IQRA National University
Department of Electrical Engineering Subject: Research Methodologies

Terminal Examination Spring 2020

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Question No: 1

a) List down different steps involve in research process?
(10)
b) Explain different steps involve in formulating a research problem?
(10)

Question No: 2

a) A traditional research design is a blue print or detailed plan for how a research study is completed, list steps involved in planning a research study?
(10)

b) Differentiate between Qualitative and Quantitative Methods of research.
(10)

Question No: 3

How study design is selected based on nature of investigation?

(10)

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☺Good Luck☺

ANSWER NO: 1 Part (A)

Following Eight steps are involved in research process:

1. Formulating a research problem (Deciding)
2. Conceptualizing the research design
3. Constructing an instrument for data collection (Planning)
4. Selecting a sample
5. Writing a research proposal
6. Collecting data
7. Processing Data (Doing)
8. Writing a research report

Step I: formulating a research problem

Formulating a research problem is the first and most important step in the research process. A research problem identifies your destination: it should tell you, your research supervisor and your readers *what* you intend to research. The more specific and clearer you are the better, as everything that follows in the research process – study design, measurement procedures, sampling strategy, frame of analysis and the style of writing of your dissertation or report – is greatly influenced by the way in which you formulate your research problem. Hence, you should examine it thoroughly, carefully and critically. The main function of formulating a research problem is to decide *what* you want to find out *about.*

Step II: conceptualizing a research design

An extremely important feature of research is the use of appropriate methods. Research involves systematic, controlled, valid and rigorous exploration and description of what is not known and establishment of associations and causation that permit the accurate prediction of outcomes under a given set of conditions. It also involves identifying gaps in knowledge, verification of what is already known and identification of past errors and limitations. The strength of *what* you find largely rests on *how* it was found.

The main function of a research design is to explain *how* you will find answers to your research questions. The research design sets out the specific details of your enquiry. A research design should include the following: the study design per se and the logistical arrangements that you propose to undertake, the measurement procedures, the sampling strategy, the frame of analysis and the timeframe.

Step III: constructing an instrument for data collection

Anything that becomes a means of collecting information for your study is called a 'research tool' or a 'research instrument', for example observation forms, interview schedules, questionnaires and interview guides.

The construction of a research instrument is the first 'practical' step in carrying out a study. You will need to decide how you are going to collect data for the proposed study and then construct a research instrument for data collection.

Step IV: selecting a sample

The accuracy of your findings largely depends upon the way you select your sample. The basic objective of any sampling design is to minimize, within the limitation of cost, the gap between the values obtained from your sample and those prevalent in the study population.

The underlying premise in sampling is that a relatively small number of units, if selected in a manner that they genuinely represent the study population, can provide – with a sufficiently high degree of probability – a fairly true reflection of the sampling population that is being studied. When selecting a sample you should attempt to achieve two key aims of sampling the avoidance of bias in the selection of a sample; and the attainment of maximum precision for a given outlay of resources.

Step V: writing a research proposal

Having done all the preparatory work, the next step is to put everything together in a way that provides adequate information about your research study, for your research supervisor and others. This overall plan, called a research proposal, tells a reader about your research problem and how you are planning to investigate. Broadly, a research proposal's main function is to detail the operational plan for obtaining answers to your research questions. In doing so it ensures – and reassures the readers of – the validity of the methodology to obtain answers accurately and objectively.

Step VI: collecting data

Having formulated a research problem, developed a study design, constructed a research instrument and selected a sample, you then collect the data from which you will draw inferences and conclusions for your study.

Many methods could be used to gather the required information. As a part of the research design, you decided upon the procedure you wanted to adopt to collect your data. In this phase *you actually collect the data*. For example, depending upon your plans, you might commence interviews, mail out a questionnaire, conduct nominal/focus group discussions or make observations.

Step VII: processing data

The way you analyze the information you collected largely depends upon two things: the type of information (descriptive, quantitative, qualitative or attitudinal); and the way you want to communicate your findings to your readers.

Step VIII: writing a research report

There are two broad categories of reports: quantitative and qualitative. As mentioned earlier, the distinction is more academic than real as in most studies you need to combine quantitative and qualitative skills. Nevertheless, there are some solely qualitative and some solely quantitative studies.

