# ACHARYA INSTITUTE OF TECHNOLOGY

***Soladevanahalli, Bengaluru – 560107***

**DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING**

# RESEARCH METHEDOLOGY AND IPR

(BRMK557)

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# COs, POs, PEOs, PSOs

## I. COURSE OUTCOMES (COS)

CO1. Explain the concepts of engineering research and Ethics associated with it.

CO2. Illustrate the procedure of Literature Review, technical reading and citations.

CO3. Describe the fundamentals of Intellectual Property, patent laws and drafting procedure

CO4. Explain the copyright laws, related rights and concepts of trademarks

CO5. Describe the principles of Industrial designs, design rights and Geographical Indications concepts.

## II. PROGRAM OUTCOMES (POS)

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **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.
3. **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.
4. **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.
5. **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.
6. **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.
7. **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.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **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.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and 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.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

**Program Specific Outcomes:**

**PSO1:** Able to apply knowledge of information management and communication systems to provide secure solutions for real-time engineering applications.
**PSO2:** Apply best software engineering practices, modern tools, and technologies to deliver quality products.

## III. CO-PO -PSO Mapping

| CO-PO Mapping Table (In the scale of 3) | | | | | | CO-PSO Mapping Table | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO/PO** | 1 | 2 | 3 | 4 | 5 | **CO/PSO** | 1 | 2 | 3 | 4 |
| CO1 | 3 | 3 | | | 3 | CO1 | | | | |
| CO2 | | | | | | CO2 | | | | |
| CO3 | | | | | | CO3 | | | | |
| CO4 | | | | | | CO4 | | | | |
| CO5 | | | | | | CO5 | | | | |
| | | | | | | | | | | |

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## MODULE – 01: INTRODUCTION AND ETHICS IN ENGINEERING RESEARCH

**SYLLABUS CONTENT**

**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.

## 1.1 Introduction: Meaning of Research

Research refers to a careful, well-defined (or redefined), objective, and systematic method of search forknowledge, or formulation of a theory that is driven by inquisitiveness for the unknown and useful on a particularaspect to make an original contribution to expand the existing knowledge base. Research involves formulation ofhypothesis 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.

As per Booth, research cycle starts with basically a practical problem: one must be clear what the problembeing attempted to solve is and why it is important. This problem motivates a research question without which onecan tend to get lost in a giant swamp of information. The question helps one zero in onto manageable volume of information, and in turn defines a research project which is an activity or set of activities that ultimately leads to resultor answer, which in turn helps to solve the practical problem that one started with in the first place as shown in thefigure below.

The building up of background for doing research includes one to acquire the ability to connect differentareas. The purpose is to prepare the mind for active work as opposed to becoming a repository or an encyclopedia.Research is not just about reading a lot of books and finding a lot of, gathering a lot of existing information. It isinstead adding, maybe small and specific, yet original, contribution to that existing body of knowledge. So, research isabout how one poses a question which has relevance to the world that we are living in, and while looking for thatanswer one must be as systematic as one can be. There must be a balance between what is achievable in a researchprogram with a finite endpoint and, the contribution it is going to make. The objective of a good research program isto try and gain insight into something. Or indeed, to try and solve a problem. Good research questions develop throughout the project actually and one can even keep modifying them. Through research, one would like to make, or develop, new knowledge about the world around us which can be written down or recorded in some way, and that knowledge can be accessed through that writing or recording. The ways of developing and accessing knowledge come in three, somewhat overlapping, broad categories.

