SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

I SEMESTER

1911104 - OPTICAL NETWORKS

Regulation – 2019

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Prepared by

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DEPARTMENT OF ECE

QUESTION BANK

SUBJECT : 1911104 - OPTICAL NETWORKS

SEM / YEAR: M.E-Communication Systems/Sem-I

UNIT-I: INTRODUCTION TO OPTICAL NETWORKS

Telecommunications Networks Architecture, Services, circuit switching and packet switching, Optical Networks: Multiplexing Techniques, Second generation Optical Networks, Optical Packet Switching, Transmission Basics: Wavelength, frequencies, and channel spacing, Wavelength standards, Optical power and loss, Network Evolution, Nonlinear Effects: Self-phase Modulation, Cross-phase Modulation, Four Wave mixing, Solitons. Components: Couplers, Isolators and Circulators, Multiplexers and Filters, Optical Amplifiers, Transmitters, Detectors, Switches, Wavelength Converters.

PART – A

Q.No	Questions	BT	Competence
1.	List the advantages and disadvantages of optical communication.	**BTL 1**	**Remembering**
2.	Assess the need for couplers and isolators.	**BTL 4**	**Analyzing**
3.	Outline the non-linear effects in WDM systems.	**BTL 2**	**Understanding**
4.	Enumerate the relationship between frequency spacing and wavelength spacing.	**BTL 1**	**Remembering**
5.	Narrate the characteristics of Solitons along with its advantage.	**BTL 1**	**Remembering**
6.	Discuss about wavelength converters.	**BTL 2**	**Understanding**
7.	Why is erbium used in EDFA?	**BTL6**	**Creating**
8.	Infer the phenomenon which determines the bandwidth of an EDFA.	**BTL 4**	**Analyzing**
9.	Demonstrate the function of coupler.	**BTL 3**	**Applying**
10.	Name and describe two major classes of filters.	**BTL 1**	**Remembering**
11.	Illustrate the characteristics of optical filters.	**BTL 3**	**Applying**
12.	What are the factors that determine the transmission distance in optical fibres?	**BTL 1**	**Remembering**
13.	Explain the function of circulators.	**BTL 4**	**Analyzing**
14.	Enumerate the features and applications of Solitons.	**BTL 1**	**Remembering**
15.	Analyze the functional types of optical amplifier.	**BTL 5**	**Evaluating**
16.	Summarize the effects of Crosstalk in SOA.	**BTL 2**	**Understanding**
17.	Describe a FP filter.	**BTL 2**	**Understanding**
18.	Investigate the functions of core and cladding in an optical fiber.Why their refractive indexes are different? Which one has to be greater and why?	**BTL6**	**Creating**
19.	Demonstrate the term ‘State of Polarization’.	**BTL 3**	**Applying**
20.	Evaluate extinction ratio.	**BTL 5**	**Evaluating**

PART – B

1.	i) Explain the architecture of a terrestrial network in detail. (6) ii) Analyze the functions of the following optical components. a) Three port circulator. (4) b) Electro-optical directional coupler (3)	**BTL 4**	**Analyzing**
2.	i) Discuss the characteristics of EDFA optical amplifier in detail. Derive its gain expression and mention its potential amplifications. (8) ii) Analyze how stimulation emission occurs in an EDFA. (5)	**BTL4**	**Analyzing**
3.	i) Summarize the main categories of nonlinear effects that occur in optical communication systems. (8) ii) Describe the methods to suppress the cross talk in optical networks. (5)	**BTL2**	**Understanding**
4.	i) Frame the different types of filtering used in optical Networks. (8) ii) Demonstrate the different types of optical switching technologies. (5)	**BTL3**	**Applying**
5.	i) Explain the principle of operation of a 2*2 fiber optic coupler with a diagram. Derive its design equations. (8) ii) Illustrate the difference between circuit-switched and packet-switched networks along with its multiplexing technique. (5)	**BTL4**	**Analyzing**
6.	Enumerate how wavelength conversion can be used in fiber networks using a) Optoelectronic approach (4) b) Optical grating (3) c) Interferometric Techniques (3) d) Wave mixing (3)	**BTL 1**	**Remembering**
7.	i) Demonstrate two complementary methods to increase the transmission capacity of a network. (8) ii) Frame the architecture of a wavelength routing network and explain its key elements. (5)	**BTL3**	**Applying**
8.	i) Generalize the principle of operation of a semiconductor optical amplifier (SOA) with a neat diagram. (8) ii) Describe the structure of an EDFA & explain the function of each component. (5)	**BTL2**	**Understanding**
9.	Outline the features and applications of i) Optical Amplifiers (8) ii) Optical switches. (5)	**BTL 1**	**Remembering**
10.	i) Evaluate in the detail about Bragg gratings. (8) ii) Determine the key features of Fiber gratings. (5)	**BTL5**	**Evaluating**
11.	Discuss in detail about i) Mach-Zehnder Interferometers. (8) ii) The high channel count multiplexer architectures. (5)	**BTL2**	**Understanding**

