ATME COLLEGE OF ENGINEERING

13th KM Stone, Bannur Road, Mysuru - 570 028

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

Course Title: RESEARCH METHODOLOGY & IPR

Course CODE: BRMK557

SEMESTER: V

Academic Year – 2024-25

INSTITUTIONAL VISION AND MISSION

VISION:

- Development of academically excellent, culturally vibrant, socially responsible and globally competent human resources.

MISSION:

- To keep pace with advancements in knowledge and make the students competitive and capable at the global level.
- To create an environment for the students to acquire the right physical, intellectual, emotional and moral foundations and shine as torchbearers of tomorrow's society.
- To strive to attain ever-higher benchmarks of educational excellence.

Department Vision and Mission

Vision:

To create Electrical & Electronics Engineers who excel to be technically competent and fulfill the cultural and social aspirations of the society.

Mission:

- To provide knowledge to students that builds a strong foundation in the basic principles of electrical engineering, problem solving abilities, analytical skills, soft skills and communication skills for their overall development.
- To offer outcome based technical education.
- To encourage faculty in training & development and to offer consultancy through research & industry interaction.

Program Educational Objectives (PEOs)

PEO1:

To produce competent and ethical Electrical and Electronics Engineers who will exhibit the necessary technical and managerial skills to perform their duties in society

PEO2:

To make students continuously acquire and enhance their technical and socio-economic skills

PEO3:

To allow students to embark on R&D activities leading to offering solutions and excel in various career paths.

PEO4:

To produce quality engineers who have the capability to work in teams and contribute to real time projects

Program Outcomes (POs)

Engineering Graduates will be able to:

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design / Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

The students will develop an ability to produce the following engineering traits:

PSO1: Apply the concepts of Electrical & Electronics Engineering to evaluate the performance of power systems and also to control industrial drives using power electronics.

PSO2: Demonstrate the concepts of process control for Industrial Automation, design models for environmental and social concerns and also exhibit continuous self- learning.

RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS

Course Code: BRMK557

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

Text book referred: 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

Meaning of Research

Definition 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.

What are research projects?

Research involves the formulation of hypotheses or problem-solving strategies, data analysis, and reasoning; and determine whether the results are consistent with the hypotheses. Research is the process of creating or presenting knowledge that does not yet exist.

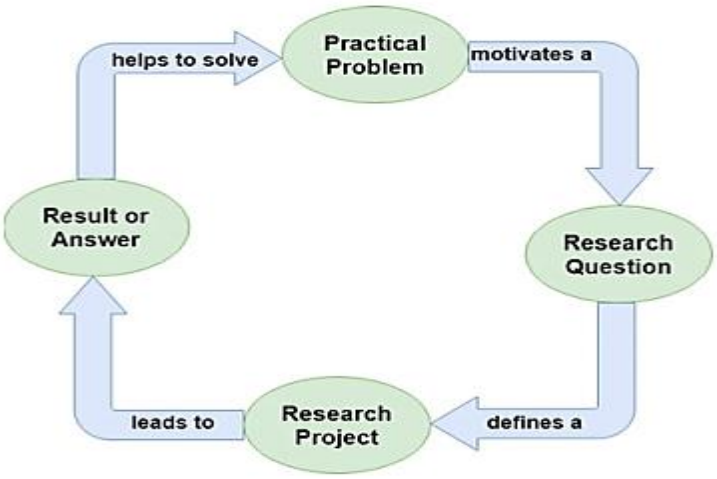
Example:

1. **Problem:** A bridge architect is trying to build a new earthquake-proof bridge.
2. **Assumption:** The engineer thinks that the new bridge using steel and concrete will be more earthquake resistant than the existing bridge.
3. **Data Collection:** Engineers collect data on earthquake performance of different bridge designs. Experts also conducted tests to measure the strength and durability of the new bridge.

4. **Data Analysis:** Designers analyze data to see if it supports the hypothesis. Engineers also use data to identify design flaws.
5. **Inferences:** Engineers make inferences from data and theory. Experts may conclude that the newly built bridge is more earthquake resistant than the existing bridge, but may also conclude that there are some flaws in the design standards that need to be addressed.
6. **Conclusion:** Engineers concluded that the new bridge construction is a promising solution to the bridge's seismic resistance problem. But the experts also agreed that more research is needed to measure and evaluate fitness.

