Lecture Plan-1

Semester:-II Class:-ECE Course Code:-MEEC-504

Subject:-Optical Communication Unit:-I

S. No.	Topic :- Introduction to Optical Communication	Time Allotted:-
1.	Introduction: Communication may be broadly defined as the transfer of information from one point to another. When information is to be conveyed over any distance a communication system is usually required. Within a communication system, the information transfer is frequently achieved by superimposing or modulating the information signal. This electromagnetic carrier is selected from the optical range of frequencies for optical communication	10 min
2	**Division of the Topic** 1. Electromagnetic Spectrum. 2. The General System. 3. Fiber communication system.	30 min
3.	**Conclusion**: Basic Concept of optical communication system is to convey the signal from the information source over the transmission medium to the destination. The optical carrier may be modulated using either an analog or digital information signal.	5 min
4	**Question / Answer** Q1 What are the advantages of optical communication? A1: Enormous Bandwidth, Small Size and Weight, Electrical Isolation, Immunity to interference and crosstalk, Signal Security. Q2 What is the range of optical fiber communication? A2 1.7micrometer to 0.8 micrometer.	5 min

Assignment to be given:-Nil

Text books :

1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH

Reference Books:

1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Doc. No.: DCE/0/15
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Lecture Plan-2

Semester:-II Class:-ECE Course Code:-MEEC-504

Subject:-Optical Communication Unit:-I

S. No.	Topic :- Block Diagram ,Advantages and disadvantages of optical communication	Time Allotted:-
1.	**Introduction**: -Optical fiber has enormous potential band width, small size and weight, electric isolation as compared to the co-axial cable	5 min
2	**Division of the Topic:-** a) Advantage 1. Enormous Potential bandwidth 2. Small size and weight 3. electrical isolation 4. interference 5. signal security b)Disadvantage 1. Testing procedure to be more complex. 2. Small size of fiber and cable creates some difficulty with splicing and forming connectors 3. New equipment and field practices to be required	35 min 5 min
3.	**Conclusion:**-The optical fiber has enormous potential band width, signal security Low transmission losses, system reliability.	5 min
4	**Question / Answer:-** Q1:- What are the advantages of optical fiber over co-axial cable? A1:- Optical fiber has low transmission loss , system reliability and ease of Maintenance.	

Assignment to be given:- What are the disadvantages of optical fiber communication

Text books :

1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH

Reference Books:

1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Doc. No.: DCE/0/15
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Lecture Plan-3

Semester:-II Class:-ECE Course Code:-MEEC-504

Subject:-Optical Communication Unit:-I

S. No.	Topic :- Transmission of light theory	Time Allotted:-
1.	**Introduction**: - Optical fiber has a transparent core and cladding of lower refractive index . It works on the principal of ray theory of light	5 min
2	**Division of the Topic:-** 1. Total internal reflection 2. Acceptance angle 3. Numerical aperture	35 min
3.	**Conclusion:-**Optical fiber works on the principle of light. An incident meteoroid ray at greater than the critical angle will continue to be reflected and will be transmitted through the fiber.	5 min
4	**Question / Answer:-** Q1:- Define reflective index? A1:- It is defined as the ratio of the velocity of the light in a vacuum to the Velocity of light in the medium. Q2:- Define Acceptance angle? A2:-It is the maximum angle to the axis at which ray may enter the fiber in order to be propagated	5 min

Assignment to be given:- A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.50 calculate refractive index of 1.47?

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

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Lecture Plan-4

Semester:-II Class:-ECE Course Code:-MEEC-504

Subject:-Optical Communication Unit:-I

S. No.	Topic :- Applications of optical communication	Time Allotted:-
1.	**Introduction**: - optical fiber communication systems can be used in public area application military application, civil ,Consumer and industrial application	5 min
2	**Division of the Topic:-** 1. Public network application 2. Military application 3. Optical sensor system 4. Local area network	35 min
3.	**Conclusion:-**Because of its enormous potential band width, small size and weight, electrical isolation , they can be used in trunk network, consumer ,industrial	5 min
4	**Question / Answer:-** Q1:- What are the disadvantages of optical fiber? A1:- 1.Testing procedure to be more complex. 2. Small size of fiber and cable creates some difficulty with splicing and forming connectors 3. New equipment and field practices to be required	5 min

Assignment to be given:- A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.50 calculate refractive index of 1.47?

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-5

Semester:-II Class:-ECE Course Code:-MEEC-504

Subject:-Optical Communication Unit:-II

S. No.	Topic :- Optical Fiber structures and Types of Fiber (step index)	Time Allotted:-
1.	**Introduction**: -in step index fiber core has a constant refractive index and a cladding of a slightly lower refractive index, in multimode step index fiber core diameter is around 50 μm.	5 min
2	**Division of the Topic:-** 1) Step index fiber 2) Types of step index fiber 3) Sketch 4) Propagation 5) Advantage	35 min
3.	**Conclusion:-**.the multimode step index fiber has large numerical apertures, as well as core diameter, facilitating easier coupling to optical sources.	5 min
4	**Question / Answer:-** Q1:- What is the relationship between guided mode and normalized frequency? A1:- Ms =(V^2) / 2 Q2:- What is the advantage of multimode over single mode step index fiber? A2:- The use of spatially incoherent optical sources.	5 min

Assignment to be given:-
A multimode step index fiber with a core diameter of 80 μm and a relative index difference of 1.5% is operating at a wave length of .85 μm, if the core refractive index is 1.48 ,
a) Estimate the normalized frequency for the fiber
b) The number of guide modes.

