GUIDELINES

FOR THE PREPARATION OF

M.S. THESIS

INDIAN INSTITUTE OF TECHNOLOGY, MADRAS

March 2025

1. CHECKLIST FOR SUBMITTING M.S. THESIS FOR EVALUATION:

1.	Copy of the Thesis for evaluation	In PDF, to be submitted in workflow
2.	Copy of your thesis abstract	In PDF, to be submitted in workflow
3.	Certificate for check against Plagiarism	- Refer Appendix I and II for guidelines for Check against Plagiarism. - See Annexure 16 for Certificate
4.	Declaration to the academic section.	- See Annexure 17
5.	Copy of last qualified degree	- By email, to the Research Evaluation Unit - This is to confirm the correctness of name which will be printed in the M.S. degree awarding certificate
6.	Latest formal passport size photo *.jpg format for printing the same in their degree certificate	- By email, to the Research Evaluation Unit - Color photo in formal attire, taken in the last 6 months - Use a clear image of your face. Do not use filters commonly used on social media. - No selfies. - Use a plain white or off-white background.

2. CHECKLIST FOR SUBMITTING M.S. APPROVED THESIS:

1.	Approved Final Thesis	- Thesis with front page as given in Annexure 1A or 1B
2.	Proforma to be submitted by the Scholar (Academic, placement and personal details)	- See Annexure 18

GUIDELINES FOR WRITING M.S. THESIS

THE ARRANGEMENT ORDER

1. COVER PAGE
2. INSIDE COVER PAGE
3. QUOTATIONS (if any)
4. DEDICATION PAGE (if any)
5. THESIS CERTIFICATE
6. LIST OF PUBLICATIONS
7. ACKNOWLEDGMENTS
8. ABSTRACT
9. TABLE OF CONTENTS
10. LIST OF TABLES
11. LIST OF FIGURES
12. GLOSSARY (if any)
13. ABBREVIATIONS (if any)
14. NOTATION (if any)
15. CHAPTERS
16. APPENDICES
17. REFERENCES
18. CURRICULUM VITAE*
19. GENERAL TEST COMMITTEE*

**Note: The Curriculum Vitae and the list of General Test Committee members should be included only in the Approved Thesis.*

The formats for various headings are given below:

1.	COVER PAGE:	See Annexure 1A and 1B. The fonts and locations of the various items on this page should be exactly as shown in Annexure 1A and 1B.
2.	INSIDE COVER PAGE:	Same as cover page.
3.	QUOTATIONS:	This should not exceed one page.
4.	DEDICATION PAGE:	This should not exceed one page.
5.	THESIS CERTIFICATE	See Annexure 2 A. The fonts and locations of the various items on the certificate should be exactly as shown in Annexure 2 A.
6.	LIST OF PUBLICATIONS:	See Annexure 2 B.
7.	ACKNOWLDGEMENTS:	This should not exceed two pages.
8.	ABSTRACT:	This should not exceed two pages (about 600 words) and should contain not more than 6 key words. See Annexure 3.
9.	TABLE OF CONTENTS:	See Annexure 4.
10.	LIST OF TABLES:	See Annexure 5.
11.	LIST OF FIGURES:	Same format as in list of tables.
12.	GLOSSARY:	See Annexure 6.
13.	ABBREVIATIONS:	See Annexure 7.
14.	NOTATION:	See Annexure 8.
15.	CHAPTERS:	See Annexure 9A and 9B.
16.	APPENDICES:	Same format as Chapters.
17.	REFERENCES:	These should be provided immediately after concluding chapter in the thesis, or after the appendices (if any). References should be complete in all respects. Indicative examples are provided in Annexure 10.

18.	SAMPLE TABLES AND FIGURES:	See Annexure 11 and 12.

The following components (points19 & 20) are to be given only in the final version of the thesis (Approved Thesis) submitted after Viva-voce / Final GTC examination.

*19.	CURRICULUM VITAE:	See Annexure 13. If the candidate prefers so, the class, distinction, or awards/ prizes obtained can be indicated. In any case, the CV, should not exceed one page.
*20.	GENERAL TEST COMMITEE:	See Annexure 14B. Use exactly the same format.

