



## Security Ink Technology in Forensic Way

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### Abstract

Forensic science is the emerging field of science to solve the different crimes in easy way. The prominence of forensic science has resulted from scientific and technological advances, raised reliance of enforcement agencies and judicial systems and its popularization through the mass media. Forensic proof is gathered, examined, evaluated, understood and conferred to create sense of a happening and supply investigative leads. Thanks to increasing the various techniques to try and do the crime, there should be some distinctive and numerous strategies to research it. Some of the crimes are well occurred, that in investigation there are not any clues and evidence would be found to more investigation. In recent time, the crime has been severally increased as the technology improves. As it is an important question for the security purpose. There are many counterfeit actions conducted in different ways. In this short review, it is explained that how the confidential documents are being duplicating and with the help of forensic science how the experts can examine the documents. The different types of documents are also mentioned in the review. It also described the forensic way of documents examination. It elucidated the documentation printing problems and various methods of printing with ink analysis.

**Keywords:** Forensic Science; Forensic Documentation; Ink Analysis; Counterfeiting; Security Ink

**Abbreviations:** CIJ: Continuous Inkjet; DOD: Drop-On-Demand; SEM-EDX: Scanning Electron Microscope/Energy Dispersive Using X-Ray; TLC: Thin layer Chromatography; HPTLC: High Performance-Thin layered Chromatography; UV: Ultraviolet; ICP-MS: Inductively Coupled Plasma Mass; FTIR: Fourier Transform-Infrared Spectroscopy.

### Introduction of Forensic Science

Forensic science is that the application of varied fields of science and technology to analyze and establish facts of interest in an exceedingly system. The discipline of rhetorical science is split into 2 components. The word rhetorical comes from the Latin word *forēnsis*, which means “of or before the forum.” and therefore the word Science Comes from Latin word *scientia*, which means “knowledge” that may be a

assortment of systematic methodologies accustomed more and more perceive the physical world and nature. rhetorical science may be a multiple disciplinary subject that uses the information of applied science, chemistry, deoxyribonucleic acid analysis, serology, physics, social science, toxicology, pathology, entomology, botany, psychology, organic chemistry, engineering, digital techniques and linguistics etc., that on an individual basis or in combined provides rise to specialized areas of rhetorical science like laptop forensics, rhetorical chemistry, rhetorical deoxyribonucleic acid analysis, rhetorical medical science, rhetorical physics, rhetorical social science, rhetorical material medical, forensic medicine, rhetorical zoological science, rhetorical biological science, rhetorical scientific discipline, rhetorical organic chemistry, rhetorical engineering, rhetorical digital techniques, rhetorical linguistics and rhetorical document

examination [1,2]. Forensic investigation is typically disbursed in multiple steps by applying varied fields of science and technology. Proof assortment is that the initial and foremost step of any rhetorical investigation. The gathering of proof relies on the very fact that “every contact leaves a trace”. Solely human failure to seek out it, study and know it will diminish its value”. The analysis of collected proof reveals the reality so as to produce justice. Within the legal method the rhetorical proof is taken into account to be most reliable compared to eye witnesses [3,4].

## Document

Section three of Indian proof Act, 1872 defines document as “Any matter expressed or delineate upon any substance by suggests that of letters, figures or marks, or by over one amongst those suggests that, meant to be used, or which can be used, for the aim of recording that matter”. Within the broad sense a document could also be outlined as something that bears marks, signs, or symbols that have which means or conveys a message to somebody [5].

**Classification of Documents:** Usually, a document is written, however a document may also be written and may be created with footage and sound. Documents area unit usually paper primarily based. The vital documents that have an effect on our day to day lives could also be classified into following categories: [5,6]