Research Cycle

Research begins with practical problems: it should be clear what the problem you are trying to solve is and why it is important.



This question raises a research question that most people would get lost in large volumes of data. The question will help to focus on the data and then explain research, which is a study or study in the result or answer, which will help solving a real problem begin with research. The initial position is shown in Figure 1.1.

Fig. 1.1 The research flow diagram

Note: Research questions? - A research question is one that the researcher tries to answer through research. It is important to formulate questions clearly and precisely before conducting any research as this will help guide the research process and ensure the accuracy and importance of the research.

Example: How does the addition of graphene nanolayers to a polymer matrix affect the properties of the composite?

This research question is unique because it focuses on the effect of graphene nanolayers on the electrical properties of the polymer matrix.

Here was also intrigued for asking the difference regarding the addition of graphene nanosheets.

These questions can also be answered as experiments can be conducted to evaluate the properties of composites with and without graphene nanolayers.

What is the importance of research and how is it done well?

Research aimed at contributing to knowledge. Research questions should be relevant to the world we live in and should be answered with appropriate time and resources.

The investigation must be systematic and precise. The purpose of research is to understand something or solve a problem. Qualitative research questions change throughout the project and can be modified as needed. Research should be used to create new knowledge that can be written or recorded in some way. Research is not just about following steps.

It's about being able to ask new questions, look at things in a new light, and come up with new solutions. Critical thinking and creativity are important aspects of research work. Through research, one seeks to create or create new information about the
world around us that can be written or recorded in some way and accessed by writing or recording.

What are the ways in which intelligence is created and acquired?

1. Observation is the easiest way to get information from places, and observation itself is important if what we are trying to observe is unusual or happy or difficult to observe. Observations lead to everything from measurement to analysis of a group of subjects to how long the firmware will take.

   Survey data usually needs to be completed in some form; this leads to a second piece of information, namely the model. For example:

   - A mechanical engineer can observe how a new product behaves under different loads. This analysis could lead to the creation of new models of energy products.
   - Observe the wear of the bearings to determine the cause of the failure.
   - Monitor the performance of the new engine to determine fuel efficiency.

2. Formulas are approximate and often simple ways of describing sometimes very complex relationships between numbers, shapes, or equations. For example, the equation of the relationship between different objects or tools in abstract form allows us to understand the phenomenon.

   For example:

- An engineer might develop a mathematical model of airflow around the wing of an airplane. The model can be used to predict the lift and drag characteristics of wind turbines.
- Construct a stress distribution model in the beam under load. The model can be used to estimate beam deflections and damage loads.
- Construct a model of the water flow in the pump. The model can be used to predict the performance of the pump and head.

3. The last category is the way things are prepared or processed by processes, procedures, methods, plans or designs to meet certain needs.

   For example:

   - An engineer may develop a method for making a new type of turbine blade. This technique can be used to create better and more durable teeth.
   - Develop a process for casting metal parts. The process can be used to produce products with high precision and repeatability.
   - Improved steel plate welding process. This technique can be used to create strong and durable connections. Section

These 3 ways are shown in the figure 1.2

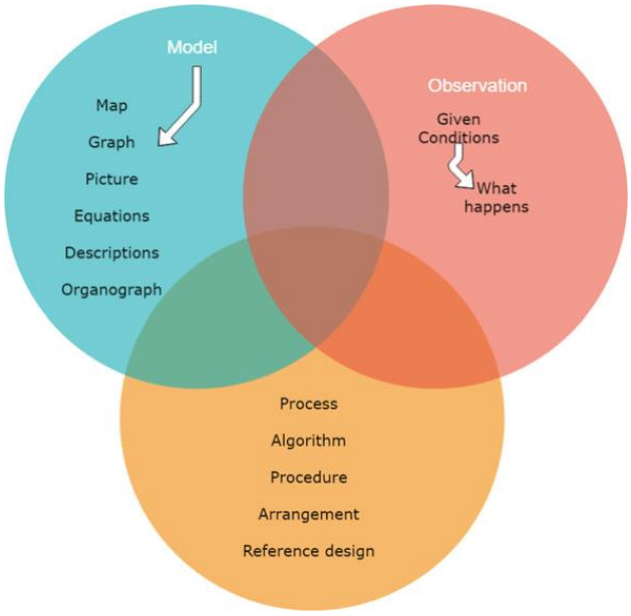


Figure 1.2 Scientific knowledge

What are the different stages of Engineering Research?

