**ST. ANNE’S**

**COLLEGE OF ENGINEERING AND TECHNOLOGY**

(Approved by AICTE, New Delhi. Affiliated to Anna University, Chennai)

(An ISO 9001: 2015 Certified Institution)

ANGUCHETTYPALAYAM, PANRUTI – 607 106.

**QUESTION BANK**

**PERIOD :** JULY - NOV 2018 **BATCH**: 2015 – 2019

**BRANCH :** ECE **YEAR/SEM:** IV/VII

**SUB CODE/NAME:** EC6016- OPTO ELECTRONIC DEVICES

**UNIT I ELEMENTS OF LIGHT AND SOLID STATE PHYSICS**

**PART – A**

1. Define uncertainty principle of Quantum mechanics**.[D]**
2. Define polarized and un polarized waves **[ID][nov/dec 2015]**
3. What is meant by doping and how will you get n type Semiconductors **[D]?**
4. Define thermal sources **[ID][nov/dec 2016]**
5. Define refractive index [**D**]
6. What are the two kinds of polarization? **[nov/dec 2015]**
7. Write the expression for calculating excitation energy ED**.[ID][may/june 2013]**
8. What do you understand wave particle Duality of Light **[D][may/june 2013]**
9. Give the expression for wave nature of light **[D].**
10. Define Brewster angle**.[D**]
11. What do you meant by interference? [**D][ Nov/dec 2016]**
12. What is meant by Diffraction? **[D] [nov/dec 2016]**
13. What are light sources and name the different types of Light sources **[D][nov/dec 2016].**
14. What is black body sources **[D][nov/dec 2016]**
15. What is line sources **[ID][nov/dec 2016]**
16. What do you understand by the quantum mechanical concepts [**D]**
17. What do you meant by semiconductor and write the different types of semiconductor? **[D]**
18. What is intrinsic semiconductor? **[D]**
19. What is extrinsic semiconductor? **[D]**
20. Differentiate Intrinsic and Extrinsic Semiconductor**.[D]**
21. What are classical sources? **[ID][nov/dec 2016]**
22. Differentiate Diffraction and Scattering **[D] [may/june 2013]**
23. Define mass action law [**D**].
24. State bragg’s law **[nov/dec 2017]**
25. Define interference and diffraction **[nov/dec 2016]**
26. Give the expression for electrical conductivity of a semiconductor **[apr/may 2017]**
27. Define snell’s law **[D**]
28. Write the fermi distribution function for the occupation of electrons and holes at finite temperature**.[D][nov/dec 2015]**
29. What is meant by polarization? [**D][nov/dec 2015]**
30. Differentiate franhofer and frenel diffraction**.[D]**
31. Write the equation for” heisenberg’s uncertainity priniciple” [**ID]**
32. Define excitons**.[D]**
33. .The average electric field in a particular 2.0 μm GaAs device is 5KV/CM. calculate the average velocity of electron if its mobility value is 8000 CM2/V-S**,[D]** **[may/june 2013]**

**PART – B**

**[first half]**

**[Wave nature of light]**

1. Derive an expression of wave nature of light starting with the Maxwell’s equation.(16**)[D][nov/dec -2016]**
2. Explain wave nature of light and the principle of superposition(8**)[D][nov/dec 2013][nov/dec -2016]**

**[Polarization]**

1. Explain polarization and its types.(16)**[D].**

**[Interference]**

1. With a neat diagram explain the interference effects in a thin film of refractive index “n**” (6)[D]**

**[Diffraction]**

1. Explain in detail about diffraction.(12)**[D]**

**[Light source]**

1. Explain in detail about thermal sources**(10)[ID]**

**[Review of quantum mechanical concepts]**

1. Derive and explain in detail the Schrödinger’s wave equation (8**) [D][apr/may -2017]**

**[Review of solid state physics]**

1. Explain the formation of energy bands in various materials.[8]**[D][nov/dec -2016]**
2. Derive an expression for electrical conductivity in solids.(8)**[D][nov/dec -2016]**
3. From the Schrödinger’s equation, explain the formation of energy bands in solids.(16**)[D][may/june -2013]**
4. Explain the energy bands in the formation of solids.(8)**[D][may/june -2013]**