12.	i) Label the architecture of Arrayed waveguide grating. (5) ii) State the principle of operation of Arrayed waveguide grating. (8)	**BTL 1**	**Remembering**
13.	Enumerate the following phenomena's along with the principle of operation with the help of suitable diagrams: i) The Transmission grating (8) ii) Reflection grating (5)	**BTL 1**	**Remembering**
14.	i) Investigate the special features of Self -Phase Modulation and Cross-Phase modulation with necessary equations. (8) ii) Elaborate the principle of operation of Isolators along with necessary diagram. (5)	**BTL6**	**Creating**
	PART – C		
1.	i) Evaluate the functionalities of an optical packet switching node with a neat diagram. (5) ii) Provide an overview of an optical fiber transmission system and explain in detail about single mode and multimode fiber. (10)	**BTL5**	**Evaluating**
2.	i) Elaborate the theory of Soliton propagation, with diagrams.(6) ii) Design a tunable micro-electro mechanical vertical cavity surface emitting laser which can overcome the challenges that we faced in realising long wavelength VCSEL's. (9)	**BTL6**	**Creating**
3.	Determine the various ways to transmit different wavelengths efficiently using the concept of Etalon and also explain its operation. (15)	**BTL5**	**Evaluating**
4.	Design an acousto-optic tunable filter and explain its power transfer function along with necessary equations. (15)	**BTL6**	**Creating**

UNIT-II: TRANSMISSION SYSTEM ENGINEERING

System Model, Power Penalty, Transmitter, Receiver, Optical Amplifiers, Crosstalk, Dispersion, Wavelength Stabilization, Overall Design Considerations. Optical Internets: Migration to IP optical networking, IP and Optical backbone, IP Routing table, MPLS and optical cross connect table, Protocol stack Alternatives, Internetworking SS7 and Legacy Transport, Internet transport network protocol stack.

PART – A

Q.No	Questions	BT	Competence
1.	What is wavelength stabilization?	**BTL 1**	**Remembering**
2.	Define laser relative intensity noise.	**BTL 1**	**Remembering**
3.	Analyze the key design parameters of a transmitter.	**BTL 1**	**Remembering**
4.	Explain how the different internet nodes interwork with each other.	**BTL 4**	**Analyzing**
5.	Estimate the different types of pumping in EDFA configurations.	**BTL5**	**Evaluating**
6.	Mention the equation used for calculating power penalty when noise is independent of signal power.	**BTL 1**	**Remembering**
7.	Summarize the concept of optical cross connect.	**BTL2**	**Understanding**
8.	Define soliton trapping gate.	**BTL 1**	**Remembering**
9.	Infer the impact of transparency in optical networks.	**BTL 4**	**Analyzing**
10.	Discuss the various types of Optical amplifiers	**BTL 2**	**Understanding**
11.	Describe the two types of cross talk.	**BTL 2**	**Understanding**