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-6

Semester:-II Class:-ECE Course Code:-MEEC-504

Subject:-Optical Communication Unit:-I

S. No.	Topic: - Graded index fibers.	Time Allotted:-
1.	**Introduction**: -Graded index do not have a constant refractive index in the core , but decreasing core index but with radial distance from a maximum value at the axis to a constant value beyond the core radius a in the cladding	5 min
2	**Division of the Topic:-** 1) Graded index fiber 2) Profile 3) Types of graded index fiber 4) Advantages	35 min
3.	**Conclusion:**-Multimode graded index fiber exhibits far less inter modal dispersion then multimode step index fiber. The multimode graded index fiber with parabolic core has transmission bandwidth greater than step index fiber bandwidths.	5 min
4	**Question / Answer:-** Q1:-Give one advantages of multimode grade index fiber? A1**:-** Multimode graded index fiber exhibits far less inter modal dispersion then multimode step index fiber. Q2:-What will be the refractive index profile of fiber core when α= 2and α =1? A2:- The refractive index profile of fiber core when α= 2will be parabolic and when α =1 will be triangular.	5 min

Assignment to be given: - A graded index fiber has a core with a parabolic refractive index profile which has a diameter of 50 μm. The fiber has a numerical aperture of 0.2. Estimate the total number of guided modes propagating in the fiber when it is operating at wavelength of 1μm.

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-7

Semester:-II Class: - ECE Course Code:MEEC-504

Subject:-Optical Communication Unit:-II

S.NO	Topic: - Single Mode fibers.	Time Allotted:-
1.	**Introduction**: - The transmission of single mode fiber must be designed to allow propagation of only one mode. In this mode only the fundamental LP 01 mode can exist.	5 min
2	**Division of the Topic:-** 1) Cut off wavelength 2) Mode- field diameter 3) Sport size 4) Group delay	35 min
3.	**Conclusion:-** They exhibit the greatest transmission bandwidths and the lowest losses of the fiber transmission media, they have a superior transmission quality over other fiber types because of the absence of modal noise	5 min
4	**Question / Answer:-** Q1:-Where is single mode fiber used? A1:- Single mode fiber are suited for high band width very long – haul application using single mode injection laser sources. Q2:- Give the major advantage of Single Mode fibers within optical fiber? A2:- The advantage of the single mode within an optical fiber is the signal dispersion caused by different modes is avoided. .	5 min

Assignment to be given:- descried with the aid of simple ray diagram
a) The multimode step index fiber b) the single mode step index fiber.

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-8

Semester:-II Class: - ECE Course Code:MEEC-504

Subject:-Optical Communication Unit:-II

S. No.	Topic :- Plastic Clad fibers and All-Plastic fibers	Time Allotted:-
1.	**Introduction**: -plastic clad fibers are multimode and have either a step index or graded index profile. They have a plastic cladding and a glass core which is frequently silica. All plastic fibers are exclusive of the multimode step index type with large core and cladding diameters.	5 min
2	**Division of the Topic:-** 1) Plastic –clad fiber. a) Structure b) Performance characteristics 2) All-plastic fibers. a) Structure b) Performance Characteristics c) Application	35 min 5 min
3.	**Conclusion:-** All plastic fiber can be used for very short – haul, low cost links. Fiber coupling and termination are relatively easy and do not require sophisticated techniques.	5 min
4	**Question / Answer:-** Q1:-What is the difference between plastic-clad and all plastic –clad fiber? A1:- Plastic clad fiber are multi mode and have either step index or a graded index Profile but all plastic – clad are exclusively multimode step index fiber. Q2:- What is the core diameter of all-plastic fiber? A2:- Core diameter : 200 to 600μm	

Assignment to be given: - Nil

Reference Readings: - optical communication……..By John M. Senior
Optical Communication systems…… By John Gowar

Lecture Plan-9

Semester:-II Class: - ECE Course Code:MEEC-504

Subject:-Optical Communication Unit:-II

S. No.	Topic :-Attenuation, material absorption losses	Time Allotted:-
1.	**Introduction**: - signal attenuation with in optical fiber, as with metallic conductor is expressed in the logarithmic unit of the decibel. Material absorption is loss mechanism related to the material composition and fabrication process for the fiber, which results in the dissipation of some of the optical power as in the wave guide.	5 min
2	**Division of the Topic:-** 1) attenuation 2) Material absorption losses in silica glass fibers i) Intrinsic absorption ii) Extrinsic absorption	35 min
3.	**Conclusion:**-the intrinsic absorption can be minimized by suitable choice of both core and cladding composition. The lowest attenuation for the fiber occurs at a wavelength of 1.55μm and is 0.2 dB $Km^{-1.}$	5 min
4	**Question / Answer:-** Q1:-How is extrinsic loss mechanism caused? A1:- the major extrinsic loss mechanism is caused by absorption due to water (as the hydroxyl or OH ion) dissolved in the glass.	5 min

Assignment to be given: - When the means optical power launched into an 8 km length of fiber is 120 μW, the mean optical power at the fiber output is 3 μW. Determine the overall signal attenuation?

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

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Lecture Plan-10

Semester:-II Class: - ECE Course Code:MEEC-504

Subject:-Optical Communication Unit:-II

S. No.	Topic :-Linear Scattering losses	Time Allotted:-
1.	**Introduction**: - There are two types of scattering linear and non linear scattering losses. Linear scattering mechanisms cause the transfer of some or all of the optical power contained within one propagating mode to be transferred linearly into different mode ,it results n attenuation of the transmitted light as the transfer may be to a leaky or radiation mode which does not continue to propagate within the fiber core ,but is radiated from the fiber	5 min
2	**Division of the Topic:-** 1. Rayleigh scattering 2. Mie scattering	35 min
3.	**Conclusion:** - Rayleigh Scattering coefficient is related to the transmission loss factor of the fiber. Mie scattering can cause significant losses. The in homogeneities can be reduced by, removing imperfection due to the glass manufacturing process, carefully controlled extrusion and coating of the fiber.	5 min
4	**Question / Answer:-** Q1:- How in homogeneities can be reduced? A1:- Removing imperfection due to the glass manufacturing process, Carefully controlled extrusion and coating of the fiber. Increasing the fiber guidance by increasing the relative refractive index Difference	5 min

Assignment to be given: - nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH

Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

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Lecture Plan-11

Semester:-II Class: - ECE Course Code:MEEC-504

Subject:-Optical Communication Unit:-II

S. No.	Topic :-Non Linear Scattering losses	Time Allotted:-
1.	**Introduction**: - It behaves as a linear channel wise increase in output optical power is directly proportional to the input optical power several non linear effects occur ,which in the case of scattering cause disproportionate attenuation , usually at high optical power levels.	5 min
2	**Division of the Topic:-** 1) Stimulated Brillouin scattering 2) Stimulated Raman Scattering	35 min
3.	**Conclusion:-** Brillouin Scattering is only significant above a threshold power density Stimulated Raman Scattering is similar to stimulated Brillouin Scattering except a high frequency optical phonon rather than acoustic phonon is generated in the scattering process.	5 min
4	**Question / Answer:-** Q1:- What are different types of Scattering losses A1:- Linear Scattering and non linear Scattering	5 min

Assignment to be given: - nil

Text books :

1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH

Reference Books:

1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

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Lecture Plan-12

Semester:-II Class: - ECE Course Code:MEEC-504

Subject:-Optical Communication Unit:-II

S. No.	Topic :-Fiber Bend losses	Time Allotted:-
1.	**Introduction**: - Fiber suffers radiation losses at bends or curve on their paths. This is due to the energy in the evanescent field at the bend exceeding the velocity of the light in the cladding and hence the guidance mechanism is inhibited , which causes light energy to be radiated from the fiber.	5 min
2	**Division of the Topic:-** Fiber bend loss Reduction of the loss	35 min
3.	**Conclusion:-** that the potential macro bending losses may be reduced by Designing fiber with large relative refractive index differences and operating at the shortest wave length possible.	5 min
4	**Question / Answer:-** Q1:-What are various methods to reduce the bending losses? A1:- Designing fiber with large relative refractive index differences operating at the shortest wave length possible	5 min

Assignment to be given: - nil

Text books :

1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH

Reference Books:

1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

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Lecture Plan-13

Semester:-II Class: - ECE Course Code:MEEC-504

Subject:-Optical Communication Unit:-II

S. No.	Topic :-Fiber splices	Time Allotted:-
1.	**Introduction**: -A permanent joint formed between two individual optical fiber in the field or factory is known as a fiber splice. Fiber splicing is frequently used to establish long haul optical fiber links Where smaller fiber lengths need to be joined.	5 min
2	**Division of the Topic:-** 1) Fusion Splices 2) Mechanical Splices 3) Multiple Splice	35 min
3.	**Conclusion:** - in case of the fusion splice the completed splice is packed so as to reduce tensile loading upon the fiber in the vicinity.	5 min
4	**Question / Answer:-** Q1:-What are different types of splices and coupler A1:- A permanent joint formed between two individual optical fiber in the field or factory is known as a fiber splice. Coupler is a device that distributes light from a main fiber into one or more branch fiber	5 min

Assignment to be given: - nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

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Lecture Plan-14

Semester:-II Class: - ECE Course Code:MEEC-504

Subject:-Optical Communication Unit:-II

S. No.	Topic :-Fiber Connectors/ Couplers	Time Allotted:-
1.	**Introduction**: -Coupler is a device that distributes light from a main fiber into one or more branch fiber. The connector design must allow for repeated connection and disconnection without problems of fiber alignment, which may clad to degradation in the performance of the transmission line at the joint.	5 min
2	**Division of the Topic:-** Connectors Couplers	35 min
3.	**Conclusion:-** connectors may be considered in three major areas The fiber termination , which protects and locates the fiber ends The fiber end alignment to provide optimum optical coupling	5 min
4	**Question / Answer:-** Q1:-What are different types of fiber connectors A1:- Cylindrical furrule connectors ,bi conical ferrule connectors duplex and multi duplex fiber connectors Q2:- What are various types of couplers? A2:-Three and four port couplers Star coupler	5 min

Assignment to be given: - nil

Text books :

1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH

Reference Books:

1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-15

Semester:-II Class: - ECE Course Code:MEEC-504

Subject:-Optical Communication Unit:-III

S. No.	Topic :- Introduction to pn junction, Recombination Process	Time Allotted:-
1.	**Introduction:** Doped n or p type semiconductor material by itself serves only as a conductor. To make devices out of these semiconductors, it is necessary to use both types of materials. The junction between the two material regions, which is known as the pn junction is responsible for the useful electrical characteristics of a semiconductor device.	10 min
2	**Division of the Topic** 1. Energy bands 2. Intrinsic and Extrinsic Materials 3. Recombination Process	30 min
3.	**Conclusion**: In a pure crystal at low temperatures, the conduction band is completely empty of electrons and the valence band is completely full. The two bands are separated by an energy gap, or band gap, in which no energy levels exits.	5 min
4	**Question / Answer** Q1 What is intrinsic carrier concentration? A1 The concentration of electrons and holes is known as the intrinsic carrier concentration. Q2 What is doping? A2 Deliberately adding impurities into the semiconductor material is known as doping.	5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-16

Semester:-II Class: - ECE

Course Code:MEEC-504

Subject:-Optical Communication Unit:-III

S. No.	Topic :-Direct and Indirect Band Gaps Semiconductors	Time Allotted:-
1.	**Introduction**: In order for electron transitions to take place to or from the conduction band with the absorption or emission of a photon, both energy and momentum must be conserved. Although a photon can have considerable energy, its momentum hv/c is very small.	10 min
2	**Division of the Topic** 1. Direct and Indirect Band gap semiconductors. 2. The spectrum of Recombination Radiation.	30 min
3.	**Conclusion**: The simplest and most probable recombination process is that where the electron and hole have the same momentum value. This is Direct band gap material Where as for indirect band gap materials, the conduction band minimum and the valence band maximum energy levels occur at different values of momentum.	5 min
4	**Question / Answer** Q1 What do you mean by lattice? A1 The periodic arrangement of atoms is called lattice. Q2 What is lattice spacing? A2:The spacing between the atoms or groups of atoms is called the lattice spacing	5 min