GUIDELINES AND STYLE NOTES FOR THESIS PRODUCTION

1.1. GENERAL GUIDELINES:

a) Scholars are required to write to publishers and obtain permission, wherever necessary, for materials to be reproduced in their Thesis.

b) Images shared under the creative commons license should not be cited using a hyperlink of the page on which they appear. Scholars must use the link that is available while downloading these images. Most websites, including Wiki and others, have a set of instructions to follow to obtain the appropriate citation. *(Refer 1.3.Guidelines for Figures/Images/Tables)*

c) Scholars must ensure adherence to the prescribed format.

d) The publications arising out of the work mentioned in this thesis must be added at the beginning of the Thesis *(Refer Annexure 2B)*

e) Scholars must follow appropriate means to use copyright material. Scholars must check the policy of individual journals regarding the use of their own published work in the Thesis. Required permission must be obtained in all cases. *(Refer Appendix III)*

f) An extension on publishing the full Thesis on the IIT repository may be granted to scholars (if needed) to publish unfinished work.

g) The sentence **"© YEAR Indian Institute of Technology Madras**" must be included (without quotes) at the left bottom of the thesis certificate page, to show the copyright of the work belongs to IITM. The "YEAR" to be replaced by the current year. E.g.: © 2025 Indian Institute of Technology Madras. *(Refer Annexure 2A)*

1.2. STYLE GUIDELINES:

1.2.A. PAPER

Use A4 (210mm x 297mm) bond un-ruled paper (80gsm) for all copies submitted use both sides of the page from acknowledgements section and onward for all printed/typed matter.

1.2.B. NUMBERING

Pages

Every page in the Thesis, except the Thesis title page, must be accounted for.

The page numbering, starting from acknowledgements and till the beginning of the introductory chapter should be printed in small Roman numbers, i.e. i, ii, iii, iv…….

The page number of the first page of each chapter should not be printed (but must be accounted for). All page numbers from the second page of each chapter should be printed using Arabic numerals i.e. 2, 3, 4, 5….

All printed page numbers should be located at the bottom centre of the page, 17mm (2/3") from the bottom edge, using normal print.

Chapters

Use only Arabic numerals. Chapter numbering should be centered on the top of the page using large bold print.

Example:

CHAPTER 1

Sections

Use only Arabic numerals with decimals. Section numbering should be left justified using bold print.

Example:

1.1, 1.2, 1.3, etc.

Subsections

Use only Arabic numerals with two decimals. Subsection numbering should be left justified using bold print.

Example:

1.1.1, 1.1.2, 1.1.3, etc.

NB: Sub-section levels beyond the third level (eg. 1.2.1.1, 3.2.1.3, etc.) are not recommended.

Equation(s)/Formula(e)

Use only Arabic numerals with single decimal. Equation numbers should be right justified using normal print. Mathematical symbols should be printed in italics.

Format: (<Chapter number><Equation serial number>)

Examples:

$$L = f_1(\underline{x}) + \sum_{i=1}^{m} \mu_i g_i(\underline{x}) + \sum_{j=2}^{k} \lambda_{1j}(f_j(\underline{x}) - \varepsilon_j) \qquad (1.1)$$

$$\int dU = \int \left[\frac{1}{2}\epsilon_0 E(cB) + \frac{1}{\mu_0} B\left(\frac{E}{c}\right)\right] A dx \qquad (1.2)$$

$$C_6H_6 + Br_2 \xrightarrow[50^0]{Fe} C_6H_5Br + HBr \qquad (1.3)$$

Please note that the equation numbers are flush right in normal print.

Reference:

Use only Arabic numerals. Serial numbering. Alphabetical order of surname or last name of first author.

Two or more references by same author(s) in the same year should be indicated by small-case alphabets in italics.

