Tribhuvan University
Institute of Engineering
Pulchowk Campus

Department of Mechanical Engineering

Master of Science (M.Sc.)

in

Technology and Innovation Management (TIM)

COURSE MATERIALS

EG804ME
Research Design and Methodology
(4 Credits)

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Introduction

Research is summarized as “systematic enquiry directed toward the creation of knowledge” (Snyder, 1984). The extent to which an enquiry is evaluated to have met the systematic rigor and the knowledge so generated accepted or otherwise has varied with discipline as research paradigms combine ontological, epistemological and methodological positions that have gained dominant play in the discipline. Multi-disciplinary, inter-disciplinary or cross-disciplinary studies or practices can profitably be innovative with an eclectic blending of wide range of skills and activities drawn from many source areas.

To be a good researcher, you have to be able to work well with a wide variety of people, understand the specific methods used to conduct research, understand the subject that you are studying, be able to convince someone to give you the funds to study it, stay on track and on schedule, speak and write persuasively, and on and on. The process of research can also be painstakingly time consuming. It can involve the overcoming of many obstacles and may unfortunately need to be revised several times as you progress through the steps.

Given the common interest to conducting useful and relevant research, it becomes very important to discuss how the design of research needs to be changed in order to ensure that the intended benefits indeed accrue.

Research design can be considered as a form of problem oriented practical scholarship. It is one of the key components in any study of social/management/technology/innovation issues. Design is the means to provide relevant information on a research question in an efficient way that meets the criteria of disciplinary/public accountability, in the sense of openness to disciplinary/public scrutiny.

Increasing awareness and concern with behavioral and social consequences and opportunities of even scientific and technological pursuits has made it all the more important that research design and methods, particularly for disciplines and postures that have both technological and social aspects, seek to steer a course of systems, strategies and tactics that span between the subjective and the objective, the natural and the social, the positivist and the critical theorist, the mathematical and the cultural or such like polarized capsules.

Any research design is characterized by both opportunities and constraints, and the selection of the optimal design is always a tradeoff between the strengths and weaknesses of different options, viewed in the context of feasibility. Drawing on a variety of examples from relevant literature and context, this course will explore research design, methodology and method considerations and options, issues of data quality and analysis and reporting.

Objectives:

The broad objectives of the course are to:

- Increase awareness of the role of research design and methodology in any enquiry process;
- Introduce a range of research design and methodology options;
- Foster an appreciation of the strengths and weaknesses of the different options for particular research objectives;
- Analyze, critique and write a research report

After attending the course, the students will be able to bring a more critical reading to the literature and have acquired a basic knowledge of research design and methodology as a contribution to their project and thesis works. The student should be able to identify and develop research design suitable to inform or solve the problem of his choosing and also execute it in credible and dependable ways.

Teaching and Examination Schedule

Year 1 Part A Type of Course: Core General

S.N.	Teaching Schedule							Examination Scheme			Total	Remarks
	Course Code	Course Title	Credit	L	T	P	Total	Theory				
								Assessment Marks	Final			
									Duration, h	Marks		
4	EG804ME	Research Design and Methodology	4	3	1	0	4	40	3	60	100	

The course will be delivered basically in a lectures mode with four contact hours weekly for a total of 13 weeks. Each week is scheduled in two sessions of two hours each. Roughly half the contact hours will be used for tutorial exercises and elaborations on topics covered in the preceding lecture session. The lectures/discussions will be largely centered on research as a tool for and subject of conscious pursuit for knowledge mapping and building (in theory and application) on research areas of disciplines and interests represented in the class and the course. Other faculty members will be called on as required.

Evaluation: Cumulative assessments will be made of interactions, outputs and presentations of activities in tutorial classes and this will carry a total of 15 marks. In addition students will be required to make a presentation of a assigned written report mid-way through the course and both the presentation and the written report will be assessed for a total of 10 marks. There will be a written test at the end of the session for 10 marks. These will make up the internal assessment of 40 marks. Class attendance requirements for

eligibility to sit for semester examination is set at a minimum of 75% as per TU regulations. No internal assessment score and a NQ (not-qualified) will be reported for students failing this attendance requirement.