Assignment to be given:-Nil

Text books :

1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH

Reference Books:

1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
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Lecture Plan-17

Semester:-II Class: - ECE Course Code:MEEC-504

Subject:-Optical Communication Unit:-III

S. No.	Topic :-Internal Quantum Efficiency	Time Allotted:-
1.	**Introduction:** When there is a constant current flow into an LED, an equilibrium condition is established. That means the excess density of electrons n and holes p is equal since the injected carriers are created and recombined in pairs such that charge neutrality is maintained within the device.	10 min
2	**Division of the Topic** Derivation of the Internal Quantum Efficiency	30 min
3.	**Conclusion**: Hence the internal quantum efficiency in the active region is the ratio of the radiative recombination rate to the total recombination rate.	5 min
4	**Question / Answer** Q1 What is the expression of internal quantum efficiency? A1: $\eta_{\text{int}} = \frac{R_r}{R_r + R_{nr}}$ Q2 What is bulk recombination lifetime τ is? A2: $\frac{1}{\tau} = \frac{1}{\tau_r} + \frac{1}{\tau_{nr}}$	5 min

Assignment to be given:-Nil

Text books :

1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH

Reference Books:

1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

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Revision :00

Lecture Plan-18

Semester:-II Class: - ECE Course Code:MEEC-504

Subject:-Optical Communication Unit:-III

S. No.	Topic :- External Quantum efficiency	Time Allotted:-
1.	**Introduction**: Not all internally generated photons exit the device. To find the emitted Power, external quantum efficiency needs to be considered.	10 min
2	**Division of the Topic** Derivation of the External Quantum Efficiency	30 min
3.	**Conclusion:** External Quantum Efficiency is defined as the ratio of the photons emitted from the LED to the number of internally generated photons.	5 min
4	**Question / Answer** Q1 What is the expression of external quantum efficiency? A1: $\pi_{ext} = \frac{1}{n(n+1)^2}$ Q2 What is the optical power emitted from the LED? A2: $P = \pi_{ext} P_{\text{int}} = \frac{P_{\text{int}}}{n(n+1)^2}$	5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, "Optical Communication Systems", PHI.
2. Gerd Keiser, "Optical Fiber Communication", TMH

Reference Books:
1. Franz JH & Jain VK, "Optical Communication", Narosa Publns
2. John M. Senior, "Optical Communication", PHI

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Lecture Plan-19

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-III

S. No.	Topic :- Light Emitting diodes- Surface Emitter Diodes	Time Allotted:-
1.	**Introduction:** For optical communication systems requiring bit rates less than approximately 100-200 Mb/s together with multimode fiber-coupled optical power in the tens of microwatts, semiconductor light emitting diodes (LEDs) are usually the best light source choice. In the surface emitter, the plane of the active LED region is oriented perpendicularly to the axis of the fiber.	10 min
2	**Division of the Topic** 1. LED Structures 2. Surface Emitter LEDs	30 min
3.	**Conclusion**: LEDs require less complex drive circuitry than laser diodes since no thermal or optical stabilization circuits are needed and they can be fabricated less expensively with higher yields.	5 min
4	**Question / Answer** Q1 What do you mean by radiance? A1: Radiance is optical power radiated into a unit solid angle per unit area of the emitting surface. Q2 What is emission response time? A2: it is the time delay between the application of a current pulse and the onset of optical emission.	5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-20

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-III

S. No.	Topic :-Edge Emitter LEDs	Time Allotted:-
1.	Introduction: Edge emitter LED consists of an active region which is the source of the incoherent light, and two guiding layers. Both have a refractive index which is lower than that of the active region but higher than the index of the surrounding material.	10 min
2	**Division of the Topic** Edge Emitter LEDs	30 min
3.	**Conclusion**: This structure forms a waveguide channel that directs the optical radiation toward the fiber core. The emission pattern of the edge emitter is more directional than that of the surface emitter.	5 min
4	**Question / Answer** Q1 What is lambertian pattern? A1: The source is equally bright when viewed from any direction, but the power diminishes as cosθ Q2 What is half power width in the parallel direction? A2: $\theta ll = 120^0$	5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH

Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-21

Semester:-II Class: - ECE Course Code:MEEC-504

Subject:-Optical Communication Unit:-III

S. No.	Topic :- LED Characteristics	Time Allotted:-
1.	**Introduction:** LEDs are characterized on the basis of optical output power, output spectrum, modulation bandwidth and reliability.	10 min
2	**Division of the Topic** 1. Optical Output Power 2. Output Spectrum 3. Modulation Bandwidth 4. Reliability	30 min
3.	**Conclusion**: Optical output power characteristics are linear corresponding to the linear part of the injection laser optical power output characteristic before lasing occurs. The spectral line width of an LED at room temperature is 0.8 to 0.9 micrometer wavelength.	5 min
4	**Question / Answer** Q1 What is modulation bandwidth? A1: The modulation bandwidth in optical communications is defined in either electrical or optical terms. Q2 What is the reliability of LEDs? A2: LEDs are affected by the catastrophic degradation mechanisms, less probability of dislocations in devices.	5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan- 22

Semester:-II Class: - ECE Course Code:MEEC-504Subject:-Optical Communication Unit:-III

S. No.	Topic :- Lens Coupling to Fiber	Time Allotted:-
1.	**Introduction:** LEDs are require to be coupled to fibers. To achieve high efficiency various coupling techniques need to be studied.	10 min
2	**Division of the Topic** (a) Ga As/ AlGa As coupling (b) Truncated Spherical Microlens Coupling	30 min
3.	**Conclusion**: Overall power efficiency is defined as the ratio of optical power coupled in to the fiber Pc to the electrical power supplied at the terminals of the device P. It is given by Npc =Pc / P It is difficult to achieve efficiency beyond 0.4%	5 min
4	Question / Answer Que How the coupling efficiency can be increased.? Ans It can be achieved by using lenses to collimate the emitted light. Que What kind of fiber is used in Ga AS/ Al Ga AS coupling? Ans A spherical ended fiber.	5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

