



Sir P. T. Science College, Modasa

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PROJECT REPORT

PHYSICS BEHIND ENDOSCOPY

Submission presented to

Hemchandracharya North Gujarat University, Patan



FOR THE DEGREE OF MASTER OF SCIENCE IN PHYSICS BY

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THIS IS TO CERTIFY THAT THE PROJECT WORK ENTITLED
"PHYSICS BEHIND ENDOSCOPY" IS CARRIED OUT BY
STUDENTS MENTIONED BELLOW, IN PARTIAL FULFILLMENTS FOR
THE AWARD OF DEGREE OF **MASTER OF SCIENCE** IN PHYSICS
DURING THE ACADEMIC YEAR 2022-2023.

THE PROJECT HAS BEEN APPROVED REQUIREMENTS IN RESPECT
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ABSTRACT

This document describe that Endoscopy is generally a very safe and effective tool in the diagnosis and therapy of various gastrointestinal (GI) disorder, and must be used in conjunction with other diagnostic modalities. The scientific application of endoscopy exploited the nobility of natural science, which is physics, to cure humans and lessen their suffering. This application relies in the first place on the scientific principle of total internal reflection. This is a physical phenomenon of light not following the general appearance of refracting through light-permeable materials. In this literature review article, the general uses for endoscopy will be examined. There are many advantages of endoscopy, including minimal morbidity and mortality. However complication may occur and there are limitation to endoscopy.

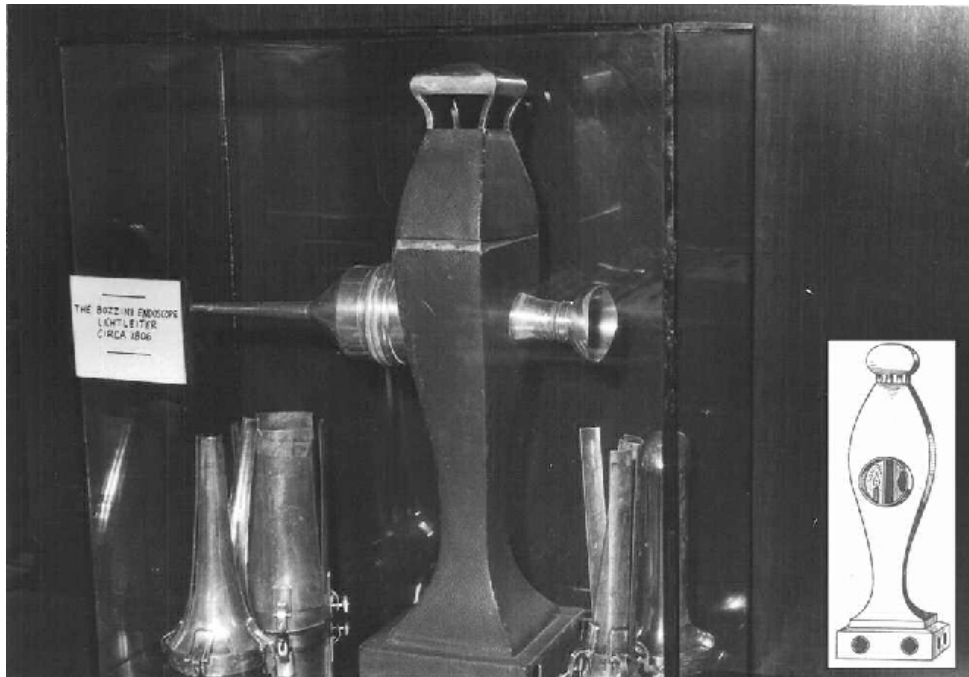
Keywords; Endoscopy, TIR; Total Internal Reflection, Optical Fiber