Outline of Course

Introduction, nature and types of research, language of research. Building blocks of research (ontology, epistemology, methodology, methods, sources). Research and criticism, the research process (applied and basic research). Inductive and deductive logic.
Research methodology and methods. Experimental designs, survey, case study, models.
Data analysis and interpretations. Tools in statistical analysis (SPSS computer program included).

Research Proposals, Research reports: contents, formats and components, writing approaches, identification of topic, development of research problem, literature review and search, building theory for research, research objectives, research questions and hypotheses, designing methods and procedures, crediting and references and referencing systems.

[Note: Because this course is designed to focus on the design, methodology and methods of research, a basic understanding of statistics is assumed.]

Reference:

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Hirsch Hadorn, G. & Others (eds) 2008, *Handbook of Trans disciplinary Research*, Springer.
McQueen, R. & Knussen, C. 2002, *Research Methods for Social Science*, Prentice Hall.
Jonker, J. & Pennik, B. 2002, *The Essence of Research Methodology*, Springer.
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Yin, R.K. 1994, *Case Study Research*, SAGE Publications, Thousand Oaks.
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Sharan, M.B. 1988, *Case Study Research in Education – A Qualitative Approach*, Jossey-Boss Inc., New York.

Alasuutari, P., Bickman, L., Brannan, J. & Brannen, J. 2008, *The SAGE Handbook of Social Research Methods*, SAGE Publications, London.
Field, A. 2009, *Discovering Statistics using SPSS*, 3rd edn, SAGE Publications, London.
Lattin, J.M., Green, P.E. & Carroll, J.D. 2002, *Analyzing Multivariate Data*, Duxbury Press, Belmont.
Leik, R.K. 1997, *Experimental Design and the Analysis of Variance*, Pine Forge Press, Thousand Oaks.
Weisberg, S. 2005, *Applied Linear Regression*, Wiley, Chichester.
Miles, M.B. & Huberman, A.M. 1990, *Qualitative Data Analysis*, SAGE Publications, Beverly Hills.
Creswell, J.W. 1994, *Research Design: Qualitative and Quantitative Approaches*, SAGE Publications, Thousand Oaks.
Blaikie, N.W.H. 2000, *Designing Social Research*, Polity Press, U.K.
Fowler, F.J., Jr. 1995, *Improving Survey Questions: Design and Evaluation*, SAGE publications, Thousand Oaks.
McGarth, R.E. 1997, *Understanding Statistics: A Research Perspective*, Longman, New York.

COURSE DELIVERY PLANNING MATRIX/LESSON PLAN

Week	Session	TOPIC	DETAILS of INPUTS/ OUTPUTS READINGS/ASSIGNMENTS/DISCUSSION QUESTIONS
1	Lecture 1	Introduction, The language of research nature of research, research and criticism	Introduction of course tutor/s, Introduction of students Introduction to course, content, conduct of course, evaluation Introduction knowledge, innovation and research, definitions, key words (Theoretical, Empirical, Nomothetic, Idiographic, Probability, Causal, Co-relational, Population, Sample, Parameter, Variable, Alternate Hypothesis, Null Hypothesis, Qualitative and Quantitative Data, Unit of Analysis, Variance etc.) Criticism Inputs: Copy of Presentation, Reading material (Handout print no.1, Chapter/s in Ref. Books).
	Tutorial 1	Contents, format and components of research proposal and research reports	Short Presentations followed by discussions. Problem based working/writing sessions on research proposal preparation Hand outs/ Chapter/s in Ref. Books
2	Lecture 2	Use of logic as a research tool, induction and deduction. The research types: basic and applied	Sources of reliable knowledge (experience, reason, authority, revelation, intuition, common sense), the scientific method, syllogism, deductive and inductive reasoning, looking at reality through own eyes and through other's eyes. logical argumentation (mathematical, cultural, discursive) Basic, applied and didactic (applied instructive) research. Research, theory and application. Inputs: Copy of Presentation, Reading material (Handout print no.2, Chapter/s in Ref. Books).
	Tutorial 2	identification of a research topic, development of research problem	Research Problems, Problematising and Identifying a Research Topic. What is the area you are interested in? What was the topic you proposed in your essay? Short Presentations followed by discussions.
3	Lecture 3	Philosophy and structure of research, research systems/ paradigms Building blocks of research (ontology, epistemology, methodology, methods, sources)	Ontology: Looking at Reality: External reality, Objective reality, Subjective reality, Constructed reality, Multiple realities, Unreality Epistemological positions: Positivist, post-positivist, Constructivist and Critical Theory and systems/paradigms of enquiry Methodology: strategies and tactics and measures of research quality in each category Hand outs/ Chapter/s in Ref. Books
	Tutorial 3	Add on/Complete Lecture 3 Philosophy of Knowledge and producing it, comparative study	Tie-up lecture 3 and review of the lecture through discussions and question answers.

