DAYANANDA SAGAR ACADEMY OF TECHNOLOGY AND MANAGEMENT

Lecture Notes on

RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS – 21RMI56

Prepared by

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Subject: **RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS**

Subject Code: **21RMI56**

COURSE OVERVIEW

The architecture of course contents introduces an individual into the field of research inferring its fundamentals, objectives, motivation and ethics towards engineering research. The course contents emphasizes on literature review pattern and technical reading focused towards publishing the research work with proper attributions and citations to the support system. The course contents introduce an individual as a researcher towards intellectual property rights and further grading into the capacities of patenting with necessary validation protocols. Further the concepts of copyrights and trademarks ensure proper understanding about its adaptation and precautions while applying the principles of any other previous references in ongoing research. Several case studies also validate the same. Industrial design rights, acts and laws ensure the learner to advance his/her findings towards the registration of their design. Geographical indications highlight the aspects of nativity of the product and its global impact upholding the credibility of its surroundings

COURSE OBJECTIVES

- To understand the knowledge on basics of research and its types.
- To learn the concept of Literature Review, Technical Reading, Attributions and Citations.
- To discuss the concepts of Intellectual Property Rights in engineering
- To interpret the concepts of copyrights, trademarks, GI and Industrial design

COURSE OUTCOMES

CO'S	Course outcomes: students will be able to
C01	Understand the fundamentals of research problem formulation and illustrate the importance of IPR in growth of individuals and nation.
C02	Apply different principles of ethics and corporate social responsibility in research publication and IPR
C03	Analyse the operational procedure of Literature Review, Technical Reading, and Drafting Processes of IPR and Publications
C04	Investigate the strategic plan for the efficient and effective distribution on research and IPR concepts that respond to evolving markets.

COURSE DETAILS

RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS	
Course Code - **21RMI56**	CIE Ma**rks – 50**
Teaching Hours / Week (L:T:P:S) - **1:2:0:0**	SEE Marks **– 50**
Total Hours of Pedagogy **– 25**	Total Marks **– 100**
Credits **- 02**	Exam Hours **- 03**

COURSE SYLLABUS

Module 1: Introduction

Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research, Finding and Solving a Worthwhile Problem. Ethics in Engineering Research, Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship.

Module 2: Literature Review and Technical Reading, Attributions and Citations

Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art, Bibliographic Databases: Web of Science, Google and Google Scholar, Effective Search: The Way Forward, Introduction to Technical Reading, Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet.

Attributions and Citations: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in, Books Dissertations, Dedication or Acknowledgments.

Module 3: Intellectual Property Rights, Patents and Process of Patenting

Introduction to Intellectual Property: Role of IP in the Economic and Cultural Development of the Society, IP Governance, IP as a Global Indicator of Innovation, Origin of IP, History of IP in India, Major Amendments in IP Laws and Acts in India.

Patents: Conditions for Obtaining a Patent Protection, To Patent or Not to Patent an Invention, Rights Associated with Patents, Enforcement of Patent Rights, Inventions, and Eligible for Patenting, Non-Patentable Matters, Patent Infringements, Avoid Public Disclosure of an Invention before Patenting.

Process of Patenting: Prior Art Search, Choice of Application to be Filed, Patent Application Forms, Jurisdiction of Filing Patent Application, Publication, Pre-grant Opposition,

Examination, Grant of a Patent, Validity of Patent Protection, Post-grant Opposition, Commercialization of a Patent, Need for a Patent Attorney/Agent, Can a Worldwide Patent be Obtained, Do I Need First to File a Patent in India, Patent Related Forms, Fee Structure, Types of Patent Applications, Commonly Used Terms in Patenting, National Bodies Dealing with Patent Affairs, Utility Models

Module 4: Copyrights and Related Rights and Trademarks

Copyrights and Related Rights: Classes of Copyrights, Criteria for Copyright, Ownership of Copyright, Copyrights of the Author, Copyright Infringements, Copyright Infringement is a Criminal Offence, Copyright Infringement is a Cognizable Offence, Fair Use Doctrine, Copyrights and Internet, Non-Copyright Work, Copyright Registration, Judicial Powers of the Registrar of Copyrights, Fee Structure, Copyright Symbol, Validity of Copyright, Copyright Profile of India, Copyright and the word 'Publish, Transfer of Copyrights to a Publisher, Copyrights and the Word 'Adaptation', Copyrights and the Word 'Indian Work', Joint Authorship, Copyright Society, Copyright Board, Copyright Enforcement Advisory Council (CEAC), International Copyright Agreements, Conventions and Treaties, Interesting Copyrights Cases.

Trademarks: Eligibility Criteria, Who Can Apply for a Trademark, Acts and Laws, Designation of Trademark Symbols, Classification of Trademarks, Registration of a Trademark is Not Compulsory, Validity of Trademark, and Types of Trademark Registered in India, Trademark Registry, and Process for Trademarks Registration, Prior Art Search, and Famous Case Law: Coca-Cola Company vs. Bisleri International Pvt. Ltd.

Module 5: Industrial Design, Geographical Indications and Case studies on Patents

Industrial Designs: Eligibility Criteria, Acts and Laws to Govern Industrial Designs, Design Rights, Enforcement of Design Rights, Non-Protectable Industrial Designs India, Protection Term, Procedure for Registration of Industrial Designs, Prior Art Search, Application for Registration, Duration of the Registration of a Design, Importance of Design Registration, Cancellation of the Registered Design, Application Forms, Classification of Industrial Designs, Designs Registration Trend in India, International Treaties, Famous Case Law: Apple Inc. vs. Samsung Electronics Co.

Geographical Indications: Acts, Laws and Rules Pertaining to GI, Ownership of GI, Rights Granted to the Holders, Registered GI in India, Identification of Registered GI, Classes of GI, Non-Registerable GI, Protection of GI, Collective or Certification Marks, Enforcement of GI Rights, Procedure for GI Registration Documents Required for GI Registration, GI Ecosystem in India.

Case Studies on Patents: Case study of Curcuma (Turmeric) Patent, Case study of Neem Patent, Case study of Basmati patent, IP Organizations in India, Schemes and Programs

Textbooks

1. Dipankar Deb • Rajeeb Dey, Valentina E. Balas "Engineering Research Methodology", ISSN 1868-4394 ISSN 1868-4408 (electronic), Intelligent Systems Reference Library, ISBN 978-981-13- 2946-3 ISBN 978-981-13-2947-0 (eBook), https://doi.org/10.1007/978-981-13-2947-0
2. Intellectual Property A Primer for Academia by Prof. Rupinder Tewari and Ms. Mamta Bhardwaj

Reference books

1. David V. Thiel "Research Methods for Engineers" Cambridge University Press, 978-1-107-03488- 4
2. Intellectual Property Rights by N.K.Acharya Asia Law House 6th Edition. ISBN: 978-93-81849-30-9

COURSE ASSESSMENT DETAILS

Assessment Details (both CIE and SEE)

- The Weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.
- The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50).
- A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.
- Continuous Internal Evaluation:
    - Three Unit Tests each of 20 Marks (duration 01 hour)
    - First test at the end of 5th week of the semester
    - Second test at the end of the 10th week of the semester
    - Third test at the end of the 15th week of the semester
    - Two assignments each of 10 Marks
    - First assignment at the end of 4th week of the semester
    - Second assignment at the end of 9th week of the semester
    - Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)
- At the end of the 13th week of the semester The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks (to have less stressed CIE, the portion of the syllabus should not be

common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

- CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the Outcome defined for the course.
- Semester End Examination: Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)
    - The question paper will be set for 100 marks. Marks scored shall be proportionally reduced to 50 marks
    - The question paper will have ten questions. Each question is set for 20 marks.
    - There will be 2 questions from each module. Each of the two questions is under a module (with a maximum of 2 sub-questions).
    - The students have to answer 5 full questions, selecting one full question from each module. Marks scored by the students will be proportionally scaled down to 50 marks

INDEX

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MODULE 1: INTRODUCTION

Syllabus

Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research, Finding and Solving a Worthwhile Problem. Ethics in Engineering Research, Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship.

MEANING OF RESEARCH

- Research refers to a careful, well-defined (or redefined), objective, and systematic method of search for knowledge, or formulation of a theory that is driven by inquisitiveness for that which is unknown and useful on a particular aspect so as to make an original contribution to expand the existing knowledge base.
- Research involves formulation of hypothesis or proposition of solutions, data analysis, and deductions; and ascertaining whether the conclusions fit the hypothesis.
- Research is a process of creating, or formulating knowledge that does not yet exist. Thus research is an art of scientific investigation

OBJECTIVES OF ENGINEERING RESEARCH

The purpose of research is to discover answers to questions through the application of scientific procedures. The main aim of research is to find out the truth which is hidden and which has not been discovered as yet. Though each research study has its own specific purpose, we may think of research objectives as falling into a number of following broad groupings:

1. Exploratory or Formulative research studies: To gain familiarity with a phenomenon or to achieve new insights into it
2. Descriptive research studies: To portray accurately the characteristics of a particular individual, situation or a group

3. Diagnostic research studies: To determine the frequency with which something occurs or with which it is associated with something else
4. Hypothesis-testing research studies: To test a hypothesis of a causal relationship between variables

The objective of engineering research is

- To solve new and important problems, and since the conclusion at the end of one's research outcome has to be new, but when one starts, the conclusion is unknown.
- Research objectives can sometimes be convoluted and difficult to follow. Knowing where and how to find different types of information helps one solve engineering problems, in both academic and professional career.
- Lack of investigation into engineering guidelines, standards, and best practices result in failures with severe repercussions. As an engineer, the ability to conduct thorough and accurate research while clearly communicating the results is extremely important in decision making.
- The main aim of the research is to apply scientific approaches to seek answers to open questions, and although each research study is particularly suited for a certain approach
- The objectives of engineering research should be to develop new theoretical or applied knowledge and not necessarily limited to obtaining abilities to obtain the desired result.
- The objectives should be framed such that in the event of not being able to achieve the desired result that is being sought, one can fall back to understanding why it is not possible, because that is also a contribution toward ongoing research in solving that problem.

MOTIVATION IN ENGINEERING RESEARCH

The possible motives may be the result of one or more of the following desires:

- Studies have shown that intrinsic motivations like interest, challenge, learning, meaning, purpose, are linked to strong creative performance;
- Extrinsic motivating factors like rewards for good work include money, fame, awards, praise, and status are very strong motivators, but may block creativity. For example:

Research outcome may enable obtaining a patent which is a good way to become rich and famous.

- Influences from others like competition, collaboration, commitment, and encouragement are also motivating factors in research. For example: my friends are all doing research and so should I, or, a person that I dislike is doing well and I want to do better.
- Personal motivation in solving unsolved problems, intellectual joy, service to community, and respectability are all driving factors.

The following factors would be a mix of extrinsic and intrinsic aspects:

- Wanting to do better than what has been achieved in the world
- Improve the state of the art in technology
- Contribute to the improvement of society
- Fulfillment of the historical legacy in the immediate socio-cultural context.

Several other factors like government directives, funding opportunities in certain areas, and terms of employment, can motivate people to get involved in engineering research.

TYPES OF ENGINEERING RESEARCH

Descriptive versus Analytical:

- Descriptive research includes comparative and co relational methods, and fact-finding inquiries, to effectively describe the present state of art. The researcher holds no control over the variables; rather only reports as it is.
- Descriptive research also includes attempts to determine causes even though the variables cannot be controlled.
- On the contrary, in analytical research, already available facts for analysis and critical evaluation are utilized. Some research studies can be both descriptive and analytical

Applied versus Fundamental:

- Research can either be applied research or fundamental (basic or pure) research.

- Applied research seeks to solve an immediate problem facing the organization, whereas fundamental research is concerned with generalizations and formulation of a theory.
- Research concerning natural phenomena or relating to pure mathematics are examples of fundamental research.
- Research to identify social or economic trends, or those that find out whether certain communications will be read and understood are examples of applied research.
- The primary objective of applied research is to determine a solution for compelling problems in actual practice, while basic research is aimed at seeking information which could have a broad base of applications in the medium to long term.

Quantitative versus Qualitative:

- Quantitative research uses statistical observations of a sufficiently large number of representative cases to draw any conclusions
- While qualitative researchers rely on a few non representative cases or verbal narrative in behavioral studies such as clustering effect in intersections in Transportation engineering to make a proposition.

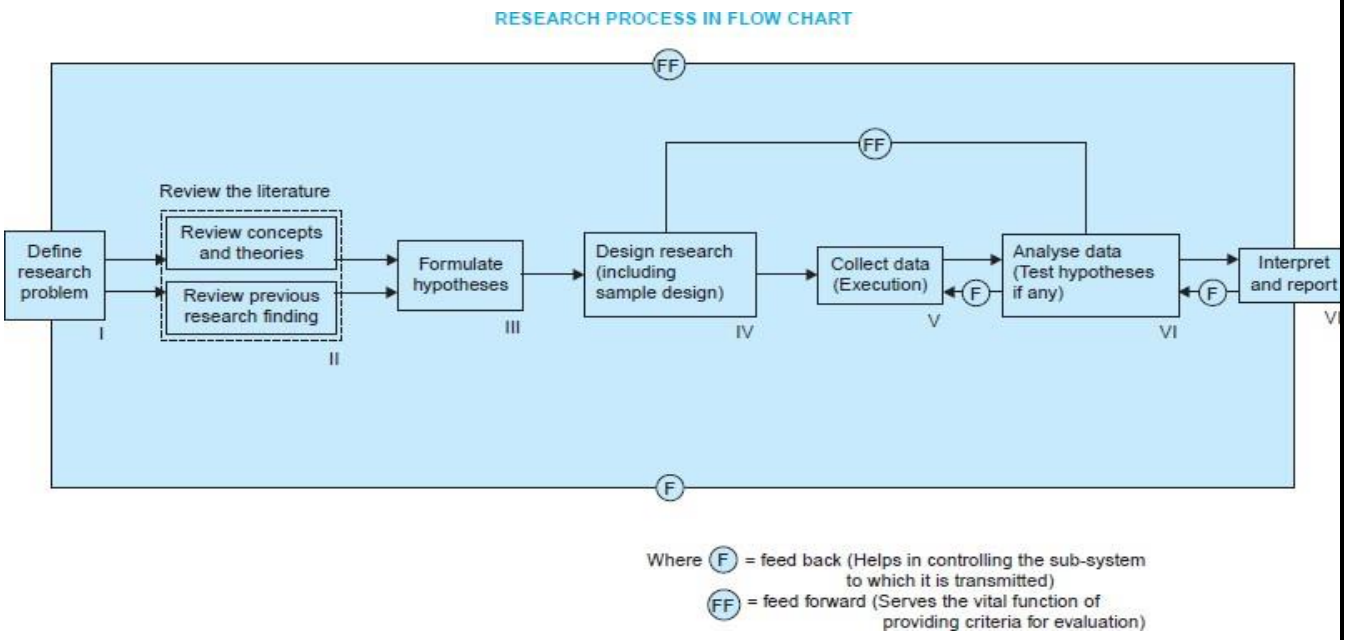
Conceptual vs. Empirical

- Conceptual research is that related to some abstract idea(s) or theory.
- It is generally used by philosophers and thinkers to develop new concepts or to reinterpret existing ones.
- On the other hand, empirical research relies on experience or observation alone, often without due regard for system and theory.
- It is data-based research, coming up with conclusions which are capable of being verified by observation or experiment. We can also call it as experimental type of research.
- In such a research it is necessary to get at facts firsthand, at their source, and actively to go about doing certain things to stimulate the production of desired information.
- In such a research, the researcher must first provide himself with a working hypothesis or guess as to the probable results. He then works to get enough facts (data) to prove or disprove his hypothesis.