- **Civil Documents:** Birth Registration Certificate, Death Certificate, wedding Registration/ Divorce Certificate etc.
- **Routine Documents:** ID card, elector ID card, PAN Card, Domicile Certificate, Caste Certificates, identity card, Examination Mark Sheets/ Degrees/ Certificates/ Testimonials, motorcar Registration Certificate, driver’s license.
- **Travel Documents:** PASS PORT, VISA, status Certificate, Resident Alien Card, Permanent Resident Card, Naturalization and Citizenship Certificates.
- **Bank Documents:** Cheques, Drafts, human Cheques, Currency Notes, mastercard, Debit Card, Smart Card.
- **Security Documents dead On Stamp Papers:** Demand commitment (DP) Note, Hypothecation/ Bank Guarantee etc., Agreement, Property Transfer/ Registration etc.
- **Judicial Documents:** vital Court Orders/ Judgments, Laboratory Reports.
- **Commerce connected Documents:** Patents and replica Rights Certification, Logo etc.
- **Paper-Less or Digital Documents:** Electronic cash Transfers through Websites, on-line Transactions, e-Banking Solutions etc. counting on the technology accustomed manufacture the documents area unit classified as written, typed, photocopied and written.
- **Handwritten Documents:** These documents area

created by people, who exploitation in writing instruments and materials. Several designs are utilized in written documents over centuries. Writing instruments embody pens, pencils, inks and marker.

- **Typed Documents:** written documents area unit created exploitation writing machine. Written documents vary counting on the typefaces of the machine. Every sort machine has sort letters explicit thereto machine. They’ll have specific physical options counting on the maker of the machine.
- **Photocopy Documents:** Photocopied documents area unit created by repetition original written or written documents by electro photography procedure. Photocopied documents look kind of like written document for the untrained eye. Photocopiers area unit machines that manufacture documents kind of like the first documents. Photocopiers, like optical maser printers area unit electricity machines altogether respects, the sole distinction being that electrostatic printer manufacture grid pattern in document. Most of solid documents like counterfeit currency area unit created exploitation color photocopiers or color printers.
- **Printed Documents:** The written documents area unit created exploitation numerous printing mechanisms. written documents contain options of a printer counting on [7]
  - 1) The such procedure utilized by them for putting the marking material i.e. ink on the paper e.g. Dot matrix, Laser, Inkjet etc.
  - 2) Inks or toners utilized in that method.

Printed Documents dissent within the print pattern, range of drops per dot and technology accustomed print, like Drop on demand thermal printing, Inkjet technology, optical maser technology etc. Printing instruments commercially accessible in market nowadays area unit inkjet printers, Laserjet printers and offset printers [8].

**Questioned Documents:** The documents, whose credibleness or supply are suspected or questioned area unit known as Questioned documents. A “Questioned” document is any signature, handwriting, writing or alternative mark whose supply or credibleness is relevant or uncertain. typically the written, written or typed documents area unit the foremost common questioned documents, though marks on doors, walls, windows or boards would even be thought of as questioned documents [9].

**Document Forensics:** Document plays a vital role in everybody’s life. Document affects our lives from birth until death e.g. the documents like credentials, positive identification, bank transactions and death certificates area unit used throughout the lifetime of a personality’s being. Any modification in any a part of document alters its which means leading to the loss to at least one of the concerned party. Document Forensics is that the discipline of rhetorical

science bearing on documents that area unit controversial in an exceedingly court of law. A document examiner is usually asked to answer several queries like the origin of supply of document. The standards of the yankee Society for Testing and Materials, International (ASTM) states that associate degree examiner “makes scientific examinations, comparisons, and analysis of documents so as to: establish genuineness or non-genuineness or to show forgery or to reveal alterations, additions or deletions, to spot or eliminate persons because the supply of handwriting, determine or eliminate the supply of typing or alternative impressions, marks/ relative proof, and write reports or offer testimony, once required, to help the users of the examiner’s services in understanding the examiner’s findings. Document forensics is that the field that has emerged to help the interpretation of proof in courts that deals with obtaining proof from the questioned documents. Ink may be a liquid or paste accustomed color a surface to supply a picture, text or style. Ink is employed for drawing or writing or printing with a pen, brush, quill or printer. Ink has existed since it had been employed in the traditional world. These early inks used a carbonous compound base and that they are often divided into sepia inks and Indian/Chinese inks. Such inks were in common use till roughly the twelfth century. Within the early twelfth century, iron-gallotannate inks became standard, though there’s ample proof that they were in use at a way earlier date. These inks combined with iron salts were blue or blue-green. Over the centuries there are various changes in ink formulation, as an example the elimination of corrosion [10,11].