Writing the report is the last and, for many, the most difficult step of the research process. This report informs the world what you have done, what you have discovered and what conclusions you have drawn from your findings. If you are clear about the whole process, you will also be clear about the way you want to write your report. Your report should be written in an academic style and be divided into different chapters and/or sections based upon the main themes of your study.

ANSWER NO: 1 Part (B)

The following four steps are involved in formulating a research problem:

1. Reviewing the literature
2. Decide what you want to find out about? (Formulating a research problem)
3. Identifying variables
4. Constructing hypotheses

(1) Literature Review:

The **literature review** is an integral part of the research process and makes a valuable contribution to almost every operational step.

The literature review can help in four ways. It can:

- Bring clarity and focus to your research problem.
- Improve your research methodology.
- Broaden your knowledge base in your research area and
- Contextualize your findings.

Steps for reviewing the literature:

a. Search for existing literature in your area of study
b. Review the literature selected
c. Develop a theoretical framework
d. Develop a conceptual framework

(a)Searching the existing literature:

To search effectively for the literature in your field of enquiry, it is imperative that you have at least some idea of the broad subject area and of the problem you wish to investigate, in order to set parameters for your search.

Keeping in mind a vague idea of the research problem you want to undertake, the following sources are useful for searching the existing literature:

- Books
- Journals
- Conferences' proceedings
- Other electronic documents (such as Patents, RFCs etc.)
- Web Pages
- Seminars

(b)Reviewing the literature selected:

Now that you have identified several books and articles as useful, the next step is to start reading them critically to pull together themes and issues that are of relevance to your study. Unless you have a theoretical framework of themes in mind to start with, use separate sheets of paper for each theme or issue you identify as you go through selected books and articles.

Start Reading the ***Material*** selected (is it literature review?)

No! So, read critically with reference to the following aspects:

1. Note whether the knowledge relevant to your theoretical framework is confirmed.
2. Note the theories presented, the criticisms of these theories, the methodologies adopted to counter/confirm them (e.g. study design, sample size, measurement procedures etc.).
3. Examine to what extent the findings can be generalized for other situations.

4. Examine the differences of opinion among other researchers and try to formulate your opinion about the validity of these differences.

(c)Develop a theoretical framework:

Examining the literature can be a never-ending task, but as you have limited time it is important to set parameters by reviewing the literature in relation to some main themes pertinent to your research topic.

- After reviewing the literature you may find that the problem you wish to investigate has its roots in a number of theories that have been developed from different perspectives.
- The information obtained from different books and journals now needs to be sorted under the main themes and theories, highlighting agreements and disagreements among authors and identifying the unanswered questions or gaps.
- Use these aspects as a basis for developing your theoretical framework.

(d)Developing a conceptual framework:

The conceptual framework is the basis of your research problem. It stems from the theoretical framework and usually focuses on the section(s) which become the basis of your study.

- The conceptual framework stems from the theoretical framework which becomes the basis of your study.
- It describes the aspects you selected from the theoretical framework to become the basis of your inquiry.
- Hence, the conceptual framework is the basis of your research problem.

(2)Decide what you want to find out about? (Formulating a research problem):

Steps in the formulation of a research problem:

1. Identify a broad field or subject area of interest to you
2. Dissect the broad area into subareas
3. Select what is of most interest to you?
4. Raise research questions
5. Formulate objectives
6. Assess your objectives (feasibility in terms of time, resources, data availability etc.)
7. Double check (go back and give final considerations)

Formulating the objectives:

Main objectives

Overall statement of the thrust of your study

The statement of the main associations and relationships that you seek to discover or establish

Sub objectives

Should be listed numerically

Each sub objective contains only one aspect of the study

Sources of Research Problems:

1. People
2. Problems
3. Programs
4. Phenomena

Considerations in selecting a research Problem:

1. Interest
2. Magnitude
3. Measurement of concepts

4. Level of expertise
5. Relevance
6. Availability of data and resources
7. Ethical issues

(3)**Identifying variables:**

The understanding and interpretation of a concept or a perception may vary from respondent to respondent, hence its measurement may not be consistent. A variable has some basis of classification and hence there is far less inconsistency in its meaning and understanding. Concepts are mental perceptions whereas variables are measurable either subjectively or objectively on one of the measurement scales. When you convert a concept into a variable you classify it on the basis of measurement into categories, thereby minimizing the inherent variability in understanding. When you are unable to measure a concept directly, you need first to convert it into indicators and then into variables.