1.2.C. TEXT

Colour: Black Print

Font:

Regular text	-	Times Roman 12 pts. And normal print
CHAPTER HEADINGS	-	Times Roman 15 pts. and bold print and all capitals.
SECTION HEADINGS	-	Times Roman 12 pts. and bold print and all capitals.
Subsection Headings	-	Times Roman 12 pts. and bold print and leading capitals, i.e. only first letter in each world to be in capital.
Special Text	-	Italics/Superscript/Subscript/Special symbols, etc., as per necessity. Special text may include footnotes, endnotes, physical or chemical symbols, mathematical notations, etc.

References	-	Same font as regular text. Serial number and all authors names to be in bold print. Journal names and book titles in italics. For format see Annexure 10.

Spacing:

Use **double spacing** between the lines.

Use **triple spacing** between paras.

All paragraphs in the thesis should be left justified completely from the first line to the last line.

Use **double spacing** between the regular text and quotations

Provide **three spaces** between:

(a) Chapter title and first sentence of a Chapter.
(b) Last line of a section/sub-section and the title of the next section/sub-section.
(c) Paragraphs.

Use **single spacing:**

(a) In footnotes and endnotes for text.
(b) In explanatory notes for tables and figures.
(c) In text corresponding to bullets, listings and quotations in the main body of the thesis.

See Annexures 9A and 9B for examples.

Use **single space** in references and **double space** between references

Justification:

The text should be fully justified.

Hyphenation should be avoided as far as possible

Text corresponding to bullets and listings should be indented.

Quotations from other research work must be indented on the left and the right, if they are longer than two lines. Shorter quotations can be included as a part of the regular text.

Widows & Orphans:

At the bottom of a page, a paragraph should have at least two lines. Similarly at the top of a page a paragraph should end with at least two lines.

1.2.D. MARGINS

The margins for the regular text are as follows:

LEFT	=	31.7MM (1.25”)
RIGHT	=	31.7MM (1.25”)
TOP	=	25.4MM (1.00”)
BOTTOM	=	17.0MM (0.67”)

Please note that the bottom of the page numbers should be 17.0mm above the bottom edge of the numbered pages.

1.2.E. TABLES:

A sample for table is provided in Annexure 11.
All table should have sharp line drawn in black ink, to separate rows/columns as and when necessary.

Tables should follow immediately after they are referred for the first time in the text. *(Refer 1.3.Guidelines for Figures/Images/Tables, pg.12, to obtain the appropriate citation)*

Splitting of paragraphs, for including tables on a page should be avoided. Provide **three spaces** on the top and the bottom of all tables to separate them from the regular text, wherever applicable. *See Annexure 9B for an example*.

The last line of the title of any table should be 10mm to 15mm above the top-most horizontal line of the table, and the title should be centered with respect to the table. The titles must be in the same font as the regular text and should be single spaced.

The title format is give below:

Table<blank><chapter number><serial number><left indent><table title>

Example (of a small table which is sought to be placed within the text):

Table 2.1 Percentage of samples with discretized priority vector rankings different from original priority vector rankings: Results of the simulation experiment.

The contents of the table will be within the surrounding double line (which indicates the top-most, left-most, right-most, and bottom-most boundaries of the table)

Wherever a table exceeds one page present the full title of the table on the first page and in the following pages provide the table number and state “(**contd.**)” after it.

Example: (notice the left justification)
Table 5.7 (**contd.**)

Wherever explanatory notes are used for clarifying any information presented inside the tables, print them after leaving a single space immediately below the tables. All tables in landscape format must be placed such that their top portions are near the binding of the thesis and their bottom portion near the outer edge.

1.2.F. FIGURES:

A sample of figures is provided in Annexure 12.

All figures, drawings, and graphs should be drawn in black ink with sharp lines and adequate contrast between different plots if more than one plot is present in the same graph.

Figures should follow immediately after they are referred to for the first time in the text. *(Refer Guidelines for Figures/Images/Tables to obtain the appropriate citation)*

Splitting of paragraphs, for including figures on a page, should be avoided. Provide **three spaces** on the top and the bottom of all figures to separate them from the regular text, wherever applicable. *See annexure 9B for an example.*

The first line of the title for figures, drawings, graphs and photos should be between 10mm and 15mm below the bottom and they should be centered with respect to the figures. The titles must be in the same font as the regular text and should be single-spaced.