- He then sets up experimental designs which he thinks will manipulate the persons or the materials concerned so as to bring forth the desired information.
- Such research is thus characterized by the experimenter's control over the variables under study and his deliberate manipulation of one of them to study its effects.
- Empirical research is appropriate when proof is sought that certain variables affect other variables in some way. Evidence gathered through experiments or empirical studies is today considered to be the most powerful support possible for a given hypothesis.

ENGINEERING RESEARCH PROCESS

Research process consists of series of actions or steps necessary to effectively carry out research and the desired sequencing of these steps.



The chart indicates that the research process consists of a number of closely related activities, as shown through I to VII. But such activities overlap continuously rather than following a strictly prescribed sequence

1. **Formulating the research problem**: There are two types of research problems, viz., those which relate to states of nature and those which relate to relationships between

variables. At the very outset the researcher must single out the problem he wants to study, i.e., he must decide the general area of interest or aspect of a subject-matter that he would like to inquire into.

2. **Extensive literature survey**: Once the problem is formulated, a brief summary of it should be written down. It is compulsory for a research worker writing a thesis for a Ph.D. degree to write a synopsis of the topic and submit it to the necessary Committee or the Research Board for approval. At this juncture the researcher should undertake extensive literature survey connected with the problem.
3. **Development of working hypotheses**: After extensive literature survey, researcher should state in clear terms the working hypothesis or hypotheses. Working hypothesis is tentative assumption made in order to draw out and test its logical or empirical consequences. Hypothesis should be very specific and limited to the piece of research in hand because it has to be tested. The role of the hypothesis is to guide the researcher by delimiting the area of research and to keep him on the right track. It sharpens his thinking and focuses attention on the more important facets of the problem.
4. **Preparing the research design**: The research problem having been formulated in clear cut terms, the researcher will be required to prepare a research design, i.e., he will have to state the conceptual structure within which research would be conducted. The preparation of such a design facilitates research to be as efficient as possible yielding maximal information. In other words, the function of research design is to provide for the collection of relevant evidence with minimal expenditure of effort, time and money.
5. **Determining sample design:** The researcher must decide the way of selecting a sample or what is popularly known as the sample design. In other words, a sample design is a definite plan determined before any data are actually collected for obtaining a sample from a given population. Sampling can be done choosing a particular unit, random unit selection, systematic pattern, homogenous group (stratified sampling), quota, cluster or area, multi stages and sequential.
6. **Collecting the data**: In dealing with any real life problem it is often found that data at hand are inadequate, and hence, it becomes necessary to collect data that are appropriate. There are several ways of collecting the appropriate data which differ considerably in

context of money costs, time and other resources at the disposal of the researcher. Primary data can be collected either through experiment or through survey. If the researcher conducts an experiment, he observes some quantitative measurements, or the data, with the help of which he examines the truth contained in his hypothesis. But in the case of a survey, data can be collected by any one or more of the following ways by observation, through personal interview, through telephonic interview, by mailing the questionnaire etc

7. **Execution of the project**: It is a very important step in the research process. If the execution of the project proceeds on correct lines, the data to be collected would be adequate and dependable. The researcher should see that the project is executed in a systematic manner and in time. A careful watch should be kept for unanticipated factors in order to keep the survey as much realistic as possible.
8. **Analysis of data:** After the data have been collected, the researcher turns to the task of analyzing them. The analysis of data requires a number of closely related operations such as establishment of categories, the application of these categories to raw data through coding, tabulation and then drawing statistical inferences. The unwieldy data should necessarily be condensed into a few manageable groups and tables for further analysis. Thus, researcher should classify the raw data into some purposeful and usable categories.
9. **Hypothesis-testing**: After analyzing the data as stated above, the researcher is in a position to test the hypotheses, if any, he had formulated earlier. Do the facts support the hypotheses or they happen to be contrary? This is the usual question which should be answered while testing hypotheses. Various tests, such as Chi square test, t-test, F-test, have been developed by statisticians for the purpose. The hypotheses may be tested through the use of one or more of such tests, depending upon the nature and object of research inquiry. Hypothesis-testing will result in either accepting the hypothesis or in rejecting it.
10. **Generalizations and interpretation**: If a hypothesis is tested and upheld several times, it may be possible for the researcher to arrive at generalization, i.e., to build a theory. As a matter of fact, the real value of research lies in its ability to arrive at certain generalizations

11. **Preparation of the report or the thesis**: Finally, the researcher has to prepare the report of what has been done by him. Writing of report must be done with great care keeping in view the following:

- The layout of the report should be as follows: (i) the preliminary pages; (ii) the main text, and (iii) the end matter.
- In its preliminary pages the report should carry title and date followed by acknowledgements and foreword. Then there should be a table of contents followed by a list of tables and list of graphs and charts, if any, given in the report.
- The main text of the report should have the following parts:

  (a) Introduction: It should contain a clear statement of the objective of the research and an explanation of the methodology adopted in accomplishing the research. The scope of the study along with various limitations should as well be stated in this part.

  (b) Summary of findings: After introduction there would appear a statement of findings and recommendations in non-technical language. If the findings are extensive, they should be summarized.

  (c) Main report: The main body of the report should be presented in logical sequence and broken-down into readily identifiable sections.

  (d) Conclusion: Towards the end of the main text, researcher should again put down the results of his research clearly and precisely. In fact, it is the final summing up.
- At the end of the report, appendices should be enlisted in respect of all technical data. Bibliography, i.e., list of books, journals, reports, etc., consulted, should also be given in the end. Index should also be given specially in a published research report.

FINDING AND SOLVING A WORTHWHILE PROBLEM

- A researcher may start out with the research problems stated by the Supervisor or posed by others that are yet to be solved. Alternately, it may involve rethinking of a basic theory, or need to be formulated or put together from the information provided in a group of papers suggested by the Supervisor.
- Research scholars are faced with the task of finding an appropriate problem on which to begin their research. Skills needed to accomplish such a task at the outset, while taking care of possible implications are critically important but often not taught

- Once the problem is vaguely identified, the process of literature survey and technical reading would take place for more certainty of the worthiness of the intended problem.
- However, an initial spark is ideally required before the process of literature survey may duly begin.
- Sometimes, an oral presentation by somebody which is followed by asking questions or introspection provides this perspective which reading papers do not.
- At other times, a development in another subject may have produced a tool or a result which has direct implications to the researcher's subject and may lead to problem identification.
- A worthwhile research problem would have one or more attributes.
- It could be non intuitive/counterintuitive even to someone who knows the area, something that the research community had been expecting for sometime, a major simplification of a central part of the theory, a new result which would start off a new subject or an area, provides a new method or improves upon known methods of doing something which has practical applications, or a result which stops further work in an area.
- The researcher has to be convinced that the problem is worthwhile before beginning to tackle it because best efforts come when the work is worth doing, and the problem and/or solution has a better chance of being accepted by the research community.
- Not all problems that one solves will be great, and sometimes major advancements are made through solutions to small problems dealt with effectively. Some problems are universally considered hard and open, and have deep implications and connections to different concepts.
- The reality is that most researchers in their lifetime do not get into such problems. However, hard problems get solved only because people tackle them.
- The question a researcher has to grapple with whether the time investment is worth it given that the likely outcome is negative, and so it is a difficult personal decision to make.
- At the same time, even in the case of failure to solve the intended hard problem, there may be partial/side results that serve the immediate need of producing some results for

the dissertation. George Pólya (1887–1985) suggested a 4-step procedure for mathematical problem-solving, which is relevant to engineering researchers as well.

The recommended steps to solve a research problem are

- Understand the problem, restate it as if it's your own, visualize the problem by drawing figures, and determine if something more is needed.
- One must start somewhere and systematically explore possible strategies to solve the problem or a simpler version of it while looking for patterns.
- Execute the plan to see if it works, and if it does not then start over with another approach. Having delved into the problem and returned to it multiple times, one might have a flash of insight or a new idea to solve the problem.
- Looking back and reflecting helps in understanding and assimilating the strategy, and is a sort of investment into the future.

ETHICS IN ENGINEERING RESEARCH

- Ethics generally refers to a set of rules distinguishing acceptable and unacceptable conduct, distinguishing right from wrong as such
- Most people learn such norms in their formative years, but moral development continues through different stages of growth. Although everyone recognizes some common ethical norms, but there is difference in interpretation and application.
- Ethical principles can be used for evaluation, proposition or interpretation of laws. Although ethics are not laws, but laws often follow ethics because ethics are our shared values.
- International norms for the ethical conduct of research have been there since the adoption of the Nuremberg Code in 1947.
- According to Whitbeck, the issues related to research credit dates back to the establishment of the British Royal Society (BRS) in the seventeenth century to refine the methods and practices of modern science. This event altered the timing and credit issues on the release of research results since BRS gave priority to whoever first submitted findings for publication, rather than trying to find out who had first discovered.

- Whitbeck raised two simple but significant questions to address the tricky issue of authorship in research:
    - Who should be included as an author and
    - The appropriate order of listing of authors.
- In an increasingly interconnected world, the issue of co-authorship is very relevant to all researchers. There are issues around individuals who may be deeply involved during the conduct of the research work, but may not contribute in the drafting phase
- Government bodies and universities worldwide have adopted certain codes for research ethics. Research ethics and the responsible conduct of research are often erroneously used interchangeably.
- Research ethics examines the appropriate application of research outcomes, while responsible conduct of research deals with the way the work is undertaken.

ETHICS IN ENGINEERING RESEARCH PRACTICE

- Technological developments raise a whole range of ethical concerns such as privacy issues and data related to surveillance systems, and so engineering researchers need to make ethical decisions and are answerable for the repercussions borne out of their research as outcomes.
- The reason that ethics matter in data used in engineering research is usually because there is impact on humans. Certain practices may be acceptable to certain people in certain situations, and the reasons for unacceptability may be perfectly valid.
- We have unprecedented access to data today, and unprecedented options for analysis of these data and consequences in engineering research related to such data. Are there things that are possible to do with this data, that we agree we should not do?
- Engineering ethics gives us the rule book; tells us, how to decide what is okay to do and what is not. Engineering research is not work in isolation to the technological development taking place.
- Researchers make many choices that matter from an ethical perspective and influence the effects of technology in many different ways:
    - By setting the ethically right requirements at the very outset, engineering researchers can ultimately influence the effects of the developed technology.

  - Influence may also be applied by researchers through design (a process that translates the requirements into a blueprint to fulfill those requirements). During the design process, decision is to be made about the priority in importance of the requirements taking ethical aspects into consideration.
  - Thirdly, engineering researchers have to choose between different alternatives fulfilling similar functions.
- Research outcomes often have unintended and undesirable side effects. It is a vital ethical responsibility of researchers to ensure that hazards/risks associated with the technologies that they develop, are minimized and alternative safer mechanisms are considered.
- If possible, the designs should be made inherently safe such that they avoid dangers, or come with safety factors, and multiple independent safety barriers, or if possible a supervisory mechanism to take control if the primary process fails.

TYPES OF RESEARCH MISCONDUCT

Engineering research should be conducted to improve the state-of-the-art of technologies. Research integrity encompasses dealing fairly with others, honesty about the methods and results, replicating the results wherever possible so as to avoid errors, protecting the welfare of research subjects, ensuring laboratory safety, and so forth. In order to prevent mistakes, peer reviews should take place before the research output is published.

There may be different types of research misconduct as described, which can be summarized as follows:

- **Fabrication (Illegitimate creation of data):** Fabrication is the act of conjuring data or experiments with a belief of knowledge about what the conclusion of the analysis or experiments would be, but cannot wait for the results possibly due to timeline pressures from supervisor or customers.
- **Falsification (Inappropriate alteration of data):** Falsification is the misrepresentation or misinterpretation, or illegitimate alteration of data or experiments, even if partly, to support a desired hypothesis even when the actual data received from experiments suggest otherwise.

Falsification and fabrication of data and results, hamper engineering research and cause false empirical data to percolate in the literature, wreck trustworthiness of individuals involved, incur additional costs, impede research progress, and cause actual and avoidable delays in technical advancement.

Misleading data can also crop up due to poor design of experiments or incorrect measurement practices.

- **Plagiarism (Taking other's work sans attribution):** Plagiarism takes place when someone uses or reuses the work (including portions) of others (text, data, tables, figures, illustrations or concepts) as if it were his/her own without explicit acknowledgement.

  Verbatim copying or reusing one's own published work is termed as self-plagiarism and is also an unacceptable practice in scientific literature.

  The increasing availability of scientific content on the internet seems to encourage plagiarism in certain cases, but also enables detection of such practices through automated software packages. How are supervisors, reviewers or editors alerted to plagiarism?

  (i) Original author comes to know and informs everyone concerned.

  (ii) Sometimes a reviewer finds out about it during the review process.

  (iii) Or, readers who come across the article or book, while doing research.

  Although there are many free tools and also paid tools available that one can procure institutional license of, one cannot conclusively identify plagiarism, but can only get a similarity score which is a metric that provides a score of the amount of similarity between already published content and the unpublished content under scrutiny.

  However, a low similarity score does not guarantee that the document is plagiarism free. It takes a human eye to ascertain whether the content has been plagiarized or not.

  It is important to see the individual scores of the sources, not just the overall similarity index. Setting a standard of a maximum allowable similarity index is inadequate usage of the tool. Patchwork plagiarism is more difficult to evaluate.

  There are simple and ethical ways to avoid a high similarity count on an about to be submitted manuscript. Sometimes, certain published content is perfect for one's research paper, perhaps in making a connection or fortifying the argument presented. The published material is available for the purpose of being used fairly.

One is not expected to churn out research outcomes in thin air.

However, whatever is relevant can be reported by paraphrasing in one's own words, that is, without verbatim copy.

One can also summarize the relevant content and naturally, the summary invariably would use one's own words. In all these cases, citing the original source is important. However, merely because one has cited a source, it does not mean that one can copy sentences (or paragraphs) of the original content verbatim.

A researcher should practice writing in such a way that the reader can recognize the difference between the ideas or results of the authors and those that are from other sources. Such a practice enables one to judge whether one is disproportionately using or relying on content from existing literature.

- **Other Aspects of Research Misconduct**: Serious deviations from accepted conduct could be construed as research misconduct. When there is both deception and damage, a fraud is deemed to have taken place. Sooner or later ethical violations get exposed.

  Simultaneous submission of the same article to two different journals also violates publication policies.

  Another issue is that when mistakes are found in an article or any published content, they are generally not reported for public access unless a researcher is driven enough to build on that mistake and provide a correct version of the same which is not always the primary objective of the researcher.

ETHICAL ISSUES RELATED TO AUTHORSHIP

- Academic authorship involves communicating scholarly work, establishing priority for their discoveries, and building peer-reputation, and comes with intrinsic burden of acceptance of the responsibility for the contents of the work. It is the primary basis of evaluation for employment, promotion, and other honors.
- There is several important research conduct and ethics related issues connected to authorship of research papers and are summarized herewith in the context of engineering research.
- Credit for research contributions is attributed in three major ways in research publications: by authorship (of the intended publication), citation (of previously

published or formally presented work), and through a written acknowledgment (of some inputs to the present research).

