

VALLIAMMAI ENGINEERING COLLEGE

SRM NAGAR, KATTANKULATHUR – 603 203.



DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

M.E., - COMMUNICATION SYSTEMS

FIRST YEAR / FIRST SEMESTER - BATCH: 2014-2016

CU7103 OPTICAL NETWORKS

SYLLABUS

CU7103 OPTICAL NETWORKS

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UNIT-I: OPTICAL SYSTEM COMPONENTS

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Light propagation in optical fibers – Loss & bandwidth, System limitations, Non-Linear effects; Solitons; Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters

UNIT-II: OPTICAL NETWORK ARCHITECTURES

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Introduction to Optical Networks; SONET / SDH standards, Metropolitan Area Networks, Layered Architecture; Broadcast and Select Networks–Topologies for Broadcast Networks, Media Access Control Protocols, Test beds for Broadcast & Select WDM; Wavelength Routing Architecture.

UNIT-III: WAVELENGTH ROUTING NETWORKS

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The optical layer, Node Designs, Optical layer cost tradeoff, Routing and wavelength Assignment[RWA], Virtual topology design, Wavelength Routing Test beds, Architectural variations.

UNIT-IV: PACKET SWITCHING AND ACCESS NETWORKS

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Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronization, Broadcast OTDM networks, Switch-based networks; Access Networks – Network Architecture overview, OTDM networks; Optical Access Network Architectures; Future Access Networks.

UNIT-V: NETWORK DESIGN AND MANAGEMENT

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Transmission System Engineering – System model, Power penalty - transmitter, receiver, Optical amplifiers, crosstalk, dispersion; Wavelength stabilization ; Overall design considerations; Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.

TOTAL: 45 PERIODS

REFERENCES:

1. Rajiv Ramaswami and Kumar N. Sivarajan, “Optical Networks: A Practical Perspective”, Harcourt Asia Pte Ltd., Second Edition 2004.
2. C. Siva Ram Moorthy and MohanGurusamy, “WDM Optical Network : Concept, Design and Algorithms”, Prentice Hall of India, 1st Edition, 2002.
3. Biswanath Mukherjee, “Optical Communication Networks”, Mc-GrawHill c1997, First Edition ISBN 0-07-044435-8.
4. P.E. Green, Jr., “Fiber Optic Networks”, Prentice Hall, NJ, 1993.
5. Rajiv Ramaswami and Kumar N. Sivarajan, “Optical Networks: A Practical Perspective”, Harcourt Asia Pte Ltd., First Edition 2004.

UNIT-I: OPTICAL SYSTEM COMPONENTS

PART A

1. Mention the advantages and disadvantages of optical communication.
2. What is the need for couplers and isolators?
3. Draw a block diagram of a fiber communication system.
4. What are the different loss components in optical fibers?
5. What are Solitons? What is their advantage?
6. What is wavelength converter?
7. Why is erbium used in EDFA?
8. What phenomenon determines the bandwidth of an EDFA?
9. What is the function of coupler?
10. Name and describe two major classes of filters.
11. What are the basic characteristics of a filter?
12. What are the factors that determine the transmission distance in optical fibers?
13. Explain the function of circulators and isolators.
14. Enumerate the features and applications of Solitons.
15. What are three functional types of optical amplifier?
16. What is Crosstalk in SOA?
17. What is FP filter?
18. Describe the functions of core and cladding in an optical fiber. Why their refractive indexes are different? Which one has to be greater and why?
19. What does the term 'State of Polarization', mean?
20. Define extinction ratio.

PART B

1. i) Define and explain Numerical aperture and TIR
ii) Discuss the functions of the following optical components.
(a) Three port circulator, ii) Electro-optical directional coupler.
2. i) Explain the characteristics of EDFA optical amplifier. Derive its gain expression.
ii) Explain how stimulation emission occurs in an EDFA
3. i) Discuss in detail, the main categories of nonlinear effects that occur In optical communication systems.
ii) Explain the advantages of optical amplifier over regenerators.
4. Describe in detail, the principle of operation of an Erbium doped fiber amplifier.
5. Explain the fabrication of a simple 2x2 fiber optic coupler with a neat diagram. Derive its coupling length.
6. Explain how wavelength conversion can be used in fiber networks.
7. List the major Causes of Attenuation in an optical fiber & explain their mechanism in detail about light propagation in a fiber?
8. Explain the principle of operation of a semiconductor optical amplifier (SOA)?
Show the structure of an EDFA & Explain the function of each component

9. What is the function & the principle of operation of an isolator and circulator? Give example of isolator and circulators Applications.
10. Explain the features and applications of optical amplifiers and Optical switches
11. Explain the principle of operation of Fabry Perot (FP) filter and Mach Zehnder Interferometer (MZI)?
12. Explain the function & the Principle of operation of Wavelength Converters?

UNIT-II: OPTICAL NETWORK ARCHITECTURES

PART A

1. Specify the Protection architectures of SONET.
2. List any 2 features of shufflenet multihop Network.
3. Compare single hop and multihop network.
4. Name any 2 routing techniques in optical communication networks.
5. Draw the basic building blocks of WDM approach.
6. What is the significance of WDM in optical networks?
7. Mention advantages of WDM. what are their types?
8. List the different topologies used in optical networks.
9. What is a optical add/drop multiplexer?
10. What are the services provided by the optical layer?
11. What are the functions of a routing node?
12. Define Broadcast and select Network?
13. Define MAN and WDM.
14. Define SONET/SDH
15. Why do we need to develop WDM fiber optic network?
16. Why is WDM the major trend in Fiber optic network?
17. Define static and reconfigurable networks.
18. Define Lambda net.
19. What are the constraints for wavelength assignment?
20. What is the difference between MAN and WAN

PART B

1. Explain the advantages of SONET and SDH standards used in optical networks.
2. Describe the frame structure and network configurations defined for SONET and SDH with diagrams.
3. Discuss the main features and mode of operation of broadcast and select networks. Discuss the design issues
4. With neat diagram, explain the elements of SONET infrastructure.
5. . Explain the optical network layered architecture with a diagram
6. Explain the factors that limit the through put in the broadcast and select networks, in detail
7. Explain in detail Network management and Protection architectures of SDH.
8. Explain the SONET format with neat diagram.