INTRODUCTION

ENDOSCOPY: The non-ionizing imaging technology that is used to investigate the interior of the human body is called endoscopy. Endoscopy comes from **Greek Word “ENDO”** means **INSIDE** and **“SCOPY”** means **TO SEE**. Endoscopy is a medical application used by physicians to ease their mission of making accurate examinations for many cases. Endoscopic devices enable physicians to have a closer look at the internal organs of the patient; they transport live picturing of the patient's organs. Endoscopes are long, thin tubes that can transmit light deeply into and out of biological tissue and are indispensable for modern surgery and medical diagnostics. Thin endoscopes can be as little as a few millimeters in diameter, but even these scopes can be destructive in certain medical procedures and they have limited imaging resolution. Endoscopes use optical fibers to produce an image of inside the body. A doctor can insert a bundle of optical fibers into the body. Some carry light into the body, and some carry light reflected off internal body surfaces back out. This allows the doctor to see an image of the inside of the body clearly, and help them diagnose diseases like cancer, or see what they are doing during keyhole surgery. The endoscopy mechanism depends on the scientific principle of total internal reflection to take inner picturing from inside the body. Therefore, clarifying the scientific principle of total internal reflection gives us the complete interpretation of the endoscopy mechanism.

HISTORY

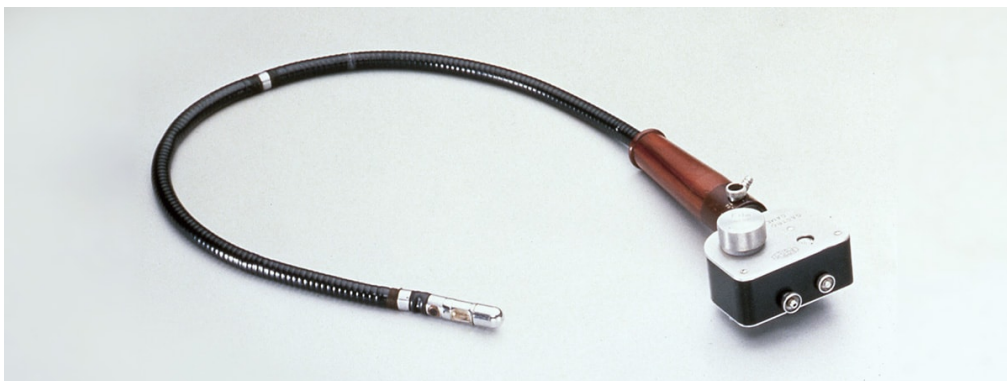
Endoscope, an instrument that allows us to peek inside of the human body, was used as early as the ancient Greek and Roman periods. An instrument considered a prototype of endoscopes was evidenced and discovered in the ruins of Pompeii. It was Philip Bozzini who in 1805 made the first attempt to observe the living human body directly through a tube he created known as a Lichtleiter (light guiding instrument) to examine the urinary tract, rectum and pharynx. In 1853, Antoine Jean Desormeaux of France developed an instrument specially designed to examine the urinary tract and the bladder. He named it "endoscope," and it was the first time this term was used in history.



After a series of trials, Dr. Adolph Kussmaul of Germany succeeded in taking a look inside the stomach of a living human body for the first time in 1868. This was tested on a sword-swallower, who could to gulp down a straight, 47-centimeter long metal tube with a diameter of 13 millimeters. Ten years later, two doctors named Max Nitze and Josef Leiter invented a cystourethroscope and in 1881, Johann von Mikulicz and his associates created the first rigid gastroscope for practical applications. These gastroscopes were not flexible at all, but finally in

1932, Dr. Rudolph Schindler invented a flexible gastroscope, -- a modified version of the earlier ones-- that allowed examinations even while the tube is bent. This tube was 75 centimeters in length and 11 millimeters in diameter. About 1/3 of the entire length of the tube toward the tip could bend to a certain degree. Rudolph Schindler examined the inside of a stomach through numerous lenses positioned throughout the tube with a miniature light bulb.

Now, let's take a look at the evolution of endoscopic development.



