber properties – optical amplification
8) Optical transmitter – laser – modulator
9) Optical receiver – photo detection – Clock&Data recovery – Bit Error Ratio calculation
10) Modulation formats – transmission - margin allocation
11) Coherent detection – optical signal processing
12) Optical networks – optical switching
13) OPtical Access Networks: Passive Optical Networks (PON) - GPON, EPON, NGPON –
14) Control plane / GMPLS - Software defined networking (SDN) - Network automation

**Lernziele und Kompetenzen:**

Students ...

- explain the functional building blocks of optical networks
- can eloborate on the different tasks provided by the logical/control plane (routing), the physical layerand transmission/data plane of optical networks
- refer which standardisation organisation contributes to the different function of optical networks
- explain the purpose of different protocols that interact along an end-to-end communication channel
- describe technologies for E/o and O/E conversion and optical switches

- express the design challenges of future optical systems for fixed and mobile access, data center interconnects,metro-regional, core, ultra-long-haul and submarine networks

**Literatur:**

[1] R. Ramaswami and K.N. Sivarajan: “Optical Networks”, Morgan Kaufman Publishers, 1998
[2] U. Black: “Optical Networks - Third generation transport systems”, Prentice Hall, 2002
[3] P. Tomsu and Chr. Schmutzer: “Next generation optical networks”, Prentice Hall, 2002
[4] M. Bossert, M. Breitbach: “Digitale Netze”, Teubner Verlag, 1997
[5] I. Kaminow and T. Li (eds.): “Optical fiber telecommunications IVA+B”, Academic Press, 2002
[6] D.E. Comer, „Computernetworks and Internets, Pearson“, 2009
[7] G.P. Agrawal, “Fiber optic communication systems”, Wiley, 1992, (new 1997)
[8] G.P. Agrawal, “Nonlinear fiber optics”, Academic Press, 1995
[9] K. Petermann: “Laser Diode Modulation and Noise”, Kluver, 1991
[10] L. Kazovsky et al., „Optical Fiber Communication Systems“, Artech House, 1996
[11] K.-P. Ho, „Phase-Modulated Optical Communication Systems“, Springer 2005
[12] H. Haunstein, Presentation material (slides) of the lectures (in English)

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**Studien-/Prüfungsleistungen:**

Optische Kommunikationsnetze (Prüfungsnummer: 30001)
(englische Bezeichnung: Optical Communication Networks)

Prüfungsleistung, mündliche Prüfung, Dauer (in Minuten): 30
Anteil an der Berechnung der Modulnote: 100% Prüfungssprache: Deutsch oder Englisch

Erstablegung: WS 2020/2021, 1. Wdh.: SS 2021
1. Prüfer: Herbert Haunstein

Optische Kommunikationsnetze (Prüfungsnummer: 849203)
(englische Bezeichnung: Optical Communication Networks)

Prüfungsleistung, mündliche Prüfung, Dauer (in Minuten): 30
Anteil an der Berechnung der Modulnote: 100% Prüfungssprache: Deutsch oder Englisch

Erstablegung: WS 2020/2021, 1. Wdh.: SS 2021
1. Prüfer: Herbert Haunstein

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**Bemerkungen:**

Prüfungssprache Deutsch oder Englisch nach Wahl des/r Studierenden.