



COLLEGE OF ENGINEERING, PUNE

(An Autonomous Institute of Government of Maharashtra.)
SHIVAJI NAGAR, PUNE - 411 005

END Semester Examination

ET-14001- Microwave and Optical Communication

Course: B. Tech

Branch: Electronics and Telecommunication Engineering

Semester: Sem VII

Year: 2014-2015

Max.Marks:60

Duration: 3 Hours Time:- 2.00pm - 5.00pm

Date: 24 NOV 2014

Instructions:

MIS No.

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1. Figures to the right indicate the full marks.
2. Mobile phones and programmable calculators are strictly prohibited.
3. Writing anything on question paper is not allowed.
4. Exchange/Sharing of anything like stationery, calculator is not allowed.
5. Assume suitable data if necessary.
6. Write your MIS Number on Question Paper

- Q 1 A** What is the frequency range of S, C, X and K band as per IEEE standard? 2
- B** An air filled rectangular waveguide has a dimensions of $a=6\text{cm}$ and $b=4\text{cm}$. The signal frequency is 3 GHz. Compute the following parameters for TE_{10} mode. 6
- i. Cut off frequency and wavelength in waveguide.
 - ii. Phase constant and phase velocity.
 - iii. Group velocity and wave impedance.
- C** What are the cavity resonators? What is the formula for resonant frequency of rectangular cavity resonator? 2
- Q 2 A** Explain the operation of H-plane tee and derive the scattering matrix for it. Why this tee is called 3 dB power splitter? 4
- B** The S parameters of a two port network are given by $S_{11}=0.2$, $S_{12}=0.6$, $S_{21}=0.6$, $S_{22}=0.1$. Is the network reciprocal and lossless? 2
- C** With a help of neat diagrams and relevant mathematical expressions explain the working of reflex klystron. 4
- Q 3 A** Explain how a parabolic reflector serves the purpose of transmitting and receiving antenna for the use in microwave spectrum. What are the feed mechanisms for this antenna? A parabolic antenna having circular mouth has a power gain of 1500 at $\lambda=10\text{cm}$. Estimate the diameter of the mouth and half power beam width of the antenna. 5
- B** Derive the radar range equation. Explain the factors that affect the maximum range of radar. 5

- Q 4 A** What do you mean by the modes of an optical fiber? Starting from the Maxwell's equations give the outline of how TE, TM and hybrid mode solutions of step index fiber can be obtained. **6**
- B** The radiative and non radiative recombination life times of minority carriers in active regions of double hetero junction LED are 60 ns and 100 ns respectively. Determine the total carrier recombination lifetime and power internally generated within the device when peak emission wavelength is 870 nm and drive current of 40mA. If the refractive index of LED material is 3.5 estimate the power emitted by the LED. **4**
- Q 5 A** Draw a schematic of Fabry-Perot cavity resonator and show how this structure works as laser diode. Derive an expression for threshold gain condition for producing sustained oscillations from the resonator. Draw a typical spectrum for this laser diode. What is the advantage of DFB laser? **6**
- B** A photo diode has a quantum efficiency of 65% when a photon of energy 1.5×10^{-19} J is incident upon it. **4**
- i. At what wavelength is the photo diode operating?
 - ii. Calculate the incident optical power required to obtain photocurrent of $2.5 \mu\text{A}$ when the photodiode is operating as described above.
- Q 6 A** Compare the performance of following components for an optical communication system. **6**
- i. LED and Laser Diode.
 - ii. PIN and Avalanche Photodiode.
 - iii. Step and Graded index multimode fiber
- B** A typical digital fiber optic link with NRZ data format has following parameters. **4**
- Data rate: 1GHz
 DFB Laser spectral width: 0.1nm
 SM fiber dispersion at 1550nm : - 0.02ns/nm-Km
 Rise time of transmitter: 0.1ns
 Rise time of receiver: 0.1ns
- Do the rise time analysis and find the maximum repeater less distance for the link.