The title format is given below:

Fig.<blank><chapter number> <serial number> <left indent> <figure title>

Example:

Fig. 6.2 Life against Maximum Stress Range based on Maximum Stroke of a Corrugation.

Wherever a figure exceeds one page (as in the case of large flow charts for computer programs) present the full title of the figure on the first page and in the following pages provide the figure number and state.

Example: (notice the left justification)

Fig. 4.23 (**contd.**)

When there are many plots in a single graph or figure, the lettering, labelling or numbering of each plot for it identification should be of a size such that even after size reduction in the thesis, the identification should be clearly legible.

All figures in landscape format must be placed such that their top portions are near the binding of the Thesis and their bottom portions near the outer edge.

1.2.G. PHOTOS

Use colour photos only if they are necessary. Remember that the thesis may have to be photocopied. In case colour photos are used, all copies of the thesis must contain only colour photos.

Use good quality photographs wherever necessary. If photographs are scanned, it must be of min. 200 dpi resolution with 256 vector rather than bit-map graphics.

Each photo should be numbered and referred to as a figure.
(Refer1.3.Guidelines for Figures/Images/Tables to obtain the appropriate citation)
Photo title should be similar to those provided for figures.

1.2.H. DRAWINGS

Drawings which are larger than A4 size are not encouraged. If larger drawings are absolutely necessary they may be suitable folded to A4 size in the thesis. Take care to reduce the sizes when the final A5 form of the thesis is prepared.

Each drawing should be numbered and referred to as a figure. *(Refer 1.3.Guidelines for Figures/Images/Tables to obtain the appropriate citation,).* Drawing title should be similar to those provided for figures.

1.2.I. FOOTNOTES

In presenting footnotes and references, use a consistent form acceptable in your discipline. See annexure 9A for a sample.

1.2.J. PUNCTUATION

Please refer to any standard style manual such as the *Chicago Manual of Style** where rule of punctuation are clarified. The research scholar must note that different styles are <u>in practice</u> nowadays.

For example, some people insert a full stop <u>before</u> ending a sentence in double quotes, whereas others insert the full stop <u>after</u> the double quotes. Both style are <u>in practice</u>.

**The Chicago Manual of Style, Prentice-Hall of India, New Delhi, 1989.*

1.3.GUIDELINES FOR FIGURES/ IMAGES/ TABLES GIVEN IN THE THESIS:

1) If figures/ images/ tables are reproduced from the scholar's own published work, a reference to the publication must be mentioned in the figure/ image/ table caption.
2) If figures/ images are obtained from publications by others or from internet sources, permission to reproduce the figures/images must be obtained, and it should be mentioned in the figure/ image caption giving a link to the source.
3) If figures/images/ tables have been adapted from previously published or obtained from figures/ sources, suitable mention must be made in the caption giving the link to the source.

1.3A. Instructions on How to cite images used in the thesis:

a) Crediting an author/photographer under the creative common license:

For obtaining Creative common license from a site such as Wikipedia, scholars are required to use the hyperlink relating to that specific image.
Instructions on how to obtain that link are provided on the website. The WIKI website gives the above information.
https://commons.wikimedia.org/wiki/Commons:Simple_media_reuse_guide

b) Crediting the author for reusing Creative commons images:

To obtain the correct hyperlink, the following set of instructions are required to be followed:

- Click on the image or Open in Media Viewer.
- Click on the download icon in the bottom right hand corner of the page.
- Click on "You need to attribute the author- Show me how" and copy the text provided.
- Scholars can choose between Plain, used where hyperlink is not possible, e.g., Printed materials and HTML for web. (Refer figure below)