The definition of a variable:

We all make value judgments constantly in our daily lives.
E.g. "this food is ***excellent***", "I could not sleep ***well*** last night", "I think this is ***wonderful***"
These are judgments based upon our own preferences, indicators or assessments.
Therefore, the basis on which they are made may vary from person to person.
These preferences are called **concepts.**
Now let us consider these examples:
"This program is effective", "This is a *waste* of time", "this product is not doing *well*", "we are providing a *quality* of service to our clients"
These are not preferences. Rather, they are judgments that require a sound basis on which to proclaim.
This warrants the use of a measuring mechanism and it is in the process of measurement that knowledge about variables plays an important role.
An image, perception or concept that is capable of measurements– hence capable of taking on different values– is called a variable.

(4)Constructing Hypothesis:

The second important consideration in the formulation of a research problem in quantitative research is the construction of a **hypothesis**. Hypotheses bring clarity, specificity and focus to a research problem, but are not essential for a study. You can conduct a valid investigation without constructing a single formal hypothesis. On the other hand, within the context of a research study, you can construct as many hypotheses as you consider to be appropriate. Some believe that one must formulate a hypothesis to undertake an investigation; however, the author does not hold this opinion. Hypotheses primarily arise from a set of 'hunches' that are tested through a study and one can conduct a perfectly valid study without having these hunches or speculations. However, in epidemiological studies, to narrow the field of investigation, it is important to formulate hypothesis.

The definition of Hypothesis:

• A proposition, condition, or principle which is assumed, perhaps without belief, in order to draw out its logical consequences and by this method to test its accord with facts which are known or may be determined.
• A proposition that is stated in a testable form and that predicts a particular relationship between two or more variables. If we think that a relationship exists, we first state it as a hypothesis and then test the hypothesis in the field.

A hypothesis could be either:
- Right
- Partially right
- wrong

The functions of a hypothesis:
• To conduct a research study requires a hypothesis but it is not essential ingredient.
• However, a hypothesis is important in terms of bringing clarity to the research problem. It serves the following functions:
- Provides a study with focus
- Tells you what data to collect
- It enhances the objectivity in the study
- Enables to formulate a theory since it helps in concluding what is true or what is false.

The characteristics of a hypothesis:
- A Hypothesis should be simple, specific and clear.
- A hypothesis should be capable of verification.
- A hypothesis should be related to the existing body of knowledge.
- A hypothesis should be operational sable.

ANSWER NO: 2 (Part A):

A traditional research design is a blue print or a detailed plan for how a research study is to be completed. It includes:
- Operationalizing variables so that they can be measured
- Selecting a sample of interest to study
- Collecting data to be used as a basis for testing hypothesis
- Analyzing the results

Steps involved in planning a research study
Following four steps are involved in planning a research study:

1) Conceptualizing a research design
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ANSWER NO: 2 PART (B):

Difference between Qualitative and Quantitative Methods of research:

i)Qualitative Method of Research:

Qualitative research is a type of empathic, empirical, exploratory, direct, physical research. It helps you understand reasons, motivations, opinions, trends that hide behind the more quantitative data of quantitative research.

Data that describes meanings and experiences .E.g. Ethnography, Case study, Survey/Sampling, Focus groups, Discourse/Text Analysis, Quantitative Description, Prediction/Classification.

- Methods include focus groups, in-depth interviews, and reviews of documents for types of themes.
- Primarily inductive process used to formulate theory or hypotheses.
- More subjective: describes a problem or condition from the point of view of those experiencing it.
- Text-based.
- More in-depth information on a few cases.

- Unstructured or semi-structured response options.
- Unstructured or semi-structured response options.
- Can be valid and reliable: largely depends on skill and rigor of the researcher.
- Time expenditure lighter on the planning end and heavier during the analysis phase.
- Less generalizable.