4	Lecture 4	Research methods (strategies): Historical research (Interpretive research)	Study of socio-physical phenomena: Nature of History, narration, precedent analysis, basis of interpretation, tactics of data collection, organization and evidence analysis and interpretation, evaluation, strengths and weaknesses Copy of Presentation, Reading material (Handout prints, Chapter/s in Ref. Books).
	Tutorial 4	Continuing on Tutorial 2: Writing research papers: literature search and review (Library and Internet)	Short Presentations followed by discussions. Nature, use and tactics (sources, organization and retrieval) of literature review (Problem based working/search and review sessions on literature for research proposal preparation/taking research forward.)
5	Lecture 5	Research methods (strategies): Qualitative research	Study of socio-physical phenomena: Nature of qualitative research (natural/field setting, interpretation and meaning , use of hermeneutics, multiple tactics, researcher as bricoleor), approaches in qualitative research (Grounded theory, Ethnography and Phenomenology) Copy of Presentation, Reading material (Handout prints, Chapter/s in Ref. Books).
	Tutorial 5	literature search and review (Library and Internet) continued	Annotated bibliography and literature review. Problem based working/search and review sessions on literature for research proposal preparation/taking research forward.
6	Lecture 6	Research methods (strategies): Qualitative research	Qualitative Research: tactics of data collection, organization and evidence evaluation, strengths and weaknesses Copy of Presentation, Reading material (Handout prints, Chapter/s in Ref. Books).
	Tutorial 6	Writing Research Objectives, Research Questions or Hypothesis	Short Presentations followed by discussions. Each student writes OQH based on his/her literature study for problem assessment/problematising.
7	Lecture 7	Research methods (strategies): Co-relational research	Study of patterns of relationship between two or more naturally occurring variables, measurement and statistical analysis: relationship and causal-comparative correlations, tactics of data collection (questionnaire, observations, mapping, sorting) multivariate analysis, factor analysis. Copy of Presentation, Reading material (Handout prints, Chapter/s in Ref. Books).
	Tutorial 7	References and Referencing (*Hand in as written assignment)	Short Presentations followed by discussions. Crediting and plagiarism. Harvard referencing (handout print) and its use (work on to literature review outputs).
8	Lecture 8	Questionnaire Method (Survey research)	Variables and units of analysis. Questionnaire and design, pretest, sample and universe (random sample, stratified sample, purposive sample) and interviews and response rate. Statistic and parameter. Preparation of Data. Summary statistics, pie charts and graphs. Short Presentations followed by discussions. Problem based working/ Exercises.
	Assessment	Presentation of reports	Seminar 1
9	Lecture 9	Research methods (strategies): Experimental and Quasi-experimental research (Causal research)	Independent (treatment) and dependent (outcome) variable, treatment, laboratory and field settings, unit of assignment and control of environment/ control groups, causality Inputs: Copy of Presentation, Reading material (Handout print no.1, Chapter/s in Ref. Books).
	Assessment	Presentation of reports	Seminar 1