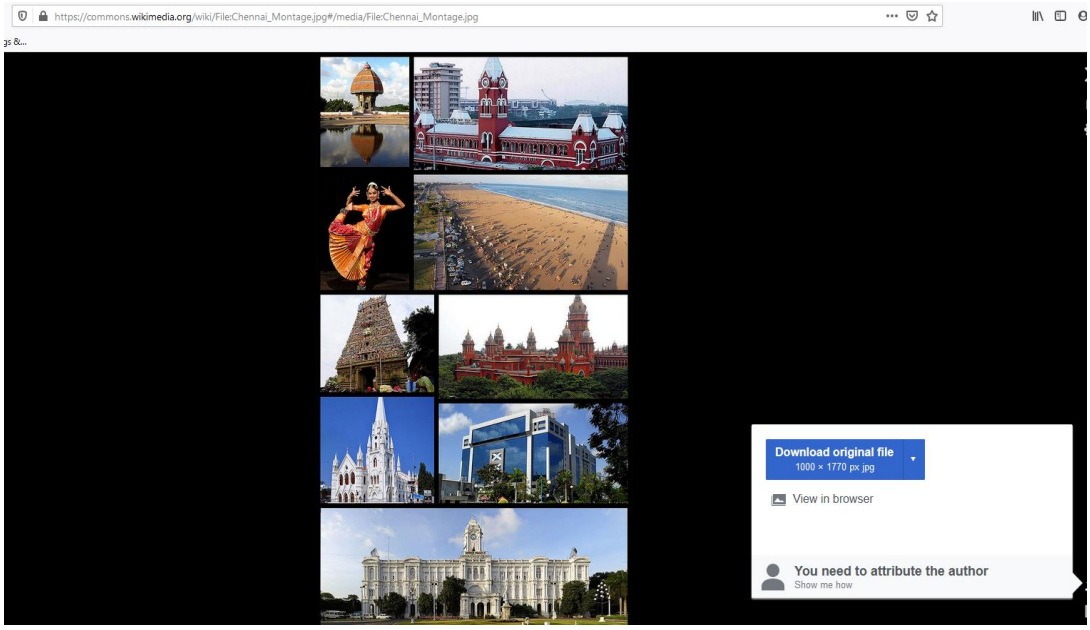

Fig. Screenshot from a wiki page, showing how to obtain the correct link to be used to cite the owner of the image.

ANNEXURE 1A

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A Thesis

Submitted by

NAME

For the award of the degree

Of

MASTER OF SCIENCE BY RESEARCH

Month, Year

ANNEXURE 1B

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CHENNAI-600 036

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ANNEXURE 2A

THESIS CERTIFICATE

This is to undertake that the Thesis titled, *<thesis title (use bold print; main title all capitals and subtitle with leading capitals)>* submitted by me to the Indian Institute of Technology Madras, for the award of *M.S BY RESEARCH.* is a bonafide record of the research work done by me under the supervision of *<Name of Guide(s)>*. The contents of this Thesis, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

*The research work has been carried out at IIT Madras and *<name of organization/institution in which the candidate is an employee>*

In order to effectively convey the idea presented in this Thesis, the following work of other authors was reprinted in the Thesis with their permission:

- Figures, Tables from previously published journal papers, to be referenced in the following way:
    - Figure/Table XX, page yy: Reprinted from… *<Ref details>*...with the permission of the authors and/or Publisher name
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Chennai 600 036 **Research Scholar**

Date:

Research Guide/ Co-ordinator*

**Applicable to External Registration candidates only*

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ANNEXURE 2B

List of Publications

The publications arising out of the work mentioned in this thesis are given as follows:

- <Detailed list of all journal and conference papers and the chapter in which the material appears.>

The papers based on the research work reported in the thesis could be listed under the broad headings "Journals" and "Conferences" indicating their current status (published / accepted) within parentheses at the end of each such citation.

I REFEREED JOURNALS BASED ON THE THESIS

1. **R. Ramanathan** (1992) Life cycle costing of biogas. *The Management Accountant*, **24**, 889-890.

2. **R. Ramanathan and G. Lakshman Sriram.** A multi-objective programming approach to energy resource allocation problems. *International Journal of Energy Research* (accepted).

II REFEREED JOURNALS (Others)

III PRESENTATIONS IN CONFERENCES

1. **R. Ramanathan and G. Lakshman Sriram.** The geometric mean method of combining individual opinions: A critique on the application of AHP to group decision process. *International AMSE Conference on Signals, Data and Systems*, New Delhi, December, 1991.