- Authorship establishes both accountability and gives due credit. A person is expected to be listed as an author only when associated as a significant contributor in research design, data interpretation, or writing of the paper. Including "guest" or "gift" (co-authorship bestowed on someone with little or no contribution to the work) authors dilutes the contribution of those who actually did the work, inappropriately inflates credentials of the listed authors, and is ethically a red flag highlighting research misconduct.
- Sometimes, the primary author dubiously bestows co-authorship on a junior faculty or a student to boost their chances of employment or promotion, which can be termed as Career-boost authorship.
- There is also an unfortunate malpractice of co-authorship that can be described as "Career-preservation authorship" wherein a head of the department, a dean, a provost, or other administrators are added as Coauthors because of quid pro quo arrangement wherein the principal author benefits from a "good relation" with the superiors and the administrator benefits from authorship without doing the required work for it. Sometimes, an actual contributor abstains from the list of authors due to no disclosed conflict of interest within the organization. Such co-authorships can be termed as ghost co-authorship. Full disclosure of all those involved in the research is important so that evaluation can happen both on the basis of findings, and also whether there was influence from the conflicts.
- In another type of questionable authorship, some researchers list one another as coauthors as a reciprocal gesture with no real collaboration except minimal reading and editing, without truly reviewing the work threadbare.
- Some authors, in trying to acquire a sole-authored work, despite relying on significant contribution to the research work from others, recognize that effort only by an acknowledgment, thereby misrepresenting the contributions of the listed authors.
- The unrecognized "author" is as a consequence, unavailable to readers for elaboration.
- All listed authors have the full obligation of all contents of a research article, and so naturally, they should also be made aware of a journal submission by the corresponding author.

- It is imperative that their consent is sought with respect to the content and that they be agreeable to the submission.
- In case of misconduct like inappropriate authorship, while the perpetrator is easier to find, the degree of appropriate accountability of the coauthors is not always obvious. Being able to quantify the contributions so as to appropriately recognize and ascertain the degree of associated accountability of each coauthor, is appealing.
- Double submission is an important ethical issue related to authorship, which involves submission of a paper to two forums simultaneously. The motivation is to increase publication possibility and possibly decrease time to publication. Reputed journals want to publish original papers, i.e., papers which have not appeared elsewhere, and strongly discourage double submission.

MODULE 2: LITERATURE REVIEW AND TECHNICAL READING, ATTRIBUTIONS AND CITATIONS

Syllabus

Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art, Bibliographic Databases: Web of Science, Google and Google Scholar, Effective Search: The Way Forward, Introduction to Technical Reading, Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet.

Attributions and Citations: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in, Books Dissertations, Dedication or Acknowledgments.

LITERATURE REVIEW AND TECHNICAL READING

- The primary goal of literature review is to know the use of content/ideas/approaches in the literature to correctly identify the problem that is vaguely known beforehand, to advocate a specific approach adapted to understanding the problem, and to access the choice of methods used.
- It also helps the researcher understand clearly that the research to be undertaken would contribute something new and innovative.
- The quality of such review can be determined by evaluating if it includes appropriate breadth and depth of the area under study, clarity, rigor, consistency, effective analysis.

NEW AND EXISTING KNOWLEDGE

- New knowledge in research can only be interpreted within the context of what is already known, and cannot exist without the foundation of existing knowledge.

- The new knowledge can have vastly different interpretations depending on what the researcher's background, and one's perception of that new knowledge can change from indifference to excitement (or vice versa), depending on what else one knows.
- The significance can normally be argued from the point of view that there is indeed an existing problem and that it is known by looking at what already exists in the field.
- The existing knowledge is needed to make the case that there is a problem and that it is important.
- One can infer that the knowledge that is sought to be produced does not yet exist by describing what other knowledge already exists and by pointing out that this part is missing so that what we have is original. To do this, one again needs the existing knowledge: the context, the significance, the originality, and the tools.
- Normally, one finds this knowledge by reading and surveying the literature in the field that was established long ago and also about the more recent knowledge which is in fact always changing.
- With this foundation in place, the new knowledge that one will make will be much more difficult to challenge than without that strong foundation in place which is ensured with lots of references to the literature.
- Often, but not always, the textbooks contain the older established knowledge and the research papers the newer work. Reading the textbooks on one's topic provide the established knowledge and the background to be able to read the newer work usually recorded in the research papers
- The research paper is written for other researchers out on the edge of knowledge and it assumes that the reader already knows a lot in that field
- The review process must explain how a research item builds on another one. An effective review of literature ensures a firm foundation for advancing knowledge, facilitates theoretical growth, eliminates as areas that might be of interest, and opens new avenues of possible work
- Generally, a good literature survey is the first expectation of a supervisor from the research student, and when done well can create a good impression that the state of art in the chosen field is well understood

- A good literature review would not draw hasty conclusions and look into the individual references to determine the underlying causes/assumptions/mechanisms in each of them so as to synthesize the available information in a much more meaningful way
- A good literature survey is typically a two-step process as enumerated below:
    - Identify the major topics or subtopics or concepts relevant to the subject under consideration.
    - Place the citation of the relevant source (article/patent/website/data, etc.) in the correct category of the concept/topic/subtopic
- It could be that as one is reading and comes across something that one considers to be very important for one's work. Naturally, one highlights that section or underlines it, or put an asterisk in the margin, so that one could come back to it later. Effectively, one is saying that it is important and hence the marking so as not to forget it.
- A comprehensive literature survey should methodically analyze and synthesize quality archived work, provide a firm foundation to a topic of interest and the choice of suitable research methodologies, and demonstrate that the proposed work would make a novel contribution to the overall field of research.

ANALYSIS AND SYNTHESIS OF PRIOR ART

- After collecting the sources, usually articles, intended to be used in the literature review, the researcher is ready to break down each article and identify the useful content in it, and then synthesize the collection of articles (integrate them and identify the conclusions that can be made from the articles as a group).
- A researcher should analyze the relevant information ascertained in below table by undertaking the following steps:
    - Understanding the hypothesis,
    - Understanding the models and the experimental conditions used,
    - Making connections,
    - Comparing and contrasting the various information, and
    - Finding out the strong points and the loopholes.

	Source 1	Source 2	…	Source M
Topic 1		✓		
Topic 2	✓			✓
⋮				
⋮				
Topic N	✓	✓		

- A literature survey grid of N topics and M sources is shown above to help crystallize the information in different categories.
- It is always good to be suspicious of the claims made in the sources that have been thoroughly reviewed, especially in the case of tall claims.
- If one is amenable to easily accept whatever is available in the literature, one may find it difficult to go beyond it in one's own work and may also fail to carefully analyze with a suspicious bent of mind one's own results subsequently.
- The goal of literature survey is to bring out something new to work on through the identification of unsolved issues, determine the problems in the existing models or experimental designs, and present a novel idea and recommendations.
- No matter where one gets the available information, one needs to critically evaluate each resource that the researcher wishes to cite. This methodology analyzes available materials to determine suitability for the intended research.
- Relying on refereed articles published in scholarly journals or granted patents can save the researcher a lot of time.
- Here are a few criteria that could help the researcher in the evaluation of the information under study:
    - Authority: What are the author's credentials and affiliation? Who publishes the information?
    - Accuracy: Based on what one already knows about the topic or from reading other sources, does the information seem credible? Does the author cite other sources in a reference list or bibliography, to support the information presented?
    - Scope: Is the source at an appropriate comprehension or research level?

BIBLIOGRAPHIC DATABASES

- "Bibliographic databases" refer to "abstracting and indexing services" useful for collecting citation-related information and possibly abstracts of research articles from scholarly literature and making them available through search.
- Performing simultaneous searches through such large databases may allow researchers to overtly rely on any one database and be limited by the intrinsic shortcoming of any one of them for quality research.
- A researcher should be able to quickly identify the databases that are of use in the idea or problem that one wishes to explore.

Web of Science

- Web of Science (formerly known as ISI or Thomson Reuters) includes multiple databases, as well as specialized tools.
- It is a good search tool for scholarly materials requiring institutional license and allows the researcher to search in a particular topic of interest, which can be made by selection in fields that are available in drop down menu such as title, topic, author, address, etc.
- The tool also allows sorting by number of citations (highest to lowest), publication date.
- Put quotes around phrases, add more keywords, or use the "Refine Results" panel on the left to narrow down the search by keyword, phrases in quotation marks, type of material such as peer-reviewed journal articles, date, language, and more.
- "Cited reference search" option enables a researcher to trace articles which have cited a formerly published paper. Using this element, it is possible to find how a familiar idea has been applied, improved, or extended subsequently.
- A structured search like this that enables narrowing and refining what one is looking for is effective to ensure that the results throw up relevant sources and time spent in studying those is likely to be well utilized.
- Based on the researcher's need the search result can be broadened or narrowed down using the built-in fields provided in this website.
- When clicked on any of the search results, this website provides the title of the paper, authors, the type of journal, volume, issue number and year of publication, abstract,

keywords, etc., so that the researcher has enough information to decide if it is worthwhile to acquire the full version of the paper.

Google and Google Scholar

- Google is a great place to start one's search when one is starting out on a topic. It can be helpful in finding freely available information, such as reports from governments, organizations, companies, and so on. However, there are limitations:
    - It's a "black box" of information. It searches everything on the Internet, with no quality control—one does not know where results are coming from.
    - There are limited search functionality and refinement options.
- Google Scholar limits one's search to scholarly literature. However, there are limitations:
    - Some of the results are not actually scholarly. An article may look scholarly at first glance, but is not a good source upon further inspection.
    - It is not comprehensive. Some publishers do not make their content available to Google Scholar.
    - There are limited search functionality and refinement options.
- There are search operators that can be used to help narrow down the results. These help one to find more relevant and useful sources of information.
- Operators can be combined within searches. Here are some basic ones that one can use:
    - OR - Broadens search by capturing synonyms or variant spellings of a concept.
    - Brackets/Parentheses ( ) - Gather OR'd synonyms of a concept together, while combining them with another concept.
    - Quotation marks " " - Narrow the search by finding words together as a phrase, instead of separately.
    - Site - limits the search to results from a specific domain or website.
    - File type - limits the search to results with a specific file extension one could look for pdf's, PowerPoint presentations, Excel spreadsheets, and so on.
- The Search Tools button at the top of the Google results gives you a variety of other options, such as limiting the results by date.
- To find the best resources on a topic, one should search in academic databases, in addition to Google.

- Databases provide access to journal articles and conference proceedings, as well as other scholarly resources.
- One gets more relevant and focused results, because they have better quality control and search functionality. One should choose a database based on subject area, date coverage, and publication type. Interfaces vary between databases, but the search techniques remain essentially the same.

EFFECTIVE SEARCH: THE WAY FORWARD

- A scholarly publication is one wherein the published outcome is authored by researchers in a specific field of skill. Such work cites all source contents used and is generally peer reviewed for accuracy and validity before publication.
- Essentially, the audience for such works is fellow experts and students in the field. The content is typically more complex and advanced than those found in general magazines.
- While most of the engineering researchers need to refer articles that appear in scholarly journals, books or other peer-reviewed sources, there is also a substantially useful content in more popular publications. These are informal in approach and aim to reach a large number of readers including both the experts in the field and also amateurs, but the content focuses on news and trends in the field.
- Research outcomes are not typically first disseminated here but are usually meant for general reading. A researcher should use all search tools for comprehensive search.
- A researcher must consider what type of information is needed, and where it could be found. Not all information is available online. Some information is only available in print.
- It can take time for scholarly and peer-reviewed information to be published. One might not be able to find scholarly information about something currently being reported in the news. The information may not be available, or studies on a topic of interest to the researcher have not occurred.
- Searching is an iterative process:
    - Experiment with different keywords and operators
    - Evaluate and assess results, use filters
    - Modify the search as needed; and

  - When relevant articles are found, look at their citations and references.
- After the search is complete, the researcher needs to engage in critical and thorough reading, making observation of the salient points in those sources, and summarize the findings.
- A detailed comparison and contrast of the findings is also required to be done.
- This entire process may be needed to be done multiple times.
- The conclusion of the entire process of literature survey includes a summary of the relevant and important work done, and also the identification of the missing links and the challenges in the open problems in the area under study.
- One must note that the literature survey is a continuous and cyclical process that may involve the researcher going back and forth till the end of the research project.
- It is very important to not lose sight of the purpose of an extensive search or literature survey, for it is possible to spend a very significant amount of one's time doing so and actually falsely think that one is working hard.
- Nothing will come of it unless one is an active reader and spends sufficient time to develop one's own ideas build on what one has read.
- It is not as if literature survey ends and then research begins, for new literature keeps appearing, and as one's understanding of the problem grows, one finds new connections and related/evolving problems which may need more search.

INTRODUCTION TO TECHNICAL READING

- It is obvious that the number of papers relevant to a particular researcher is very few, compared to the actual number of research papers available from peer-reviewed technical sources.
- It is also important to know where to read from; relying on refereed journals and books published by reputed publishers is always better than relying on easily available random articles off the web.
- While reading an engineering research paper, the goal is to understand the technical contributions that the authors are making. Given the abundance of journal articles, it is useful to adopt a quick, purposeful, and useful way of reading these manuscripts.

- It is not the same as reading a newspaper. It may require rereading the paper multiple times and one might expect to spend many hours reading the paper.
- Amount of time to be spent will get ascertained after an initial skimming through the paper to decide whether it is worth careful reading.
- There will also be papers where it is not worth reading all the details in the first instance. It is quite possible that the details are of limited value, or simply one does not feel competent to understand the information yet.
- Start out the skimming process by reading the title and keywords (these are anyways; probably what caught the initial attention in the first place). If on reading these, it does not sufficiently seem to be interesting; it is better to stop reading and look for something else to read.
- One should then read the abstract to get an overview of the paper in minimum time. Again, if it does not seem sufficiently important to the field of study, one should stop reading further.
- If the abstract is of interest, one should skip most of the paper and go straight to the conclusions to find if the paper is relevant to the intended purpose, and if so, then one should read the figures, tables, and the captions therein, because these would not take much time but would provide a broad enough idea as to what was done in the paper.
- If the paper has continued to be of interest so far, then one is now ready to delve into the Introduction section to know the background information about the work and also to ascertain why the authors did that particular study and in what ways the paper furthers the state of the art.
- The next sections to read are the Results and Discussion sections which is really the heart of the paper. One should really read further sections like the Experimental Setup/Modeling, etc., only if one is really interested and wishes to understand exactly what was done to better understand the meaning of the data and its interpretation.
- A researcher will always need to be searching for the relevant literature and keeping up to date with it. If one is busy with a small project, the advisor might just give a single important paper to read. But with a larger one, you will be searching for one's own literature to read. For this one will need a strategy as there is just too much work out there to read everything.

CONCEPTUALIZING RESEARCH

- The characteristics of a research objective are that it must have new knowledge at the center and that it must be accepted by the community of other researchers and recognized as significant.
- Besides being original and significant, a good research problem should also be solvable or achievable. This requirement already asks us to think about the method and the tools that could be used to obtain that new knowledge.
- Now, the significance and the originality and all the theory that we read and tools and methods that we need to take on a problem, all of these normally come from the existing recorded literature and knowledge in the field.
- Coming up with a good research objective, conceptualizing the research that meets all of these requirements is a tough thing to do. It means that one must already be aware of what is in the literature. That is, by the time one actually has a good research objective, one is probably already an expert at the edge of knowledge else it is difficult to say with confidence that one has a good research objective.
- So, when working at the research (Ph.D) level, one needs to be prepared to become that expert, one needs to be continually reading the literature so as to bring together the three parts:
    - Significant problem,
    - The knowledge that will address it, and
    - A possible way to make that new knowledge.
- How these three aspects would come together will be different for every person doing research and it will be different in every field, but the only way to be that expert is by immersing oneself in the literature and knowing about what already exists in the field.
- However, if one is working on a research project that is of a smaller scope, then conceptualizing the research is possibly too tough to do, and one does not have the time that it takes to become that expert at the edge of knowledge.
- In this case, the researcher needs the help of someone else, typically the supervisor who may already be an expert and an active researcher in that field, and may advise on what a good research objective might be.