Engineering studies usually begin with a broad field of study, such as management. The work is then narrowed down to one specific topic, such as microbial oil control.

Finally, the topic narrows down to a specific question the study is trying to answer,
such as the management of single- compartment microbial fuel cells. Sometimes this can be reversed. Also, solving the problem effectively is doing more than half the work done. Because a good problem is difficult but successful and has the potential to benefit the region.

Definition of engineering research: Engineering research is the process of developing ideas and seeking improvements in knowledge and skills in order to be able to analyze, plan, design and conduct various types of research related to engineering and technology research and development.

Meaning of Selected Words:

- **Curious** – I am interested in learning different things.
- **Critical thinking** - Self-directed, self-disciplined, trying to think the best of the wrong.

1.1 Objectives of Engineering Research

Objectives of Engineering Research/ challenges of engineering research?

The objective of engineering research is to solve new and important problems, the results of the research should be new, but the results are not known when the research starts. Therefore, it can be argued that getting started is difficult on its own. The answer is that people make predictable decisions based on "quasi-evidence", intuition, and imagination. The prediction gives a target to strive for and after the first attempt the result will prove the prediction wrong. However, this work may suggest new avenues or goals that may rely on some changes in the original goals or require new ideas or have negative consequences that make the original goal or some goals impossible to achieve.

Aim of Research

The main purpose of research is to use the research method to find answers to open questions, although each research is appropriate in some way.

What are different types of research studies? Give an example.

Research or theory of structure, explanation, diagnosis, and evaluation.

- **Research or Scientific Research:** This type of research is often used to understand a problem or problem. **For example**, an engineer might do scientific research to better understand why machines fail.
- **Scientific Research:** This type of research is used to describe current events.

  For example, an engineer might make a statement to determine the average lifespan of a species.
- **Diagnostic Study:** This type of study is used to determine the cause of the problem.

  For example, an engineer may investigate to determine why some engines are not performing as expected.
- **Hypothesis Testing Research:** This type of research is used to test a hypothesis.

  For example, an engineer may conduct a hypothesis test to determine whether a new wind turbine design will make it work.

1.2 Motivation in Engineering Research

- **Intrinsic Motivation:** This is the desire to do something for one's own good without any external reward. Intrinsically motivated engineers are driven by a passion for learning, solving problems, and changing the world.
- **Extrinsic Motivation:** The desire to do something for reward or recognition. Extrinsically motivated engineers may be motivated by money, fame, awards, or career advancement opportunities.
- **Social Motivation:** The desire to do something to meet the needs of others or to fit into the group. A social worker may be motivated by a desire to please a colleague, please a mentor, or meet the expectations of a parent or teacher.
- Engineers are motivated by thinking in addition to these three main motivations:

  1. **Solving unsolvable problems:** Engineers are often motivated by thinking to find solutions to problems in the world's most difficult problems.
  2. **Improving the Latest Technology:** Engineers are constantly looking for ways to improve existing technologies and create new ones.
  3. **Contributing to the Improvement of Society**: Engineers want to use their knowledge and skills to make the world a better place.

Finally, the motivation for engineering research is as diverse as the engineers themselves. But all engineers want to change the world.

Types of Engineering Research

There are three main types of research: descriptive research, applied research, and basic research.

Scientific explanation of current events. It doesn't try to explain why things are the way they are, but can be used to identify patterns and trends. Example: A description might look at the average lifespan of a lighting type.

(i) Descriptive versus Analytical

(ii) Applied versus Fundamental

(iii) Quantitative versus Qualitative

1. **Descriptive Research:**

Descriptive research focuses on describing a situation or phenomenon without manipulating variables. It aims to provide a snapshot of the current state.