Provides depth and detail:
Looks deeper than analyzing ranks and counts by recording attitudes, feelings and behaviors.
Creates Openness:
Encouraging people to expand on their responses can open up new topic areas not initially considered.
Simulates people's Individual Experiences:
A detail picture can be built up about why people act in certain ways and their feelings about these actions.
Attempts to avoid Pre-judgments:
If used alongside quantitative data collection, it can explain why a particular response was given.

ii) Quantitative Methods of research:

Quantitative research helps to quantify, use numeric data or just data that can then be easily transformed into statistics, and it measures behavior, opinions and attitudes of a large sample of respondents.
Data that focuses on numbers, frequencies and describes experiments. E.g. True Experiment, Quasi-Experiment and Meta-analysis.
Allows for broader study, involving a greater number of subjects, and enhancing the generalization of the results.

- Surveys, structured interviews & observations, and reviews of records or documents for numeric information.
- Primarily deductive process used to test pre-specified concepts, constructs, and hypotheses that make up a theory.
- More objective: provides observed effects (interpreted by researchers) of a program on a problem or condition.
- Number-based.
- Less in-depth but more breadth of information across a large number of cases.
- Fixed response options.
- Statistical tests are used for analysis.
- Can be valid and reliable: largely depends on the measurement device or instrument used.
- Time expenditure heavier on the planning phase and lighter on the analysis phase.
- More generalizable.

Can allow for greater objectivity and accuracy of results:
Generally, quantitative methods are designed to provide summaries of data that support generalizations about the phenomenon under study. In order to accomplish this, quantitative research usually involves few variables and many cases, and employs prescribed procedures to ensure reliability.
Using standards means that the research can be replicated, and then analyzed and compared with similar studies:

Quantitative methods allow us to summarize vast sources of information and facilitate comparisons across categories and over time.

Personal bias can be avoided:

By researches keeping a 'distance' from participating subjects and employing subjects unknown to them.

ANSWER NO: 3

Study designs based on the nature of the investigation:

On the basis of the nature of the investigation, study designs in quantitative research can be classified as:

1) Experimental:

- If a relationship is studied by starting from the cause to establish the effects, it is called experimental study.
- The independent variables can be observed, introduced, manipulated, or controlled by the researcher or someone else.

2) Non-experimental:

- If a study focuses on starting from the effects to trace the cause, it is classified as a non-experimental study.
- Variables cannot be introduced/manipulated etc. As the assumed cause has already occurred. Instead, the researcher retrospectively links the cause to the outcome.

3) Quasi- or semi-experimental:

- A mixture of traits of both experimental and non-experimental study designs

To understand the differences, let us consider some examples. Suppose you want to test the following: the impact of a particular teaching method on the level of comprehension of students; the effectiveness of a programme such as random breath testing on the level of road accidents; or the usefulness of a drug such as azidothymidine (AZT) in treating people who are HIV-positive; or imagine any similar situation in your own academic or professional field. In such situations there is assumed to be a *cause-and-effect* relationship. There are two ways of studying this relationship. The first involves the researcher (or someone else) introducing the intervention that is assumed to be the 'cause' of change, and waiting until it has produced – or has been given sufficient time to produce – the change.

The second consists of the researcher observing a phenomenon and attempting to establish what caused it. In this instance the researcher starts from the effect(s) or outcome(s) and attempts to determine causation. If a relationship is studied in the first way, starting from the cause to establish the effects, it is classified as an **experimental study**. If the second path is followed – that is, starting from the effects to trace the cause – it is classified as a **non-experimental study** (see Figure 1) below.