- An established researcher in any field should be able to immediately point to the landmark literature that one should read first. Otherwise one would need to spend a lot of time reading the literature to discover.

CRITICAL AND CREATIVE READING

- Reading a research paper is a critical process. The reader should not be under the assumption that reported results or arguments are correct. Rather, being suspicious and asking appropriate questions is in fact a good thing.
- Have the authors attempted to solve the right problem? Are there simpler solutions that have not been considered? What are the limitations (both stated and ignored) of the solution and are there any missing links? Are the assumptions that were made reasonable? Is there a logical flow to the paper or is there a flaw in the reasoning? These need to be ascertained apart from the relevance and the importance of the work, by careful reading.
- Use of judgmental approach and boldness to make judgments is needed while reading.
- Flexibility to discard previous erroneous judgments is also critical.
- Additionally, it is important to ascertain whether the data presented in the paper is right data to substantiate the argument that was made in the paper and whether the data was gathered and interpreted in a correct manner.
- Critical reading is relatively easy. It is relatively easier to critically read to find the mistakes than to read it so as to find the good ideas in the paper. Anyone who has been a regular reviewer of journal articles would agree to such a statement.
- Reading creatively is harder, and requires a positive approach in search. In creative reading, the idea is to actively look for other applications, interesting generalizations, or extended work which the authors might have missed? Are there plausible modifications that may throw up important practical challenges? One might be able to decipher properly if one would like to start researching an extended part of this work, and what should be the immediate next aspect to focus upon.

TAKING NOTES WHILE READING

- A researcher reads to write and writes well only if the reading skills are good.
- The bridge between reading and actually writing a paper is the act of taking notes during and shortly after the process of reading.
- There is a well-known saying that the faintest writing is better than the best memory, and it applies to researchers who need to read and build on that knowledge to write building on the notes taken.
- Many researchers take notes on the margins of their copies of papers or even digitally on an article aggregator tool.
- In each research paper, there are a lot of things that one might like to highlight for later use such as definitions, explanations, and concepts.
- If there are questions of criticisms, these need to be written down so as to avoid being forgotten later on. Such efforts pay significantly when one has to go back and reread the same content after a long time.
- On completing a thorough reading, a good technical reading should end with a summary of the paper in a few sentences describing the contributions.
- But to elucidate the technical merit, the paper needs to be looked at from comparative perspective with respect to existing works in that specific area.
- A thorough reading should bring out whether there are new ideas in the paper, or if existing ideas were implemented through experiments or in a new application, or if different existing ideas were brought together under a novel framework.
- Obviously, the type of contribution a paper is actually making can be determined better by having read other papers in the area.

READING MATHEMATICS AND ALGORITHMS

- Mathematics is often the foundation of new advances, for evolution and development of engineering research and practice. An engineering researcher generally cannot avoid mathematical derivations or proofs as part of research work.
- In fact, these are the heart of any technical paper. Therefore, one should avoid skimming them.

- By meticulous reading of the proofs or algorithms, after having identified the relevance of the paper, one can develop sound understanding about the problem that the authors have attempted to solve.
- Implementation of an intricate algorithm in programming languages such as C, C++ or Java is prone to errors.
- And even if the researcher is confident about the paper in hand, and thinks that the algorithm will work, there is a fair chance that it will not work at all. So one may wish to code it quickly to check if it actually works.

READING A DATASHEET

- Researchers in different fields of engineering will need to read certain types of documents. For example, mechanical and civil engineers would need to read drawings related to mechanical parts and buildings. Researchers in the field of electronics need to read datasheets.
- On occasions, researchers in other fields may also need to incorporate a certain electronic part in which case careful reading of the datasheet is imperative.
- The same principles like initial skimming of the datasheet are required to ascertain whether further careful reading is needed.
- Datasheets are instruction manuals for electronic components, which (hopefully) details what a component does and how one may use it. Datasheets enable a researcher (or a working professional) to design a circuit or debug any given circuit with that component.
- The first page of the datasheet usually summarizes a part's function and features, basic specifications, and usually provides a functional block diagram with the internal functions of the part.
- A pin out provides the physical location of a part's pins, with special mark for pin 1 so that the part can be correctly plugged into the circuit. Some parts also provide graphs showing performance versus various criteria (supply voltage, temperature, etc.), and safe region for reliable operation which should be carefully read and noted by the researcher.
- One should be also in the lookout for truth tables which describe what sort of inputs provide what types of outputs, and also timing diagrams which lay out how and at what speed data is sent and received from the part.

- Datasheets usually end with accurate dimensions of the packages a part is available in. This is useful for printed circuit board (PCB) layout. When working with a new part, or when deciding which part to use in the research work, it is recommended to carefully read that part's datasheet to come up with a bit of shortcut that may potentially save many hours later on.

ATTRIBUTES AND CITATION: Giving credits wherever due

- Academic writing, by definition, must follow certain rules and conventions.
- Among the most important of these are the rules and conventions about citing, referencing, attributing, and acknowledging the works of others.
- That means giving proper credit wherever due.
- Citing is the practice of quoting from, referring to other authors' works and ideas in the text of our work in such a way that the context is clear to the reader.
- Referencing is the listing of the full publication details of a published work that is cited so as to give background information to the readers.
- Acknowledgment in research publications indicates contributions to scientific work.
- However, acknowledgment, attributions, and citations differ in the manner of their application.

CITATIONS: FUNCTIONS AND ATTRIBUTES

- Citations (references) credit others for their work, while allowing the readers to trace the source publication if needed.
- Any portion of someone else's work or ideas in papers, patents, or presentations must be used in any new document only by clearly citing the source.
- This applies to all forms of written sources in the form of texts, images, sounds, etc. and failure to do may be considered plagiarism
- When a bibliography of previously published patents or papers is placed in the new works of a researcher, a connection is established between the new and previous work.
- As per relevance to context, the researcher provides due credit through the use of a citation.

- Citations help the readers to verify the quality and importance of the new work and justification of the findings. It is a way to tell readers that certain material in the researcher's present work has come from another source and as an ethical responsibility; appropriate credit has been given to the original author or writer.
- Materials that can be cited include journal papers, conference proceeding, books, theses, newspaper articles, websites, or other online resources and personal communication.
- Preferably, citations should be given at the end of a sentence or the end of a paragraph as can be seen even in this particular paragraph. Citation must contain enough details so that readers can easily find the referenced material.
- A researcher needs to cite each source twice:
    (i) in-text citation, in the text of the article exactly where the source is quoted or paraphrased, and
    (ii) a second time in the references, typically at the end of the chapter or a book or at the end of a research article
- LaTeX, a document preparation system often used by engineering researchers to automatically format documents that comply with standard formatting needs, is very effective to track and update citations
- There are three main functions of citation:
    (i) **Verification function**: Authors have a scope for finding intentional or unintentional distortion of research or misleading statements. Citation offers the readers a chance to ascertain if the original source is justified or not, and if that assertion is properly described in the present work
    (ii) **Acknowledgment function**: Researchers primarily receive credit for their work through citations. Citations play crucial role in promotion of individual researchers and their continued employment. Many reputed organizations and institutes provide research funding based on the reputations of the researchers. Citations help all researchers to enhance their reputation and provide detailed background of the research work.
    (iii) **Documentation function**: Citations are also used to document scientific concepts and historical progress of any particular technology over the years

- Citations are the currency that authors would wish to accumulate and the technical community gives them credit for these contributions. When other authors make citations, they honor those who initiated the ideas
- Authors should cite sources to indicate significance of the work to the reader. Relevant citations help authors develop an easily understandable argument and prevent the need to navigate through work irrelevant to the reader's interest areas
- There are certain cases when references do not fulfill the actual goal of citations and acknowledgments, and thus do not benefit the reader.
    - Spurious citations: In certain cases, when citation is not required or an appropriate one is not found, if the author nevertheless goes ahead with including one anyways, it would be considered as a spurious citation
    - Biased citations: When authors cite thework of their friends or colleagues despite there being no significant connection between the two works, or when they do not cite work of genuine significance because they do not wish to give credit in the form of citation to certain individuals, then such actions can be classified as biased citations.
    - Self-citations: There is nothing wrong in citing one's prior work if the citation is really relevant. Self-citation of prior papers is natural because the latest paper is often a part of a larger research project which is ongoing
    - Coercive citations: Despite shortcomings, impact factors remain a primary method of quantification of research. One side effect is that it creates an incentive for editors to indulge in coercion to add citations to the editor's journal

IMPACT OF TITLES AND KEYWORDS ON CITATION

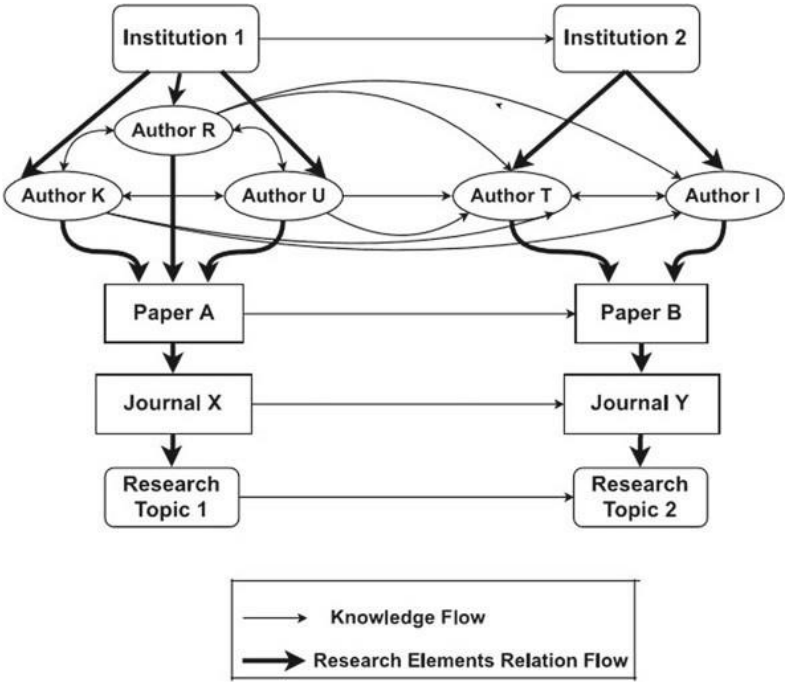
- The citation rate of any research paper depends on various factors including significance and availability of the journal, publication types, research area, and importance of the published research work.
- Other factors like length of the title, type of the title, and selected keywords also impact the citation count. Title is the most important attribute of any research paper.
- It is the main indication of the research area or subject and is used by researcher as a source of information during literature survey.

- Title plays important role in marketing and makes research papers traceable.
- A good title is informative, represents a paper effectively to readers, and gains their attention. Some titles are informative but do not capture attention of readers, some titles are attractive but not informative or related to the readers' research area.
- The download count and citation of a research paper might be influenced by title.
- There are three different aspects which provide a particular behavior to the title:
    - Types of the title,
    - Length of the title, and
    - Presence of specific markers
- Longer titles mainly include the study methodology and/or results in more detail, and so attract more attention and citations
- In general, titles containing a question mark, colon, and reference to a specific geographical region are associated with lower citation rates, also result-describing titles usually get citations than method-describing titles.
- Additionally, review articles and original articles usually receive more citations than short communication articles.
- At least two keywords in the title can increase the chance of finding and reading the article as well as get more citations.
- Keywords represent essential information as well as main content of the article, which are relevant to the area of research. Search engines, journal, digital libraries, and indexing services use keywords for categorization of the research topic and to direct the work to the relevant audience.

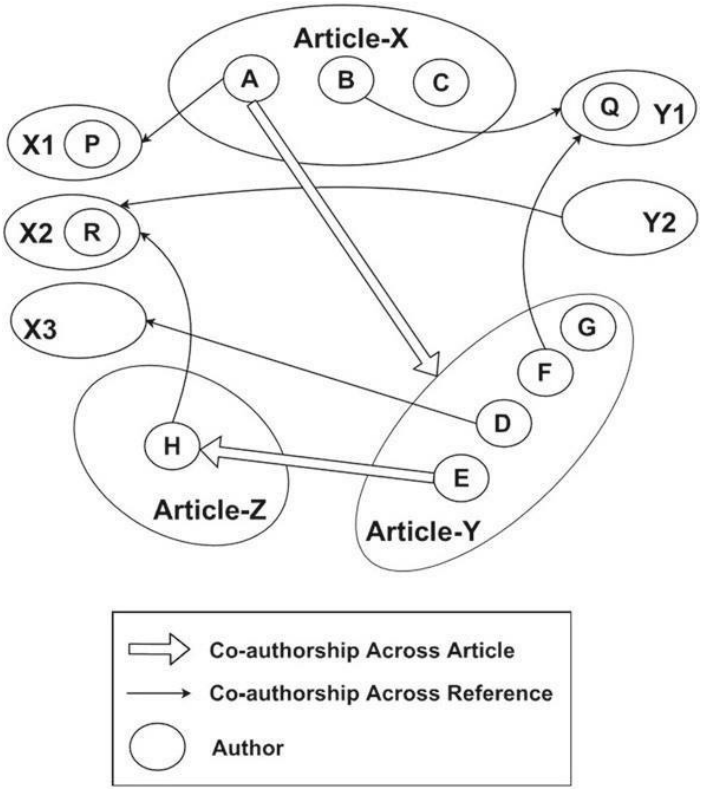
KNOWLEDGE FLOW THROUGH CITATION

- Knowledge flows through verbal communications, books, documents, video, audio, and images, which plays a powerful role in research community in promoting the formulation of new knowledge.
- In engineering research, knowledge flow is primarily in the form of books, thesis, articles, patents, and reports. Citing a source is important for transmission of knowledge from previous work to an innovation

- Knowledge flow happens between co-authors during research collaboration, among other researchers through their paper citation network, and also between institutions, departments, research fields or topics, and elements of research



- If paper A is cited by paper B, then knowledge flows through citation networks across institutions.
- The complex interdisciplinary nature of research encourages scholars to cooperate with each other to grab more advantages through collaboration, thereby improving quality of the research
- The below figure shows a relationship between co-authorship and different types of citations. Three articles (X, Y, and Z) and five references (X1, X2, X3, Y1, and Y2) of article X and Y, respectively, are considered. A, B, and C are authors of article X, and D, E, F, G, and also A are authors of article Y. Article Z has two authors H and E. References X1, X2, X3, Y1, and Y2 have authors (A, P), (H, R), (D), (Q, B, F), and (R), respectively.



CITING DATASETS

- The nature of engineering research has evolved rapidly and now relies heavily on data to justify claims and provide experimental evidences and so data citations must fetch proper credit to the creator of the dataset as citations of other objects like research articles.
- Data citations should have provisions to give credit and legal attribution to all contributors, enable identification and access, while recognizing that a specific style may not apply to all data.
- Ascertaining the ownership of data can be a complicated issue especially with large datasets, and issues of funding can also make it a difficult matter.
- A researcher should obtain necessary permission for using data from a particular source.
- Citations related to datasets should include enough information so that a reader could find the same dataset again in the future, even if the link provided no longer works.
- It is proper to include a mixture of general and specific information to enable a reader to be certain that the search result is the same dataset that was sought.

Examples:

1. Historical Data, Sotavento (Wind Farm), Corunna, Spain (July 2016): [Accessed: 4 Oct. 2016] Retrieved from http://www.sotaventogalicia.com/en/real-time-data/historical
2. Deb, D (2016). [Personnel survey]. Unpublished raw data.