IV PUBLICATIONS IN CONFERENCE PROCEEDINGS

(Please Note: Publications in any unrefereed journals, magazines, volumes, etc. should not be listed)

ANNEXURE 3

ABSTRACT

KEYWORDS: Construction projects; multiple-resource scheduling; goal programming; simulation.

Construction projects involve large capital investments and in view of the limited availability of resources, the control of cost, execution time and quality of these projects is very important. Construction managers should aim for efficient utilization of resources to achieve a project's objectives and for effective project management. In construction projects multiple resources have to be dynamically allocated to different activities which are simultaneously carried out in different project sites while keeping in mind multiple objectives. The present work is perhaps one of the earliest attempts to take up this challenge, with a focus on practical realities.

A questionnaire-based survey was undertaken in order to find out, the level of awareness among professionals in the Indian construction industry on the various project management techniques, the extent of use of computers in planning and implementation of construction projects, and the importance attached to the multi-objective, multiple resources scheduling problem in practice. The results of the survey indicated that construction managers at various levels are beginning to show increasing interest in modern project resource scheduling techniques.

Construction managers have to balance conflicting multiple objectives such as maximizing profit, minimizing cost and time overruns, maximizing utilization of resources, etc. Multiple resource scheduling models, available in the research literature dealing with

production scheduling, cannot be applied directly to construction projects. Viable multiple objective resource scheduling models are yet to be developed for application in construction projects. A single objective resource scheduling model has been developed to perform resource levelling (NIRLEM) and allocation (NIRAM). It has been compared with other existing models and shown to be superior. This model serves as the basis for the development of a multi-objective model.

A multi-objective goal programming model (GOPRELA) has been developed here. It considers conflicting objectives of the owner (minimizing project completion time), the project manager (minimizing variation in resource deployment and maximizing resource utilization), and the contractor (minimizing cash flow deviations) to get a satisfactory (best compromise) solution. This has been applied to small and large single projects involving multiple resources, and its solution has been evaluated.

However, goal programming is not suitable for solving the problem of multiple resources in large projects with multiple objectives as the problem tends to become NP-complete. Hence, simulation has been resorted to for solving the problem and has also been validated. The simulation model has been extended to the case of scheduling multiple resources across multiple projects with multiple objectives. The extended simulation model can be used in practice.

The limitations and scope for further work are also discussed.

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(Please Note: The above is only a sample)

ANNEXURE 6

GLOSSARY

The following are some of the commonly used terms in this thesis:

Biogas-Electricity	This refers to the electricity generated by feeding biogas in a dual-fuel mode.
Criterion	This refers to the yardstick on which the performance of different alternatives are evaluated.
Combination	When an energy resource is employed for satisfying the demands of a specific energy end-use, it becomes a combination. For example, coal-cooking is a combination. Such combinations form the decision alternatives in this thesis.

(Please Note: The above is only a sample)

ANNEXURE 7

ABBREVIATIONS

The research scholar must take utmost care in the use of technical abbreviations. For example, "KM" stands for "Kelvin Mega" and not kilometer (which should be abbreviated as km) and "gms" stands for "gram meter second" and not "grams" (which should be abbreviated as g). In addition, abbreviations pertaining to any specific discipline should be listed in alphabetical order as shown below:

AHP	The Analytic Hierarchy Process
BC	Benefit/Cost ratio
EP	Expected Priority
ERA	Energy Resource Allocation

(Please Note: The above is only a sample)

ANNEXURE 8

NOTATION

The research scholar must explain the meaning of special symbols and notations used in the thesis. Define English symbols, Greek symbols, and Miscellaneous symbols separately. Some examples are presented below.