**[second half]**

**[Review of semiconductor physics semiconductor junction device]**

1. Derive the expression for Concentration of Electrons and Holes in an intrinsic Semiconductor, with relevant Diagram **(16 ) [D]**
2. Show that the Fermi Dirac function is symmetrical about E=EF at any temperature.(8)**[D][apr/may** -**2017]**
3. Derive an expression for the product (np) for a degenerate n type semiconductor.(8)**[D][apr/may -2017]**
4. Explain in detail about intrinsic semiconductor, with relevant diagrams.(16)**[D][may/june -2013]**
5. Discuss about Drift and Diffusion of carriers with relevant mathematical expression(4 ) **[D][may/june 2013]**
6. Explain about the excess carriers in semiconductors.(4)[**D][may/june -2013]**
7. Discuss about drift and diffusion of carriers with relavant mathematical expressions.(4)**[D][may/june-** **2013]**
8. Explain in detail about intrinsic and extrinsic semiconductors with neat diagram.(16)**[D][may/june -2013]**
9. Define a)saturation current density b)avalanche break down c)miller indices of crystal (6**)[D]**

UNIT II DISPLAY DEVICES AND LASERS

**PART – A**

1. What is Photoluminescence **[nov/dec 2016][D]**
2. What are the different Luminescence Process**[D]**
3. How Population Inversion is is achieved in Lasers? **[D]**
4. How is mode locking is achieved in Laser medium. [**nov/dec2016**] **[D]**
5. Differentiate between characteristic and non characteristic energy level system in phosphors**[D]**
6. What is meant by Injection Luminescence? **[D]**

# What is meant by stokes shift?[may/june 2013][nov/dec2013] [D]

# Why cathode luminescence is less efficiency than photoluminescence?[may/june 2013] [D]

1. A typical He-Ne laser operates with a current of 10m A at a dc voltage of 2500V and gives a output of 5m W. Determine the overall power efficiency? [MAY/JUNE 2013] **[D]**
2. What do you understand by threshold condition in laser**[D]**

# What is meant by threshold condition for laser oscillations? [D]

# What are the type of lasers[D]

# What is a cryotron? [ may-13] [D]

# What are liquid crystals?[may-12] [D]

# What are the advantages of liquid crystal display?[may-13] [D]

# Define electroluminescence. [nov/dec 2015] [D]

# Name the different types of LCDS. [nov/dec 2015] [D]

# What is meant by modulation bandwidth of LED?[apr/may 2017] [D]

# What is frank-keldysh effect? [apr/may 2017] [D]

# Mention some important LED materials.[nov/dec 2016] [D]

# What do you meant by mode locking. [nov/dec 2016] [D]

# Find the Q-factor of a laser cavity oscillating at 650nm and having a line width of 1MHz.[may/june 2013] [D]

# List down any four advantages of LED over lasers. [nov/dec 2017] [D]

# State Heisenberg’s uncertainty principle [D]

# What are major causes of losses in laser[D]

# Discuss about the threshold conditions in laser. [D]

# What are the two common electroluminescent devices? [D]

# Differentiate between characteristic and non characteristic energy level system in phosphors[D]

# How is Population Inversion is achieved in Lasers [D]

# What is meant by optical pumping in lasers? [D]

**PART – B**

**[first half]**

**[Electro luminescence]**

# Explain the following terms (i).Photo luminescence (ii).Cathode luminescence (iii).Electro luminescence (iv).Injection luminescence.(16) [D][NOV/DEC 2016]

# Explain the mechanism of electro luminescence with neat diagram and also explain about operation of ac electroluminescence device.(16)[D][NOV/DEC 2013][NOV/DEC2016]

# [LED]

# Explain the operation of LED and also derive an expression for the frequency response and modulation bandwidth of an LED.(16) [D][APR/MAY 2017]

1. Discuss the different types of hetero-S structure LEDs along with diagrams**?(10)[D][DEC13]**
2. What are the major advantages of LED over LCD**?[8][D] [MAY-12]**

# [Liquid crystal displays]

# Explain the construction and operation of LCD (16)[D][MAY/JUNE 2013]

# Explain the construction and working of various Display devices.(16)[D]

1. Explain plasma devices**.(10)[D]**

**[second half]**

# [Laser emission, absorption, radiation, population inversion]

1. Explain the theory of LASER Emission and population inversion.(**12)[D][nov/dec 2016]**
2. Applications of LASER **.(4)[D][nov/dec 2016]**
3. Describe the operation of semiconductor laser in detail**.(10)[D][nov/dec 2015]**
4. Draw the common – cathode LED seven segment display and explain its working.**(6)[D] [nov/dec 2015]**
5. Explain injection luminescence and photo luminescence in detail**.(8)[D] [nov/dec 2015]**
6. Explain cathode luminescence and population inversion**.(8)[D][nov/dec 2015]**
7. Explain the classes of LASER’S with examples**.(6)[D][apr/may 2017]**
8. Derive an expression for gain in a semiconducting medium**.(10)[D][apr/may 2017]**
9. Discuss the theory of population inversion and threshold condition in two layer laser system and also explain the various transition involved in a four level system**.(16)[D][may/june 2013] [nov dec 2016] [apr/may 2017]**
10. Discuss about the various Classification of laser.(**16)[D]**