12.	Label a probable migration scenario to IP Optical Networking.	**BTL4**	**Analyzing**
13.	What is dispersion?	**BTL 1**	**Remembering**
14.	Formulate the three models for interconnection for IP over optical networks.	**BTL 6**	**Creating**
15.	Illustrate the spectral width of SLM DFB lasers and directly modulating a DFB laser.	**BTL 3**	**Applying**
16.	Which are the factors that help us to decide the type of fiber to be used?	**BTL 6**	**Creating**
17.	Demonstrate the principle of a wavelength locker.	**BTL3**	**Applying**
18.	Determine the modes of operation of a laser and mention the range of its drive current.	**BTL 5**	**Evaluating**
19.	Show how bit interleaved multiplexing is performed.	**BTL3**	**Applying**
20.	Summarize the key parameters related to a transmitter and receiver.	**BTL 2**	**Understanding**
	PART B		
1.	Label an example of an optical backbone network that supports IP and lambda forwarding along with subnets and its support of non optical nodes. (13)	**BTL 1**	**Remembering**
2.	Discuss the following considerations involved in the overall design of a network: a) Transmitter &Transmission system (4) b) Receiver (2) c) Cross talk and Wavelength stabilization. (7)	**BTL 3**	**Applying**
3.	i) Illustrate in detail about power transients. (8) ii) Demonstrate about ”Lasing Loop” problem which occurs in ring networks. (5)	**BTL 3**	**Applying**
4.	i) Describe the two forms of crosstalk that arise in WDM systems. (8) ii) Discuss the different types of approaches used for crosstalk reduction. (5)	**BTL 2**	**Understanding**
5.	Write short notes on Chromatic Dispersion Limits a) NRZ modulation (8) b) RZ modulation (5)	**BTL 1**	**Remembering**
6.	Estimate the power penalty of two systems which has the same peak transmit power. (13)	**BTL 5**	**Evaluating**
7.	i) Analyze in detail about the different fiber types. (06) ii) Discuss about transmit power and amplifier spacing. (07)	**BTL 4**	**Analyzing**
8.	Illustrate in detail about the MPLS and Optical Cross connect table. (13)	**BTL 2**	**Understanding**
9.	With the help of a neat diagram, explain the operation of a bidirectional transmission system and also mention the use of an optical circulator which is used for separating their directions. (13)	**BTL2**	**Understanding**
10.	Enumerate the different methods inco-operated in WDM link employing chromatic dispersion compensating fiber. (13)	**BTL 1**	**Remembering**
11.	Write about the different components of a unidirectional WDM Link with the help of a neat block diagram. (13)	**BTL6**	**Creating**
12.	Summarize the entities which are involved in internet transport network protocol stack. (13)	**BTL 4**	**Analyzing**

13.	i) Explain the power penalty in optical network design. (08) ii) Point out the important characteristics of Amplifier spacing penalty. (05)	**BTL 4**	**Analyzing**
14.	i) State the important criteria for wavelength planning. (08) ii) Mention the reasons about the difficulties of designing networks than designing point to point links. (05)	**BTL 1**	**Remembering**
	PART – C		
1.	Estimate the steps to reduce switch cross talk using a) Spatial dilation (08) b) Wavelength dilation (07)	**BTL 5**	**Evaluating**
2.	Elaborate a) The working principle of any one optical amplifier with a neat diagram. (08) b) Design a system with cascaded optical amplifiers and show the plot of Power versus amplifier spacing. (07)	**BTL 6**	**Creating**
3.	Determine the effect of unequal amplifier gains at different wavelengths and discuss the gain saturation in EDFA's. (15)	**BTL 5**	**Evaluating**
4.	Compare the limitations due to intermodal dispersion, chromatic dispersion and polarization mode dispersion and explain in detail about the operation of polarization mode dispersion. (15)	**BTL 6**	**Creating**

UNIT-III: SONET, SDH AND OPTICAL TRANSPORT NETWORKS (OTNS)

SONET and SDH: SONET multiplexing hierarchy, Frame structure, Functional Component, problem detection, concatenation. Architecture of Optical Transport Networks (OTNs): Digital wrapper, in-band and out-of band control signalling, Importance of Multiplexing and multiplexing hierarchies, SONET multiplexing hierarchies, SDH multiplexing hierarchies, New Optical Transport, OTN layered Model, Generic Framing Procedure (GFP)

PART – A

Q.No	Questions	BT Level	Competence
1.	Define SONET and SDH.	**BTL 1**	**Remembering**
2.	Describe the problems faced by Plesiochronous digital hierarchy.	**BTL 4**	**Analyzing**
3.	Compare synchronous and asynchronous multiplexing with the help of a diagram.	**BTL 4**	**Analyzing**
4.	How the SONET/SDH avoided the problem of connecting vendor's equipment over transmission link?	**BTL 1**	**Remembering**
5.	Enumerate the functionality of generic framing procedure.	**BTL 1**	**Remembering**
6.	Outline the layers of SONET/SDH standards.	**BTL 2**	**Understanding**
7.	Illustrate the functional components of SONET.	**BTL 3**	**Applying**
8.	Mention the six failures that could occur in a link or a node.	**BTL 1**	**Remembering**
9.	Illustrate an optical add/drop multiplexer.	**BTL 3**	**Applying**
10.	Determine the major components of SDH.	**BTL 5**	**Evaluating**
11.	Describe the operation of In-band signalling.	**BTL 2**	**Understanding**
12.	Summarize the purpose of ISDN in networks.	**BTL 2**	**Understanding**
13.	Estimate what would happen if an optical node is not capable of O/E/O operations?	**BTL 5**	**Evaluating**
14.	Summarize the operation of SONET/SDH.	**BTL 2**	**Understanding**
15.	Propose the importance of multiplexing and its hierarchies.	**BTL 6**	**Creating**