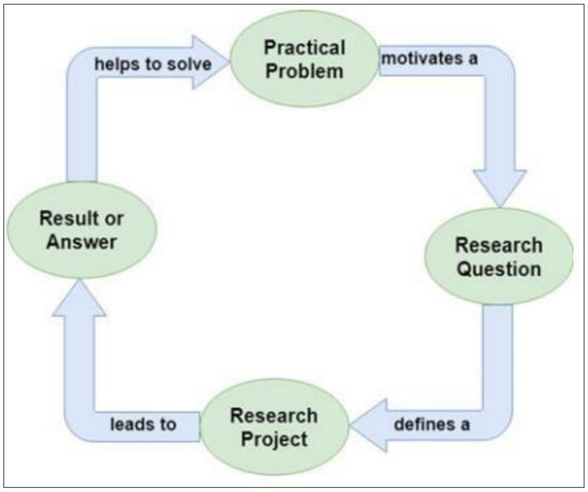


**Figure: The research flow diagram**

Observation is the most fundamental way of obtaining information from a source, and it could be significant if the thing that we are trying to observe is strange or exciting, or is difficult to observe. Observation takes different forms from something like measurements in a laboratory to a survey among a group of subjects to the time it takes for a firmware routine to run. The observational data often needs to be processed in some form and this leads to the second category of knowledge, the model.

Models are approximated, often simplified ways of describing sometimes very complex interactions in the form of a statistical relationship, a figure, or a set of mathematical equations. For instance, the modelling equation captures the relationship between different attributes or the behaviour of the device in an abstract form and enables us to understand the observed phenomena. The final category is a way of arranging or doing things through processes, algorithms, procedures, arrangements, or reference designs, to get a certain desired result. The categories of knowledge as enumerated above are shown in the below figure.

Good research involves systematic collection and analysis of information and is followed by an attempt to infer a little bit beyond the already known information in a way that is a significant value addition. Usually, engineering research is a journey that traverses from a research area (example: Control Systems), to the topic (example: Control of Microbial Fuel Cells) and finally onto the problem (example: Adaptive Control of Single Chamber Microbial Fuel Cells) (Area → Topic → Problem). Getting a good problem to solve is more than half the work done. However, sometimes he journeys can be reverse, for example, the traversal from (Problem → Topic → Area). This can happen when one is led to a problem through a connection to another problem whose top structure is different.