# Mode Locking:

1. Describe the concept of producing high power short duration pulses from laser. What are the various methods to accomplish this? Explain them. (**Explain Mode locking of laser)(16)[ID**] **[nov/dec 2013]**
2. Explain active and passive mode locking**.(4)[D][may/june 2013]**

**UNIT III OPTICAL DETECTION DEVICES**

**PART – A**

1. Explain thermal detectors**.[D]**

# What is the internal quantum efficiency of photo detector?[D]

# Explain photoconductors. [D]

# What do you mean by Kerr effect?[nov/dec 2015] [D]

# Draw the V-I characteristics of a photo diode?[nov/dec 2015] [D]

# What are the different types of photo detectors? [D]

# What are the factors that limit the response time of photodiodes? [nov/dec2016] [D]

# Define noise equivalent power. [D]

# Discuss briefly about pin photodiode. [D]

# What are the various modes involved in charge separation of photo diodes. [D][nov/dec 2016]

# Calculate the thermal noise current of a photo receiver circuit with a bandwidth of 1 GHz connected to a load resistance of 1k ohms. [D] [apr/may 2017]

# Define Pockels effect. [D]

# What is the working principle of thermal detectors? [D] [ nov/dec 2016]

# What is bolometer? [D] [nov/dec 2016]

# Define the external quantum efficiency of a photo detector. [D] [apr/may 2017]

# Define the gain-bandwidth product of the photoconductive detector. [D] [nov/dec 2017]

# What are the advantages of photoconductive detectors? [D] [may/june 2013]

# Calculate the maximum frequency of operation of the thermal detector with thermal time constant of 1ms? [D][may/june 2013]

# What are the limitations of germanium based photo diodes? [D] [may/june 2013]

1. Define conversion efficiency of a solar cell**. [D][nov/dec 2017]**

# What are the different noises present in the avalanche photodiode? [D] [ may12]

# What are the required properties of photo detector? [D]

# Define signal to noise ratio in photoconductors. [D]

# Draw the block diagram of thermal detectors. [D]

# Define responsivity. [D]

1. Calculate the quantum efficiency of an avalanche photodiode with a responsivity of 0.7 A/W which detects 1.5 um photo excitation. **[D]** [ **nov/dec 2017]**
2. What are the different factors that determine the response time of photo detector? [ **may 2012] [D]**
3. What are the condition for total internal reflection. **[D]**
4. What is photo detectors?[**D]**
5. What is avalanche photo diode**?[D]**

**PART – B**

**[first half]**

# [Photo detector-thermal detector]

# Explain the principle construction and operation of various thermal detectors.(16)[D][nov/dec 2016,2015]

# Explain the principle, construction and working of Pyro electric detector.(10)[D ][may/june 2013]

1. Explain the structure and operation of thermal Detector**. (8) [D]**

# [Photo devices]

# Brief about photo emissive devices.(6)[D][may/june 2013]

# Brief about the various noise sources in a photo multiplier tube.(8)[D][may/june 2013]

# [Photo conductors]

# Compare the principle, construction and working of a thermal detector and a photo conductive detector.(16)[D][may/june 2013]

# Explain in detail about photo conductors.(16)[D]

1. Derive expressions for the gain of a photoconductor with dc excitation at different levels of increasing applied bias**?(16)[D] [may-2010,2008,2007]**

# Derive an expression for the gain of a photoconductor with dc excitation if the device in case of both the contacts are ohmic.(16)[D][nov/dec 2017]

# [second half]

# [Photo diodes]

# With an equivalent circuit,explain the factors affecting the bandwidth of a PIN photo diode.(8)[D][may/june 2013]

# Discuss the characteristics of p-i-n photodiode with its energy band diagram under biased condition and arrive at the expression for its quantum efficiency.(16)[D][apr/may 2017]

1. Discuss the characteristic of P-I-N photodiode with energy band diagram**? (10)[D]**
2. Compare the noise performance of Photoconductor and PIN photodiode **.(8)[D]**
3. Discuss in detail about the construction and working of PIN photodiode **.(16)[D]**
4. Write a note on .avalanche photodiode**.(10)[D]**
5. Discuss the different types of noises in the photodiodes.(**16)[D] [nov/dec-12]**
6. Discuss in detail about the construction and working of PIN photodiode**.(16)[D]**
7. Consider a typical avalanche photodiode with the following parameters incident