Example:

1. Suppose you want to understand the shopping habits of people in a particular neighbourhood. You conduct a survey asking questions about where they shop, how often, and what products they prefer. The results provide a description of the current state of shopping habits in that neighbourhood.
2. Conducting a survey to understand the preferences of students in your school without manipulating any factors.

2. **Analytical Research:**

Analytical research goes a step further, analysing existing data to uncover patterns, relationships, or reasons behind observed phenomena.

Example: Building on the descriptive research, you now want to analyze the data more deeply. You take the information gathered and try to identify patterns and reasons behind the shopping habits. For example, you might analyze whether income levels or age influence where people shop. This deeper analysis helps you understand the factors influencing the observed shopping behaviours.

3. **Applied Research:**

Applied research seeks to solve practical problems or address real-world issues. Its goal is to provide solutions and is often more focused on immediate, practical applications.

Example: Developing a new type of fertilizer to increase crop yield in agriculture.

4. **Fundamental Research:**

Fundamental research, on the other hand, is driven by a curiosity to expand knowledge. It doesn't necessarily have an immediate practical application and often explores theoretical concepts.

Example: Studying the behaviour of subatomic particles in physics to enhance our understanding of the fundamental principles of the universe.

5. **Quantitative Research:**

Quantitative research involves the collection and analysis of numerical data. It is focused on measurable variables to establish patterns or relationships.

Example: Conducting a survey to gather numerical data on the number of hours students spend on homework each week.

6. **Qualitative Research:**

Qualitative research deals with non-numerical data, often using methods like interviews or observations to explore underlying meanings, attitudes, or perspectives.

Example: Conducting in-depth interviews with individuals to understand their experiences and perceptions of a particular social issue.

Finding and Solving a Worthwhile Problem

- Qualifying research questions may contain one or more features. Something the social sciences hope for from time to time may lead to a lack of understanding/idea even for a person familiar with the work, the simplicity of the method's importance, a new topic or a new phenomenon to initiate an answer.
- Giving a new method or developing a method of knowledge that is in good use or is the result of being unable to continue in a region.
- The researcher must ensure that the problem is appropriate before starting work on it, as the best effort is made when the work is appropriate and the problem and/or solution will be accepted by the scientific community.
- Unresolved issues raised by the research director or raised by others. It may involve a rethinking

of key assumptions or may need to be developed or compiled from information provided by the supervisor in the report.

- The task facing scientific researchers is to find the right problem to begin their research. The skills needed to complete these tasks from the start. Once the problem is clearly identified, the research and reading process is done to clarify the value of the problem.

George Pólya (1887-1985) proposed four steps for solving mathematical problems.

Suggested steps in solving a research question are:

(i) understand the question, modify it to suit you, visualize the problem, and decide if there is more detail.

(ii) One must start somewhere and systematically explore possible strategies to solve the problem or a simpler version of it while looking for patterns.

(iii) Follow the plan to see if it works, if not, start over with another method. After researching a problem and coming back many times, people may experience a sudden revelation or come up with a new idea to solve the problem.

(iv) Looking back and thinking helps to understand and assimilate ideas and is an investment in the future.

Ethics in Engineering Research

Ethics is generally concerned with the processes or skills that distinguish bad behavior from wrong. Everyone knows some moral principles, but there are differences in their interpretation and application. Moral development proceeds through various stages of development. Ethics can be used to evaluate, recommend, or interpret policy.

- Morality is not law, but laws usually follow morality because morality is our common virtue.
- International codes of ethics have emerged since the Nuremberg Law was passed in 1947. Issues related to research scores date back to the 17th century, from the founding of the Royal Society (BRS) to refine scientific credit methods and methods. modern scientific practice. Rather than trying to identify who made the first discovery, BRS focuses on who first submitted research results to publication.
- Whitbeck [4] tackles the thorny issue of authorship in science by asking two simple but important questions:

- who should be listed as the author; and
- the appropriate registration orders.

- Government agencies and universities around the world have adopted specific policies regarding research practices.
- Research ethics and responsible research are often used interchangeably. Research ethics examines the appropriate use of research results, while research responsibility is about performance.

Ethics in Engineering Research Practice

Engineering researchers must make ethical decisions and be responsible for the impact of their research. Information used in engineering research is important because it affects people.