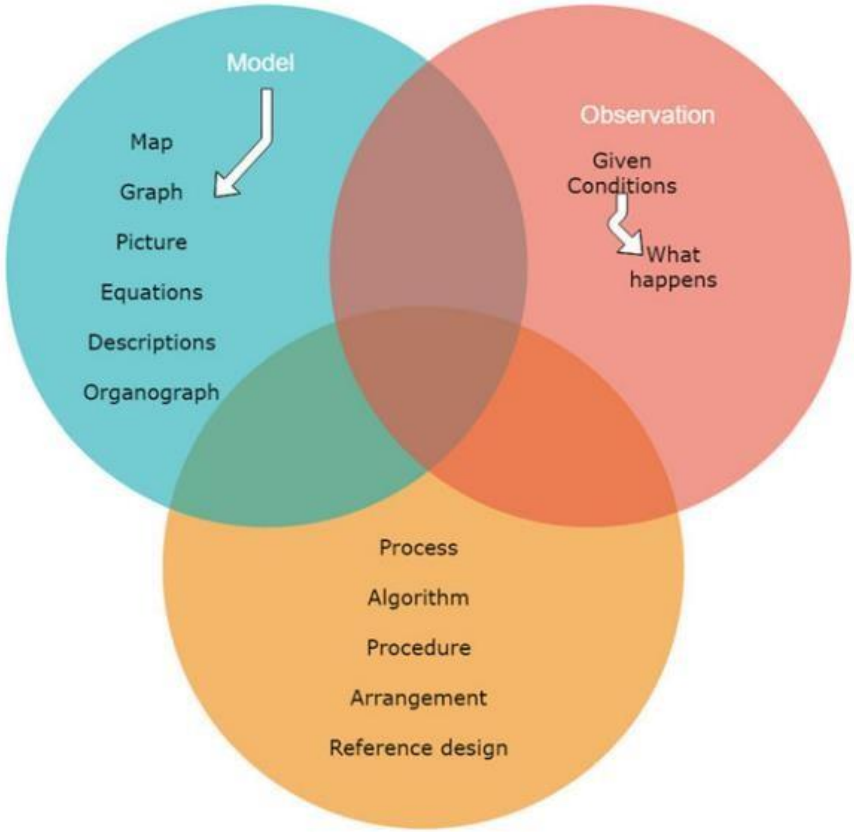


**Figure: The categories of knowledge in research**

Engineering research is the process of developing the perspectives and seeking improvements in knowledge and skills to enable the recognition, planning, design, and execution of research in a wide range of forms relevant for engineering and technology investigations and developments. We can start off by describing some problem in theworld that exists that is bugging or worrying us and that we should be addressing. It could be that there is something we would like to do or accomplish but currently cannot because we lack the knowledge to do so. It could be that there is something that already works, but we do not know why and we would like to understand it better. It could be thatwe want to do something to see what will happen,

## 1.2 Objectives of Engineering Research

The objective of engineering research is to solve new and important problems, and since the conclusion at the end of one's research outcome must be new, but when one starts, the conclusion is unknown. So, the start itself is tricky, one may say. The answer is, based on "circumstantial evidence", intuition, and imagination, one guesses what may be a possible conclusion. A guess gives a target to work toward, and after initial attempts, it may turn out that the guess is incorrect. But the work may suggest new worthy avenues or targets which may be based on some modifications of the initial target, or may need new techniques, or one may obtain negative results which may render the initial target or some other targets as not realizable, or may lead to fortunate discoveries while looking for something else (serendipity). 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, in general, the following are different types of research studies: exploratory or formulative, descriptive, diagnostic, and hypothesis-testing. 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. Of course, someone else might come along and propose a different approach where the desired objective is indeed possible to be achieved.

## 1.3 Motivation in Engineering Research

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

I. Studies have shown that intrinsic motivations like interest, challenge, learning, meaning, purpose, are linked to strong creative performance
II. Extrinsic motivating factors like rewards for good work include money, fame, awards, praise, and statusare 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.
III. 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.
IV. 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
- Fulfilment of the historical legacy in the immediate sociocultural context.

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

## 1.4 Types of Engineering Research

The different types of research are

I. **Descriptive versus Analytical:** Descriptive research includes comparative and correlational 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.

II. **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 researchis to determine a solution for compelling problems in actual practice, while basic research is aimed atseeking information which could have a broad base of applications in the medium to long term.

III. **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.

## 1.5 Finding and Solving a Worthwhile Problem

A researcher may start out with the research problems stated by the Supervisor or posed by others that areyet to be solved. Alternately, it may involve rethinking of a basic theory, or need to be formulated or put togetherfrom 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 atthe 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 haveproduced 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 nonintuitive/counterintuitive even to someone who knows the area, something that the research community had been expecting for some time, amajor 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 hasa 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 notget 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, andso it is a difficult personal decision to make. At the same time, even in the case of failure to solve the intended hardproblem, 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. Recent work such as suggest the relevance of these recommendations. The recommended steps to solve a research problem are

(i) Understand the problem, restate it as if it's your own, visualize the problem by drawing figures, and determine if something more is needed.
(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) 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 newidea to solve the problem
(iv) Looking back and reflecting helps in understanding and assimilating the strategy, and is a sort of investment into the future.

## 1.6 Ethics in Engineering Research

Ethics generally refers to a set of rules distinguishing acceptable and unacceptable conduct, distinguishing right from wrong, or wise aphorisms like the sayings of Chanakya. 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 forevaluation, 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 to the establishment of the BritishRoyal Society (BRS) in the seventeenth century to refine the methods and practices of modern science. This eventaltered 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:

1. Who should be included as an author and
2. 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. Additionally, certain universities now put restrictions on co-authorship to preventmalpractices.

Government bodies, and universities worldwide have adopted certain codes for research ethics. Researchethics 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 workis undertaken.

## 1.7 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 usthe 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 ways:

(i) By setting the ethically right requirements at the very outset, engineering researchers can ultimately influence the effects of the developed technology.
(ii) Influence may also be applied by researchers through design (a process that translates the requirements into a blueprint to fulfil those requirements). During the design process, decision is to be made aboutthe priority in importance of the requirements taking ethical aspects into consideration.
(iii) Thirdly, engineering researchers must choose between different alternatives fulfilling similar functions.