# Optical power=50mw ,Efficiency =85%, optical Frequency=4.5\*1014 HZ, Breakdown voltage =30 v ,Dark current =12.5 n A, parameter n ’ for the multiplication =2.Assume that the series resistance is negligible. Calculate the photon current.(16)[D][nov/dec 2015]

**[Detector Performance**]

# Describe the various parameters used to access the performance of a detector.(16) )[D][nov/dec 2016,2015]

1. Explain the various detector performance parameters **(16)[D]**

[UNIT IV OPTOELECTRONIC MODULATOR](#_TOC_250001)

**PART – A**

1. Compare Analog Modulation Digital Modulation **[D**] **[nov/dec 2016]**
2. Define the term birefringence. **[D]**
3. Define electro-optic modulators and electro-optic effect[**D**]
4. What are magneto-optic devices**?** [**D] [apr/may 2017]**
5. What are acoustoptic devices? [**D**]
6. What do you mean by SEED? [**D]**
7. What are acoustoptic modulators? [**D**]
8. What are the limitations of acoustoptic modulators? [**D**]
9. Define acoustoptic filter. [**D]**
10. Name the different types of electro-optic modulators[**D]**
11. What are the drawbacks of analog modulation? [**D**]
12. Define electro-optic modulators. [**D]**
13. Define the term electro-optic effect**.[may/june 2013]** [**D]**
14. What is quantum confined stark effect? [**may/june 2013] [D]**
15. Define electro optic co-efficient**.[nov/dec 2015]** **[D]**
16. Mention any two methods of digital modulation**.[nov/dec 2015**] [**D]**
17. What is the Principle of quantum confined stark effect(QCSE) based optical modulation**[may/june 2013]** **[D]**
18. Write the expression to find the field-dependent change in the refractive index**.[May/June2013]** **[D]**
19. Define the term birefringence. [**D]**
20. What are mageneto-optic devices? **[D**]
21. What are acoustoptic devices? [**D]**
22. What do you mean by SEED? [**D]**
23. What are the different types of SEED? [**D]**
24. Why we go for bipolar controller modulator? [**D]**
25. What are the advantages of bipolar controller modulator? [**D**]
26. Mention the categories of acoustoptic devices. [**D]**
27. What are the limitations of acoustoptic modulators? [**D**]
28. Define acoustoptic filter. [**D]**
29. Mention the types of acoustoptic filter. **[D]**
30. Define collinear filter and non-collinear filter. [**D]**
31. Types of acoustic filter? [**D**]
32. Advantages of bipolar controller modulator? [**D]**

**PART – B**

**[first half]**

**[Analog and Digital Modulation]**

1. Explain the concept of external modulation and compare with direct modulation**.** **(6)[D][may/june 2013]**
2. Briefly explain about the Analog and Digital Modulation.[D]
3. Compare analog modulation with digital modulation**.(6)[D][nov/dec 2015]**

**[Electro-optic modulators]**

1. Explain with neat diagram, the construction of electro optic effect based external modulator. Also deduce the expression of modulated light. **(10)[D][may/june 2013]**
2. Explain the concept of birefringence in Uniaxial crystal with necessary diagrams.(**8)[D][may/june 2013]**
3. Derive the expression for retardation between two waves due to applied voltage in electro optic material**.(8) [D][May/June 2013]**
4. Explain the significance for multiple quantum wells in opto electronic devices**.(6)[D][may/june 2013]**
5. Explain about quantum confined stark effect(QCSE).(**8)[D][apr/may 2017]**
6. Explain about BRAQWET modulator**.(8)[D][apr/may 2017]**
7. Explain with neat diagram, the construction of electro optic effect based external modulator. Also deduce the expression of modulated light**.(16)[D][nov/dec - 2015]**
8. Explain the Electro-Optic Modulator**.(10)[D][nov/dec 2016] [apr/may 2017]**
9. Discuss in detail the principle and operation of QCSE based optical switching device**.(10)[D][may/june 2013]**
10. Explain the operating principle of electro optic modulators and derive the necessary equations**.(16)[D][nov/dec 2015]**

**[second half]**

**[Magneto Optic Devices]**

1. Explain about magneto optic-kerr effect**.(8)[D**]

**[Acoustoptic devices]**

1. Explain about Acoustic optic effect**.(8)[D][nov/dec 2013]**
2. Explain about acoustic optic deflector**.(6)[D]**

**[Optical, Switching and Logic Devices]**

1. Discuss in detail the principle and operation of a photonic switch based on self electro optic Device (SEED).(**10)[D][may/june 2013]**
2. Explain the concept of Bipolar controller Modulator**.(6)[D][may/june 2013**]
3. Explain the operation of optical devices in detail**.(10) [D][nov/dec 2015]**
4. Discuss in detail about SEED**.(16)[ID][nov/dec - 2015]**
5. Explain the concept of Bipolar controller Modulator**.(8)[D][nov/dec - 2015]**