In most fountain pens just about any properly created ink are often used, even supposing several pen makers attempt to promote sales of their own label ink. As a degree of curiosity, the initial which means of “blue-black” ink wasn’t an outline of a color, however rather of a method. The ink was blue upon writing, however later once oxidization it turned black. Characterization of early ball-point pen inks is evident. Until 1950, all inks had wash-and-wear dyestuffs or iron gallotannate and oil-based solvents. Typically rosin or rosin acid was accustomed improve body. Solely in 1953, however, ball-points became a preferred item with the writing public. Copper phthalocyanine dyes were introduced into inks by experimentation in 1954 and commercially before long thenceforth. Some issues with the initial ball-point inks were slow drying, broadening of written lines throughout the drying method, fading, and smudging. Second generation ball-point inks area unit composed of a solvent, a coloring agent, anti-corrosives, waterproofing, and “private” materials. to boost the ink characteristics the fashionable inks area unit currently containing several substances like dyes, pigments, vehicles, surfactants, resins, lubricants, solubilizers, material, fluoresces, humectants, driers, plasticizers, waxes, greases, soaps and detergents etc [12,13]. Each part is completely different functions like

dyes or pigments area unit used as a color. The color is also dye or pigment or may be their combination. Dyes area unit soluble within the liquid body of the ink i.e. vehicle. Pigments are unit insoluble in vehicle as they’re finely grounded multi-molecular granules. The composition of auto affects the flowing and drying characteristics of the ink. The comparison of various writing/printing inks on a document is that the main goal of the foremost investigations. Usually inks can be in binary compound, liquid, paste or powder type. A number of the inks area unit classified and mentioned below reckoning on the writing/printing instrument [14]:

- **Fountain Pen Inks:** There are unit 2 forms of pen ink iron gallotannate kind and solution of artificial dyes. Fashionable inks of kind 2 contain artificial blue dyes to produce a right away blue color to that bit by bit turns black once oxidization on paper. This explains the origin of the name blueish pen ink. This category of ink is additionally terribly stable. This ink is insoluble in water and can’t be effectively erased by abrasion. The foremost standard pen ink consists of associate degree binary compound artificial dye. These inks area unit bright and engaging in color, however they’re not nearly as stable because the carbon blueish inks. A number of the artificial dyes are used fade and soluble in water. The foremost fashionable ink of this kind contains pigmented dyes, like copper phthalocyanine that makes these inks far more permanent [14].
- **Ballpoint Pen Inks:** The Biro developed in Europe regarding 1939 and was at first distributed in Argentina regarding 1943. In 1946, many million Sir Joshua Reynolds ballpoint pen pens reached the market within the united state. Biro inks contain artificial dyes in varied glycol solvent or group alcohol. The dyes in ballpoint pen inks will contain up to five hundredth of the whole formulation. Many alternative ingredients square measure typically additional to the ink to impart specific characteristic. These ingredients contains fatty acids, resins, surface active agents, corrosion management ingredients and additives kind of like those in rolling ball marker inks and fountain inks. The water based mostly inks square measure clearly water soluble, wherever because the dissolving agent based mostly inks square measure water resistance and may solely be dissolved with sturdy organic solvents. Formamide or glycol solvents square measure essential ingredient in fiber tip inks to stay the fiber tip from drying out. Fiber tip inks that contain metalized dyes square measure lightweight quick [14].
- **Gel Pen Ink:** The most recent development within the writing instrument trade is that the introduction of the gel pen by the japanese. Four brands of gel pen are introduced. (1) The Uni ball signo by Mitsubishi; (2) the equid j-5; (3) the pentel Hybrid; and (4) the sakura Gilly roll pen. These pens are marketed by the Japanese

since the mid-1980s and a restricted provide of the pens was oversubscribed within us regarding 1993. Gel inks contain fully insoluble colored pigments instead of organic dyes. Writing with ink is extremely kind of like the looks of the writing with a Biro. This ink, that is water based mostly, could be a gel and not a liquid. It's insoluble each in water and robust organic solvents. This property makes it not possible to investigate for the aim of comparison 2 or a lot of inks of this kind [15].