English Symbols (in alphabetical order)

a	the mean radius of the Earth = 6.37 x 10^6 m
a_n	a series of expansion coefficients with index n
A_c	total fractional area coverage by clouds
b_e , b_ϕ	regression coefficients for eccentricity and obliquity
B_g	equilibrium Bowen ration
$B_\nu(T)$	Planck's blackbody emission at frequency ν and temperature T
Q_{abs}	absorption coefficient
R^*	universal gas constant
S_{O_3}	heating from solar radiation absorption by ozone
$S^\uparrow(z)$	upward solar flux at altitude z

Greek Symbols

α_g	albedo of bare ground
β_E	ratio of evapotranspiration to potential evaporation
$\delta^{18}O$	normalized deviation of $^{18}O/^{16}O$ fraction from normal in %
ΔF_{ao}	the divergence of the horizontal transport of energy by the atmosphere and ocean
$\sigma(x)$	the standard deviation of x
ψ_M	meridional mass stream function

Miscellaneous Symbols

$\|x\|$	absolute value of x
$^0/_{00}$	per thousand

ANNEXURE 9A

CHAPTER 1

ENERGY POLICY: ISSUES, MODELS AND METHODOLOGIES

The indispensable role of energy in national development has been aptly demonstrated, in the last two decades, by the rapid rise in energy prices, the effects of energy shortages and disruptions, and the resultant problems in trade balances and reduced economic growth (Commoner, 1976; Fisher, 1974). The energy sector is capital intensive accounting for about 30% of the Union budget in India (Economic Survey, 1992). Being the largest service sector, any policy changes made in it such as price changes, investment pattern, research and development etc., affect the entire economy. Energy has exclusive linkages with other sectors of the economy and hence it should not be viewed in isolation but as a subsystem of the overall energy-economic-environmental system (Sonenblum, 1978; Odum and Odum, 1981). Energy has been recognized as a factor of production similar to land, labor and capital (Grivoyannis, 1983). Often, energy recovery and conversion processes account for a significant portion of environmental problems such as air and water pollution, land use, and generation of solid wastes. Planning and policy specification in the energy sector should reflect these linkages to serve national objectives. Energy policy should also consider economic, environmental and societal issues such as equity, poverty, energy conservation, long term availability of resources, technological excellence, employment generation, self reliance, environmental protection, etc. (Cohen, 1978; Maillet, 1987).

* <A part of this / This> chapter is published in <Give the complete reference of the journal paper in line with the format adopted to cite references in the thesis. If the contents of this chapter are published in more than one papaer, then provide all the references>

In addition, energy can play a vital role in solving problems peculiar to developing economies such as India's, *viz.* the rural-urban dichotomy, balanced economic development, foreign exchange requirements, and others (Reuter and Voss, 1990).

1.1 ENERGY POLICY - THE MAIN ISSUES

"Public policy analysis can be defined as an effort aimed at obtaining and synthesizing pertinent information in order to evaluate the policy alternatives and determine the 'best' policy[1].

1.1.1 Survey Articles

One of the earliest surveys on energy policy models was carried out by Searl (1973). A number of survey articles have been published since then by Hogan (1975), Shapiro (1975), Chapman (1976), Hoffman and Wood (1976), Beaujean *et al.* (1977), Brock and Nesbitt (1977), Hoffman and Jorhensen (1977), Blair (1978), Greenberger (1979), Hartman (1979), Manne *et al.* (1979), Stratton (1979), Samouilidis (1980), Bayraktar *et al.* (1981), Cherniavsky (1981), Hafele and Kirchmayer (1981), Nijkamp (1981), Rath-Nagel and Voss (1981), Hoffman and Basile (1982), Kavrakoglu (1982), Samouilidis and Mitropoulos (1982), Lakshmanan and Nijkamp (1983), Lev (1983), Samouilidis and Berahas (1983), Siskos and Hubert (1983), Goldenberg *et al.* (1985), Lakshmanan and Johansson (1985), Capros and Samoulidis (1988), Bolton (1989), Knight (1989), Shukla (1992), and others. The following paragraphs provide a .....

---

[1] The term 'best' policy refers to a decision process involving multiple decisions or pressure groups and multiple decision criteria (Capros and Samouilidis, 1988).

