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Study of Fiber Optic Medical Drugs Sensor

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Abstract:
Fiber optic sensors are performing a significant functionof the field of sensors. This is due to unprompted response andfacilityduringtreatment. The proposeduseoptisystem software to study the characterization ofmedical drugs by use important type of modulation was called intensity modulated fiber optic sensors. In the work, I have been using of parabolic index Multimode fiber operated on650nm. A small portion of cladding has been taken awayin the middle of the fiber opticand the core stay isuncovered in directing liquid of differentrefractiveindicesof four medicals drugssolutions, for example Pro final, Tallinn-D, Actifed and Ercèfuryl 4%. Thetwoterminationsof the fiber are contactedwith a spatial visualizerto read the mode of medicaldrugsbefore and after sensor. The refractive index of directive liquid varies from sample name liquids and the total output powersmaximum Q. Factorhas been studied.

***Keywords**: Uncladded optical fiber as sensors, intensity modulated. Intrinsic andExtrinsic optical fiber sensor.*

I. INTRODUCTION

Fiber optic sensors recently brought is an important development in the field of technology and became sensing application in all fields [1]. Fiber optic sensors, presenting havemany advantages traditional electric or electromechanical sensors, including low manufacturing cost, diminutive and flexible structures, immunities to electromagnetic fields, and the capability of distributive and multi-parameter sensing on a single fiber. Extreme harsh environments such as temperature greater than 800°C or as low as a few Kelvin, present unique defy and opportunities to fiber optic sensors. In addition, semiconductors characterized by small and light in weight and being so by adopting the laser source and the optical detector [2],The sensing devices for using fiber-optic is very important and useful for physical and chemical phenomena, and it includes the use of a wide range such astemperature [3],liquid level[4],radiation, strain, refractive index[5], shaking, concentration of liquid[6], chemical analysis[7] . In fact and truth, fiber-optic sensors can be implemented the functions of in practice and features for remote sensing faster than conventional devices, as well as sufficient sensitivity.Therefor can improve perform measurement tasks that would comparewith conventional sensors.

In the present experiment, measurement refractive index of the medical drugs solutions, for example Profinal, Tullin-D, Actifed and Ercèfuryl 4% by using refracometer device, and using optisystem software to study the performance analysis of drug solutions byremoving cladding in the middle ofparabolicgraded index multimode fiber and replace by medical drugs solutions .Using Several samples of drugs and medical used for the purpose of examination with a different concentration put on the site of removing cladding represented by a fiber optic sensor. The output power at each of the guiding liquids is measured. Various properties like totalmodes,output power, maximum Q. Factorhas been studied.

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2. BACKGROUND THEORY

Fiber opticit can be defined as a carrier channelof light from an external source of the place of the sensor, and the optical fiber sensor can split into three main parts and is in a location sensor, the principle of operation and application, based on the site as well as the sensor can be divided into two types as the distribution of the external or intrinsic. [8].

2.1 Intrinsic optical fiber sensor

The change of internal property optical fiber as a result of environmental changes in the formation this leads to the formation of the optical signal may be in the form of the intensity and frequency or phase may be polarization and this is a fundamental Intrinsic of sensor [9]. The figure below shows basic concept of intrinsic optical sensor.

2.2 Extrinsic optical fiber sensor.

The concept of the external optical sensor is of a particular place and represent light reflected of the mirrors, gas, liquid cell, or many other technical aspects that will initiate the establishment of a light signal [10].The fiber just acts as a means to propagate the light from the location of sensing only

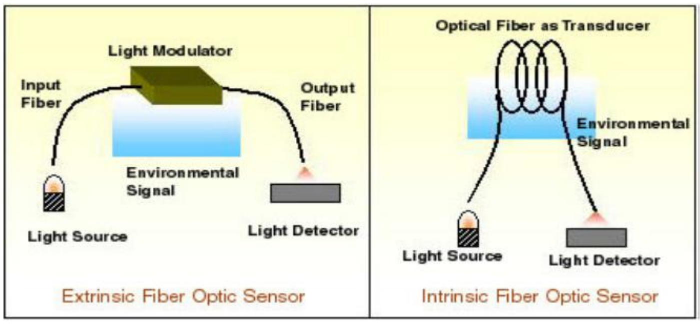

Fig.(1). Extrinsic and intrinsic types of fiber optic sensors[11].

2.3.Intensity Modulated Optical Fiber Sensors.