- **Dye Pack:** Dye pack could be a red stain wont to mark purloined currency. it's a guided incendiary device employed by some banks to preemptively foil a bank theft by inflicting purloined money to be for good marked with dye shortly once a theft. Dye pack contains 1-methylaminoanthraquinone (MAAQ) moreover as alternative dyes [15].
- **Printing Ink:** In the past centuries the printing trade might be mentioned terribly exactly thanks to the existence of only 1 or 2 writing. Nowadays the situation is extremely completely different. Recently the technology is obtaining advanced day by day and therefore the role of printer is dynamical. The quick growing dynamical setting causes the printer to stay on dynamical as per the need and additionally the printer's ink. All of the most important and minor parts of ink confirm the top behavior of the print quality [2]. A good printer's ink should meet each press and print needs. In printing inks, four completely different colors of ink square measure employed: cyan, magenta, yellow and black. All alternative colors will be shaped by 'overprinting' these inks, e.g., red is made by overprinting yellow and magenta, because the yellow absorbs the blue lightweight and magenta absorbs the inexperienced light, yield pure red lightweight. Cyan, magenta and yellow add along to convey brown color typically. Printing inks square measure developed to transfer and reproduce a picture from a printing surface so as to convey a message, to convey an ornamental impact to the substrate or to serve several alternative functions. The printing film thickness can rely on the method used that is typically between a pair of and three  $\mu\text{m}$ . color printing inks primarily contains oil, soyabean oil, or an important oil liquid because the solvent combined with organic pigments created from salts of nitrogen-containing compounds. Inorganic pigments in printing inks embody chrome inexperienced, Prussian blue, pigment and molybdate orange. White pigments, like pigment, square measure used either by themselves or to regulate characteristics of color inks. Most red writing inks square measure dilute resolution of the red dye fluorescein. Blue color will be obtained with substituted triphenylmethane dyes etc [16-18].
- **Copier/Printer Toners:** Toner could be a fine ink utilized in optical device printers and photocopiers. Earlier toner

was a combination of carbon powder, iron compound and alternative parts. duplicator and electrostatic printer toners usually contains resins; cross-linking agents; binding agents; carriers; varied additives and with color optical device printers, coloring agents. The carbon was softening and mixed with a compound. Toner particles square measure dissolved by the warmth of the fuser, and bind to the paper. The particular compound used varies with manufacturer however will be a will be a vinylbenzene salt polymer, a polyester organic compound, a vinylbenzene hydrocarbon polymer, or a number of alternative special polymers. Toner formulations vary from manufacturer to manufacturer and even from machine to machine. Usually formulation, grain size and freezing point vary the foremost. Toner has historically been created by combining the ingredients and making a block that was broken or pelletized, then changed into a fine powder with a controlled particle size vary by air jet edge. The results square measure in toner granules with varied sizes and rounded in form. To urge a fine print, some firms square measure employing an activity to grow toner particles from molecular reagents. This leads to a lot of uniform size and shapes of toner particles. The smaller uniform shapes allow a lot of correct color replica and a lot of economical toner use. trendy optical device toner cartridges supposed to be used in color copiers and printers are available cyan, Magenta, Yellow and Black [19]. Toners usually carries with it binder rosin like cinnamene, phenylethylene by-product homopolymers, phenylethylene copolymers; magnetic materials like Iron oxides, magnetic metals; Surface treating agents like Silane coupling agents and Ti coupling agents; Surface active agents like Na dodecyl sulphate and Na tetradecyl sulfate; Charge dominant Agents like Organometallic compounds; flow ability up agents like Inorganic oxides, lampblack, and carbon fluoride; sprucing agents like metal oxides, nitrides, carbides and metal salts; colouring agents like lampblack in black toner, Isoindolinone compounds, anthraquinone compounds for Yellow toner, Condensation chemical group compounds, anthraquinone compounds, base dye lake compounds, phenol compounds for Magenta toner, Copper phthalocyanine compounds and derivatives for Cyan toner [17].