STYLES FOR CITATION

- Citation styles differ primarily in the order, and syntax of information about references, depending on difference in priorities attributed to concision, readability, dates, authors, and publications.
- Some of the most common styles for citation

ASCE style (American Society of Civil Engineers)

Template for books:
Author Surname, Author Initial. (Year Published). Title. Publisher, City, Pages Used.

Example:
Wearstler, K., and Bogart, J. (2004). Modern glamour. Regan Books, NY.

Template for websites:
Author Credentials / Company Name (Year Published). 'Title'. http://Website URL (Oct. 10, 2013).

Example:
Blade cleaning services (2015): http://www.bladecleaning.com/problematica (29 Oct, 2016).

Template for journal publications:
Author Surname, Author Initial. (Year Published). 'Title'. Publication Title, Volume number(Issue number), Pages Used.

Example:
Johnston, L. (2014). "How an Inconvenient Truth Expanded The Climate Change Dialogue abd Reignited An Ethical Purpose in The United States". 1–160.

IEEE style (Institute of Electrical and Electronics Engineers

Chapter in an edited book
[1] A. Rezi and M. Allam, "Techniques in array processing by means of transformations," in Control and Dynamic Systems, Vol. 69, Multidimensional Systems, C. T. Leondes, Ed. San Diego: Academic Press, 1995, pp. 133–180.

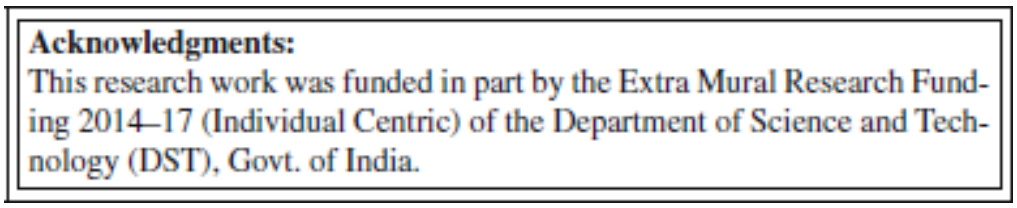
ACKNOWLEDGMENT AND ATTRIBUTION

- Acknowledgment section is a place to provide a brief appreciation of the contribution of someone or an organization or funding body to the present work.
- If no particular guideline is available for the intended publication, then it can be introduced at the end of the text or as a footnote.
- Acknowledgment is a common practice to recognize persons or agencies for being responsible in some form or other for completion of a publishable research outcome.
- Acknowledgment displays a relationship among people, agencies, institutions, and research. In some case, certain individuals may help in the research work but may not deserve to be included as authors. As a sign of gratitude, such contributions should be acknowledged
- Acknowledgments and attributions are also very important in the publications of journal or conference papers. Giving proper credit wherever it is due is very important and even if the contribution is minor, it should not be neglected.
- In engineering research, acknowledgments are meant for participating technicians, students, funding agency, grant number, institution, or anyone who provide scientific inputs, shared unpublished results, provided equipment, or participated in discussions.

WHAT SHOULD BE ACKNOWLEDGED

- Every author should know that what should/should not be acknowledged.
- Author should acknowledge quotation, ideas, facts, paraphrasing, funding organization, oral discussion or support, laboratory, and computer work.
- Quotation: In technical writing such as in the field of engineering, quotes are used very rarely. Quotations are of two types:
    - Direct quotations are used when author use actual words or sentences in the same order as the original one. Author should use quotation marks for the words or sentences with proper acknowledgment.
    - Indirect quotation summarizes or paraphrases the actual quote. In such cases, it is important to acknowledge with proper name and date.

- Authors should acknowledge people who give appropriate contribution in their research work. Non-research work contributions are not generally acknowledged in a scientific paper but it may be in a thesis. Persons must be acknowledged by authors, who gave a scientific or technical guidance, take part in some discussions, or shared information to author. Authors should acknowledge assistants, students, or technicians, who helped experimentally and theoretically during the research work.
- If the researcher received grant from a funding agency and if those funds were used in the work reported in the publication, then such support should always be acknowledged by providing full details of the funding program and grant number in the acknowledgment section. The authors should also gratefully acknowledge use of the services and facilities of any center or organization with which they are not formally affiliated to.
- An example of acknowledgment of grant received is as follows:



- Many technical journals explicitly discourage authors to thank the reviewers in their article submissions. This could be construed as favoritism or an attempt to encourage reviewers to accept their manuscript for reasons other than scientific merit.
- Acknowledging that results have been presented elsewhere: If the results were presented as an abstract in a journal, then there should be a suitable citation. If the results were presented as part of scientific meeting, symposium, or other gathering, then some relevant information should be provided.
- At the very least, the name of the gathering and year should be cited. Other helpful items include the location of the gathering (city and state or country) and the full date of the occasion.
- By acknowledging all help received in one's research work, the author(s) demonstrate integrity as a researcher, which in turn encourages continued collaboration from those who helped out in different ways.

- Failure to acknowledge funding may result in the discontinuation of current funding and/or ineligibility to receive future funding for a certain number of years or indefinitely.

ACKNOWLEDGEMENTS IN BOOKS / DISSERTATION

- A page of acknowledgments is usually included at the beginning of a thesis/ dissertation immediately following the table of contents.
- These acknowledgments are longer than the one or two sentence statements in journal papers or articles in conference proceedings.
- These detailed acknowledgments enable the researcher to thank all those who have contributed in completion of the research work. Careful thought needs to be given concerning those whose inputs are to be acknowledged and in what order.
- Generally, one should express appreciation in a concise manner and avoid emotive language.
- The following are often acknowledged in these types of acknowledgments: main supervisor, second supervisor, peers in the lab, other academic staff in the department, technical or support staff in the department, colleagues from other departments, other institutions, or organizations, former students, family, and friends

Sample Acknowledgement in Thesis:
I wish to express my sincere appreciation to my supervisor Prof. Gang Tao for the useful comments, remarks and encouragement throughout this thesis work. Furthermore, I wish to express my thanks to Prof. Jacob Hammer for introducing me to the topic and for the support along the way. Also, I like to thank my peers in the Adaptive Control Lab such as Yu Liu and Shanshan Li, who have shared their precious time during many lively technical discussions. I would like to thank my family members who have supported me throughout this journey in many different ways.

DEDICATION OR ACKNOWLEDGEMENTS

- Dedication is almost never used in a journal paper, an article in conference proceedings, or a patent, and it is used exclusively in larger documents like books, thesis, or dissertations.

- While acknowledgments are reserved for those who helped out with the book in some way or another (editing, moral support, etc), a dedication is to whomever the author would like it to be dedicated to, whether it is the author's mother, the best friend, the pet dog, or Almighty God. And yes, it is possible to dedicate something to someone while also mentioning them in the acknowledgments.
- For example, one may dedicate a book to one's spouse, but acknowledge them for being the moral support and putting up with when one gets stressed.
- The acknowledgments in technical books can be sometimes as brief as the ones in journal articles.
- The acknowledgment section of a technical report may be a paragraph that is longer than a journal paper but shorter than dissertations.
- Generally, the length of the acknowledgment may have some correlation with the length of the document.

MODULE 3: INTELLECTUAL PROPERTY RIGHTS, PATENTS AND PROCESS OF PATENTING

Syllabus

Introduction to Intellectual Property: Role of IP in the Economic and Cultural Development of the Society, IP Governance, IP as a Global Indicator of Innovation, Origin of IP, History of IP in India, Major Amendments in IP Laws and Acts in India.

Patents: Conditions for Obtaining a Patent Protection, To Patent or Not to Patent an Invention, Rights Associated with Patents, Enforcement of Patent Rights, Inventions, and Eligible for Patenting, Non-Patentable Matters, Patent Infringements, Avoid Public Disclosure of an Invention before Patenting.

Process of Patenting: Prior Art Search, Choice of Application to be Filed, Patent Application Forms, Jurisdiction of Filing Patent Application, Publication, Pre-grant Opposition, Examination, Grant of a Patent, Validity of Patent Protection, Post-grant Opposition, Commercialization of a Patent, Need for a Patent Attorney/Agent, Can a Worldwide Patent be Obtained, Do I Need First to File a Patent in India, Patent Related Forms, Fee Structure, Types of Patent Applications, Commonly Used Terms in Patenting, National Bodies Dealing with Patent Affairs, Utility Models

INTRODUCTION TO INTELLECTUAL PROPERTY

- Intellectual Property (IP) is the terminology attributed to intangible assets having commercial value, and arising from human intelligence, creativity, and imagination, but typically lacking physical form.
- Intellectual Property Rights (IPR) is the privileges accorded to the creator/inventor (of IP) in conformance with the laws. These rights are given to the creator/inventor in exchange for revealing the process of creation/invention in the public domain. The inventor is conferred with the special rights to use, sell, distribute, offering for sale and restricting others from using the invention without his prior permission

- Broadly, IP comprises of two branches i.e. Copyrights and Related Rights and Industrial Property Rights.
    - Copyrights and Related Rights refer to the creative expressions in the fields of literature and art, such as books, publications, architecture, music, wood/stone carvings, pictures, portrays sculptures, films and computer-based software's/databases.
    - The Industrial Property Rights refer to the Patents, Trademarks, Trade Services, Industrial Designs and Geographical Indications
- **Copyright**: Copyright is the right bestowed on the owner or creator in relation to publication, and distribution of a piece of writing, music, picture or related works. Copyright also applies to technical contents such as software, datasheets and related documents.
- **Patents:** A patent is a legal record that bestows the holder the exclusive right over an invention as per the claims, in a limited geographical domain and for a limited duration by thwarting possible interested parties from any form of manufacture, use or sale of the product or outcome of the invention
- **Trademarks:** A trademark is a sign that suitably differentiates the owner's goods or services from those of others
- **Trade services**: Any services in relation to trade or any trade related financing, lending or other financial accommodation provided(or to be provided) by the bank, including but not limited to issuance/amendment of letter of credit, document arrival under letter of credit, application for negotiation and inquiries etc.,
- **Industrial Designs**: An industrial design protection is related to certain specific ornamental shapes associated with products whose duplication the owner may wish to prevent
- **Geographical Indications:** A geographical indication (GI) is a name or sign used on products which corresponds to a specific geographical location or origin. Items that meet geographical origin and quality standards may be endorsed with a government-issued stamp which acts as official certification of the origins and standards of the product.

ROLE OF IP IN THE ECONOMIC AND CULTURAL DEVELOPMENT OF THE SOCIETY

- Creativity being the keystone of progress, no civilized society can afford to ignore the basic requirement of encouraging the same. The economic and social development of a society is largely dependent on creativity.
- The protection provided by the IPR to the creators/innovators is in fact an act of incentivization for encouraging them to create more and motivates others to create new.
- However, if IPR is practiced rigidly, it may have a negative impact on the progress of society. For example, compliance with the Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement has affected the farming community as they are unable to store seeds for the next crop. Multinational companies regulate the price of seeds, which is generally beyond the reach of a majority of the farmers.
- To circumvent the negative impact of IPR, certain laws, exceptions and limitations associated with IPR have been enacted to maintain a balance between the interests of the creators/inventors and the community.
- For example, farmers rights under the Protection of Plant Varieties and Farmers Rights (PVP&FR) Act, 2001 entitles them to many privileges, such as Rights on seeds provides rights to the farmers to save seeds, use seeds and share, exchange or sell seeds to other farmers.
- Right to protection against accusations of infringement protects the farmers from infringement and other legal accusation levied upon them due to his legal ignorance in using other‘s plant varieties.
- The use of copyrighted material for education and religious ceremonies is exempted from the operation of the rights granted in the Copyright Act.
- Similarly, a patent can be revoked in favor of compulsory licensing by the government during an emergency or a natural calamity.
- In addition, if an invention/creation is not in the interest of society, it is not registered by the government for grant of any rights associated with IP. For example, cloning of human embryos is banned for IP protection, and so is the creation of super microbial pathogens, which can play havoc with human lives.

IP GOVERNANCE

- Since IP is an integral component of human society, each and every nation has dedicated agencies for laying out the guidelines, implementation and enforcement of IP related matters.
- In India, many organizations/agencies deal with various aspects of IP. The governance of all categories of IP, except the Plant Variety and Farmers Rights Act, is carried out by the Department for Promotion of Industry & Internal Trade (DPIIT) under the aegis of Ministry of Commerce and Industry, Govt. of India.
- There are a few other dedicated organizations/departments established by the government to promote patent-ecosystem (patent awareness, patent filing and patent commercialization) in India e.g. Technology Information Forecasting and Assessment Council (TIFAC), National Research Development Corporation (NRDC) and Cell for IPR Promotion and Management (CIPAM), etc.
- In order to create a hassle-free exchange of IP related activities amongst all the nations, it is imperative to have minimum standards of rules and regulations pertaining to all aspects of IP including rights, empowerment, exceptions, etc.
- To achieve this goal, the United Nations (UN) has established an organization called the World Intellectual Property Organization (WIPO).
- This agency is at the forefront of imparting knowledge about IP and governs international filing and registration of IP through various Conventions and Treaties like Paris Conventions, Patent Cooperation Treaty (PCT), Rome Convention, Berne Convention, etc.

IP AS A GLOBAL INDICATOR OF INNOVATION

- IP, especially patents, is considered as one of the important cogs in assessing the innovation index of a nation.
- The global ranking organizations always have IP or a subset of IP as one of the parameters for understanding and grading the Science, Technology and Innovation (STI) ecosystem of a nation.

- For example, the Scimago (publically available online portal which ranks journals and countries based on the data taken from Scopus) 2020 report ranked India at 4th position in the parameter of a number of Research Publications and 50th position in the parameter of Intellectual Property Rights.
- The global ranking can be improved by sensitizing the teaching and scientific communities about the importance of IP and creating infrastructure for the same in the institutes of higher learning.

ORIGIN OF IP

- Though there is no official record of the origin of IP, it is believed that a rudimentary form of IP was being practiced around 500 Before the Common Era (BCE) in Sybaris, a state of Greece.
- The natives of Sybaris were granted a year‘s protection for using their intellect to create ―any new improvement in luxury.
- A practical and pragmatic approach for IP governance started taking shape in medieval Europe. In 1623, Britain passed an Intellectual Property Legislation which entitled guilds (association of artisans or merchants) to create innovations and bring them to market for trade purposes.
- However, this legislation brought a lot of resentment amongst the public, and thus was replaced by the Statute of Monopolies‘, which gave the rights to the original creator/inventor for 14 years. Another legislation, Statute of Anne‘, was passed by the British parliament in 1710.
- This legislation aimed at strengthening copyrights by providing rights to the authors for recreation and distribution of their work. The work could also be renewed for another 14 years.
- By the end of the 18th century and the beginning of the 19th century, almost every country started laying down IP legislation to protect their novel inventions and creations.