The simplest and easiest sensor devices used are represented by the intensity modulated sensor, which has been studied on a large-scale, especially in the fields of optical sensor. These sensors used amplitude modulation for the purpose of fumbling in the sensing area of optical fiber.The optical sensor used modulated intensity can measure the intensity of the signal transmitted through the optical fiber, as well as measuring changes in the intensity of the signal and using a detector subject at the end of the fiber output and sensitivity of the change of light intensity of signing,due to variation in refractive index of the drugs. Measurementscan also be performed by replacing thecladding with a material such as a drugs that changes optical properties .From such an analysis a very useful quantity emerges called normalized frequency, V. It is the characteristics of the insulating material is glass for GI.MMF, wavelength and physical dimensions of the fiber, and is given by[12].

$$V = \frac{2\pi}{\lambda}\, a.(NA) = \frac{2\pi}{\lambda}\, a.\, n_1.(2\Delta)^{1/2} \quad \ldots\ldots\ldots(1)$$

$$NA = (\, n_1^2 - \, n_2^2)^{1/2}. \quad \ldots\ldots\ldots(2)$$

$$\Delta = (n_1 - \, n_2)/\, n_1 \quad \ldots\ldots\ldots..(3)$$

where a is the core radius,n_1 refractive index of the core,$n_2$refractive index of the drugs, NA is numerical aperture ,Δ is the relative refractive index difference, and λ is thewavelength.

It can be shown that the number of modes supported by a parabolic graded index multimode fibergiven by.

$$M_{graded} = \left(\frac{\propto}{\propto+2}\right).\left(\frac{V^2}{2}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots(4)$$

Where$\propto$= 2 which represented the profile parameter of GI-MMF.

3- Simulation design and setup.

Thesensor system consists of two parts to study the indication after and before the samples as shown inFig.(2), first of them is the transmitter part and the other is receiver part. The transmitter consists of four , continuous wave laser (CW), pulse modulation generators ,pseudo random bit sequence generator

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and modulator. For Multimode optical fibers (MMOFs) of length 3 cm are used simultaneously as a sensor medium by changing the cladding of these fibers with other materials with different refractive indices, these materials is liquid drags. In other side the receiver which consists a photo detector, continuous wave laser (CW) will be modulated Input signal through Mach-Zehnder modulator. Finaly input a signal is supplied by continuous laser with at650nm wavelength at power 20dbm. In this system the fibers have core radius of 50 µm and cladding radius of 125 µm where the refractive index of the core is 1.46 and the cladding material are replaced by liquids as shown in table (1). To compare between the two signals after and before the fibers a spatial visualizeris used to measure the power and to show the mode distributionthe results are shown in fig.(3-4).