- **Inkjet Inks:** Inkjet inks square measure low consistency fluids, usually 4-30 centipoises and carries with it a colorant, solvent, binder and additive. Manufactures are square measure typically reluctant to disclose specific ingredients of their ink product so as to guard their trade secrets. But several analyses have been tired the past so as to supply the ink formulations and plenty of resources square measure accessible to provide helpful info for business still as rhetorical purpose of read. Specific dye and pigment combos confirm the amount of



all different chemicals to be utilized in producing inkjet ink. The colorants in inkjet inks square measure chiefly dyes. Pigments should have a particle size but  $3\mu\text{m}$ . Dyes ought to be extremely soluble within the solvent and may have high thermal stability and lightweight fastness. to manage the consistency permanently drop formation and to bind the colorant so as to stick to the surface to be written the binders square measure utilized in inkjet inks that carries with it one or additional polymers. Finally numerous additives square measure enclosed to switch flow properties and surface energy (which ought to be  $>35\text{mN m}^{-1}$  to provide a well outlined stream of droplets) [20].

Although there square measure several variations to the inkjet ink formula, the key ingredient parts of this ink square measure colorant, water, vehicles, humectants, co-solvents, fixative, surfactants, resin, biocides/fungicide and buffering agents. Colorants will vary wide in quality and magnificence. Water soluble dyes are in inkjet inks square measure the most important demand for ink jet printers, since water is often the first solvent and ink parts should stay in resolution to stay from plugging the jet mechanism. Water that makes up fifty to ninety p.c of the combo is what dilutes the colorant and different chemicals to form the ink unfold thinly and equally because it is distributed from the cartridge. Inkjet inks comprise of various vehicles like water and/or glycol, different derivates of glycol, ethers, amides, urea, substituted organic compound, ethers, chemical group acids and their salts, esters, alcohols, organosulfides, organosulfoxides, sulfones, alcohol derivatives, so as to forestall or deter evaporation of the water-based formula co solvent and humectants square measure used. As evaporation happens at the print head, the formula and consistency of the ink will alter unfavorably. Different agents and chemicals square measure blended with the 3 major parts of the ink formula to make a final product that spreads and dries equally and adheres to the paper while not flaws, like feather [21].

The purpose of adding biocides, fungicides and buffering agents in inks is to stay the ink free from bacterium and fungi which may alter the formula and management the hydrogen ion concentration balance that's needed for long run storage. Rigorously monitored levels of fixative and penetrant materials square measure added to help with delivery of ink to paper and to manage simply what quantity ink adheres to the surface. Surfactants square measure one among main ingredient of ink management the consistency of the ink, and permit it to flow swimmingly through the cartridge. Insufficient chemical agent would possibly cause the ink to clog within the cartridge, whereas an excessive amount of chemical agent would loosen it up then cause it to drip out. Surfactants like alkyl group diphenyl chemical compound disulphonates etc. are becoming utilized in inkjet

inks. To manage the sturdiness of the written character once it's dried on the paper, generally maker's square measure mistreatment resins. Printing inks square measure applied by 5 major printing processes. The most printing processes are: Lithography, flexography, gravure, relief printing, screen printing, toner printing systems and inkjet printing. Number of the minor printing processes is measured intaglio or recess printing and planographic printing that square measure seldom used aside from special purpose. Out of all printing processes inkjet printing is common, economical and most used nowadays for business and private use [20].

### Printing Media

The computer processed documents area unit written onto paper by optical device, Inkjet, matrix Printers, etc. In matrix printer, every character is diagrammatic by a pattern of dots, and a group of the fine needles is activated by knowledge from the pc to construct the form of the relevant character by hanging through a ribbon control against the paper. Optical device printers contain a light-sensitive drum that, once it becomes charged, produces static negative of the image to be written. charged toner besprent on the drum can hold the charged areas before being ironed on the sheet of paper, manufacturing the document whereas inkjet printing generate image by the means that of non-impact victimization laptop management. It directs tiny droplets or particles in fast succession on to the surface of a substrate beneath laptop management. There are unit numerous doable ways in which of generating and sticking out droplets in inkjet printing like continuous inkjet (CIJ) and Drop-on-demand (DOD). Ink jet printers use grids of small nozzles that, once heated, visit onto the paper. Ink jet printers usually turn out print with somewhat ragged look that is simple to identify. Though' it's simple to acknowledge documents created by ink jet printers, it's difficult to differentiate between the documents created by inkjet technology [21,22].