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Revision :00

Lecture Plan- 23

Semester:-II Class: - ECE Course Code:MEEC-504Subject:-Optical Communication Unit:-III

S. No.	Topic :- LED Behaviour at Higher Frequencies	Time Allotted:-
1.	**Introduction**: Behaviour of luminescent diodes need to be analysed when it is modulated at high frequencies. In practice the behaviour of diode is likely to affected by proximity of emitting surface. We wish to relate optical output power to the input electrical input power as a function of frequency. as a function of frequency.	10 min
2	**Division of the Topic** (a) Derivation of equation (b) Study of output power as a function of modulating frequency. (c) Effect of increasing bandwidth.	30 min
3.	**Conclusion**: It can be concluded from the graph that at very high modulating frequencies output power reduces.	5 min
4	**Question / Answer** **Q! At what frequencies the power starts reducing** **A1 At frequencies above 1 / 2 the out put of the source starts falling down.**	5 min

Assignment to be given:-Nil

Text books :

1. John Gowar, "Optical Communication Systems", PHI.
2. Gerd Keiser, "Optical Fiber Communication", TMH

Reference Books:

1. Franz JH & Jain VK, "Optical Communication", Narosa Publns
2. John M. Senior, "Optical Communication", PHI

Lecture Plan-24

Semester:-II Class: - ECE Course Code:MEEC-504

Subject:-Optical Communication Unit:-III

S. No.	Topic :-Laser Action	Time Allotted:-
1.	**Introduction:** lasers come in many forms with dimensions ranging from the size of a grain of salt to one that will occupy an entire room. The lasing medium can be a gas, a liquid, an insulating crystal or a semiconductor.	10 min
2	**Division of the Topic** Laser Action- 1. Photon absorption 2. Spontaneous Emission 3. Stimulated Emission	30 min
3.	**Conclusion**: In a semiconductor laser, population inversion is accomplished by injecting electrons into the material at the device contacts to fill the lower energy states of the conduction band.	5 min
4	**Question / Answer** Q1 What do you mean by population inversion? A1: If the population of the excited states is greater than that of the ground state is known as population inversion.	5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH

Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-25

Semester:-II Class: - ECE Course Code:MEEC-504

Subject:-Optical Communication Unit:-III

S. No.	Topic :- Laser Diode Modes	Time Allotted:-
1.	**Introduction**: For optical fiber communication systems requiring bandwidths greater than approximately 200MHz, the semiconductor injection laser diode is preferred over the LED. All laser diodes in use are multilayered heterojunction devices. The construction of laser diodes is more complicated because of the additional requirement of current confinement in a small lasing cavity. The optical radiation within the resonance cavity of a laser diode sets up a pattern of electrical and magnetic field lines called the modes of the cavity.	10 min
2	**Division of the Topic** Transverse electric Modes: 1. Longitudinal Modes 2. Lateral Modes Transverse Magnetic Modes 1. Longitudinal Modes 2. Lateral Modes	30 min
3.	**Conclusion**: Transverse modes are associated with the electromagnetic field and beam profile in the direction perpendicular to the plane of the pn junction. These modes are of great importance, since they largely determine such laser characteristics as the radiation pattern and the threshold current density.	5 min
4	**Question / Answer** Q1 What do you mean by lasing? A1: Lasing is a condition at which light amplification becomes possible in the laser diode. Q2 What is the requirement of lasing? A2: The requirement of lasing is that a population inversion be achieved.	5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-26

Semester:-II Class: - ECE Course Code:MEEC-504

Subject:-Optical Communication Unit:-III

S. No.	Topic :- Types Of Laser- Injection laser	Time Allotted:-
1.	**Introduction**: -The injection laser has major advantage over semiconductor laser that is it has high radiance due to amplifying effect of stimulated emission. They supply milli watts of optical fiber modulation capability extends up to GHz level	10 min
2	**Division of the Topic:-** 1. Advantages over LED 2. Efficiency 3. Stripe geometry 4. Laser mode 5. Characteristics	30 min
3.	**Conclusion:** - ILD has high radiance due to the amplifying effect of stimulation emission, they have good spatial which allows the output to be focused by a lenses into a sport which has a greater intensity than dispersed unfocussed emission.	5 min
4	**Question / Answer:-** Q1: What is the advantage of ILD? A1: They have high radiance and narrow line width.	5 min

Assignment to be given: - NIL

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH

Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-27

Semester:-II Class: - ECE Course Code:MEEC-504Subject:-
Optical Communication Unit:-III

S. No.	Topic :- Lasing Threshold Conditions	Time Allotted:-
1.	**Introduction**: Steady state conditions for laser oscillation are achieved when the gain in the amplifying medium exactly balances the total losses. Hence although population inversion between the energy levels providing the laser transition is necessary for oscillation to be established, it is not alone sufficient for lasing to occur.	10 min
2	**Division of the Topic** Threshold condition for laser oscillation	30 min
3.	**Conclusion**: A minimum or threshold gain within the amplifying medium must be attained such that laser oscillations are initiated and sustained. This threshold gain may be determined by considering the change in energy of a light beam as it passes through the amplifying medium.	5 min
4	**Question / Answer** Q1 What should be the threshold gain for laser action to take place? A1: Threshold gain per unit length should be high in order to balance the losses from the cavity.	5 min

Assignment to be given:- Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-28

Semester:-II Class: - ECE Course Code:MEEC-504Subject:-Optical Communication Unit:-III

S. No.	Topic :- Laser Structure and Characteristics.	Time Allotted:-
1.	**Introduction**: There are different types of lasers like injection laser, gain guided laser, index guided laser & cavity laser.	5 min
2	**Division of the Topic:-** i) Gain guided laser ii) Index guided laser iii) Cavity laser iv) Buried hetero structure laser v) Laser Characteristics vi)	35 min
3.	**Conclusion:-** By adjusting cavity length, the modes can be discriminated. Buried hetero structure laser offers both multi mode and single mode operation. Threshold current tends to increase with temp.	5 min
4	**Question / Answer:-** Q.1 What are the drawbacks of gain guided laser? A1. a) Lower coupling efficiency. b) There are kinks in the O/P curve.	5 min

Assignment to be given:- Describe the Buried hetero structure laser.