9. Explain the types of WDM in detail.
10. Explain briefly the test beds for Broadcast and select WDM networks
11. Distinguish 1) MAN from WAN 2) MAN from LAN
12. Explain the differences between FDM and WDM.

UNIT-III: WAVELENGTH ROUTING NETWORKS

PART A

1. What is optical layer overhead?
2. What are the constraints for wavelength assignment?
3. What is the need for wavelength routing test beds?
4. Name any two routing techniques in optical communication networks.
5. Draw the basic building blocks of WDM approach.
6. What is WRA?
7. What are the virtual topology designs?
8. What is the need for wavelength routing test beds?
9. What is the need for minimization of routing updates in networking?
10. What are the various types of optical laser?
11. What is the principle of client layers of the optical layer?
12. What are the features of optical layer?
13. Define the topologies for broadcast networks?
14. What are the constraints for routing assignment?
15. Define static and reconfigurable networks.
16. What is FDDI?
17. What is 3R and 2R?
18. What is an access network?
19. Define packet switched networks
20. What are the merits of virtual topology design?

PART B

1. Discuss how by providing networking functions within the optical layer, significant cost saving is achieved.
2. What problems are encountered in routing and wavelength assignment?
3. Explain how wavelength conversion can be used in fiber networks.
4. Explain the functions of Media access control protocols?
5. Discuss the concepts of Routing and wavelength assignment with neat diagram.
6. Explain in detail the issues in network design of wavelength routing networks and optical layer cost tradeoffs.
7. Explain the functions of client layer in optical layer?
8. Explain the significance of wavelength converter in detail, with an example
9. Explain how node designs are carried out in WRN with an example
10. Discuss the issues in wavelength routed networks.
11. Give an account on Wavelength routing test beds.
12. Explain the Wavelength routing architecture with a diagram?

UNIT-IV: PACKET SWITCHING AND ACCESS NETWORKS

PART A

1. What is the concept and advantages of OTDM?
2. Define OTDM
3. What is the principle of Acousto optic tunable filter?
4. Define photonic packet switched networks.
5. What is the need for synchronization?
6. What is multiplexing?
7. What is de-multiplexing?
8. What is service access point?
9. What is the significance of OTDM?
10. What are the key design objectives of optical TDM Networks?
11. What are the merits of photonic switching over electronic switching?
12. Give the difference between fixed delay and tunable delay.
13. What are the functions of media access control protocol?
14. What is optical phase lock loop?
15. Differentiate broadcast network and switch based networks
16. Draw the OTN layered model
17. What is a future access network?
18. What is the principle of OTDM?
19. Comment on how network architecture related to OFC.
20. How topology is related to configuration management. Explain?

PART B

1. Explain the principle of OTDM in detail.
2. Explain the unique features of broadcast OTDM networks.
3. Explain the Optical Access Network Architecture.
4. How label switching differs from IP forwarding? Also explain the advantages of switching. Explain the point to point network topology
5. Explain the significance of future access network.
6. With neat diagram explain the OTN layered model.
7. Explain the principle of photonic packet switching with an example. Enumerate its features over electronic switching.
8. Describe in detail, the architecture & classification of different types of fiber access networks.
9. Compare and contrast Broadcast networks and switch based networks in detail.
10. With neat diagram explain the design objectives and construction of Optical Networking
11. What is the need for synchronization in optical access networks?
12. Explain the operating principle of optical mux and de-mux. Show how an optical AND gate can be used to extract a multiplexed channel.

UNIT-V: NETWORK DESIGN AND MANAGEMENT

PART A

1. What is wavelength stabilization?
2. Define laser relative intensity noise.
3. What are the system parameters associated with receiver?
4. What is the goal of performance management?
5. What are the different types of pumping in EDFA configurations?
6. What are the basic functions of Link Management protocols?
7. What is the concept of optical cross connect?
8. What is soliton trapping gate?
9. What is extinction ratio?
10. List the various types of Optical amplifiers.
11. What are the 2 types of cross talk?
12. Write down the network management functions.
13. What is dispersion?
14. What are the three models for interconnection for IP over optical networks?
15. What are the 3 building blocks of OXC?
16. What is the significance of alarm management?
17. What is enhanced HFC?
18. What is meant by synchronization in optical networks?
19. Show how bit interleaved multiplexing is performed.
20. What are the key parameters related to a transmitter and receiver.

PART B

1. Discuss how by providing networking functions within the optical layer, significant cost saving is achieved.
2. Explain the functions of Media access control protocols.
3. Describe how synchronization is achieved using tunable delays and optical phase lock loop
4. Describe the two forms of crosstalk that arise in WDM systems.
5. Explain the approach used for crosstalk reduction.
6. Discuss in detail equipment, connection and adaptation management functions of configuration management.
7. Explain in detail Network management and Protection architectures of SDH.
8. What is meant by Broadcast and select Network? Discuss the design issues and objectives in detail.
9. Discuss in detail, SDM, TDM and WDM approaches in High capacity Networks.
10. Explain the topologies related to configuration management.
11. Explain the working of a tunable optical delay line.
12. Explain how optical phase lock loop is implemented.