### Ink Analysis

Just because a document seems to possess been written throughout within the same ink doesn't mean it's not been altered or more to. With the advance technologies criminals notice varied that to change the document which become nearly not possible to spot by the naked eyes. Information of the composition of ink is important to differentiate inks accustomed manufacture a faux document and to match various inks to spot the supply of the written document. Ink analysis is a crucial a part of the investigation of questioned documents, together with cheques, wills, altered records, counterfeit currency, anonymous letters, driving licenses, contracts, citizen registrations, passports, petitions, threatening letters, suicide notes and lottery tickets etc., though inks from completely different firms could look

an equivalent, there is some necessary variations in their chemical composition. These is discovered by laboratory analysis and also the results will facilitate assess whether or not there are any additions or alterations drained a document. Ink analysis will specialize in a replacement chemical and analytical strategies or techniques. It's a step to extend the discriminating power of social control agencies which may use the advance techniques of ink analysis throughout their criminal investigations. Examination of document below magnifier will give informative information. The ink is also analyzed by non-destructive or damaging strategies. it's preferred to approach the non-damaging strategies initial so the document is left intact and because the damaging strategies, alter the document below analysis [23]. Here below are some of the laboratory/instrumentation based techniques to determine or to investigate the documents.

### **Video Spectral Comparator**

The main technique of non-damaging ink analysis is examination of ink mistreatment Video Spectral Comparator. The VSC is an imaging device that enables an examiner to research inks, visualize hidden safety features, and reveal alterations on a document. It involves recording of spectra below coefficient, absorbance and coefficient of reflection mode supported the quantity of sunshine transmitted, absorbed and mirrored severally. Every ink ought to provide a spectrum. The spectrum of the ink on the document will thus be compared with the spectra of ordinary inks.

### **Scanning Microscope-Energy-Dispersive X-ray Spectrographic**

The microscopic analysis of document by Fourier rework below Red spectrographic analysis also can give valuable and distinguishable information for varied styles of ink. The coupling of Scanning microscope together with Energy-dispersive X-ray spectrographic analysis (SEM-EDX) is another non damaging analytical technique used for the basic analysis or chemical characterization of ink. SEM provides elaborated high resolution pictures of the sample by restoring a targeted ray across the surface and police investigation secondary or backscattered negatron signal whereas EDX provides elemental identification and quantitative integrative info concerning the sample. wherever there's impractical to collect the data concerning the ink from non-damaging analysis the damaging strategies also can use [24].

### **Thin Layer Chromatography**

The main technique of damaging analysis of ink is skinny Layer action (TLC). In reality, it's not terribly damaging to the document if through with care. However, a photographic

record of the first document is taken before the procedure is started. a small sample of the inked paper is punched out employing a skinny, hollow needle; a hypodermic is right. The sample is placed during a tube with a solvent that dissolves the ink. Next, a small spot of the sample resolution is placed onto attention Plate, aboard spots from varied reference ink samples. The attention Plate is placed during a beaker containing a tiny low quantity of another solvent. It's positioned so the plate dips into the solvent however the spots of sample stay dry. The solvent is caught up the attention plate through capillarity and also the sample spots move up with it. The tip result with attention may be a pattern of colored spots, referred to as a recording, for every ink. Inks can have different chromatograms. If the sample ink has an equivalent recording mutually of the reference inks, it suggests they're an equivalent and then identification is created.

### **High Performance-Thin layered Chromatography**

Another technique known as High Performance skinny Layer action (HPTLC) is an increased sort of attention and may be used as another thereto. It involves the applying of ink samples and commonplace on activity plate and developing the plate in appropriate solvents. when the activity development it permits the detection and scanning of spots together with the documentation of chromatic plate [22,24].

### **UltraViolet Visible Photometer**

UV-Visible is another damaging technique to spot what's in an ink. UV-Visible photometer is an instrument accustomed live the quantity of ultraviolet (UV) and visual lightweight absorbed by an answer. Reckoning on the substance, the chemical absorbs a precise quantity of sunshine that causes electrons to maneuver from one energy state to a better one. The quantity of sunshine that reaches the instrument's detector is then recorded as a spectrum. The basic analysis of ink will give wonderful distinguishable options for ink.

### **Inductively Coupled Plasma Mass**

Inductively Coupled Plasma Mass or ICP-MS is an analytical technique used for elemental determinations. The basic identification of ink will prove as a good tool for the analysis of suspected ink and so its comparison with the identification of ordinary inks.