[**UNIT V OPTOELECTRONIC INTEGRATED CIRCUITS**](#_TOC_250000)

**PART – A**

1. What are optoelectronic integrated circuits?[**D]**
2. What are active guided wave devices and give examples? [**D]**
3. Mention the applications of optoelectronic integrated circuits[**D]**
4. List out the advantages of optoelectronic integrated circuits. [**D]** [**nov/dec2016]**
5. List out the advantages of optoelectronic integrated circuits. [**D**] [**nov/dec 2015**]
6. What is meant by plasma etching? **[D] [nov/dec 2015**]
7. What are the disadvantages of hybrid integration? **[D]**
8. Distinguish between hybrid and monolithic integration[**D]**
9. Define waveguide. [**D]**
10. What is the objective of OEIC? [**D]**
11. What are the major differences in characteristics of opto electronic IC’s when compared to conventional electronic IC’S? **[D] [may/june 2013**]
12. Give the conditions for complete power transfer from one guide to another in an optical waveguide directional coupler. [**D][may/june 2013]**
13. Mention the types of waveguides**[D]**
14. What do you meant by MODFET? [**D]**
15. Write briefly about hybrid integration. **[D]**
16. Write briefly about monolithic integration. [**D]**
17. What are the disadvantages of hybrid integration? **[D]**
18. How can we achieve monolithic integration? [**D]**
19. What is the disadvantage of vertical monolithic integration? **[D]**
20. What is the advantages and disadvantages of horizontal scheme? [**D]**
21. What is the objective of OEIC? **[D]**
22. Distinguish between hybrid and monolithic integration[**D]**
23. List out the advantages of optoelectronic integrated circuits[**D]**
24. Define waveguide. [**D]**
25. Explain briefly about directional coupler. [**D]**
26. What do you meant by front-end photo receivers? **[D]**
27. Mention the types of integrated receivers. [**D]**
28. Explain briefly about directional coupler. [**D]**
29. What are the disadvantages of hybrid opto electronic integration? **[D]** **[may/june 2013]**
30. List the factors that dictate the half wave voltage in an active wave guide device? [**D**] [**may/june 2013]**

**PART – B**

**[first half]**

**[Hybrid and monolithic integration]**

1. Explain the merits and limitations of monolithic integration**.(6)[D][nov/dec 2015]**
2. Difference between hybrid and monolithic integration**.(6)[D]**

**[Application of opto electronic integrated circuits, integrated transmitters and receivers]**

1. Explain any two applications of OEIC in detail.**(8)[D][may/june-2013] [nov/dec 2016]**
2. What is the need of integration of opto-electronic devices**.(6)[D]**
3. Write a note on Monolithic and hybrid integration OEIC fabrication.(8)[D][may/june-2013]
4. Explain the importance of Optoelectronic Integration**.(8)[D][nov/dec-2103]**
5. Explain the importance of Optoelectronic Integration.(**4)[D] [may/june-2013]**
6. Describe the working of integrated transmitters and receivers**.(10)[D][nov/dec 2015]**
7. Discuss the noise performance in Integrated photo receivers.(8)[D] [**may/june-2013]**
8. Describe the fabrication process of an opto electronic integrated transmitter circuit by molecular beam epitaxy regrowth.**(16)[D][may/june 2012]**
9. Brief about the principal forms of opto electronic integration with their relative merits and demerits**.(12)[D] [may/june-2013]**
10. Draw the diagram of a PIN diode and HBT integrated front end photo receiver and explain its operation.(8)[D][may/june-2013]

**[second half]**

**[Guided wave devices]**

1. Explain the operation of wave guide coupler.(**4)[D] [may/june-2013]**
2. Explain the operation of wave guide interferometer**.(6)[D][may/june-2013]**
3. Explain the operation of active directional coupler switch**.(6)[D] [may/june-2013]**
4. Explain the principles and operation of [**nov/dec-2013] [nov/dec 2016**]
5. Waveguide Coupler
6. Waveguide interferometer
7. Active directional coupler switch
8. Active guided wave devices**(12)[D]**
9. Describe about the guided wave Mach-Zehnder interferometer.**(12)[ID]**
10. Explain about low-loss waveguides**.(6)[D]**
11. Application of opto electronic integrated circuits in radar applications**.(8)[D].**

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