ENDOSCOPY PROCEDURE

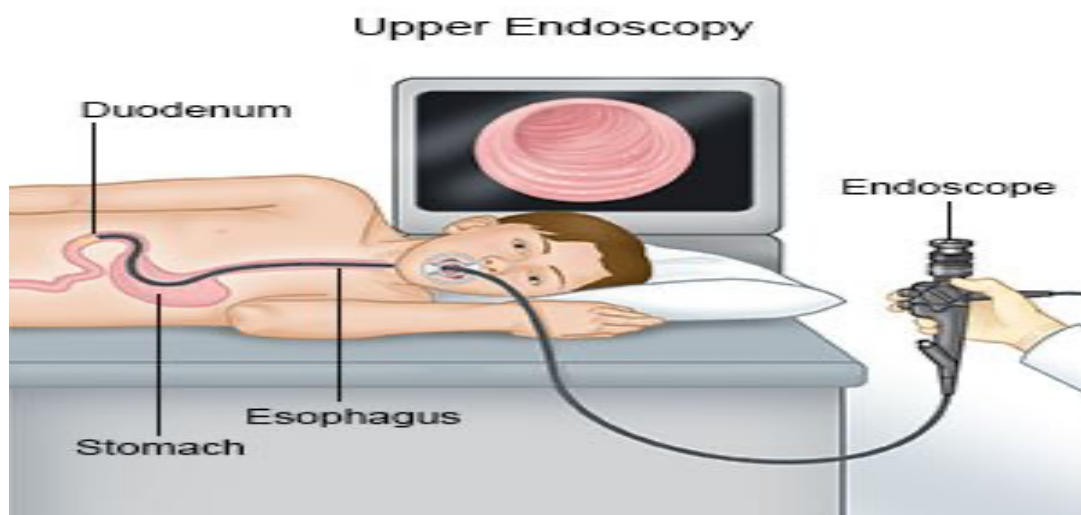
Endoscopy is a nonsurgical procedure used to examine a person's digestive tract. A long, thin tube with a small camera inside, called an endoscope, is passed into your body through a natural opening such as your mouth, your doctor can view pictures of your digestive tract on a color TV monitor. Your GP may refer you for an endoscopy if you're having certain symptoms. It will usually be done at an endoscopy unit in a hospital.

During an upper endoscopy, an endoscope is easily passed through the [mouth](#) and throat and into the [esophagus](#), allowing the doctor to view the esophagus, [stomach](#), and upper part of the small intestine.

Similarly, endoscopes can be passed into the large intestine ([colon](#)) through the rectum to examine this area of the intestine. This procedure is called sigmoidoscopy or colonoscopy depending on how far up the colon is examined.

A special form of endoscopy called endoscopic retrograde cholangiopancreatography, or ERCP, allows pictures of the [pancreas](#), [gallbladder](#), and related structures to be taken. ERCP is also used for stent placement and biopsies.

Endoscopic [ultrasound](#) or EUS combines upper endoscopy and ultrasound examination to obtain images and information about various parts of the digestive tract.



PRINCIPAL OF ENDOSCOPY

Principle:

Endoscopes generate a picture of the inside of the body using optical fibers. A bundle of optical fibers could be inserted into the body by a doctor. Some convey illumination into the body, while others reflect lighting off internal body components back outward.

The endoscope employs the total internal reflection concept using optical fibers. This procedure is used to study the interior of a hollow organ or cavities throughout the body.

An endoscope is made up of an optical system that carries illumination to the item being seen and either the equivalent. This illuminating light is carried towards the object by an optical fiber package throughout most current endoscopes.

Therefore, the principle of total internal reflection is used in the endoscope by using optical fibers.

NOW,

WHAT IS OPTICAL FIBRE?

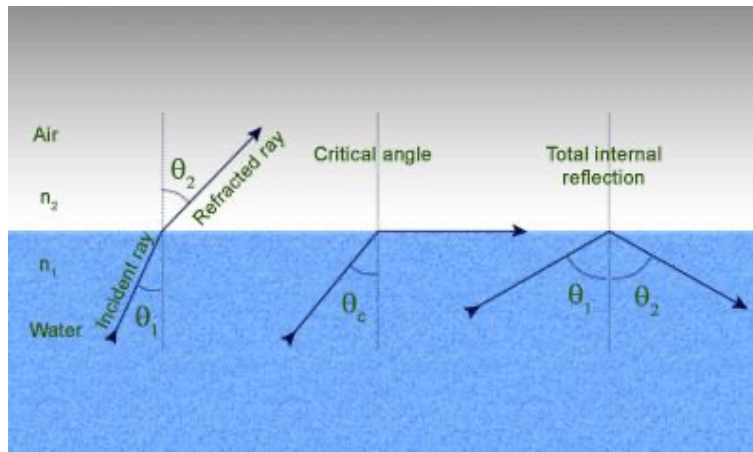
A thin fiber of glass through which light travels. The light becomes trapped inside the fiber because of repeated Total Internal Reflection, before emerging from the far end.