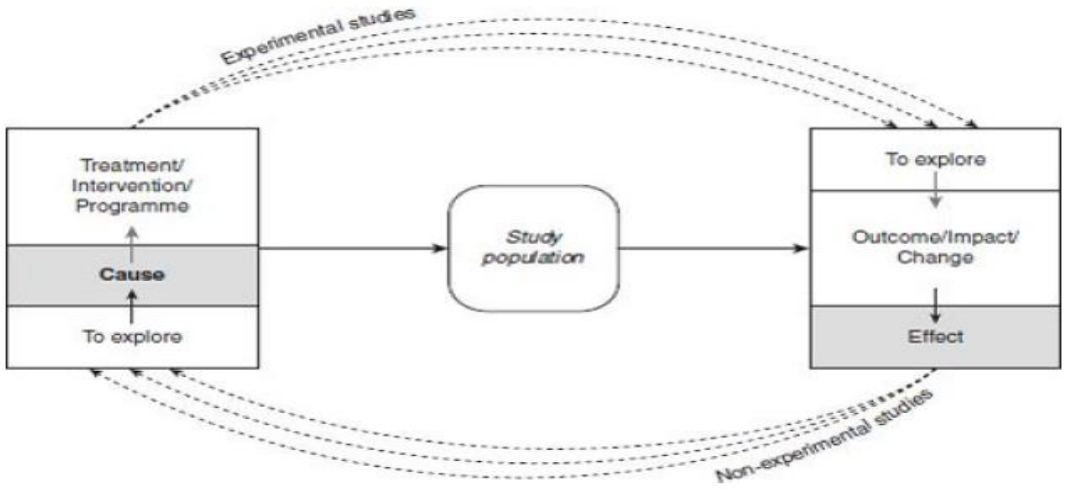

Figure 1: Experimental and non-experimental studies

In the former case the independent variable can be 'observed', introduced, controlled or manipulated by the researcher or someone else, whereas in the latter this cannot happen as the assumed cause has already occurred. Instead, the researcher retrospectively links the cause(s) to the outcome(s). A **semi experimental study** or **quasi-experimental study** has the properties of both experimental and no experimental studies; part of the study may be non-experimental and the other part experimental.

An experimental study can be carried out in either a 'controlled' or a 'natural' environment. For an experiment in a controlled environment, the researcher (or someone else) introduces the intervention or stimulus to study its effects. The study population is in a 'controlled' situation such as a room. For an experiment in a 'natural' environment, the study population is exposed to an intervention in its own environment. Experimental studies can be further classified on the basis of whether or not the study population is randomly assigned to different treatment groups. One of the biggest problems in comparable designs (those in which you compare two or more groups) is a lack of certainty that the different groups are in fact comparable in every respect except the treatment. The process of randomization is designed to ensure that the groups are comparable. In a **random design**, the study population, the experimental treatments or both are not predetermined but randomly assigned (see Figure 2). Random assignment in experiments means that any individual or unit of a study population group has an *equal* and *independent* chance of becoming part of an experimental or control group or, in the case of multiple treatment modalities, any treatment has an equal and independent chance of being assigned to any of the population groups. It is important to note that the concept of randomization can be applied to any of the experimental designs we discuss.

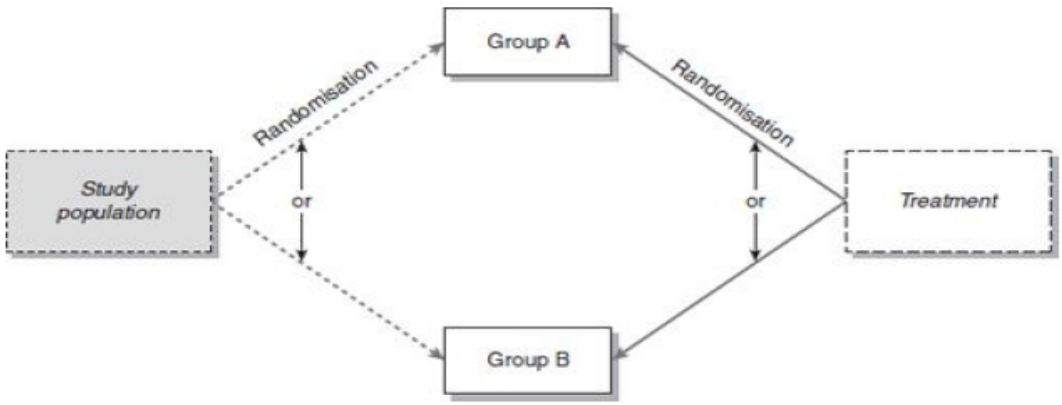

Figure 2: Randomization in experiments