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Doc. No.: DCE/0/15
Revision :00

Lecture Plan-29

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-III

S. No.	Topic :- Laser to Fiber Coupling and comparison with LED Source.	Time Allotted:-
1.	**Introduction**: - Light needs to be efficiently coupled to optical fiber . Having studied LED as well as LASER , we will try to compare the advantages and disadvantages of both these sources.	5 min
2	**Division of the Topic:-** a. Techniques of coupling b. Reliability & mean life of LED & Laser c. Efficiency d. Temp. dependence.	35 min
3.	**Conclusion:-** Some advantages of LED over laser combined with high radiance development and possible use of high bandwidth devices have ensured that LED remains an extensively used source for optical fiber comm..	5 min
4	**Question / Answer:-** i)What is Internal Quantum efficiency of LED and LASER ? A1. LED 50 %, LASER 60 to 80% Q2. Which source can operate in multimode? A2. LED	5 min

Assignment to be given:- NIL

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-30

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-IV

S. No.	Topic :- Principal and Types of Optical Detectors	Time Allotted:-
1.	**Introduction** : Optical Detectors convert the received optical signal into electrical signal. It should have high sensitivity at the operating wave length.	10 min
2	**Division of the Topic:-** **1.** The performance and compatibility requirement. 2. Optical detection principles 3. Absorption 4. Direct and indirect absorption	30 min
3.	**Conclusion:-**. They should have high sensitivity at operating wavelength, high fidelity, large electrical response, high reliability.	5 min
4	**Question / Answer:-** Q1: Define the term absorption? A1: The absorption of photons in a photodiode to produce carrier pair and thus a photo current, is dependent on the absorption coefficients αo of the light in semiconductor used to fabricate the device. Q2: Define the term quantum efficiency? A2: Quantum Efficiency is defined as the fraction of incident photons which are absorbed by the photo detector and generate electron which are collected at the detector terminals.	5 min

Assignment to be given:- Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-31

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-IV

S. No.	Topic :- Characteristics Of Photo Detector and Responsivity.	Time Allotted:-
1.	**Introduction**: - p-n diode has both depletion and diffusion region. The depletion is formed by immobile positively charged donor atoms in n-type of semiconductor and immobile charged acceptor atoms in p-type of material.	10 min
2	**Division of the Topic:-** 1. Responsivity 2. Semiconductor photo diode without internal gain 3. p-n photodiode 4. Output characteristics	30 min
3.	**Conclusion:**-. The photons are absorbed in depletion region that is why the depletion is made as long as possible by decreasing the doping in the n-type material. Depletion width in a p-n photo diode is normally 1 to 3 micro meters.	5 min
4	**Question / Answer:-** Q1: Define the term responsivity? A1: It is defined as the ratio of the input photo current in amperes to the incident optical power in watt. Q2: What is the relation between the quantum efficiency and responsivity? A2: The responsivity is directly proportional to the quantum efficiency at a particular wave length.	5 min

Assignment to be given:-
When 3*10^11 photon each with a wave length of .85 μm are incident on a photo diode, on average 1.2*10^11 electrons are collected at the terminal of the device. Determine the quantum efficiency and the responsivity of the photodiode at .85μm

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-32

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-IV

S. No.	Topic :- Intrinsic Absorption, Quantum Efficiency	Time Allotted:-
1.	**Introduction**: The absorption of photons in a photodiode to produce carrier pairs and thus a photocurrent, is dependent on the absorption coefficient α_o of the light in the semiconductor used to fabricate the device.	10 min
2	**Division of the Topic** 1. Intrinsic Absorption, 2. Derivation of Quantum efficiency	30 min
3.	**Conclusion**: Hence the quantum efficiency η is defined as the fraction incident photons which are absorbed by the photo detector and generate electrons which are collected at the detector terminals.	5 min
4	**Question / Answer** Q1 On which factor the absorption coefficients of semiconductor materials depend? A1 Wavelength. Q2 What is the expression of quantum efficiency? A2 η = number of electrons collected / number of incident photons.	5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-33

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-IV

S. No.	Topic :- Materials for PIN Photo detectors	Time Allotted:-
1.	**Introduction**: This device incorporates a p+ - InGaAsP layer to provide a heterojunction structure which improves quantum efficiency.	10 min
2	**Division of the Topic** Materials for PIN Photo detectors,	30 min
3.	**Conclusion**: It is fabricated as a mesa structure which reduces parasitic capacitances. Unfortunately, charge trapping can occur at the n- p+ - InGaAsP interface. This may cause limitations in the response time of the device.	5 min
4	**Question / Answer** Q1 What is the use of a depleted InGaAs layer? A1 It provides high quantum efficiency and bandwidth. Q2 Why low doping is preferred? A2 It permits full depletion of the In GaAs layer at low voltage of 5V.	5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-34

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-IV

S. No.	Topic :- Impulse and frequency response of a PIN Photodiode.	Time Allotted:-
1.	**Introduction**: In order to allow operation at longer wavelengths where the light penetrates more deeply into the semiconductor material a wider depletion region is necessary. To achieve this n type material is doped so lightly that it can be considered intrinsic and to make a low resistance contact a highly doped n type layer is added. This creates a p-i-n structure.	10 min
2	**Division of the Topic** 1. Principle of working 2. Speed of response 3. Impulse and frequency response of a PIN Photodiode,	30 min
3.	**Conclusion**: It has the simplest structure, with the light being introduced through the upper p+ layer. However, a drawback with this structure is a quantum efficiency penalty which results from optical absorption in the undepleted p+ layer.	5 min
4	Question / Answer Q1 What is drift time of carriers through the depletion region? A1: It is the time taken by the carriers to drift across the depletion region.	5 min