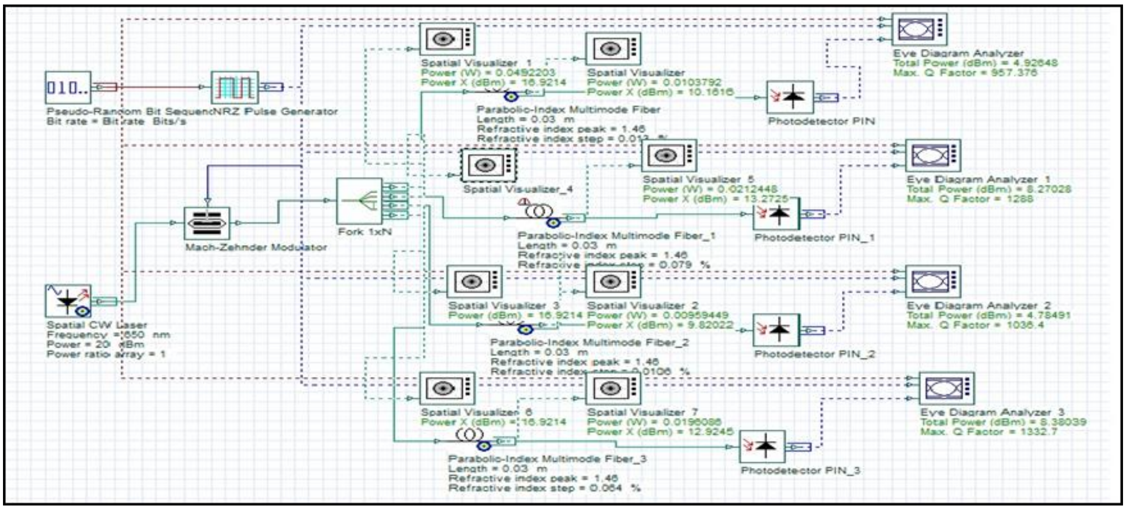


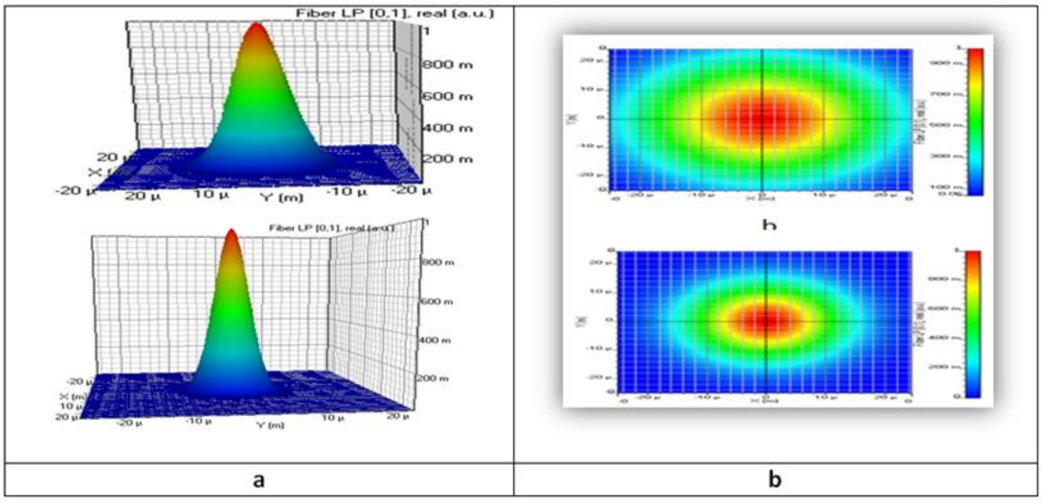
Fig. (2): The Design of sensor simulated model with Optisystem System software

4- Result and Disscusion:

In this paper, analysis the parametric performance and comparison of the different format in Multimode optical fiber sensor system is done by opti-system simulation software. The outcome of analysis, simulation at various refractive index using different (MMOFs) fora single transmission channel that explain in Table1.Where the refractive index of materials are measured experimentally using refractometer type (Abbe- refractometer AR3/AR4 with illumination unit) at different degree of temperature.

Table(1):Various refractive index of liquids at different temperature with differentresults after and before the sample.

Sample Name of Medical Drugs	Refractive index(n)	Temperature (C)	Refractive index step	Power (W) before Sensor	Power (W) after Sensor	Maximum Q. Factor
Profinal	1.4410	20.8	0.0130	0.0492203	0.0103792	957.376
Tullin-D	1.4485	20.8	0.0079	0.0492203	0.0212448	1288
Actifed	1.4445	20.7	0.0106	0.0492203	0.00959449	1036.4
Ercéfuryl 4%	1.3665	19.6	0.064	0.0492203	0.0196086	1332.7



Fig(3). The reading are measured by spatial visulazer meter in 3D&2D (a) before sensor and (b)after sensor for both medical drugs Profinal and Tullin-D respectively.

