



**SECOND SEMESTER 2021-2022**

**Course Handout Part II**

Date: 09-01-2023

In addition to Part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

*Course No.* : **BITS G661**  
*Course Title* : **Research Methodology I**  
*Instructor-in-Charge* : Karthik Chethan V.

**Scope and Objective of the Course:**

This course introduces the student to the scientific method of conducting research and will provide a practical framework on which a student can base his/her research. The objective of this course is to inculcate a systematic approach to research including formulating a research topic, testable hypothesis, designing experiments, collecting and analyzing data and presenting their research in the form of reports, articles, thesis and seminars. The course also introduces the student to various analytical instruments and equipment commonly used in research laboratories as well as tools for data analysis. As part of the course, students will work on projects in which they can integrate the concepts learnt in class.

**Course Outcomes (CO):**

CO1. To learn and gain some insights in real research related problem statements and its association in product innovation (familiarity with reactions, processes, problem solving, product development and characterization of materials that are commonly encountered in adhesive, composite, aerospace, defence, soap, food, chemical and biotechnology industries).

CO2. To conduct hypothesis based discussions to solve these statements and engineering based issues in a confident and feasible manner by combining conceptual, numerical and design based solutions learnt during the course of the semester. The issues can be product development, process, quality control and application related.

CO3. To inculcate the skill of coupling micro and macro aspects of research and development, and to apply interdisciplinary skills of science and engineering in problem-solving. The course will attempt to cover various case studies in research and development.

**Student Learning Outcomes (SLO):** SLOs are outcomes (a) through (k) plus any additional outcomes that may be articulated during the course.

- (a) an ability to learnt to alleviate and manage fear (fear of failure, embarrassment, grades etc.) which rears its ugly head in learning and learn to connect and collaborate with peers and faculty in and out of classrooms. To develop into thinking (how and why) and collaborative individuals.
- (b) an ability to apply knowledge of science and engineering.

- (c) an ability to design and conduct characterization experiments, as well as to analyze and interpret results.
- (d) an ability to select and apply relevant characterization techniques to meet specific desired needs within realistic constraints such as availability, expertise and economics.
- (e) an ability to function on teams.
- (f) an ability to identify, formulate, and solve engineering problems.
- (g) an understanding of professional and ethical responsibility.
- (h) an ability to communicate effectively.
- (i) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (j) a recognition of the need for, and an ability to engage in life-long learning
- (k) a knowledge of contemporary issues
- (l) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

#### **Textbooks:**

1. C.George Thomas “Research Methodology and Scientific Writing”, Ane Books Pvt. Ltd., 2015.

#### **Reference Books:**

R1. Martin Goldstein and Inge F. Goldstein, HOW WE KNOW, An exploration of the scientific process, Da Capo Press; Revised ed. edition (22 March 1981) (Available in Amazon India, <https://www.amazon.in/How-We-Know-Martin-Goldstein/dp/030680140X> )

#### **Course Plan:**

<b>Lecture No.</b>	<b>Learning objectives</b>	<b>Topics to be covered</b>	<b>Chapter in the Text Book</b>
1-2	Describe the elements of research and the scientific method	Need for academic research Introduction to the scientific method Research methodology and research methods	1
3	Identify the approaches to research Differentiate between types of research	Formal and informal approaches to research Basic versus applied research, Qualitative and Quantitative research, Experimental research, Variables in research	3
4-11	Formulate a hypothesis Design experiments using statistical tools Understand the significance of controls	Cause effect relationships, hypothesis, experiments, errors, use of controls, Statistical design of experiments, Taguchi methods Framing a hypothesis	4, 5
12-20	Collect relevant data Analyze data using statistical tests Represent data appropriately in tables, graphs, etc.	Data collection and record keeping Data analysis Statistics – commonly used tests, Grey relational analysis (GRA) Representing data – tables versus figures Illustrations, Types of graphs Use of tools such as MS Excel, Origin	6, 11

21-24	Carry out a thorough literature review and summarize Identify and use tools to store and organize literature	Importance of reviewing the literature Sources available Locating relevant literature Reliability of sources Note making, Paraphrasing, Writing a review Citing literature	8, 12
25-30	Write a paper Describe the elements of a journal article, thesis Make clear and well defined presentations Present ideas, data and results in a forum	Scientific writing – grammar, writing styles, Writing research papers, review papers, thesis Selecting a journal Editing, formatting, Referencing Review and peer review, Proofreading Presentations, posters, How to present in seminars	10, 13, 14
31	Understand the ethical aspects of research	Ethics in research, Plagiarism Intellectual Property Rights Unscientific practices, Whistle blowing	15
32-40	Explain the principle involved in various analytical instruments and equipment	Demonstrations of equipment such as DSC, TGA, FTIR, Microscopes, spectrophotometer, chromatography systems, UTM, XRD, XRF, SEM and others. Analysis of data and images.	Lab manuals

#### Evaluation Scheme:

Component	Duration	Weightage	Date & Time	Remarks
Midterm	90 mins	20%	14/03 2.00 - 3.30PM	Open Book
Continual Evaluation*	NA	45%		Open Book
Comprehensive Exam.	3 hours	35 %	11/05 FN	Open book

\*Continual evaluation will involve brainstorming and interacting in class, hands-on experimental and modeling or numerical work as part of problem solving assignments followed by video presentations and discussions and lab visits. Each student will work on a minimum of 2 short hands-on activities and 1 group project for the semester. For a fair continual evaluation, attending classes and interacting in class and conducting activities is imperative.

**Chamber Consultation Hour:** TBA

**Notices:** Will be uploaded on CMS website

**Make-up Policy:** Make up will only be granted for genuine reasons and only with prior permission.

**Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable

Karthik Chethan V.

**INSTRUCTOR-IN-CHARGE**