HISTORY OF IP IN INDIA

Patents

- The history of the Indian patent system dates back to the pre independence era of British rule. The first patent related legislation in India was Act VI of 1856, adapted from the British Patent Law of 1852. The objective of this legislation was to encourage the inventions of new and useful manufactures.
- At the beginning of the 20th century, all the earlier Acts related to inventions and designs were done away with the introduction of "The Indian Patents and Designs Act" 1911 (Act II of 1911).
- As per this Act, the governance of patents was placed under the management of the Controller of Patents. In the next three decades, many amendments were introduced for reciprocal arrangements with other countries for securing priority dates. These amendments dealt with;
    - Use of invention by the government
    - Patent of Addition
    - Enhancing the term of the patent from 14 years to 16 years.
    - Filing of Provisional Application and submission of Complete Application within 9 months from the date of filing the application.
- Keeping the national interest in mind, recommendations were made in 1949 as a modification to existing "The Indian Patents and Designs Act". And those recommendations are as follows
    - Misuse of patents rights needs to be prevented.
    - There must be a clear indication in the Act that food, medicine and surgical and curative devices should be made available to the masses at the cheapest rate by giving reasonable compensation to the owner of the patent.
    - Amendments in Sections 22, 23 and 23A of the Patent and Design Act, 1911 on the lines of the UK Patent Act.
- These recommendations were introduced in the Act XXXII of 1950.
- Two years later, another amendment (Act LXX of 1952) was made to provide compulsory licensing of patents related to food, drugs and chemicals killing insects and

microbes. Based on these amendments, a bill was presented in the parliament in 1953 but was rejected.

- In 1957 a committee was constituted and the committee submitted its report to the government in 1959. It comprised of two segments addressing
    - General aspects of the patent laws, and
    - Bill rejected back in 1953.
- The revised patent legislation was submitted to the Lok Sabha in 1965. After many hiccups, clarifications and modifications the Patents Act, 1970
- In 1999, The Patents (Amendment) Act, 1999 was introduced providing for the filing of applications for _Product Patents' in the areas of drugs, pharmaceuticals and agrochemicals
- The new Patent Act also included provisions for the grant of Exclusive Market Rights (EMRs) for the distribution and sale of pharma products on fulfillment of certain conditions. The second amendment to the 1970 Act was made through the Patents (Amendment) Act, 2002 (Act 38 of 2002). This Act introduced new Patent Rules, 2003, thus replacing the earlier Patents Rules, 1972.
- With the rapidly changing scenario of IPR at a global level, a need was felt to further amend the Patent Act, 1970. The highlight of the Patents (Amendments) Act 2005 were:
    - Product patent for inventions in all fields of technology.
    - New forms of known substances excluded to prevent ever greening of the patent.
    - Rationalization of the opposition procedure.
    - Introduction of pre-grant opposition by representation.
    - Introduction of post-grant opposition.
    - Compulsory license for export purposes.
    - Compulsory license for manufacture.
    - Extension of grace period from 6 months to 12 months for filing a patent, if published in government exhibition.

Copyrights and related rights

- The concept of copyrights started way back in the 15th century. However, the actual need for copyrights law was felt only after the invention of printers and copiers.

- Before the invention of printers, writing could be created only once. It was highly laborious and the risk of errors was involved in the manual process of copying by a scribe.
- The evolution of copyrights law in India occurred in three phases. First, two phases were enacted during the British Raj.
    - In the first phase, the concept of copyrights was introduced in 1847 through an enactment during the East India Company‘s regime. The term of copyrights was for the lifetime of the author plus seven years after death. The registration of copyright was mandatory for the enforcement of rights under the Act. The government could grant a compulsory license to publish a book if the owner of the copyright, upon the death of the author, refused to allow its publication.
    - In the second phase Indian legislature, under the British Raj, enacted the Copyright Act of 1914 based on the Imperial Copyright Act (1911) of the UK. An Act for criminal sanction for an infringement was introduced.
    - The third phase of the copyrights regime was witnessed post independence. The Copyright Act 1957 was enacted, superseding the Indian Copyright Act, 1914, in order to suit the provisions of the Berne Convention (1886).
- The 1957 Act has been amended six times (1983, 1984, 1992, 1994 and 1999, 2012), to comply with WIPO Copyright Treaty (WCT), 1996 and WIPO Performances and Phonograms Treaty (WPPT), 1996.
- India is an active member of nearly all significant international Conventions/Treaties related to Copyright Law e.g. the Berne Convention as modified in Paris in 1971, the Universal Copyright Convention (1951), the Rome Convention (1961), WCT, WPPT and (TRIPS, 1995).

Trademarks

- The first statutory law related to Trademarks (TM) in India was the Trade Marks Act, 1940, which was carved out from the Trade Marks Act, 1938 of the UK.
- It was followed by the incorporation of provisions of TM stated in the Indian Penal Code, Criminal Procedure Code and the Sea Customs Act.

- Later on, Trade Marks Act, 1940 was rechristened as Trade and Merchandise Marks Act, 1958.
- Nearly four decades later, this Act was repealed by the Trade Marks Act, 1999. The need for this occurred to comply with the provisions of the TRIPS. It is the current governing law related to register TM.

Geographical Indications

- India, as a member of WTO, enacted the Geographical Indications of Goods (Registration and Protection) Act, 1999.
- It came into force with effect from 15th September 2003. Geographical Indicators have been defined under Article 22 (1) of the WTO Agreement on TRIPS.

Industrial Design

- The need to protect Industrial Designs (ID) was recognized in the 18th century and the Indian legislation enacted the "Patterns and Designs Act" in 1872 for the first time. The Act was enacted to protect the rights over the creation of the designs and novel patterns by the inventors.
- The Act was replaced by the British Patents and Designs Act in 1907, which later became the basis for the Indian Patents and Designs Act, 1911.
- In 1970, a separate Act was enacted for the patent, i.e. the Patent Act, 1970. The Indian Patents and Designs Act, 1911, remained in force for designs only.
- Finally, in the year 2000, a dedicated Act for the ID was passed, which came into force in 2001.

Semiconductor Integrated Circuits and Layout designs

- In the 21st century, Information Technology (IT) has revolutionized the economic and societal growth of the world economy.
- The rapid and tremendous scientific advancements in the field of IT resulted in the creation of a new class of IP called the Layout-Design of the Semiconductor Integrated Circuits. Various organizations, including WTO and TRIPS Agreement laid down rules

and regulations regarding the protection of Semiconductor Integrated Circuits and Layout Designs (SICLD)

- India being a member of the WTO also passed an Act called the SICLD Act, 2000. This Act is TRIPS compliant and fulfils the conditions of the TRIPS agreement (Articles. 35 to 38) concerning the protection of SICLD.

Plant varieties

- Till 1970s, not much emphasis was laid on patentable matter originating from animals and plants. However, microbes and microbial products/processes were patentable.
- To include all kinds of biological materials under the ambit of patent laws, a decision to enact a new sui generis law under the International Convention for the Protection of New Varieties of Plants (UPOV, 1978) and UPOV, 1991 was taken.
- These decisions were taken to address environmental and public interest concerns.
- The Indian Patents Act, 1970 excludes ―plants and animals in whole or any part thereof other than microorganisms‖ from patentability.
- To comply with the mandate of Article 27.3 (b) of TRIPS, India adopted the Protection of Plant Varieties and Farmers Rights (PPV&FR) Act, 2001 as a sui generis regime protecting not only new plant varieties but also farmer's rights.

Biodiversity conservation

- In 1927 the "Indian Forest Act" and later on the "Wildlife Protection Act" 1972 was enacted to provide legal protection to biodiversity.
- In 1988, the "National Forest Policy" was passed, which brought revolutionary changes in the conservation and management of biodiversity.
- The Acts and policies in force to protect the environment and biodiversity in India include Mining and Mineral Development Regulation Act, 1957; Water (prevention and control of pollution) Act, 1974; Forest Conservation Act, 1980; Biological Diversity Act, 2002; Scheduled Tribes and other Traditional Forest Dwellers (recognition of rights) Act, 2006; National Biodiversity Action Plan, 2009; National Environment Policy, 2006 and a few more.

MAJOR AMENDMENTS IN IP LAWS AND ACTS IN INDIA

In order to fill the gaps existing in the IP Laws and Acts and also to introduce new guidelines/directions based on the current scenario (socially and politically), each nation keeps on updating the concerned IP Laws and Acts. Some of the salient amendments made in Indian Laws and Acts on IPR are mentioned below:

Sl. No	Year	Historical Proceedings
		PATENTS
1	1856	▪ The Act VI of 1856 on the protection of inventions based on the British Patent Law of 1852.
2	1859	▪ Rights renamed as "Exclusive Privileges" ▪ Time for the priority increased from 6 months to 12 months.
3	1883	▪ The Patterns and Designs Protection Act ▪ Introduction of novelty in the invention. ▪ A grace period of 6 months for the disclosure of the invention.
4	1911	▪ Renamed as "The Indian Patent and Design Act" and brought under the management of "Controller of Patents"
5	1930	▪ Introduction of Patent of Addition. ▪ Government can use the invention if required. ▪ The term of patent protection increased from 14 to 16 years.
6	1945	▪ Filing of the provisional specification to secure the priority date. ▪ Provision of submitting complete specifications within 9 months.
7	1949	▪ Dedicated Committee formed under the leadership of Justice Bakshi Tek Chand for reviewing patent system as per the national environment.
8	1950	▪ A working statement needs to be submitted at the Patent Office ▪ Endorsement of the Patents with the words "License of Right" on the application made by the government so that the Controller could grant the license.
9	1952	▪ Provision of "Compulsory License" in the areas of food, medicine and insecticide germicide. ▪ Process for producing substance or any invention relating to surgical

		or curative devices.
10	1965	▪ After incorporation of the recommendation submitted by the committee formed in 1949, a new bill was introduced in Lok Sabha but was not cleared.
11	1967	▪ Again submitted to Parliamentary Committee. ▪ 1911 Act remained applicable for Designs.
12	1970	▪ The Patent Act, 1970 passed by the Parliament Committee.
13	1972	▪ The Patent Act, 1970 came into force with the introduction of patent rules.
14	1995	▪ TRIPS Agreement was signed by India and got transition period 1995-2005 to make domestic laws compatible with TRIPS.
15	1999	▪ Introducing the provisions for receiving the applications for the product patent in the field of pharmaceuticals and agro-chemicals (mail box)*. ▪ Provisions for the grant of EMRs for distribution and sale of pharma products on fulfillment of certain conditions. ▪ Grant of EMR subject to certain conditions. After the amendments (1999) the product patents related to the pharmaceuticals and agrochemicals were kept on hold for examination till 2005. It is called a mailbox or black box.
16	2002	▪ The uniform 20-year term of the patent for all inventions. ▪ Disclosure of source and geographical origin of biological material made compulsory. ▪ Establishment of Appellate Board. ▪ Compulsory License provisions strengthened.
17	2003	▪ The Patents Rules, 2003 were introduced.
18	2005	▪ Product patent for inventions in all fields of technology including food, drug, chemicals and microorganisms. ▪ New forms of known substances excluded in order to prevent the ever-greening of the patent. ▪ Introduction of the pre-grant opposition.

		▪ Introduction of post-grant opposition. ▪ Extension of grace period to 12 months.
COPYRIGHTS AND RELATED RIGHTS		
1	1847	▪ The concept of Copyrights in India was introduced. ▪ Validity - Lifetime+7 years but not more than 42 years in total.
2	1914	▪ Copyright Act, 1914 was introduced based on the ▪ Imperial Copyright Act, 1911 of UK.
3	1957	▪ Copyright Act, 1914 was replaced with Copyright Act, 1957 with minor modifications
4	1984	▪ Penalty on second and subsequent conviction
5	1994	▪ Registration of Copyright Society made mandatory
6	2012	▪ To comply with international Treaties for copyrights protection in the digital environment. ▪ Right to receive royalties for authors and music composers. ▪ Exception of copyrights for physically disabled persons to access any work.
7	2013	▪ Copyrights Rules, 2013 introduced.
TRADEMARKS		
1	1940	▪ Trademarks Registry established in India.
2	1958	▪ The Trade and Merchandise Marks Act, 1958 enacted as per TRIPS Agreement.
3	1999	▪ Amended to avoid duplicity and ensure securing proprietors trade and goodwill
4	2002	▪ Trademarks Rules introduced.
5	2010	▪ Amended to comply with Madrid Protocol for international filing. ▪ Provision for filing opposition of the registration within 4 months.\
6	2013	▪ Trademarks Rules introduced.
GEOGRAPHICAL INDICATIONS		
1	1999	▪ Being a member of the World Trade Organization (TRIPS), GI of goods (Registration and Protection) Act was introduced.

2	2002	▪ The Geographical Indications of Goods (Registration and Protection) Rules, 2002 was introduced.
3	2003	▪ The Geographical Indications of Goods (Registration & Protection) Act came into force
INDUSTRIAL DESIGNS/ DESIGNS		
1	1872	▪ Patterns and Designs Protection Act introduced for the protection of new patterns and designs.
2	1888	▪ Amended as Invention and Design Act, 1988 for the protection of new inventions and designs.
3	1911	▪ Renamed as The Indian Patent and Design Act.
4	2000	▪ Design Act, 2000 was introduced; separated from the Indian Patent and Design Act.
5	2001	▪ Design Rules, 2001 introduced.
SEMICONDUCTOR INTEGRATED CIRCUITS: LAYOUT DESIGNS (SICLD)		
1	2000	▪ Semiconductor Integrated Circuits Layout Design (SICLD) Act 2000 introduced as a signatory of WTO.
2	2001	▪ SICLD Rules introduced.
PROTECTION OF PLANT VARITIES AND FARMERS RIGHTS		
1	1970	▪ The Patent Act, 1970 excluded plants and animals in whole or in any part from patentability (in 1999 amendments).
2	1991	▪ Enactment of protection of new varieties of plants on sui generis basis on the lines of UPOV.
3	2001	▪ In line with TRIPS Agreement enactment of PPV&FR Act was introduced.
BIOLOGICAL DIVERSITY		
1	2002	▪ The Biological Diversity Act, 2002 introduced on the lines of the Convention on Biological Diversity (CBD, 1992).
2	2003	▪ Establishment of National Biodiversity Authority. ▪ Designation of repositories under the Biological Diversity Act
3	2004	▪ Biological Diversity Rules introduced.

PATENTS

- A patent is an exclusive right granted for an innovation that generally provides a new way of doing something or offers a new technical solution to a problem.
- The exclusive right legally protects the invention from being copied or reproduced by others.
- In return, the invention must be disclosed in an application in a manner sufficiently clear and complete to enable it to be replicated by a person with an ordinary level of skill in the relevant field.

CONDITIONS FOR OBTAINING A PATENT PROTECTION

There is a set criterion, as provided in Section 2(1)(j) of the Patents Act, 1970, which must be fulfilled for a product or a process to qualify for the grant of a patent. The criterion encompasses:

- Novelty - *Not part of 'State of the Art'*. The innovation claimed in the patent application is new and not known to anybody in the world. In other words, the innovation is
    - not in the knowledge of the public,
    - not published anywhere through any means of publication and
    - not be claimed in any other specification by any other applicant.
- Inventive step - *Not obvious to the person (s) skilled in the art.* The innovation is
    - a technical advancement over the existing knowledge,
    - possesses economic significance and,
    - not obvious to a person skilled in the concerned subject.
- Capable of industrial application - *For the benefit of society*. The invention is capable of being made or used in any industry.

TO PATENT OR NOT TO PATENT AN INVENTION

- Once an invention has been developed, the inventor has to decide whether to exploit the invention for personal benefits as provided by the statutory laws of the country or put it in the public domain.
- By and large, the inventor prefers the former option. Only a miniscule of inventions is placed in the public domain without claiming any benefits.

- In the latter case, anybody can exploit the innovation for commercial or societal benefit without paying any money to the inventor.
- If the owner of an invention wishes to seek monetary gains, he can choose from either of the two options, i.e. patenting or Trade Secret. If the inventor is absolutely sure of maintaining the secrecy of invention for a very long period (maybe 100 years or more) and the probability of reverse engineering of the technology is nil or very low, then the "Trade Secret" category is preferred.
- If the invention has a short life span or can be kept secret only for a small period of time (a couple of years or so) or the probability of reverse engineering is high once the invention is in the public domain, then the "patent" category is preferred.