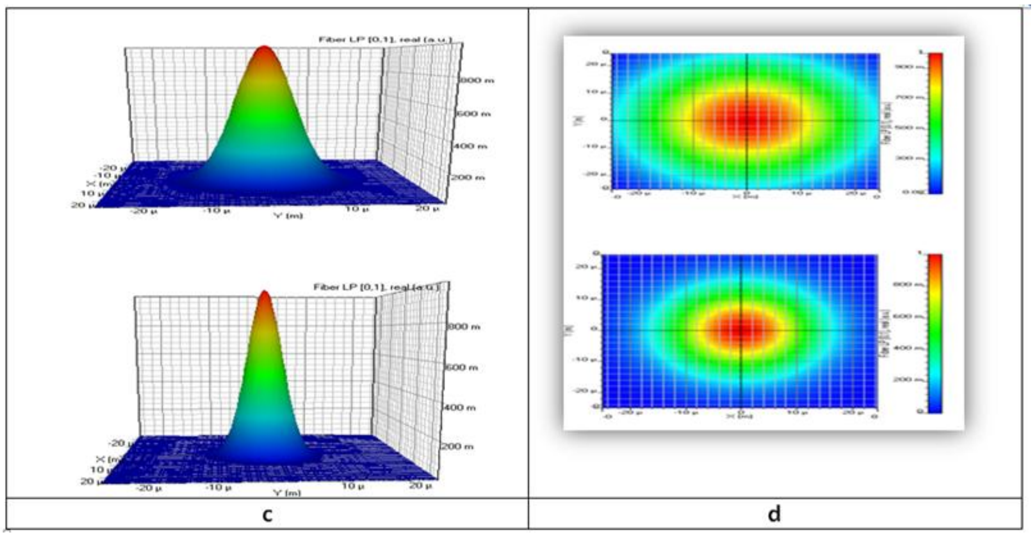


Fig.(4). The reading are measured by spatial visulazer meter in 3D&2D (c) before sensor and (d)after sensor for both medical drugs Actifed and Ercèfuryl 4% respectively.

From Fig.4 into Fig.5. illustrate the reading of Eye diagram Analyzer , explain Q. Factorand output power for four medical drugs solutions for example Profinal, Tullin-D, Actifed and Ercèfuryl 4%.

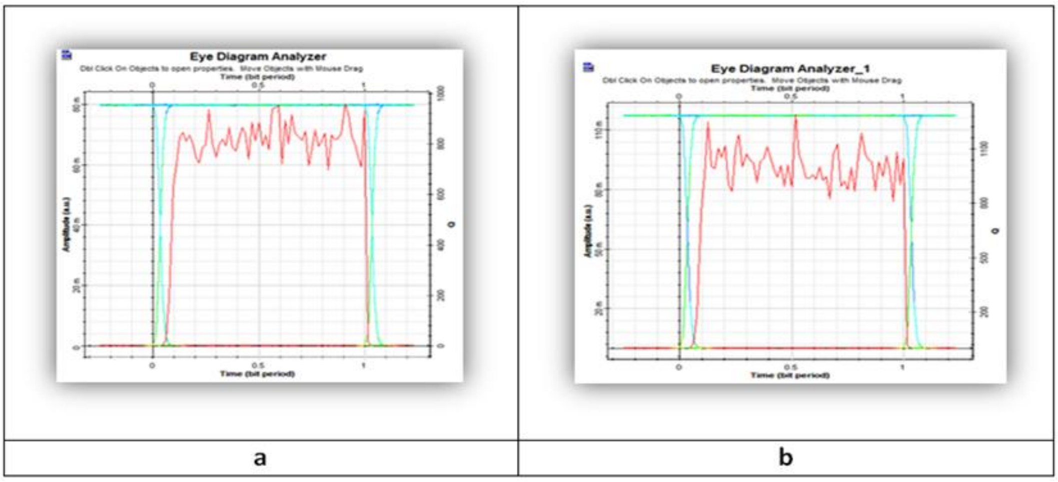
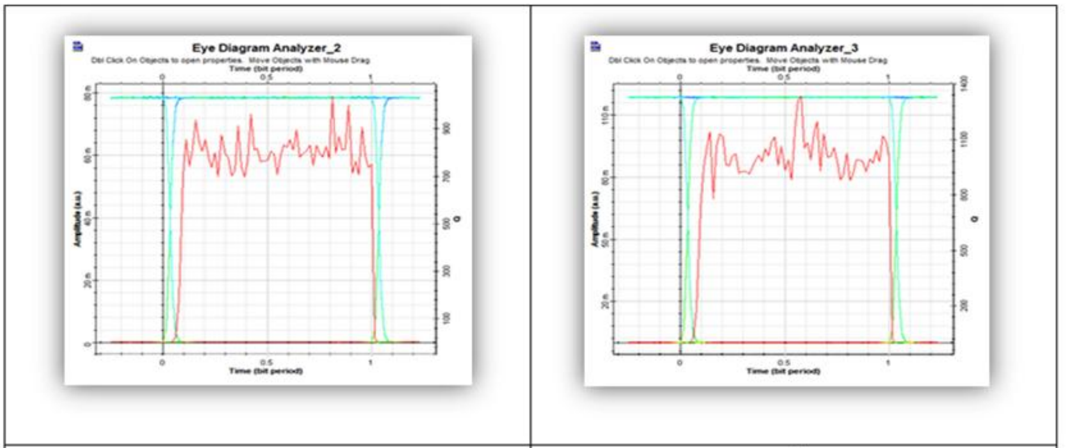