Some practices may be acceptable to some people in some circumstances, and the reasons for their acceptance may not be entirely valid. Today we have unprecedented access to data, unprecedented options for data analysis, and the emergence of engineering studies involving data. Engineering ethics provides us with a rulebook; teaches us how to decide what is allowed and what is not.

Scientists make various choices regarding ethics and the impact of technology in various ways:

- By setting ethical standards up front, engineering scientists can influence the full benefits of advancing technology.
- Researchers can also tap into the power of design—the process of transforming needs into designs designed to meet those needs. Ethical decisions should be made to determine the importance and importance of the requirements while creating the process.
- Third, engineering scientists must choose different options to complete similar tasks.

Research findings often have negative side effects. It is the primary responsibility of scientists to ensure that the hazards/risks associated with the technology they develop are minimized and to evaluate safer alternatives.

The design should have a centralized security where possible or have security features and a variety of independent security measures to avoid danger, or, if Yes, a control system in case the main system fails.

Types of research Misconduct

Research ethics involves treating others fairly, being honest about methods and results, repeating results as much as possible to avoid mistakes, protecting the health of research, ensuring safety in the laboratory, etc. includes.

To avoid inaccuracies, the research should be peer-reviewed before it is published. Research fraud described in Section Search Documents may include:

(i) Fabrication: Fabrication is the creation of documents or a test of knowledge in the belief that the person understands the results of the analysis. or the test is OK but will not be able to wait for results due to time pressure from the supervisor or user.

(ii) Falsification (falsification of information): Falsification refers to the misrepresentation or misinterpretation of an information or test, or the making, respectively, of illegal changes to support a hypothesis, even if actual data from experimental data suggest otherwise. Fraud and fabrication of information and results undermines engineering research, introduces false information into the database, undermines the trust of stakeholders, undermines cost increases, hinders scientific progress, and causes real and avoidable delays in technological development.

Data errors can also occur due to poor testing or inaccurate measurements. The image of engineering scientists as objective seekers of truth is often tarnished by the discovery of information about fraud. While researchers want to continue working on published data that could become part of research papers, they can avoid this bad practice by always trying to reproduce results.

(iii) Plagiarism (excluding the use of someone else's work): Plagiarism is manifest when a person uses or reuses another work (including parts) (text, document, table, picture, diagram or content) as it appears in his work. emerges out. Thank you. Copying or reusing one's own published work is called self-plagiarism, which is bad practice in the scientific literature. Although the increase in search terms on the Internet seems to encourage plagiarism in some cases, it can also be detected by software packages.

How are supervisors, reviewers or editors alerted to plagiarism?

1. Original author comes to know and informs everyone concerned.
2. Sometimes a reviewer finds out about it during the review process.
3. Or, readers who come across the article or book, while doing research.

(iv) **Other types of research bias:** Significant deviations from accepted behavior can be interpreted

as research bias. In cases where deception and harm are in question, fraud is considered to have taken place. Sooner or later moral violations will occur. Submitting an article to two different journals at the same time is also a violation of the copyright. Another problem is that when there are errors in the text or published content, these errors are usually not made public for public access unless a competent researcher presses them to create the error and provide a good resemblance to the correct version, which is not always available. Primary research goal.

How can we warn reviewers, reviewers or editors about plagiarism? Article

(i) The Secretary-General informs and informs all concerned. Section

(iii) Or readers who come across articles or books during research.

Although there are many free and paid materials for school leave, they are not criminal, they only get Similar score in content analysis, similarity index of published content and unpublished content.

However, a similar score does not guarantee that the document is free of plagiarism. Whether the content is plagiarism should be evaluated by human eyes. It is important

to look at individual ratings of sources, not overall results. Setting a parameter to a parameter of maximum similarity means under-utilizing the tool. Patchwork plagiarism is difficult to measure.

There are some simple and ethical ways to avoid the same thing in the next post. Sometimes some published content is good for a research paper; maybe it can make a connection or strengthen a claim. Printed material is provided for fair use purposes. People do not create scientific results out of nothing. However, important points can be explained in your own words, so there is no need for copying.