16.	Label SONET multiplexing and mapping hierarchy.	**BTL 1**	**Remembering**
17.	Draw the different parts of OTN Multiplexing hierarchy.	**BTL 4**	**Analyzing**
18.	Define control plane.	**BTL 1**	**Remembering**
19.	Deduce the idea behind the digital wrapper.	**BTL 6**	**Creating**
20.	Demonstrate the comparison of signalling systems.	**BTL 3**	**Applying**
	PART-B		
1.	Analyse the SONET/SDH standards for the following: i) Multiplexing Structure (8) ii) Frame Structure (5)	**BTL 4**	**Analyzing**
2.	Determine the major functional components of i) SONET Link (7) ii) SDH Link (6)	**BTL 5**	**Evaluating**
3.	Deduce the idea of digital wrapper with the help of a neat diagram. (13)	**BTL6**	**Creating**
4.	Describe about control plane and data plane along with their relationship. (13)	**BTL2**	**Understanding**
5.	i) Analyze the problems faced by second generation digital transport networks. (8) ii)Explain the approach of third generation digital transport networks. (5)	**BTL 4**	**Analyzing**
6.	Illustrate in detail the rules and actions used for detection of problems and failure on a link through SONET and SDH. (13)	**BTL 3**	**Applying**
7.	i)Describe what would happen if the signalling link fails? (5) ii) Summarize the importance of multiplexing and its hierarchies in a network. (8)	**BTL2**	**Understanding**
8.	Mention the details of SONET and SDH Multiplexing hierarchy with a detailed diagram. (13)	**BTL1**	**Remembering**
9.	i)How to concatenate three STS-1s into one STS-3c frame? (3) ii) Demonstrate the difference between Inband and Out-of-band control signalling. (10)	**BTL3**	**Applying**
10.	Enumerate the levels of ODUk multiplexing used in New Optical Transport Network and also explain its multiplexing method. (13)	**BTL1**	**Remembering**
11.	Explain the revised SDH transport hierarchy with a neat diagram. (13)	**BTL 4**	**Analysing**
12.	Mention in detail the layered model of SONET/SDH Layered model and explain their function. (13)	**BTL1**	**Remembering**
13.	Describe the functions of a digital wrapper layer and explain how the layered model is more elaborate than SONET/SDH layered model.(13)	**BTL2**	**Understanding**
14.	List out the ways through which the user payload can be encapsulated into an optical payload unit. (13)	**BTL1**	**Remembering**
	PART-C		
1.	Elaborate the arrangement for a full functionality stack and reduced functionality stack with detailed diagram. (15)	**BTL 5**	**Evaluating**
2.	Deduce the relationship of generic framing procedure with clients and optical transport paths along with its frame structure with the help of a neat diagram. (15)	**BTL6**	**Creating**
3.	Evaluate the common aspects of generic framing procedure and also discuss about its client –specific aspects. (15)	**BTL5**	**Evaluating**