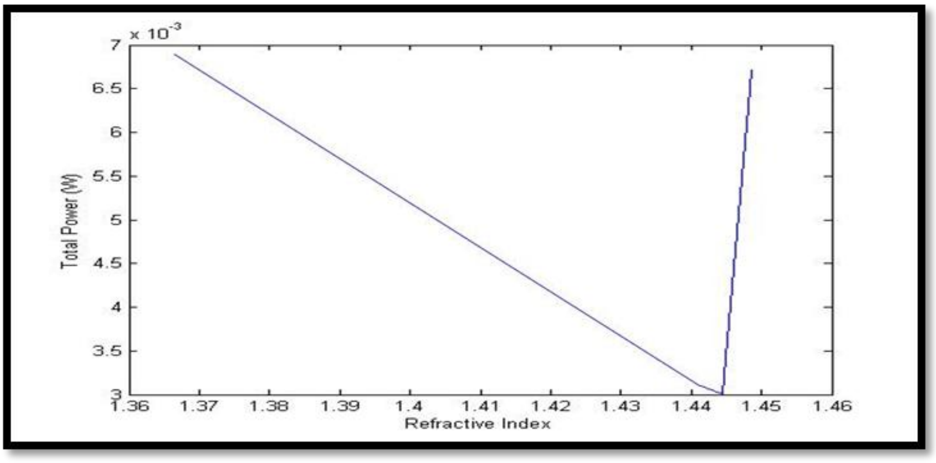
Fig. (5): Eye diagram analyzer ofmedical drugs. (a) Profinal and. (b)Tullin



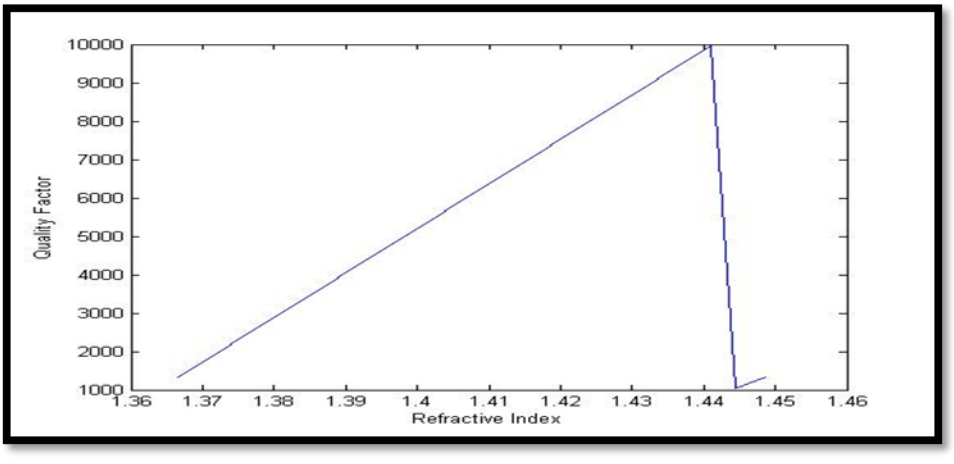
c	d

Fig. (6): Eye diagram analyzer ofmedical drugs. (c) Actifed and (d) Ercèfuryl 4%.

The graphs as seen from Fig. 7 and Fig. 8 shows the relationship between refractive index for four differentmedicaldrugsmeasured to get him experimentally using refractometer type (Abbe-refractometer AR3/AR4 with illumination unit) at different degree of temperature, of GI- MMOF as a function to total power and quality factor respectively, these figures are plotted using matlab program version 7.12.