It is important to emphasize the importance in all this. However, the mention of a source does not mean that a sentence (or sentence) in the main content can be repeated. Researchers should practice writing in such a way that readers can distinguish the author's ideas or conclusions from other sources. This practice allows people to decide whether they are overusing or relying on the content of available information.

Ethical Issues Related to Authorship

Academic writing includes communicating the learning work, criticizing its findings, and promoting the reputation of peers, as well as the role of accepting responsibility for work details. It forms the basis of performance appraisal, promotion, and other accolades.

Some important research and ethical issues related to the writing of research papers are described below:

- Research scores in published research are achieved through three main methods: writing, writing, and written verification. Authorship creates responsibility and builds credibility. An individual is listed as an author only if they have made significant contributions to the design, interpretation, or writing of the data.
- Such “guests” or “awards” (given to authors who have contributed little or no contribution to the work) will make contributions from genuine employees, have a negative impact on enrollees' seniority, and morality is important. Red flags of false research.
- In some cases, the authors of the study made a collaborative effort, called writing support activities, to increase the chances of employment or promotion of university teachers or students takes advantage of the "relationship" with administrators, and administrators benefit from the article without having to take any action on it.
- Sometimes participants give consent because there is no conflict of interest in the organization. Some co-authorships may be called ghost co-authoring. It is important to disclose all people involved in the research so that the assessment can be based on research results and whether there are conflicting issues.
- In another form of ambiguous writing, some scholars write alone, collaboratively, as a co-author, with no real collaboration other than less reading and editing, and no real review of previous work. This effort is only through recognition. So, readers cannot explain the lack of "write “confirmation.
- All registered authors are solely responsible for the entire content of the research article, so they should be aware of what the author is sending to the journal.
- Their consent must be sought for content, and they agree to post it. In cases of abuse, such as a typo, where the perpetrator is easy to find, the necessity of authors' responsibility is not always clear. It's interesting to be able to analyze revenue to be sure and determine each author's level of responsibility.
- Double posting is an important ethical issue regarding posting and joining two forums at the same time. The motivation is to increase the ability to advertise and reduce the time spent on advertising.

- Prestigious journals are expected to publish originals, i.e. material that has not been published elsewhere and that negatively impacts submissions.

Case studies for each of the ethical issues related to authorship mentioned:

1. ***Guest/Gift Authorship:*** Case Study: In a research paper on renewable energy, a professor's name is included as an author despite minimal involvement. The professor provided general advice but didn't contribute to the research design, data collection, or writing. This inclusion dilutes the contributions of the primary researchers.
2. ***Career-Boost Authorship:*** Case Study: A junior researcher is listed as a coauthor in multiple publications led by a senior colleague. The junior researcher's contributions are minor, but the senior colleague aims to boost their career prospects by associating them with numerous publications.
3. ***Career-Preservation Authorship:*** Case Study: An administrative head of a department is added as a coauthor in multiple research papers despite minimal involvement. The administrator benefits from authorship due to their position, creating an ethical concern regarding the true contribution to the research.
4. ***Ghost Coauthorship:*** Case Study: A company executive, who provided critical insights for a research project, is intentionally omitted from the list of authors due to a conflict of interest within the organization. This omission hides a significant contributor's involvement.
5. ***Reciprocal Gestures without Collaboration:*** Case Study: Two researchers agree to include each other as coauthors in their papers without substantial collaboration. They provide minimal input, essentially engaging in reciprocal authorship gestures, which misrepresent their individual contributions.
6. ***Double Submission:*** Case Study: A group of researchers submits a manuscript to two different journals simultaneously to increase their chances of publication. However, this practice violates ethical guidelines as reputable journals expect original work and discourage such simultaneous submissions.

RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS

Course Code: BRMK557

Module-2

A. **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.

B. **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.

Text book referred: 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

A. 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 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 analyse 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.

Table 1.1: The literature survey grid

	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 analyse 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 analyses 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 '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'sown 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.

RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS

Course Code: BRMK557

MODULE-3: INTRODUCTION TO INTELLECTUAL PROPERTY

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 Patent Protection, To Patent or Not to Patent an Invention. Rights Associated with Patents. Enforcement of Patent Rights. Inventions 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.

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.