### **Fourier Transform-Infrared Spectroscopy**

Besides all the techniques Fourier Transform-Infra Red spectrographic analysis is taken into account to be an awfully powerful technique. It's accustomed acquire spectrum of a

solid, liquid or gas supported useful teams of the compound gift in sample. FTIR mass spectrometer at the same time collects spectral information during a wide spectral varies. This makes infrared spectrographic analysis helpful for many styles of analysis [25].

### Forensic Document Examination

The Forensic Examiners encountered the analysis of following documents in their routine case works: [26]

- a. Identification of handwritten documents.
- b. Identification of forged documents.
- c. Identification of typewriter.
- d. Deciphering obliterations, alterations and erasures.
- e. Identification of inks and writing instruments.
- f. Printer identification of the document.
- g. Photograph tampering.

### Problems in Printed Documents

It has been noted that there's a big increase within the variety of documents ready by printers, copiers and multisystem perform within the past four decades. The intensive access, simple use, straightforward affordability of those systems makes it easy to make dishonorable document employing an ink and/or toner. Examination of written questioned document plays a serious role within the investigation of various cases. Though most of the documents area unit currently made victimization strategies that deter counterfeiting because of the actual colored fibers, advanced patterns, and specialized inks accustomed turn out documents. It makes forgery extraordinarily tough however still the criminals usually commit to forgery them. Determination of credibleness of various varieties of documents will bring about to issues of characterizing a number of the materials accustomed turn out the document like ink and/or toner. Determinative the whole of printer or setup and/or establishing, however a document was made area unit major a part of verification of authentication of document. Microscopically it's potential to determine however a document was made to some extent. Determination of the whole of printer might involve a qualitative analysis of the ink gift on the document. Within the context of written questioned documents examination, rhetorical analyst must answer the queries like: [24-26]

1. Is that the document consistent, implying whether or not the content written within the document is ready from one source?
2. Identification of supply printer or printing techniques.
3. Area unit 2 documents similar, i.e., written victimization printer were of same brand?
4. Simply because a document seems to own been written throughout within the same ink doesn't mean it's not been altered or additional too. To mend the geniuses

of the document: data of the composition of ink is important to differentiate the inks accustomed turn out a faux document or to match various inks and to spot the supply of the written document.

5. Though all inks of various firms might look a similar, there may be some necessary variations in their chemical composition. These may be discovered by laboratory analysis and therefore the results will facilitate to assess whether or not there are any additions or alterations exhausted a document.

### Conclusion

This study is incredibly helpful for the supply identification of printer wont to print extortion /threatening letter also on verify whether or not the actual printer was wont to print a suspected document or counterfeit currency. The comparison of 2 or a lot of ink entries to see similarities or variations in inks are often administrated with the results conferred during this study. This will give data regarding whether or not entries are another or altered. The study is additionally terribly useful to see whether or not 2 or a lot of entries were written with constant formula and batch of ink. This provides a lead whether or not sure document might is written with constant printer or not.

### References

1. Wang Z, Wan L, Shao Y, Zou D, Liu N, et al. (2019) Three-Dimensional Printing Technology Combined with Postmortem Computed Tomography Angiography as New Form of Forensic Evidence: A Case Report. *Am J Forensic Med Pathol* 40(1): 61-64.
2. Dave PY (2020) A Path of Sympathetic to the Forensic Science from the Sight of Forensic Anthropology. *J Forensic Res* 11(5): 1-8.
3. (2012) Informatiktage Scientific informatics congress. *Lecture Notes in Informatics*, GI edition, Seminars.
4. Trejos T, Torrione P, Corzo R, Raeva A, Subedi K, et al. (2016) A Novel Forensic Tool for the Characterization and Comparison of Printing Ink Evidence: Development and Evaluation of a Searchable Database Using Data Fusion of Spectrochemical Methods. *J Forensic Sci* 61(3): 715-724.
5. Szafarska M, Wietecha Pośluszny R, Woźniakiewicz M, Kościelniak P (2011) Application of capillary electrophoresis to examination of color inkjet printing inks for forensic purposes. *Forensic Sci Int* 212(1-3): 78-85.
6. Szafarska M, Solarz A, Wietecha Pośluszny R,