Fig(7): Refractive index vs. total power for differentmedical drugs



Fig(8): Refractive index vs. quality factor for different medical drugs

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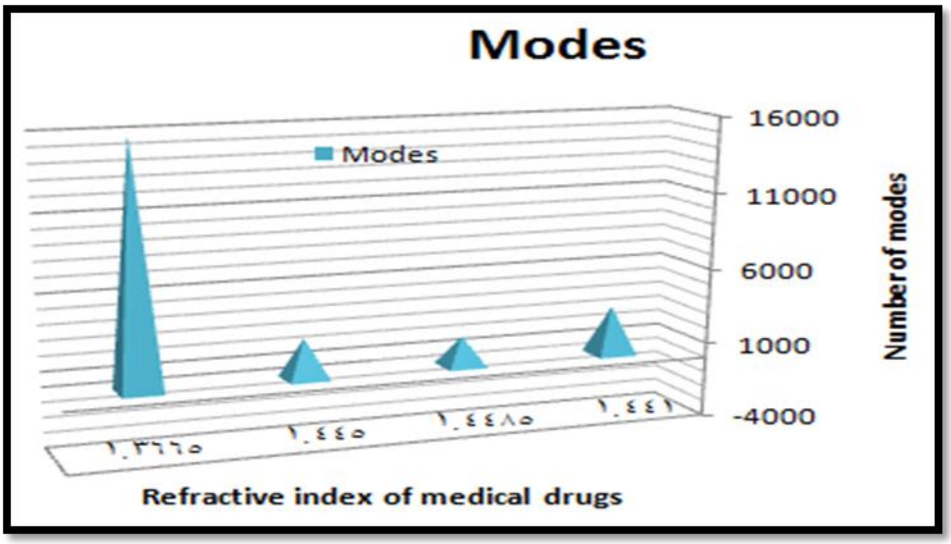
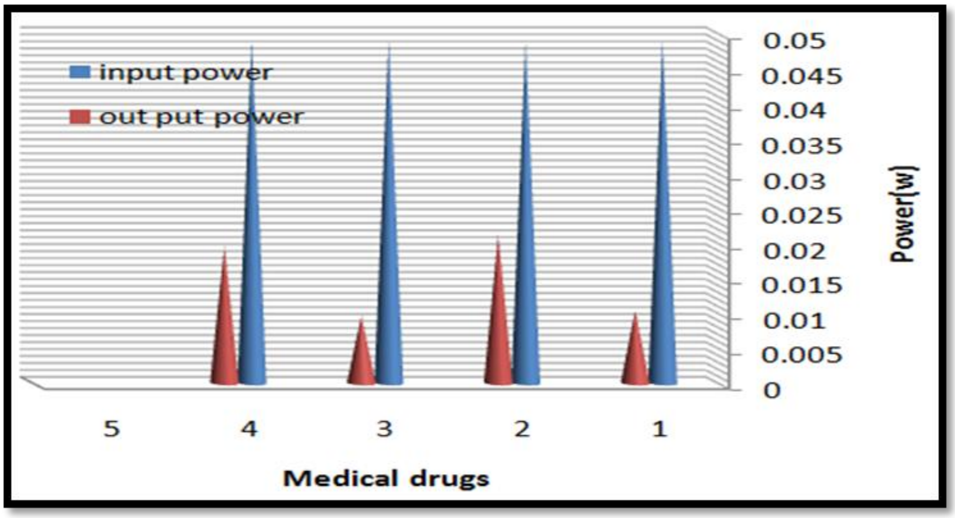


Fig(9): Refractive index vs. modes for different medical drugs



Fig(10): Input and output power vs. modes for different medical drugs

In this work, study performance of four differentmedical drugs that used as a cladding of MMOF for studying the sensing effect.As well as developed a comprehensive comparison in terms of the Q factor, input and output power, spectrum, eye charts and the average output power to determine the performance studies of sensor with medicaldragsusing GI-MMOFs shows in above tables.

As seen from fig. 7 and fig.8, when compare the result for use four different types ofmedical drugs, show that all reading changes refractive index of drugs were set at four values which are 1.441, 1.4485, 1.4445, and 1.3665 the link distance of optical fiber was set 3 cm. The refractive index step becomes 0.013, 0.0079, 0.0106 and 0.064.The set of all these parameters changes the power gain to reach the maximum value (0.00689 W) at refractive index 1.3665 , the minimum power (0.003009 W) at 1.4445. These values of total power correspond to quality factor at values of maximum Q-factor 1036.4 at 1.4445and minimum Q-factor 1332.7 at refractive index of 1.3665. Simulation shows that as increasing refractive index of the medical drags is increased Q-factor parameters and decrease the output power.It is clearly from the Fig(10) the number of modes has maximum value atrefractive index 1.3665 .

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5. CONCLUSION

In this paper, the assessment study performance of different drags for useGI-MMOFs, show that as increasing refractive index drags will be linear increased Q-factor parameters and decrease the power until it reaches certain value of refractive index 1.4445 where the reciprocal behavior happen,where the Q-factor is the alternate of total power and number of modes proportional inverse with increasing value of drags refractive index.

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