Course Structure

3.1 Introduction to Intellectual Property
3.2 Role of IP in the Economic and Cultural Development of the Society
3.3 IP Governance
3.4 IP as a Global Indicator of Innovation
3.5 Origin of IP History of IP in India.
3.6 Major Amendments in IP Laws and Acts in India.
3.7 Patent Protection and Rights Associated
3.8 Enforcement of Patent Rights
3.9 Inventions Eligible for Patenting

3.10 Process of Patenting
3.11 Jurisdiction of Filing Patent Application
3.12 National Bodies Dealing with Patent Affairs and Utility Models

3.1 Introduction to Intellectual Property

Intellectual Property (IP) is a special category of property created by human intellect (mind) in the fields of arts, literature, science, trade, etc. Since IP is a novel creation of the mind, it is intangible (i.e. invisible and indivisible) in nature and differs from the tangible property, such as land, house, gold and car with which we are quite familiar. Intellectual Property Rights (IPR) are 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. The aforementioned rights do not apply to the physical object (e.g. book or computer or mobile phone) in which the creation may be embodied but attributed to the intellectual creativity. 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. The salient features of all the above-mentioned categories are discussed in the ensuing chapters.

3.2 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 and novel things. However, if IPR is practised 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 and 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 favour 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. In addition, India is enriched with massive biodiversity and genetic resources and their use is embodied in what is referred to as Traditional Knowledge (TK). However, the use of such knowledge and resources are not limited to local contexts as many innovations relate to and draw on them. Therefore, the main issue of concern is to protect TK and genetic resources, which are rapidly coming under the governance of sometimes conflicting IPR policies. To derive maximum benefit from them, the establishment of adequate legal infrastructure and enforcement is required. With initiatives like Make in India Atmanirbhar Bharat and supporting local. homegrown brands, and easy as well as accessible approach to patents and trademarks registration, it is possible to reap the benefits of our resources.

3.3 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, GoI. 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.

3.4 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 (publicly 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.

3.5 Origin of IP History of IP in India

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. The rights conferred to the inventor were termed as _Exclusive Privileges. In 1859, certain amendments were made to the Act, such as:

A few years later, it was felt that Designs could also pass the criteria of the invention and thus should be included in the Patent Act. The new Act was rechristened as ―The Patterns and Designs Protection Act‖ under Act XIII of 1872. This Act was further amended in 1883 (XVI of 1883) to include the provision of protection for Novelty in the invention. 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;

1. Use of invention by the government.
2. Patent of Addition.
3. Enhancing the term of the patent from 14 years to 16 years.
4. Filing of Provisional Application and submission of Complete Application within 9 months from the date of filing the application.

After India got independence in 1947, many patent experts felt the need to review the Indian Patents and Designs Act, 1911, keeping the national interest (economic and political) in mind. A dedicated

committee, chaired by a renowned Justice Bakshi Tek Chand (retired Judge of Lahore High Court), was constituted in 1949 to review the advantages of the patent system. The committee submitted a plethora of recommendations, including:

1. Misuse of patents rights needs to be prevented.
2. 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.
3. Amendments in Sections 22, 23 and 23A of the Patent and Design Act, 1911 on the lines of the UK Patent Act.

3.5.1 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. During the 15th and 16th centuries, printing was invented and widely established in Europe. Copies of Bibles were the first to be printed. The government had allowed the printing of the documents without any restrictions, but this led to the spreading of a lot of governmental information. Subsequently, the government started issuing licenses for printing.

3.5.2 Trademarks

The first statutory law related to Trademarks (TM) in India was the Trademarks Act, 1940, which was carved out from the Trademarks 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, Trademarks Act, 1940 was rechristened as Trade and Merchandise Marks Act 1958. Nearly four decades later, this Act was repealed by the Trademarks Act, 1999. The need for this occurred to comply with the provisions of the TRIPS. It is the current governing law related to registered TM.

3.6 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:

S.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 fulfilment of certain conditions. ➢ Grant of EMR subject to certain conditions. * *after the amendments (1999) the product*

Table 1.1: History of Laws and Acts pertaining to intellectual property in India

Source: http://www.ipindia.nic.in/history-of-indian-patent-system.htm