- Woźniakiewicz M, Kościelniak P (2010) Extraction of colour inkjet printing inks from printouts for forensic purpose. *Acta Chim Slov* 57(4): 963-971.
7. Schweitzer W, Thali M, Aldomar E, Ebert L (2020) Overview of the use of 3D printing in forensic medicine. *Rechtsmedizin* 30(5): 292-299.
  8. Dave PY (2020) Short Review on Printing Ink Technology to Prevent Counterfeit of the Products. *J Adv Chem Sci* 6(4): 693-697.
  9. Roach P, Shirtcliffe NJ, Newton MI (2008) Progress in superhydrophobic surface development. *Soft Matter* 4(2): 224-240.
  10. Trejos T, Flores A, Almirall JR (2010) Micro-spectrochemical analysis of document paper and gel inks by laser ablation inductively coupled plasma mass spectrometry and laser induced breakdown spectroscopy. *Spectrochim Acta Part B At Spectrosc* 65(11): 884-895.
  11. Marro A, Bandukwala T, Mak W (2016) Three-Dimensional Printing and Medical Imaging: A Review of the Methods and Applications. *Curr Probl Diagn Radiol* 45(1): 2-9.
  12. Kula A, Król M, Wietecha Połuszny R, Woźniakiewicz M, Kościelniak P (2014) Application of CE-MS to examination of black inkjet printing inks for forensic purposes. *Talanta* 128: 92-101.
  13. Kanaparthi A, Katne T, Gantala R, Gotoor S (2020) Delve into the third dimension: Pertinence of 3D printing in forensic odontology. *J Indian Acad Oral Med Radiol* 32(2): 172-177.
  14. S Khanna (2017) Exploring the 3rd Dimension: Application of 3D Printing In Forensic Odontology. *J Forensic Sci Crim Investig* 3(4): 1-4.
  15. Itamiya H, Sugita R (2015) Effects of printing and ninhydrin treatment on forensic analysis of paper. *Forensic Sci Int* 255: 38-42.
  16. Rawlani SM, Rawlani SS, Bhowate RR, Chandak RM, Khubchandani M (2017) Racial characteristics of human teeth. *Int J Forensic Odontology* 2(1): 38-42.
  17. Heidari Rarani M, Rafiee Afarani M, Zahedi AM (2019) Mechanical characterization of FDM 3D printing of continuous carbon fiber reinforced PLA composites. *Compos Part B Eng* 175: 107147.
  18. Dave PY, Jyoti Sharma (2020) Carbon Dot-Lanthanide Composite Based Smart Luminescent Anticounterfeiting Material. *J Nanosci Technol* 6(4): 924-927.
  19. Gross AC, Erkal JL, Lockwood SY, Chen C, Spence DM (2014) Evaluation of 3D printing and its potential impact on biotechnology and the chemical sciences. *Anal Chem* 86(7): 3240-3253.
  20. Corzo R (2018) Elemental Characterization of Printing Inks and Strengthening the Evaluation of Forensic Glass Evidence. Florida International University.
  21. Errickson A, Fawcett H, Thompson TJU, Campbell A (2020) The effect of different imaging techniques for the visualisation of evidence in court on jury comprehension. *Int J Legal Med* 134(4): 1451-1455.
  22. Ebert LC, Thali MJ, Ross S (2011) Getting in touch-3D printing in Forensic Imaging. *Forensic Sci Int* 211(1-3): e1-e6.
  23. Subedi K, Trejos T, Almirall J (2015) Forensic analysis of printing inks using tandem laser induced breakdown spectroscopy and laser ablation inductively coupled plasma mass spectrometry. *Spectrochim Acta Part B At Spectrosc* 103-104: 76-83.
  24. Carew RM, Errickson D (2020) An Overview of 3D Printing in Forensic Science: The Tangible Third-Dimension. *J Forensic Sci* 65(5): 1752-1760.
  25. Carew RM, Morgan RM, Rando C (2019) A Preliminary Investigation into the Accuracy of 3D Modeling and 3D Printing in Forensic Anthropology Evidence Reconstruction. *J Forensic Sci* 64(2): 342-352.
  26. Oliver J, Chen J (2002) Use of Signature Analysis to Discriminate Digital Printing Technologies. *Int Conf Digit Print Technol*, pp: 218-222.