RIGHTS ASSOCIATED WITH PATENTS

- As per the Court of Law, a patent owner has the right to decide who may or may not use the patented invention.
- In other words, the patent protection provided by the law states that the invention cannot be commercially made, used, distributed, imported, or sold by others without the patent owner's consent.
- The patent owner may permit other parties to use the invention on mutually agreed terms.
- As a matter of fact, the patent rights are negative rights as the owner is restricting others from using the patent in any manner without his prior permission.
- The patent holder may choose to sue the infringing party to stop illegal use of the patent and also ask for compensation for the unauthorized use.

ENFORCEMENT OF PATENT RIGHTS

- Enforcement is the process of ensuring compliance with laws, regulations, rules, standards and social norms.
- Patent rights are usually enforced by the judicial courts.
- The Court of Law has the authority to stop patent infringement.
- However, the main responsibility for monitoring, identifying and taking action against infringers of a patent lies with the patent owner.

INVENTIONS ELIGIBLE FOR PATENTING

- Patents may be granted for inventions/technologies in any field, ranging from a paper clip or ballpoint pen to a nanotechnology chip or a Harvard mouse (mouse with cancer genes).
- It is a general belief that patents are awarded only to major scientific breakthroughs. But, it is not true.
- In fact, the majority of patents are granted to inventions displaying an improvement over the existing invention.
- For example, many patents can be awarded to a single molecule e.g. penicillin's (an antibiotic that kills microbes) and its derivatives. The derivatives are made by making subtle changes in the structure of the penicillin resulting in new/improved properties, such as acid stability or temperature stability or killing a wide range of microbes (germs). The new antibiotic molecules, known as second, third or fourth generation penicillin's can also be patented.
- In our daily life, we use many patented items, such as toothbrush, toothpaste, shoes, pen, eyeglasses, textiles, mobile phones, wrist watch, bicycle, scooter, car, television, cold drinks, beverages and many more.
- It is not uncommon that many products contain several inventions (patents) e.g. the laptop computer involves hundreds of inventions working together. Similarly, cars, mobile phones and televisions have many patented components.

NON-PATENTABLE MATTERS

In the Patent Act, 1970, there are some exclusion (product and processes) that cannot be patented, such as:

- **Invention contrary to public morality** - a method for human cloning, a method for gambling.
- **Mere discovery** - finding a new micro-organism occurring freely in nature, laws of gravity.
- **Mere discovery of a new form of a known substance** - use of aspirin for heart treatment. Aspirin was patented for reducing fever and mild pains.

- **Frivolous invention** - dough supplemented with herbs, merely changing the taste of the dough, 100 years calendar, and bus timetable.
- **Arrangement or rearrangement** - an umbrella fitted with a fan, a torch attached to a bucket.
- **Inventions falling within Section 20(1) of the Atomic Energy Act, 1962** - inventions relating to compounds of Uranium, Beryllium, Thorium, Plutonium, Radium, Graphite, Lithium and more as notified by the Central Government from time to time.
- **Literary, dramatic, musical, artistic work** - books, sculptures, drawings, paintings, computer programmer, mathematical calculations, online chatting method, method of teaching, method of learning a language as they are the subject matter of Copyright Act. 1957.
- **Topography of integrated circuits** - protection of layout designs of integrated circuits is provided separately under the Semiconductor Integrated Circuit Layout Designs Act, 2000.
- **Plants and animals** - plants and animals in whole or any part including seeds, varieties and species and essentially biological processes for the production or propagation of plants and animals are excluded from the scope of protection under patents.
- **Traditional knowledge** - an invention which in effect is traditional knowledge or which is an aggregation or duplication of known properties of traditionally known components are also excluded.

PATENT INFRINGEMENTS

- Once the patent is granted to the applicant, he owns the right to use or exploit the invention in any capacity. If anyone uses the invention without the prior permission of the owner, that act will be considered an infringement of the invention. Infringements can be classified into two categories
- **Direct Infringement** - when a product is substantially close to any patented product or in a case where the marketing or commercial use of the invention is carried out without the permission of the owner of the invention.
- **Indirect Infringement** - When some amount of deceit or accidental infringement happens without any intention of infringement. If such an unlawful act has been

committed, the patentee holds the right to sue the infringer through judicial intervention. Every country has certain laws to deal with such unlawful acts. Following reliefs are made available to the patentee:

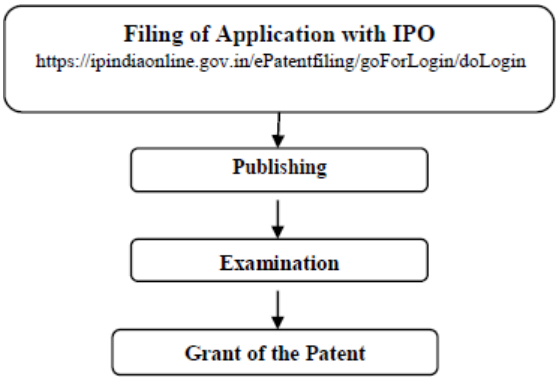
- Interlocutory/interim injunction.
- Damages or accounts of profits.
- Permanent injunction

AVOID PUBLIC DISCLOSURE OF AN INVENTION BEFORE PATENTING

- Generally, an invention that has been either published or publicly displayed cannot be patented, as the claimed invention will lose the Novelty 'criterion.
- However, under certain circumstances, the Patents Act provides a grace period of 12 months for filing a patent application from the date of its publication in a journal or presentation in a reputed scientific society or exhibition.
- Sometimes, disclosure of an invention before filing a patent application is unavoidable, e.g. selling your invention to a potential investor or a business partner who would like to know complete details of the invention in order to judge its commercial value. In such a case, it is advisable to sign a Non-Disclosure Agreement (NDA) or any other confidential agreement to safeguards your interest

PROCESS OF PATENTING

- In India, the process of grant of a patent is a lengthy procedure that may take anywhere 3-4 years or more. The major steps involved in this process are listed in figure



- While the process of patenting includes – Prior art search, Choice of Application to be Filed, Patent Application Forms, Jurisdiction of Filing Patent Application, Publication, Pre-grant Opposition, Examination, Grant of a Patent, Validity of Patent Protection, Post-grant Opposition

PRIOR ART SEARCH

- Before an inventor embarks upon the patent filing process, he has to ensure that his invention is novel as per the criterion for the grant of a patent. For this, he/she has to check whether or not his invention already exists in the public domain.
- For this, he/she needs to read patent documents and Non-Patent Literature (NPL), scientific journals/reports/magazines, etc.
- The information lying in the public domain in any form, either before the filing of the patent application or the priority date of the patent application claiming the invention, is termed as Prior Art.
- Conducting a prior art search before filing the patent has advantages as it averts infringement, tracks research and development and provides access to detailed information on the invention.
- The prior art search is carried out on the parameters such as novelty, patentability, state of the art, infringement, validity and freedom to operate.
- The commonly used databases for prior art search fall in two categories i.e. Patents Databases and NPL. The patent databases are
    - Indian Patent Advanced Search System (InPASS- http://ipindiaservices.gov.in/publicsearch/).
    - Patentscope (WIPO- https://www.wipo.int/patentscope/en/).
    - Espacenet (EU- https://worldwide.espacenet.com/patent/).
    - USPTO (USA- https://www.uspto.gov/).
    - Google Patents Advanced Search (https://patents.google.com/advanced).
    - Orbit Intelligence (https://www.questel.com/business-intelligence-software/orbit-intelligence/).
    - Derwent Innovation (https://clarivate.com/derwent/solutions/derwent-innovation/).

- PROQUEST (https://about.proquest.com/search/?searchKeyword=patent+).

- Non-Patent Literature (NPL)
  - Scholarly publications: Handbooks, Textbooks, Withdrawn, Patents, Encyclopedias, Journals (IEEE, Research Gate, Springer, Wiley Online Library, etc.), Dissertations, NCBI's, PubMed, Conference Proceedings, Technical Reports, Public Conferences, etc.
  - Industry/trade publications: Industry reviews and public disclosures (Social media, YouTube, Books, Magazines, Datasheets, Blueprints, etc.).
  - Others: Newspapers, Websites, Technology blogs, Researchers websites, etc.
  - Although, majority of NPL data is available freely on the public forum, some of the journals are paid and can be accessed after paying the subscription.
  - Major Patent Office's such as the United States Patent and Trademark Office's (USPTO), European Patent Office (EPO), Japan Patent Office (JPO), etc. are maintaining in house NPL databases to make patents examination more effective

CHOICE OF APPLICATION TO BE FILED

Once a decision has been made to patent the invention, the next step is, what kind of application needs to be filed i.e. provisional patent application or complete (Final) patent application - generally, the provisional patent application is preferred for the following reasons:

- It is cheaper, takes less time, and involves fewer formalities.
- Any improvements made in the invention after the filing of the provisional application can be included in the final application. In other words, the provisional application does not require complete specifications of the inventions. The application can be filed even though some data is yet to be collected from pending experiments.
- A provisional application allows you to secure a priority date for the patent applied.

PATENT APPLICATION FORMS

- As per the Patent Act, 1970 (Section 39) and the Patents Rules, 2003 (Rule 7, 54, 135 and sub rule (1) of rule 20, the application for the grant of patent is filed using Form-1 and Form-2.

- The information sought in Form-1 is general in nature i.e. Title of Application, Names of Applicant(s) and Inventor(s), Type of Application (Ordinary, Convention, PCT-NP (PCT-National Phase), Divisional, Patent of Addition, etc.).
- Whereas Form-2 seeks technical information and whether to file the provisional application or complete the application. For Provisional Application, only Description of the Invention and the Abstract is to be furnished. Whereas, Complete Application requires Description of the Invention, Abstract, Claims and the manner in which invention have to be performed.
- The Claims of the patent are a very crucial part of the specifications because they define the actual boundary of the invention.
- Claims specify what is actually claimed by the invention and what is being sought to be protected. It clearly describes what the patent does and does not cover

<table>
<tr><td colspan="3">"FORM 1
THE PATENTS ACT 1970 (39 of 1970) and
THE PATENTS RULES, 2003
APPLICATION FOR GRANT OF PATENT
(See section 7, 54 and 135 and sub-rule (1) of rule 20)</td><td colspan="3">(FOR OFFICE USE ONLY)</td></tr>
<tr><td colspan="3"></td><td>Application No.</td><td></td></tr>
<tr><td colspan="3"></td><td>Filing date:</td><td></td></tr>
<tr><td colspan="3"></td><td>Amountof Feepaid:</td><td></td></tr>
<tr><td colspan="3"></td><td>CBR No:</td><td></td></tr>
<tr><td colspan="3"></td><td>Signature:</td><td></td></tr>
<tr><td colspan="3">1. APPLICANT'S REFERENCE / IDENTIFICATION NO. (AS ALLOTTED BY OFFICE)</td><td colspan="3"></td></tr>
<tr><td colspan="6">2. TYPE OF APPLICATION [Please tick (1) at the appropriate category]</td></tr>
<tr><td colspan="2">Ordinary ( )</td><td colspan="2">Convention ( )</td><td colspan="2">PCT-NP ( )</td></tr>
<tr><td>Divisional ( )</td><td>Patent of Addition ( )</td><td>Divisional ( )</td><td>Patent of Addition ( )</td><td>Divisional ( )</td><td>Patent of Addition ( )</td></tr>
</table>

3A APPLICANT(S)				
Name in Full	Nationality	Countryof Residence	Address of the Applicant	
			House No.	
			Street	
			City	
			State	
			Country	
			Pin code	

3B CATEGORY OF APPLICANT [Please tick ( ) at the appropriate category]		
Natural Person ( )	Other than Natural Person	
	Small Entity ( )	Start-up ( ) Others ( )

4. INVENTOR(S) [Please tick (1) at the appropriate category]		
Are all the inventor(s) same as the applicant(s) named above?	Yes ( )	No ( )

If "No", furnish the details of the inventor(s)

Name in Full	Nationality	Country of Residence	Address of the Inventor	
			House No.	
			Street	
			City	
			State	
			Country	
			Pin code	

5. TITLE OF THE INVENTION		
6. AUTHORISED REGISTERED PATENT AGENT(S)	IN/PA No.	
	Name	
	Mobile No.	
7. ADDRESS FOR SERVICE OF APPLICANT IN INDIA	Name	
	Postal Address	
	Telephone No.	
	Mobile No.	
	Fax No.	
	E-mail ID	

8. IN CASE OF APPLICATION CLAIMLNG PRIORITY OF APPLICATION FILED IN CONVENTION COUNTRY, PARTICULARS OF CONVENTION APPLICATION					
Country	Application number	Filing date	Name of the applicant	Title of the invention	IPC (as classified in the convention country)

9. IN CASE OF PCT NATIONAL PHASE APPLICATION, PARTICULARS OF INTERNATIONAL APPLICATION FILED UNDER PATENT CO-OPERATION TREATY (PCT)	
International application number	International filing date

10. IN CASE OF DIVISIONAL APPLICATION FILED UNDER SECTION 16, PARTICULARS OF ORIGINAL (FIRST) APPLICATION	
Original (first) application No.	Date of filing of original (first) application

11. IN CASE OF PATENT OF ADDITION FILED UNDER SECTION 54, PARTICULARS OF MAIN APPLICATION OR PATENT	
Main application/patent No.	Date of filing of main application

12. DECLARATIONS

(i) Declaration by the inventor(s)

(In case the applicant is an assignee: the inventors) may sign herein below or the applicant may upload the assignment or enclose the assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period).

I/We,the above named inventor(s) is/are the true & first inventor(s) for this Invention and declare that the applicant(s) herein is/are my/our assignee or legal representative.

(a) Date
(b) Signature(s)
(c) Name(s)

(ii) Declaration by the applicant(s) in the convention country

(In case the applicant in India is different than the applicant in the convention country: the applicant in the convention country **may** sign herein below or applicant in India may upload the assignment from the applicant in the convention country or enclose the said assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period)

I/we, the applicant(s) in the convention country declare that the applicant(s) herein is/are my/our assignee or legal representative.

(a) Date
(b) Signature(s)
(c) Name(s) of the signatory

Source: http://www.ipindia.nic.in

FORM 2
THE PATENT ACT 1970
(39 of 1970)
&
The Patents Rules, 2003
PROVISIONAL/COMPLETE SPECIFICATION
(See section 10 and rule 13)

1. TITLE OF THE INVENTION

2. APPLICANT(S)

(a) NAME:

(b) NATIONALITY:

(c) ADDRESS:

3. PREAMBLE TO THE DESCRIPTION

PROVISIONAL	**COMPLETE**
The following specification describes the invention.	The following specification particularly describes the invention and the manner in which it is to be performed.