Assignment to be given:-Nil

Text books :

1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH

Reference Books:

1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-35

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-IV

S. No.	Topic :- Noise in PN Photo Diodes	Time Allotted:-
1.	**Introduction**: - The overall sensitivity of a photodiode results from the random current and voltage fluctuations which occur at the device output terminals.	5 min
2	**Division of the Topic:-** **i)** Dark current ii) Shot noise iii) Noise effective power (NEP) & Detectivity.	35 min
3.	**Conclusion:**- The detector average current always exhibits a random fluctuation about its mean value . Detectivity is defined as inverse of NEP	5 min
4	**Question / Answer:-** Q1 What is NEP ? It is the incident optical power at a particular wave length to produce a photo detector current equal to rms noise current.	5 min

Assignment to be given:- NIL

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-36

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-IV

S. No.	Topic :- APD Multiplication Process	Time Allotted:-
1.	**Introduction**: The process of impact ionization produces additional carriers leading to carrier multiplication factors as great as 10^4 .	5 min
2	**Division of the Topic:-** i) Avalanche Photodiode & Avalanche breakdown. ii) Impact Ionization iii) RC Time constant effect.	35 min
3.	**Conclusion:-** Uniformity of carrier multiplication can be ensured by using defect free materials . APD operation gives a constant gain – band width product.	5 min
4	**Question / Answer:-** Q1. What is the value of reverse bias required for impact ionization ? A1. 50 to 400 V .approx . Q.2. What is the value of electric field generated? A2. $3x10^5$ V/cm.	5 min

Assignment to be given:- NIL

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-37

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-IV

S. No.	Topic :-Avalanche Photo detectors (Design and Bandwidth)	Time Allotted:-
1.	**Introduction**: Avalanche Photodiode is second major type of optical communications detector. This has a more sophisticated structure than the p-i-n photodiode in order to create an extremely high electrical field region.	10 min
2	**Division of the Topic** 1. The multiplication process, 2. APD Design, 3. APD Bandwidth	30 min
3.	**Conclusion:** As well as the depletion region where most of the photons are absorbed and the primary carrier pairs generated, there is a high field region in which holes and electrons can acquire sufficient energy to excite new electron- hole pairs.	5 min
4	**Question / Answer** Q1 What is the advantage of avalanche photodiode? A1 Internal gain is very high, high sensitivity. Q2 What is the disadvantage of avalanche photodiode? A2 Fabrication difficulty due to complex structure, often high bias voltages are required.	5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-38

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-IV

S. No.	Topic :-APD Noise	Time Allotted:-
1.	**Introduction**: The noise equivalent power is defined as the incident optical power, at a wavelength or with a specified spectral content required to produce a photo detector current equal to the rms noise current within a unit bandwidth.	10 min
2	**Division of the Topic** APD Noise	30 min
3.	**Conclusion**: The overall sensitivity of a photodiode results from the random current and voltage fluctuations which occur at the device output terminals in both the presence and absence of an incident optical signal.	
4	**Question / Answer** Q1 What is dark current? A1 It is the level of the output photocurrent when there is no intended optical signal present. Q2 How it can be minimized? A2 Through the use of high quality, detect-free material which reduces the number of carriers generated in the depletion region.	5 min 5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH

Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-39

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-V

S. No.	Topic :- Optical transmitter circuit	Time Allotted:-
1.	**Introduction**: An optical transmitter circuit including a light receiving element, such as a photodiode, which monitors the optical output of a light emitting element such as a semiconductor laser. A current-voltage converting circuit supplies a drive current from a drive circuit to the light emitting element and converts the output voltage of the light receiving element into voltage. An APC amplifier compares the converted output signals and a reference signal, and a hold circuit holds the output signal of the APC amplifier and uses the output signal as a current control signal of the drive circuit. A "1" continuous signal detecting circuit detects the continuation of "1" in a specified number of bits in the input data (DATA) and updates the hold value in the hold circuit.	10 min
2	**Division of the Topic** LED drive circuits laser drive circuits	30 min
3.	**Conclusion**: LED drive circuits are easier to operate than LASER drive circuits. LASER circuits are although more powerful and higher speed. Both drive circuits can work on analog and digital transmission systems.	5 min
4	**Question / Answer** Discuss the major considerations of drive circuits.	5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, "Optical Communication Systems", PHI.
2. Gerd Keiser, "Optical Fiber Communication", TMH
Reference Books:
1. Franz JH & Jain VK, "Optical Communication", Narosa Publns
2. John M. Senior, "Optical Communication", PHI

Lecture Plan-40

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-V

S. No.	**Topic :-** optical receiver circuit;Structure, Pre amplifier, AGC, Equalization,	**Time Allotted:-**
1.	**Introduction** The function of optical receiver is to convert the received optical signal into an electrical current at the detector .it is amplified to obtain a suitable signal level. Initial amplification is performed in the preamplifier circuit where it is used to minimize the noise.	10 min
2	**Division of the Topic** Structure Pre amplifier AGC Equalization,	30 min
3.	**Conclusion** Bipolar and FET can be operated for preamplification and gain control. AGC is simply to bias the APD with a constant d.c current source. The linear channel provided by the optical fiber receiver required to perform equalization.	5 min
4	**Question / Answer** Describe the block diagram of receiver circuit.	5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH

Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-41

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-V

S. No.	Topic :- Analog Systems	Time Allotted:-
1.	**Introduction** The analog signal can be transmitted within an optical fiber communication system using one of several modulation techniques. The simplest form of analog modulation for optical fiber comm. Is directly intensity modulation of the optical source.	10 min
2	**Division of the Topic** analog modulation direct modulation sub carrier modulation	30 min
3.	**Conclusion** Direct modulation of the optical source intensity with the baseband signal, no electrical signal is modulated or demodulated is required. Intensity modulation is used for baseband signal. The subcarrier is frequency modulated by the message signal.	5 min
4	**Question / Answer** Explain D-IM and an FM-IM of optical fiber communication system.	5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH

Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-42

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-V

S. No.	Topic :- Optical sub-carrier multiplexing	Time Allotted:-
1.	**Introduction** WDM involves the transmission of a number of different peak wavelength optical signals in parallel on a single optical fiber.TDM involves the transmission of different wavelength on a single at different time.	10 min
2	**Division of the Topic** TDM WDM	30 min
3.	**Conclusion** **These** techniques are very useful to transmit the large data over different wavelength at different time.	
4	**Question / Answer**	5 min 5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-43

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-V

S. No.	Topic :- Coherent receiver	Time Allotted:-
1.	**Introduction** Both are common in radio-frequency technology as methods of detection of phase- and frequency-modulated signals. The basic idea is to mix a faint signal wave with a strong local oscillator wave, e.g., by means of a beamsplitter, and then send it to a detector with a quadratic non-linearity that shifts the spectrum of the signal to lower frequencies together with amplification by an amplitude of the local oscillator.	10 min
2	**Division of the Topic** Homodyne Detection heterodyne detection	30 min
3.	**Conclusion** Homodyne detection uses local oscillator light with the same carrier frequency as the signal. The idea behind the heterodyne readout principle is the generalization of the homodyne readout, i.e., again, the use of strong local oscillator light to be mixed up with the faint signal light leaking out the dark port of the GW interferometer	5 min
4	**Question / Answer** **Ex**plain the basic concepts of detection.	5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH

Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-44

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-VI

S. No.	Topic :- noise in coherent receiver	Time Allotted:-
1.	**Introduction** Coherent optical fiber communications have been studied intensively because of their high receiver sensitivity and high-frequency selectivity. With the advent of an erbium-doped fiber amplifier (EDFA), however, the first advantage seems to have become less attractive. Nevertheless, the combination of the EDFA and coherent techniques offers a number of attractive features.	10 min
2	**Division of the Topic** Polarization control	30 min
3.	**Conclusion** the excess beat noises (common-mode and image-band beat noises) from optical amplifiers can be suppressed by using coherent receivers such as a balanced receiver and a double-stage phase-diversity (DSPD) receiver. The noise figure (NF) of the excess-noise-suppressed coherent receivers with an optical preamplifier is shown to be 0 dB. Bit-error-rate (BER)	5 min
4	**Question / Answer** Calculation of BER.	5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-45

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-VI

S. No.	Topic :- , phase diversity receivers.	Time Allotted:-
1.	**Introduction** The use of phase diversity homodyne receivers, which have excellent performance even when the laser linewidth is of the same order of magnitude as the bit rate, to construct coherent systems with semiconductor lasers and moderate bandwidth receivers is considered.	10 min
2	**Division of the Topic** phase diversity homodyne receiver	30 min
3.	**Conclusion** Theoretical, experimental, and computer simulation results of a study of a linewidth homodyne phase-diversity receiver is presented. A 150-Mb/s system with an IF linewidth of more than 50% of the bit rate is investigated in depth and is experimentally shown to operate within 1.8 dB from its theoretical limit	5 min
4	**Question / Answer**	5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH

Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-46

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-VI

S. No.	Topic:- synchronous, Asynchronous and self synchronous demodulation	Time Allotted:-
1.	**Introduction** synchronous quadrature phase-shift keying data is recovered in real-time after transmission with standard distributed feedback lasers using a digital inphase and quadrature receiver. Forward-error-correction-compatible performance is reached at 800 Mb/s after 63 km of fiber. Self-homodyne operation with an external cavity laser is error-free.	10 min
2	**Division of the Topic** Demodulation techniques	30 min
3.	**Conclusion** The different techniques is used according to the requirement.	
4	**Question / Answer**	5 min 5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH
Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-47

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-VI

S. No.	Topic :- Reusability and laser line-width	Time Allotted:-
1.	**Introduction** The Radio over Fiber systems have of late emerged as the most promising solution for distribution of the radio signals between the base station (BS) and the mobile switching center(MSC) owing to its low cost, reduced complexity at the BS, centralized signal processing a nd high mobility combined with the high fiber bandwidth low loss over the fiber.	10 min
2	**Division of the Topic** BER	30 min
3.	**Conclusion** However since the fiber channel is prone to the dispersive effects, any signal launched along the fiber will, due to the dispersive nature of the fiber, have phase noise added to it. This phase noise will affect the performance of the channel and will degrade the Carrier to Noise Ratio (CNR) and hence the Bit error Rate (BER) of the signal launched in the fiber. The phase noises arise due to the finite spectral widths of the laser diode and the RF oscillator	5 min
4	**Question / Answer**	5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH

Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI

Lecture Plan-48

Semester:-II Class: - ECE Course Code:MEEC-504
Subject:-Optical Communication Unit:-VI

S. No.	Topic :- , phase diversity receivers.	Time Allotted:-
1.	**Introduction** The use of phase diversity homodyne receivers, which have excellent performance even when the laser linewidth is of the same order of magnitude as the bit rate, to construct coherent systems with semiconductor lasers and moderate bandwidth receivers is considered.	10 min
2	**Division of the Topic** phase diversity homodyne receiver	30 min
3.	**Conclusion** Theoretical, experimental, and computer simulation results of a study of a linewidth homodyne phase-diversity receiver is presented. A 150-Mb/s system with an IF linewidth of more than 50% of the bit rate is investigated in depth and is experimentally shown to operate within 1.8 dB from its theoretical limit	5 min
4	**Question / Answer**	5 min

Assignment to be given:-Nil

Text books :
1. John Gowar, “Optical Communication Systems”, PHI.
2. Gerd Keiser, “Optical Fiber Communication”, TMH

Reference Books:
1. Franz JH & Jain VK, “Optical Communication”, Narosa Publns
2. John M. Senior, “Optical Communication”, PHI