4.	Explain about the benefits of using SONET/SDH compared to other networks. (15)	**BTL6**	**Creating**

UNIT-IV: WDM, NETWORK TOPOLOGIES, MPLS AND OPTICAL NETWORKS			
WDM: WDM operation, Dense Wavelength Division Multiplexing (DWDM), Erbium-doped Fiber (EDF), WDM amplifiers, Add-Drop Multiplexers, Wavelength Continuity Property, Higher dispersion for DWDM, Tunable DWDM Lasers.			
PART – A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	Mention the basic principle behind the WDM .	**BTL 1**	**Remembering**
2.	Draw the generalized view of an optical ADM.	**BTL 1**	**Remembering**
3.	When does a WDM light wave satisfies the wavelength continuity property?	**BTL6**	**Creating**
4.	Discuss about WDM Cross-Connects.	**BTL2**	**Understanding**
5.	Label the topology of a conventional optical TDM System.	**BTL 1**	**Remembering**
6.	How are the erbium doped fiber deployed in an optical network?	**BTL 3**	**Applying**
7.	Design an optical amplifier that can be used in a WDM.	**BTL 6**	**Creating**
8.	Determine how Nortel Network calculates the adjusted system loss budget in a network.	**BTL5**	**Evaluating**
9.	Why WDM Network is called so?	**BTL 1**	**Remembering**
10.	Discuss about Erbium doped fiber.	**BTL2**	**Understanding**
11.	Illustrate channel spacing in networks. Analyze about Advanced NZDF.	**BTL 3**	**Applying**
12.	Show the relationship of a SONET/SDH to WDM with the help of necessary diagram.	**BTL 2**	**Understanding**
13.	How Tunable Lasers are found to be useful?	**BTL 4**	**Analyzing**
14.	Write an example of WDM Link.	**BTL 1**	**Remembering**
15.	Analyze a complementary method to increase the capacity of a DWDM System.	**BTL 4**	**Analyzing**
16.	List out the prime job of WDM Cross Connects.	**BTL 1**	**Remembering**
17.	Discuss the allowable range of chromatic dispersion so that the receiver end will be not changed.	**BTL 2**	**Understanding**
18.	Analyze the reason behind gain flatness in an optical amplifier.	**BTL 4**	**Analyzing**
19.	Demonstrate an OXC with the help of a functional diagram.	**BTL 3**	**Applying**
20.	Determine the use of an equalization filter in Optical networks.	**BTL 5**	**Evaluating**
PART B			
1.	Discuss about the operation of the WDM in optical networks with the help of a neat diagram. (13)	**BTL 2**	**Understanding**
2.	i)Discuss the relationship of WDM to SONET/SDH. (7) ii)Summarize about Erbium doped fiber. (6)	**BTL 1**	**Remembering**
3.	Compare the topology of TDM and WDM based topologies with the help of a neat diagram. (13)	**BTL 4**	**Analysing**

4.	Explain the use of optical amplifiers in a WDM Transmission System and discuss about gain flatness. (13)	**BTL 2**	**Understanding**
5.	Summarize about Add/Drop Multiplexers with the help of a the neat diagram. (13)	**BTL 2**	**Understanding**
6.	Illustrate a general view about WDM Crossconnects. (13)	**BTL 3**	**Applying**
7.	Explain the higher dispersion for DWDM. (13)	**BTL 4**	**Analyzing**
8.	How to determine the frequency and the wavelength spacings in a WDM Link with necessary diagram. (13)	**BTL 4**	**Analyzing**
9.	Elaborate about Dense wave division multiplexing, TDM and WDM Optical System with a neat diagram. (13)	**BTL 5**	**Evaluating**
10.	With a neat label, organize the network elements in such a way which shows that SDH/SONET layers operate over the WDM Layer. (13)	**BTL 1**	**Remembering**
11.	Illustrate how does wavelength add-drop multiplexer supports the management of fiber capacity ? (13)	**BTL3**	**Applying**
12.	Design a DWDM wavelength plan with a neat diagram. (13)	**BTL6**	**Creating**
13.	With a neat diagram, explain how to reduce the chromatic dispersion in a Nortel network. (13)	**BTL1**	**Remembering**
14.	Enumerate the importance of Advanced NZDF,its dispersion rate and the way it reduces the non linearities. (13)	**BTL 1**	**Remembering**
PART C			
1.	Elaborate the ways of managing a WDM Channel at the ADM. (15)	**BTL5**	**Evaluating**
2.	Explain how WDM allowed optical networks to increase the capacity and also write the difference between Frequency division and Wavelength division Multiplexing. (15)	**BTL6**	**Creating**
3.	Elaborate the working ,uses and Applications of Wavelength division multiplexing. (15)	**BTL5**	**Evaluating**
4.	Deduce the importance of scalable DWDM systems in enabling service providers to accommodate consumer demand for ever increasing amount of bandwidth. (15)	**BTL6**	**Creating**

UNIT-V: NETWORK TOPOLOGIES AND PROTECTION SCHEMES

Robust networks, Line and path protection switching, Types of topology, Point to point topology, bi-directional line-switched ring (BLSR), meshed topology, Passive optical networks, Metro optical networks 28 MPLS and Optical Networks: IS label switching, Forwarding equivalence class (FEC), Types of MPLS nodes, Label distribution and binding, label swapping and traffic forwarding, MPLS support of Virtual Private Networks (VPN), MPLS traffic engineering, Multi protocol Lambda switching (MPIS).