4. DESCRIPTION (Description shall start from next page)

5. CLAIMS (not applicable for provisional specification. Claims should start with the preamble — 'I/we claim' on separate page)

6. DATE AND SIGNATURE (to be given at the end of last page of specification)

7. ABSTRACT OF THE INVENTION (to be given along with complete specification on separate page)

Note: -

* Repeat boxes in case of more than one entry.
* To be signed by the applicant(s) or by authorized registered patent agent.
* Name of the applicant should be given in full, family name in the beginning.
* Complete address of the applicant should be given stating the postal index no. /code, state and country.
* Strike out the column which is/are not applicable

Source: http://www.ipindia.nic.in

JURISDICTION OF FILING PATENT APPLICATION

Region	States	Address
NORTH	Haryana, Himachal Pradesh, Punjab, Rajasthan, Uttar Pradesh, Uttarakhand, Delhi and the Union Territory of Chandigarh, Jammu and Kashmir and Ladakh.	Intellectual Property Office Building, Plot No. 32, Sector 14, Dwarka, New Delhi-110078 Phone: 011-28032491 Fax: 011-28034301 Email: delhi-patent@nic.in
SOUTH	Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Telangana and the Union Territories of Pondicherry and Lakshadweep	Patent Office Intellectual Property Building G.S.T. Road, Guindy, Chennai-600032 Phone: 044-22505242 Fax: 044-22502066 Email: chennaipatent@nic.in
WEST	Maharashtra, Gujarat, Madhya Pradesh, Goa and Chhattisgarh and the Union Territories of Daman and Diu & Dadra and Nagar Haveli	Boudhik Sampada Bhawan, Antop Hill, S. M. Road, Mumbai - 400 037. Phone: 022- 24153651, 24148165 Fax: 022-24130387 Email: mumbaipatent@nic.in
REST OF INDIA	Remaining States	Intellectual Property Office Building, CP-2 Sector V, Salt Lake City, Kolkata-700091 Phone: 033-23679101, 033-23671987 Fax: 033-23671988 Email: kolkatapatent@nic.in

PUBLICATION

- Once the patent application has been filed at the Regional Patent Office, the patent application is kept secret for 18 months in the Patent Office.

- After the expiry of 18 months (from the date of filing of the application or the priority claimed date, whichever is earlier), the application is published in the Official Journal of Patent Office (http://www.ipindia.nic.in/journalpatents.html).
- The purpose of publishing the application is to inform the public about the invention. The publication of an application is a mandatory step.

PRE-GRANT OPPOSITION

- If anybody has an objection to the invention claimed in the patent application, he/she can challenge the application by approaching the Controller of Patents within 6 months from the date of publication. It is termed as Pre-grant Opposition.
- Depending on the outcome of the case, the patent application may be rejected or recommended for the next step, i.e. patent examination.
- Although the patent application is kept secret for 18 months, but under special circumstances, this period can be reduced when the patentee/applicant plans to sell or license the patent or seek an investor).
- For this, the applicant has to fill a Form-9 and submit it to the Controller General.

EXAMINATION

- Patent examination is a critical step in the process of grant of a patent. All the important criteria (novel, inventive step, etc.) are scrutinized by the professionals depending on the content of the invention.
- Usually, the examiner raises certain queries/doubts which need to be addressed by the inventors. Once the examiner is satisfied with the answers received from the inventors, the application is recommended for the grant of a patent.
- It is pertinent to mention that a patent application is not examined automatically after clearing the publication stage. The applicant or his representative has to make a request for examination of the patent by filing Form-18A and submitting the same within 48 months from the date of filing of the application

GRANT OF PATENT

- After fulfilling all the requirements for the grant of a patent, including all objections/queries raised by the Patent Examiner and the public at large, the patent is granted to the applicant.
- The granted patent is published in the Official Journal of the Patent Office.
- This journal is published every Friday and contains information related to patent applications published under section (u/s) 11A, post-grant publication, restoration of patent, notifications, list of non-working patents and public notices issued by the Patent Office.

VALIDITY OF PATENT PROTECTION

- The patent protection is granted to an applicant for a limited period, generally 20 years, starting from the date of filing of the application.
- Once a patent is granted for an invention in India, the next vital step is to ensure that it is renewed annually by paying Patent Renewal Fee as per Section 53, Rule 80 of the Indian Patents Act, till the expiry of the patent grant period.
- Non-payment of Patent Renewal Fee might result in the cancellation of the patent.
- In some countries, patent protection may be extended beyond 20 years.
- The extension aims to compensate for the time expended on the administrative approval procedure before products can be put on the market. The time taken for this procedure means that the patent owner may sometimes not be able to benefit from his right for a considerable period after the grant of the patent.

POST GRANT OPPOSITION

- Once the patent has been granted by the Patent Office, it still can be challenged by anyone within one year from the date of publication of the grant of the patent.
- The granted patent can be challenged either via a Patent Office or in a Court of Law.
- These bodies may invalidate or revoke a patent upon a successful challenge by the interested party on the grounds mentioned below:

- The applicant for the patent wrongfully obtained the invention or any part of the invention.
- The invention claimed has been published before the priority date.
- The invention claimed was publicly known / used before the priority date.
- The invention claimed is obvious and does not involve an inventive step.
- The subject of the claim is not patentable as per Chapter II of the Patent Act, 1970.
- The details/specifications of the invention do not sufficiently and clearly describe the invention.

COMMERCIALIZATION OF A PATENT

- The patent owner may grant permission to an individual/organization/industry to make, use, and sell his patented invention. This takes place according to agreed terms and conditions between the involving parties.
- A patent owner may grant a license to a third party for the reasons mentioned below:
  - The patent owner has a decent job e.g. university professor and has no desire or aptitude to exploit the patent on his own.
  - The patent owner may not have the necessary manufacturing facilities.
  - The manufacturing facility is not able to meet the market demand.
  - The patent owner wishes to concentrate on one geographic market; for other geographical markets, he may choose to license the patent rights.
- Once the patent is granted, the patentee (person holding the rights to the patent) enjoys the exclusive rights to use the patented invention.
- Only the patentee has the right to license or deal with the patent for any deliberations. Although, the validity of the granted patent is for 20 years (from the date of filing a patent application), but the patentee is required to furnish information (Form-27), on an annual basis relating to the commercialization/selling of the patent. It is called as Working/Licensing of the Patent.
- The licensing of a patent can be exclusive or non-exclusive.

- In an Exclusive License, the patent is sold to only one individual/organization for a fixed time period. During this time period, no other person or entity can exploit the relevant IP except the named licensee.
- In Non-Exclusive License, a patentee can sell his patent rights to as many individuals/parties as he likes. If the patentee is not able to commercialize his patent within three years from the date of the grant of a patent, any person may submit an application to the Controller of Patents for grant of Compulsory Licensing (of the patent), subject to the fulfillment of following conditions:
    - Reasonable requirements of the public concerning the patented invention have not been satisfied.
    - The patented invention is not available to the public at a reasonable price.
    - The patented invention is not worked in the territory of India.

NEED FOR PATENT ATTORNEY / AGENT

- In general, applicants can prepare their patent applications and file them without assistance from a patent attorney.
- However, given the complexity of patent documents, it is advisable to seek legal assistance from a patent attorney/agent when drafting a patent application.
- Furthermore, the legislation of many countries requires that an applicant, whose ordinary residence or principal place of business is outside the country, be represented by an attorney or agent qualified in the country (which usually means an agent or attorney who resides and practices in that country

CAN A WORLDWIDE PATENT BE OBTAINED?

- There is no such term as Universal Patent or World Patent or International Patent as the patent rights are territorial.
- An application for a patent must be filed with a Patent Office of the country in which one wishes to seek patent protection. Unfortunately, this option becomes laborious, cumbersome, time consuming and expensive if one wishes to file a patent application in many countries.

- To ease out this issue, many Regional Offices have been established which receive patent applications on behalf of a group of nations e.g. European Patent Office and African Regional Intellectual Property Organization.
- A single application is sufficient to cover many nations that are members of a particular regional office/organization.
- However, if one wishes to seek patent protection in several countries worldwide, it is preferred to file an international patent under the Patent Cooperation Treaty (PCT).
- The only condition is that the applicant‘s country should be a member of PCT. India, along with over 190 nations, is a member of PCT.

DO I NEED FIRST TO FILE A PATENT IN INDIA

- Yes, in general, Indian residents are required to file the patent application first in India. Subsequently, they may file for patent protection in other countries.
- But for this, prior approval is needed from the Patent Office. However, this approval can be waived off under the following circumstances:
    - The applicant is not an Indian resident.
    - If 6 weeks have expired since the patent application was filed in India by an Indian resident.
    - If two or more inventors are working on an invention in a foreign country and one of the inventors is an Indian resident. The invention does not have a potential market in India and hence does not wish to file the patent in India. In such a scenario, the Indian resident has to seek Foreign Filing Permission (FFP) from an Indian Patent Office.
    - In case of international collaboration, if one part of the invention originated in India and the inventor is an Indian resident, he has to seek permission to file the patent outside India.
    - If the invention is related to defense or atomic energy or utility model, the inventor/s needs to seek permission from the Indian Patent Office because inventions related to these domains are not the subject matter of patentability in India.

PATENT RELATED FORMS

- There are over 30 patent-related forms. Some of them are mentioned below.

Form No.	Title of Form
1	Application for a grant of a patent
2	Provisional/Complete specifications
7	Notice of opposition on grant of a patent
7A	For filing a representation opposing grant of a patent
17	Application for compulsory license
18	Request for examination of the application for patent
21	Request for termination of compulsory license
22	Application for registration of patent agent
27	Statement regarding the working of the patented invention on a commercial scale in India
30	Miscellaneous form to be used when no other form is prescribed

Source: http://www.ipindia.nic.in/writereaddata/Portal/IPORule/1_70_1_The-Patents-Rules-2003-Updated-till-23-June-2017.pdf

FEES STRUCTURE

- As per the patent Act, 1970 and The Patents Rules (1972), the requisite fee has been specified based on the type of form/s to be submitted to the Office.
- Electronically filed applications are 10% cheaper than physical filing.

Item	Natural person/ startup (₹)	Small entity alone or with a natural person /startup (₹)	Others alone or with natural person/ startup/ small entity (₹)
Provisional/Complete Specifications	1,600	4,000	8,000
Request for Early Publication	2,500	6,250	12,500
Request for Examination	4,000	10,000	20,000
Express Request For Examination	5,600	14,000	28,000
Renewal Fees (Annually)			
3^{rd} to 6^{th} Year	800	2,000	4,000
6^{th} to 10^{th} Year	2,400	6,000	12,000
11^{th} to 15^{th} Year	4,800	12,000	24,000
16^{th} to 20^{th} year	8,000	20,000	40,000

Source: http://www.ipindia.nic.in/writereaddata/Portal/IPOFormUpload/ 1_11_1/ Fees.pdf

TYPES OF PATENT APPLICATIONS

- **Provisional Application** - A patent application filed when the invention is not fully finalized and some part of the invention is still under experimentation. Such type of application helps to obtain the priority date for the invention.
- **Ordinary Application** - A patent application filed with complete specifications and claims but without claiming any priority date.
- **PCT Application** - An international application filed in accordance with PCT. A single application can be filed to seek patent protection and claim priority in all the member countries of PCT.
- **Divisional Application** - When an application claims more than one invention, the applicant on his own or to meet the official objection on the ground of plurality may

divide the application and file two or more applications. This application divided out of the parent one is known as a Divisional Application.

- **Patent of Addition Application** - When an invention is a slight modification of the earlier invention for which the patentee has already applied for or has obtained a patent, the applicant can go for Patent of Addition, if the modification in the invention is new. Benefit - There is no need to pay a separate renewal fee for the Patent of Addition, during the term of the main patent. It expires along with the main patent.
- **Convention Application** - If a patent application has been filed in the Indian Patent Office and the applicant wishes to file the same invention in the one or more Convention countries (e.g. Paris Convention) by claiming the same priority date on which application was filed in India, such an application is known as Convention Application. The applicant has to file Convention Application within 12 months from the date of filing in India to claim the same priority date.

COMMONLY USED TERMS IN PATENTING

Sl. No	Terms	Definition
1	Inventor	Creator of an invention
2	Applicant	Organization/individual/industry that files a patent application or applies for a patent
3	Patentee	A person/organization who owns the patent (granted)
4	Licensee	Organization/individual/industry which obtains a license of the patent from the Patentee for commercialization purpose
5	Assignee	A person in whose name patent has been assigned legally
6	In force	The applicant is paying the annuity (renewal fee) for the patent to keep it alive (Active Patent)
7	Working of a patent	The selling of a patent to an individual/party for commercial exploitation is called as working of a patent
8	Patent Specification	Patent specification is a written description of the invention and the way of representation and process of making and using the same

9	Priority right	It is a time-limited right, activated by the first filing of an application for a patent
10	Priority date	The claimed date on which the first application for the invention is filed
11	Patent claims	Claims can be defined as the scope of the protection conferred by a patent, or the protection sought in a patent application. The purpose of the claims is to define which subject matter is protected by the patent
12	National phase application	An application filed to obtain patents in different countries simultaneously based on a single International/PCT application
13	Patent revocation	The revocation means cancellation of the patent due to certain reasons, such as lack of patentability or wrongfully obtaining a patent
14	Restoration of patent	Once a patent has been ceased (e.g. due to non-payment of the fee) it can be restored within a permitted period by paying the requisite fee

NATIONAL BODIES DEALING WITH PATENT AFFAIRS

There are many departments/organizations/bodies dealing with various aspects of patents, namely,

- **The Indian Patent Office (IPO)** - The Office of the Controller General of Patents, Designs and Trade Marks generally known as the Indian Patent Office, is an agency under the Department for Promotion of Industry and Internal Trade which administers the Indian law of Patents, Designs and Trade Marks.
- **Department for Promotion for Industry and Internal Trade (DPIIT)** - DPIIT, earlier known as the Department of Industrial Policy and Promotion (DIPP), under the Ministry of Commerce and Industry, Govt. of India, is the apex IP body. It came into existence in 1995 and is the main body for regulating and administering the industrial sector.
- **Technology Information, Forecasting and Assessment Council (TIFAC)** - The importance of undertaking technology forecasting and assessment studies on a systematic

and continuing basis was highlighted in the Government of India's Technology Policy Statement (TPS) of 1983. Therefore in 1985, TIFAC was established as an autonomous body, registered as a Society in 1988, under the Department of Science and Technology. It is an important cog in filling a critical gap in the overall Science and Technology system of India. Its mission is to assess the state-of-art of technologies and set directions for future technological developments in India in important socio-economic sectors

- **National Research Development Corporation (NRDC) -** NRDC, an enterprise of Department of Scientific & Industrial Research (DSIR), Govt. of India, was set up in 1953 with a mandate to develop, promote and transfer/commercialize IP and technologies emanating from Higher Education Institutes (HEIs), R&D research laboratories/institutions and Public Sector Undertakings (PSUs). NRDC has a repository of 2500 Indian technologies, filed over 1700 Patents and transferred about 5000 technologies in different sectors in India. It has also created a technology data bank (http://fccollc.com/nrdclive/) containing information regarding technologies available in various fields, such as electrical & electronics, mechanical, coil, mining, biotechnology, healthcare, leather, etc.

UTILITY MODELS

- In many cases, a new invention involves an incremental improvement over the existing products, but this technical improvement is not sufficient enough to pass the stringent criterion of Novelty and Non-obviousness set aside for the grant of a patent. Such small innovations can still be legally protected in some countries and termed as 'Utility Models' or 'Petty Patents' or 'Innovation Patents'.
- In this case, the criterion of Novelty and Non-obviousness are diluted or relinquished. But the requirement of industrial application or utility is the same as that for patents.
- Utility Model is a helpful tool for Micro, Small and Medium Enterprises (MSME) since the grant of a Utility Model is usually less rigorous and involves minimal cost.
- MSMEs do not have deep pockets to carry out intensive R&D leading to the grant of patents. But their innovations are good enough for improving their products/processes and bringing more financial rewards. Such inventions pass the requirements set aside for Utility Models but not for patents.

- The life of the Utility Model is less as compared to the patents. It varies from 7-15 years in different countries.
- Nearly 80 countries, including France, Germany, Japan, South Korea, China, Finland, Russian Federation and Spain, provide protection for Utility Models under their IPR laws.
- India till date does not recognize utility patents. If these small patents are recognized under IP protection in India, it will catapult the number of patents (filed and granted) on annual basis.