WHAT IS TOTAL INTERNAL REFLECTION?

Total internal reflection is defined as:

The phenomenon which occurs when the light rays travel from a more optically denser medium to a less optically denser medium.

Consider the following situation. A ray of light passes from a medium of water to that of air. Light ray will be refracted at the junction separating the two media. Since it passes from a medium of a higher refractive index to that having a lower refractive index, the refracted light ray bends away from the normal. At a specific angle of incidence, the incident ray of light is refracted in such a way that it passes along the surface of the water. This particular angle of incidence is called the 'critical angle'. Here the angle of refraction is 90 degrees. When the angle of incidence is greater than the critical angle, the incident ray is reflected back to the medium. We call this phenomenon total internal reflection.



Formula of Total Internal Reflection: $\frac{n_1}{n_2} = \frac{\sin r}{\sin i}$

$$n_1 \sin \theta_1 = n_2 \sin \theta_2.$$

The critical angle is reached when θ_2 is 90 degrees:

$$n_1 \sin \theta_c = n_2 \sin 90^\circ = n_2$$

Thus we have the following expression for the critical angle:

$$\sin \theta_c = n_2/n_1.$$

Notations Used In The Total Internal Reflection Formula And Critical Angle

- r is the angle of refraction
- i is the angle of incidence
- n_1 is the refractive index in medium 1
- n_2 is the refractive index in medium 2
- θ is the critical angle

APPLICATIONS:

Endoscopy is used for many procedures:

- During pregnancy
 - o The amnion (amnioscopy)
 - o The fetus (fetoscopy)
- Plastic surgery
- Panendoscopy (or triple endoscopy)
 - o Combines laryngoscopy, esophagoscopy, and bronchoscopy
- Orthopedic surgery
 - o Hand surgery, such as endoscopic carpal tunnel release
 - o Knee surgery, such as anterior cruciate ligament reconstruction
 - o Epidural space (Epiduroscopy)
 - o Bursae (Bursectomy)
- Endodontic surgery
 - o Maxillary sinus surgery
 - o Apicoectomy
- Endoscopic endonasal surgery
- Endoscopic spinal surgery

An endoscopy is a simple procedure that allows a doctor to look inside human bodies using an instrument called an endoscope. A cutting tool can be attached to the end of the endoscope, and the apparatus can then be used to perform minor procedures such as tissue biopsies, banding of oesophageal varices or removal of polyps.

Application in other fields:

- For non-medical use, such as internal inspection of complex technical systems, borescopes are used. These are similar to endoscopes.
- The planning and architectural community use architectural endoscopy for pre-visualization of scale models of proposed buildings and cities
- Endoscopes are also a tool helpful in the examination of improvised explosive devices by bomb disposal personnel.
- Law enforcement uses endoscopes for conducting surveillance via tight spaces.

TYPES OF ENDOSCOPIES:

There are many types of endoscopy procedures, including:

Arthroscopy: Used to examine your joints. The scope is inserted through a small cut in the skin near your joint.

Bronchoscopy: Used to examine the large airways of the lungs (bronchial tubes). The scope is inserted through your mouth and into your airway.

Colonoscopy: Used to examine your colon. The scope is inserted through your anus and is passed up the far end of the large intestine.

Colposcopy: Used to examine your cervix. The scope is inserted through your vaginal opening.

Cystoscopy: Used to examine the inside of your bladder. The scope is inserted through your urethra (the tube that connects the bladder to the outside of the body).

Endoscopic Retrograde Cholangiopancreatography (ERCP): Used to examine your bile and pancreatic ducts. The scope is inserted through your mouth and threaded down your digestive tract.

Esophagogastroduodenoscopy (EGD): Used to examine your esophagus, stomach, and duodenum (the first part of the small intestine). The tube is inserted through your mouth and guided down your digestive tract.

Laparoscopy: Used to examine your peritoneal cavity (the area that holds the abdominal organs). The scope is inserted through small incisions in your abdomen.

Laryngoscopy: Used to examine your larynx (voice box). The scope is inserted through your mouth.

Mediastinoscopy: Used to examine the space between your lungs (the mediastinum). The scope is inserted through an incision in your chest wall.

Proctoscopy: Used to examine the rectum (the last 6 to 8 inches of the colon or large intestine). The scope is inserted through the anus.