PART – A

Q.No	Questions	BT Level	Competence
1	What does the term diversity refers to?	**BTL 1**	**Remembering**
2	Mention the different kinds of protection switching.	**BTL 1**	**Remembering**
3	Deduce the meaning of working fiber.	**BTL6**	**Creating**
4	Label Point to point topology.	**BTL2**	**Understanding**
5.	Mention Constraint based label distribution protocol.	**BTL 1**	**Remembering**
6.	Illustrate the factors upon which an optical network topology depends upon?	**BTL 3**	**Applying**
7.	Design a Label Stacking in a VPN.	**BTL 6**	**Creating**
8.	Evaluate the function of line protection and path protection switching.	**BTL5**	**Evaluating**
9.	Mention protection fiber.	**BTL 1**	**Remembering**

10.	Describe the different functions of Traffic engineering in MPLS environment.	**BTL2**	**Understanding**
11.	How can we protect the extra traffic in a network?	**BTL 3**	**Applying**
12.	Discuss about label merging.	**BTL 2**	**Understanding**
13.	Analyze the objectives of traffic engineering.	**BTL 4**	**Analyzing**
14.	Tell about Virtual Private Networks.	**BTL 1**	**Remembering**
15.	Explain the functionalities of MPLS nodes.	**BTL 4**	**Analyzing**
16.	List the benefits of Bidirectional line switched ring.	**BTL 1**	**Remembering**
17.	Summarize the relationship between OXC and MPLS Operations with the help of a diagram.	**BTL 2**	**Understanding**
18.	Analyze the attributes that are associated with traffic trunk.	**BTL 4**	**Analyzing**
19.	Illustrate about adaptivity attributes.	**BTL 3**	**Applying**
20.	Elaborate what would happen if a fiber terminates on a device which acts both as an OXC an an IP router.	**BTL 5**	**Evaluating**
	PART B		
1.	i)Describe the two different types of protection switching scheme. (7) ii)Discuss the different network topologies and their attributes with the help of necessary diagram. (6)	**BTL 2**	**Understanding**
2.	i)Mention in detail about Point To Point Topology with the help of a neat diagram. (5) ii)Write about 1:N Protection Channel Sharing and the different options that can be implemented to protect the extra traffic. (8)	**BTL1**	**Remembering**
3.	i)Show how the parallel links are concatenated together in optical channels. (7) ii)Tell about the messages that can be send between the nodes if all sub channels are operating without any problems. (6)	**BTL1**	**Remembering**
4.	Draw the architecture of a bidirectional line switched ring and explain its working. (13)	**BTL1**	**Remembering**
5.	Enumerate the way through which a four fiber BLSR recovers from a loss of connectivity between the fiber nodes. (13)	**BTL1**	**Remembering**
6.	Describe Meshed topology and explain the traffic flow with the help of necessary diagrams. (13)	**BTL 2**	**Understanding**
7.	i)Summarize the key elements of PON Technology. (6) ii) Discuss the scope of Optical Ethernets and Ethernet PONs. (7)	**BTL 2**	**Understanding**
8.	i)Illustrate about label switching and the reasons for using label switching. (8) ii)Demonstrate about Metro Optical Networking. (5)	**BTL 3**	**Applying**
9.	i)Show how does the MPLS nodes perform with a neat diagram. (8) ii)Explain about the forwarding equivalence class. (5)	**BTL 3**	**Applying**
10.	Analyze about the principle of Label Distribution and Binding. (13)	**BTL 4**	**Analyzing**
11.	Describe the relationship of OXC and MPLS Operations with a detailed diagram. (13)	**BTL 4**	**Analyzing**
12.	Explain about MPLS and Optical wavelength correlation. (13)	**BTL 4**	**Analyzing**
13.	Elaborate about the Multiprotocol lambda based switching . (13)	**BTL 5**	**Evaluating**

14.	i)Deduce the requirements need for TE support in an MPLS Network. (7) ii)Propose an aspect where a node becomes O/E/O mode. (6)	**BTL 6**	**Creating**
PART –C			
1.	Evaluate Label swapping and traffic forwarding. (15)	**BTL5**	**Evaluating**
2.	Plan bout the support of MPLS for Virtual Private Networks. (15)	**BTL6**	**Creating**
3.	Organize the details of MPLS Traffic Engineering and traffic oriented performance. (15)	**BTL6**	**Creating**
4.	i)Determine the operations of MPLS and Optical Control planes. (7) ii)Deduce about Traffic trunks,Traffic flows and Label switched paths. (8)	**BTL5**	**Evaluating**