10	Lecture 10	Research methods (strategies): Experimental and Quasi-experimental research (Causal research)	Experiments and random assignment, non-random assignments and quasi-experiments, tactics: setting, treatment and measurements. Criticism Inputs: Copy of Presentation, Reading materials, Chapter/s in Ref. Books).
	Tutorial 8	Data analysis and interpretations SPECIALIST LECTURER	Other tools of data collection: Inventory, direct observation, conference, focus groups etc. Descriptive and inferential statistics: Relationship among variables, scatter plots, histograms, frequency polygons. Statistical significance, probability, standard deviation, confidence levels and range, sampling error, degree of freedom, Chi Square, Lambda. Regression. Short Presentations followed by discussions. Problem based working/ Exercises.
11	Lecture 11	Research methods (strategies): Simulation and modeling research SPECIALIST LECTURER	Principles and use, modeling and simulation, scale and complexity, types of models iconic, analog, operational and mathematical; comparison with other methods, tactical concerns and criticism, accuracy of replication, completeness of input data, computer as a tool in modeling. Inputs: Copy of Presentation, Reading materials, Chapter/s in Ref. Books).
	Tutorial 9	Data analysis and interpretations Tools in statistical Analysis (SPSS, EXCEL applications) SPECIALIST LECTURER	Descriptive and inferential statistics. Regression. Short Presentations followed by discussions. Problem based working/ Exercises.
12	Lecture 12	Research methods (strategies): Case studies (combined strategies)	General principles: phenomena and context, causal linkages, theory building, multiple sources of evidence, single and multiple cases. Designing and conducting Case studies.
	Tutorial 10	Data analysis and interpretations Tools in statistical Analysis (SPSS, EXCEL applications) SPECIALIST LECTURER	Descriptive and inferential statistics. Regression. Short Presentations followed by discussions. Problem based working/ Exercises.
13	Lecture 13	Research methods (strategies): Case studies (combined strategies)	Analyzing Case studies. Collection of data, sources and tactics. Making case study report
	Tutorial 11	Writing Research report	Study of sample research report. Exercise in class /Turning in of assignment
14	Lecture 14	Selecting strategies/designing methods and procedures	Research and Theory, Research and Application, choosing strategies/designing appropriate methods and procedure for particular problems of research. Rethinking validity and Reliability
	Last Session	Assessment	Class Test

Sudarshan Raj Tiwari is professor of architecture and teaches classes at Bachelor, Master and Doctoral levels. His current teaching subject areas are Nepalese Architectural History, Design Thesis, Planning Theory and Research Methods. His area of research interest is historical architecture, urbanism and culture.

Sudarshan Raj Tiwari, born at Bishalnagar in Kathmandu in June 1950, completed his schooling in Kathmandu passing his School Leaving Certificate examination from Juddhodaya Public High School in first division with eighth position on the board in 1966. He also learned freehand sketching under Chandraman Maskey. He completed intermediate studies in sciences from Amrit Science College and passed at the top of Tribhuvan University list in 1968. He studied architecture and earned Bachelor's degree from School of Planning and Architecture, New Delhi (University of Delhi) in 1973 with first class and gold medal. He took his Master's degree in Architecture from University of Hawaii, USA in 1977 specializing on housing in tropical countries. His interest drew him to the study of Nepali historical architecture, urbanism and culture, which led to a PhD from Tribhuvan University for his dissertation on ancient settlements of Kathmandu Valley in 1995.

He has served in the faculty of Tribhuvan University's Institute of Engineering for more than thirtyfive years, and was Dean of the Institute of Engineering between 1988 and 1992. Prof Tiwari has worked at several world heritage sites such as Lumbini, Swoyambhu, Changunarayan and Bhaktapur Durbar Square. He has also consulted on infrastructure for health and education sector projects of World Bank in Nepal and Afghanistan between 1992 and 2009.

His publications include the books *Tiered Temples of Nepal* (1988), *The Ancient Settlements of the Kathmandu Valley* (2001), *The Brick and the Bull* (2002) and *Temples of the Nepal Valley* (2009).

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