Research outcomes often have unintended and undesirable side effects. It is a vital ethical responsibility of researchersto 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 takecontrol if the primary process fails.

## 1.8 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 to avoid errors, protecting the welfare of research subjects, ensuring laboratory safety, and so forth. To prevent mistakes, peer reviews should take place before the research output is published.

There may be different types of research misconduct as described in research articles, which can be summarized asfollows:

(i) **Fabrication (Illegitimate creation of data):** Fabrication is the act of conjuring data or experimentswith 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.

(ii) **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, because false empirical data to percolate in the literature, wreck trustworthiness of individuals involved, incur additional costs, impede researchprogress, and cause actual and avoidable delays in technical advancement. Misleading data can also cropup due to poor design of experiments or incorrect measurement practices. The image of engineering researchers as objective truth seekers is often jeopardized by the discovery of data related frauds. Such misconduct can be thwarted by researchers by always trying to reproduce the results independently whenever they are interested to do further work in a published material which is likely to be part of theirliterature survey.

(iii) **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 (Eg: iTheticate: http://www.ithenticate.com/.)

How are supervisors, reviewers or editors alerted to plagiarism?

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

Although there are many free tools and 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 practise 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.

(iv) 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.

# 1.9 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 honours. There are several important research conduct and ethics related issues connected to authorship of research papers as described by Newman and Jones 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" (coauthorship bestowed on someone with little or no contribution to the work) authors dilutes the contribution of those who 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 coauthorship 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 coauthorship 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 nondisclosed conflict of interest within the organization. Such coauthorships can be termed as ghost coauthorship. Full disclosure of all those involved in the research is important so that evaluation can happen both based on findings, and 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 consequently, 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 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.

## 2. POINTS TO BE REMEMBERED

- Research and Types of Engineering Research
  Types of Research:
  Exploring or Formulative Research
  Descriptive Research
  Diagnostic Research
  Hypothesis-Testing Research
- Engineering Research and its Objectives
- Types of Engineering Research
  Descriptive v/s Analytical Research
  Applied v/s Fundamental Research
  Quantitative v/s Qualitative Research
- Motivations of Engineering Research
  Intrinsic Motivation
  Extrinsic Motivation
  Motivation factors
  Personal motivation
- Engineering Misconduct
- Ethical issues related to authorship

## 3. THINK BEYOND THE CONTENT

- Challenges faced in Engineering Research
- Plagiarism tools

## 4. QUESTION BANK

1. What is Engineering Research? What are the primary objectives of conducting research in engineering?
2. What are the various types of engineering research? Explain.
3. Explain Fabrication, Falsification and Plagiarism related to Engineering research.
4. What ethical considerations and responsibilities should be taken into account when determining authorship in engineering research?
5. Discuss objectives of research.
6. Write a note on Motivation in research.
7. Describe process of research while highlighting the types of research.
8. Explain the criteria of good research.

9. Define research problem? Discuss the main issues which should receive the attention of the researcher in formulating the research problem. Give suitable examples to elucidate your points.
10. Explain the significance of research in modern days.
11. Classify the types of research, explain.
12. Outline the steps involved in research process
13. What is plagiarism, discuss its significance in research field.
14. Write a note research ethics.
15. Discuss ethical issues related to authorship.
16. Discuss types of research misconduct.

# 5. REFERENCES

- **https://www.youtube.com/watch?v=Og3oV7qH2BU&list=PLvwDlZ1XQPg5Goq09kqYlTZhf_K1QTbWr&index=8**
- **https://www.youtube.com/watch?v=m6FyOzW8sfQ**
- Dr. Santosh M Nejakar, Dr. Harish Bendigeri "Research Methodology and Intellectual Property Rights", ISBN 978-93-5987-928-4, Edition: 2023-24.
- David V. Thiel "Research Methods for Engineers" Cambridge University Press, 978-1-107-03488-4