Mansoura University
Faculty of Engineering
Department of Electronics &Telecoms Engineering

Optional Course: Optoelectronics
Final Exam June 2012
Level 3 Cohort
Time allowed: 3 Hours

ANSWER THE FOLLOWING QUESTIONS: MAXIMUM MRAK IS 70

QUESTION ONE (16 marks)

The core and cladding refractive indices of a symmetric dielectric slab waveguide are 1.6 and 1.5 respectively. The core thickness is 1 μm and the operating wavelength, λ, is 1.55 μm.

a. Calculate the normalised frequency and the number of guided TE modes (4 marks).
b. Calculate the effective index of the fundamental TE mode using Newoton-Raphson method (6 marks).
c. Derive an expression for the guided fundamental TE mode power in a dielectric waveguide (6 marks).

QUESTION TWO (16 marks)

a. For a directional coupler formed of two symmetric straight planar waveguides,
    i. Write down the coupled- mode equations (4 marks).
    ii. Explain the factors affecting the coupling coefficient (4 marks).
b. For a lossless synchronous directional coupler,
    i. Solve the coupled-mode equations to find the z-dependent modal amplitudes $A_1(z)$ and $A_2(z)$ (4 marks).
    ii. Prove that the total propagating power, $P(z)$, is conserved (4 marks).

QUESTION THREE (16 marks)

a. For an asynchronous directional coupler,
    i. Write down an equation for the power transferred from the first to the second guide (4 marks).
    ii. Plot the power transferred to the second guide versus phase mismatch between the two guides (4 marks).
b. Using the asynchronous directional coupler, explain with aid of equations and neat sketches the methodology for the design of an electro-optic switch (8 marks).

QUESTION FOUR (20 marks)

a. Explain the principal of operation of Bragg gratings a filter (10 marks).
b. For a surface-plasmon waveguide,
    i. Sketch the surface-plasmon wave pattern (4 marks).
    ii. Derive expression for the propagation constant o these waves (6 marks).

QUESTION FIVE (12 marks)

An alternative view of a synchronous directional coupler can be based on the well known optical principle that the output from a linear device is given by the sum of all possible routes between input and output.

Figure (i) below shows one path between an input to guide 1 and an output from guide 2. This involves a single scattering at an arbitrary position z, such that $0 < z < L$.

If the scattering amplitude per unit length is $-j\kappa$, and the input amplitude is A_{10}, the net contribution from all such paths is:

$$A^1_{2L} = -j\kappa A_{10} \int_0^L dz = -j\kappa L \, A_{10}$$

Figure (ii) below shows another possible route, involving three scatterings.

(a) If the sum of all such paths is denoted by A_{2L}^3, evaluate A_{2L}^3 (4 marks).

(b) Draw the paths contributing to A_{2L}^5 which has five scatterings, and evaluate the integral for this case (4 marks).

(c) Sum the series $A_{2L} = A_{2L}^1 + A_{2L}^3 + A_{2L}^5 + \ldots\ldots$, and show that it corresponds to the normal solution for a synchronous directional coupler (4 marks).

(i)

Guide 2

Guide 1

$z = 0$ $z = L$

(ii)
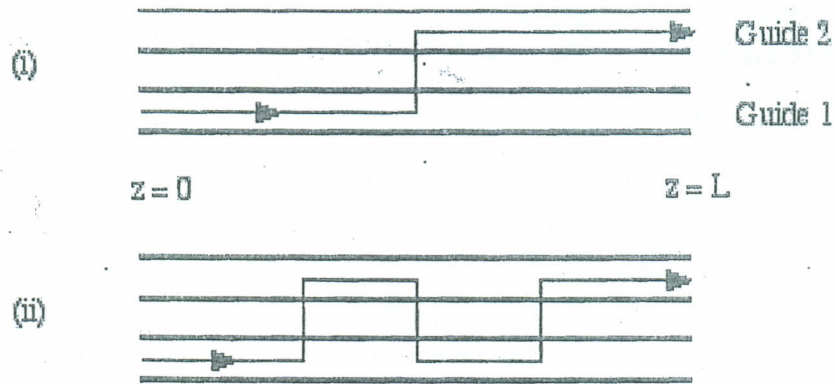
All the best;

S. S. A. Obayya, FIEE, FInstP

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Answar All Questions. Assume any missing Data.

Q1. A user enters http://www.mans.edu.eg/default.htm in the address line of a browser. Which statement is true about this transaction?
(a) The "http" portion indicates the protocol that is being used, (b) The "default.htm" portion is the specific service name, (c) The retrieved web page will be displayed in URL code

Q2. Which OSI layer addressing is required to route packets between two networks?
(a) Layer 1, (b) Layer 2, (c) Layer 3, (d) Layer 4

Q3. Which application layer protocol allows administrators to log into a server from remote locations and control a server as though logged in locally?
(a) DNS, (b) FTP, (c) DHCP, (d) SMTP, (e) Telnet

Q4. Node JS is a new IT software. Referring to this new technology answer the following:
a- What are the main usages of this software? Give brief description.
b- Which programming language is used to develop applications with this software
c- What is type of programming is used by Node JS? Synchronous or Asynchronous programming. Give brief description for both types.

Q5. The basic Node JS server code is show below. Give detailed description of each line of the code.

```
var express = require('express');
var routes = require('./routes');
var app = module.exports = express.createServer();
app.listen(5000);
console.log("Express server listening on port 5000");
// Configuration
app.configure(function(){
  app.set('views', __dirname + '/views');
  app.set('view engine', 'jade');
  app.use(express.bodyParser());
  app.use(express.methodOverride());
  app.use(app.router);
  app.use(express.static(__dirname + '/public'));
});
```

```
app.configure('development', function(){
  app.use(express.errorHandler({ dumpExceptions: true, showStack:
true }));
});
app.configure('production', function(){
  app.use(express.errorHandler());
});
app.get('/', function(err, result){
  res.send("Hello World");
  console.log("New server request answered");
});
```

Q6. Translate the following 'jade' file to 'HTML':

Data to be sent to jade file is:

```
persons = [{id:10, name:'Ahmad'}, {id:20, name:'Hassan'}]
```

jade file:

```
table(border=3, style='color:red')
  -each person in persons
    tr
      td ID
      td=person.id
      td Name
      td=person.name
```

Q7. Mongo database engine is one of the powerful NoSQL database engine on the internet. The record structure is based on Binary Script Object Notation (BSON). If collection "names" contains the following:

```
{fName:"Ahmad", bDate:25/1/2011, bPlace:"Mansoura"}
{fName:"Haasan", bDate:25/12/2001, bPlace:"Minia"}
{fName:"Ali", bDate:5/1/2002, bPlace:"Cairo"}
```

What is the output of the following queries?
```
a)  db.names.find();
b)  db.names.findOne();
c)  db.names.find({fName:"Ali"});
d)  db.names.find({bDate:25/1/2011}, {fName:1});
```