Thoracoscopy: Used to examine your lungs. The scope is inserted through small incisions in your chest wall.

ADVANTAGES

Endoscopies are generally painless, although they may still cause some discomfort. Compared with the stress experienced by the body in a full surgical procedure, an endoscopy is simple, low risk, and cost effective.

Other advantages include:

An endoscopy is used to diagnose conditions that affect the digestive system. Endoscopy can help identify ulcers, bleeding, celiac disease, blockages, inflammation, and tumors. It can help find the cause of unexplained symptoms, such as heartburn, abdominal pain, and bleeding, nausea, vomiting, and pain. An endoscopy is more accurate than gastrointestinal X-rays for detecting abnormal growths such as cancer.

It's considered one of the safest medical procedures and carries low level of risks.

Endoscopes can be used by an outpatients department and does not need to be done by a hospital.

This reduces costs.

RISKS AND SIDE EFFECTS OF ENDOSCOPY

An endoscopy is a relatively safe procedure. However, there are certain risks involved. Risks depend on the area that is being examined.

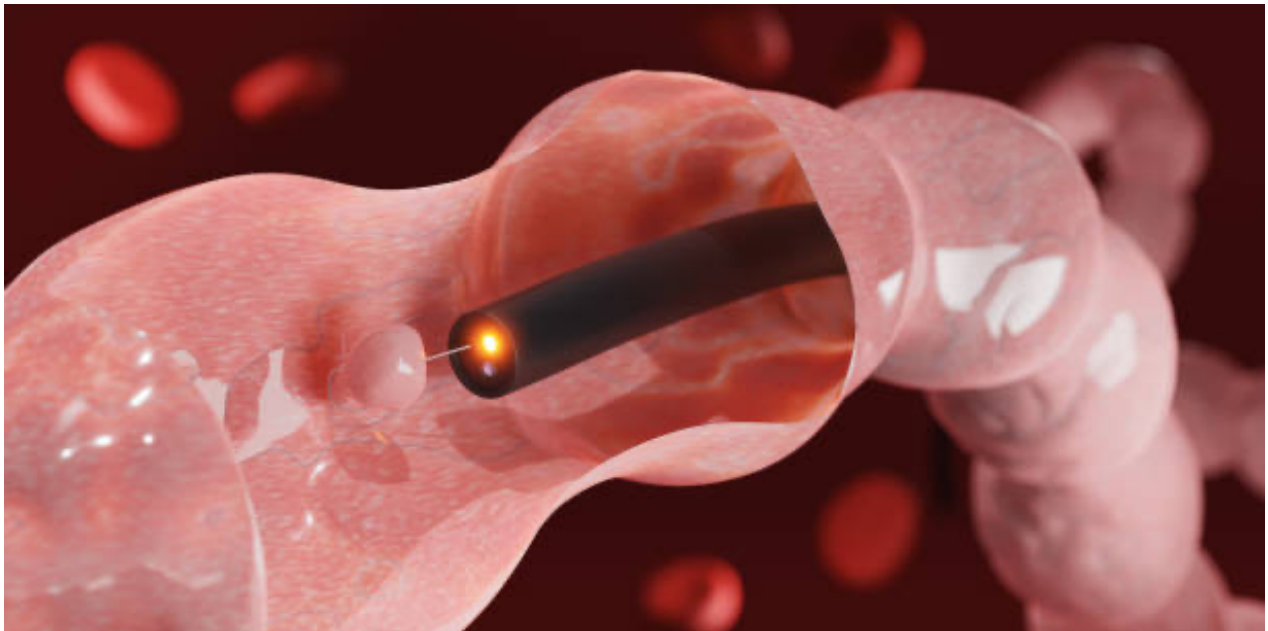
Risks of endoscopy may include:

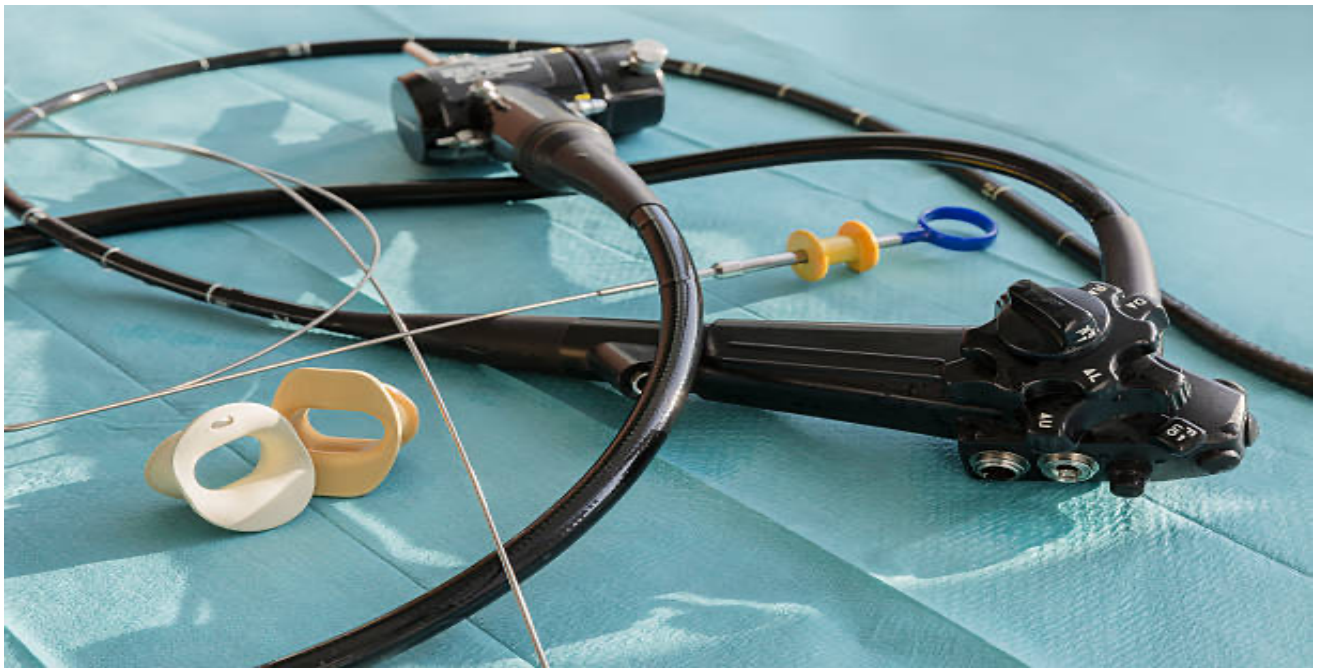
- Over-sedation, although sedation is not always necessary
- Feeling bloated for a short time after the procedure
- Mild cramping
- A numb throat for a few hours due to the use of local anesthetic
- Infection of the area of investigation, which most commonly occurs when additional procedures are carried out at the same time (the infections are normally minor and treatable with a course of antibiotics)
- Persistent pain in the area of the endoscopy
- Perforation or tear of the lining of the stomach or esophagus, a rare but serious complication
- Internal bleeding, usually minor and sometimes treatable by endoscopic cauterization
- Complications related to preexisting conditions

Any of the following symptoms should be reported to a doctor:

- Dark-colored stool
- Shortness of breath
- Severe and persistent abdominal pain
- Chest pain
- Vomiting blood

PHOTOGRAPHS OF ENDOSCOPY





CERTIFICATES





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ETiFON-2021



National Conference on
**Emerging Trends in
Functional Oxides and Nanomaterials**



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THIS IS TO CERTIFY THAT

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Department of physics, saurashtra University, Rajkot

has participated in the National Conference on
"Emerging Trends in Functional Oxides and Nanomaterials" (ETiFON-2021)
organized by Department of Physics, Saurashtra University, Rajkot, Gujarat, India
during October 28-29, 2021.

DR. P.S. SOLANKI
Convener

PROF. N.A. SHAH
Convener

PROF. M.J. JOSHI
Chairman & Head



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- *Digital & Employability Skills*
- *Financial Literacy*
- *Basics of Data Privacy & Cyber Security*
- *Nano-Entrepreneurship*



Date: 16-04-2022

Osheen Chavhan
Founder & CEO - Infispark



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A handwritten signature in blue ink.

Osheen Chavhan
Founder & CEO - InfiSpark



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Founder & CEO - InfSpark



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Founder & CEO - InfiSpark

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CONCLUSION