ANNEXURE 9B

The finding and eliminating of special cause variation is the responsibility of those working in the process. It is the responsibility of those managing the process to find and eliminate the common cause to bring about an improvement in process (Table 2.1). Lack of understanding of these concepts by management will lead to misinterpretation of the patterns of variation. Some of the losses resulting from misinterpretation are (Nolan and Provost, 1990):

* blaming people for problems beyond their control,
* spending money for new equipment when they are not needed,
* wasting time looking for explanations of a perceived trend when nothing has changed, and
* taking other actions when it would have been better to do nothing.

Table 2.1 Responsibility for Variation (Adapted from Francis and Gerwels, 1989).

Type of Variation	Frequency of Occurrence	Charac-teristic	Action Needed	Respon-sibility
Common cause	High (>90%)	Fault of the system	Fundamental system change	Manage-ment
Special cause	Low (<10%)	Traceable to an assignable cause	Find the source and take preventive action	Local work force

When a process has only common causes affecting the outcomes, it is called a stable process and is said to be in a state of statistical control. A stable process does not necessarily mean that the product produced or service provided is meeting specifications or is satisfactory. It only means that the cause system for variation remains constant over time and the outcome is predictable. In an unstable process the magnitude of

variation from one period to the next is unpredictable. Some of the advantages of a stable process are (Deming, 1986):

1. The process has an identity; its performance is predictable. It has a measurable and communicable capability.
2. Costs are predictable.
3. Productivity is at a maximum and costs at a minimum under the present system.
4. The effects of changes in the system can be measured with greater speed and reliability. Without statistical control it is difficult to measure the effect of a change in the system.
5. The soundest way to cut inspection is through getting the process into control (Burr, 1976).

Shewhart developed the control chart as a tool to separate special causes from common causes. It consists of three statistically based lines: the centerline (CL), an upper control limit (UCL), and a lower control limit (LCL) (Figure 2.1).

Data for the sample statistic (or quality characteristic) is divided into subgroups. The subgroups should be selected in a way that makes each subgroup as homogeneous as possible and gives the maximum opportunity for variation from one subgroup to another. Often, especially for variables control charts, the subgrouping is based on the order in which the product is produced.

In general, 3-sigma limits are used for the UCL and LCL. As a general model, the 3-sigma limits can be expressed as (Grant and Leavenworth, 1988)

$$UCL_y = E(y) + 3\sigma_y \quad (2.1)$$

$$CL_y = E(y) \quad (2.2)$$

$$LCL_y = E(y) - 3\sigma_y \quad (2.3)$$

where,

y = random variable or control statistic to be plotted on the control chart,

$E(y)$ = expected value of the statistical variable,

σ_y = standard deviation of the variable y.

The probability that an exactly normally distributed random variable will fall outside the 3-sigma control limits is very low (0.0027). Hence, the chance of occurrence of a point falling outside the limits is very rare. Only in the case of variables control charts (X chart) will the distribution of the random variables tend towards a normal distribution. In the case of other control charts (R chart, p chart, c chart, etc.) this is not true. However, by Tchebycheff's inequality theorem, for any distribution at least $1 - (1/t^2)$ of any set of finite numbers must fall within the range $\mu \pm t\sigma$. If $t = 3$, then for even the most badly distorted distribution, 89 percent or more of the values are between $\pm 3\sigma$. Thus, it can be said that the occurrence of a point randomly falling outside 3-sigma limits is very unlikely. The exact probability values can be computed for other distributions, but they are time consuming and the order of magnitude is the same as in the case of a normal distribution. Experience has shown that the 3-sigma limits provide an economic balance between the cost of hunting for special causes when they are absent and the cost of not hunting for them when they are present (Grant and Leavenworth, 1988).

In addition to points falling outside the control limits, there are other situations which may indicate that assignable causes are present. When several consecutive points lie on one side of the central line, it is called a run. Based on probability theory, some authors have proposed certain sets of rules which can be .....

ANNEXURE 10

REFERENCES

Examples

For papers by single author:

<S.No.>. **Saaty, T.L.** (1986a) Exploring optimization through hierarchies and ratio scales. *Socio-Economic Planning Sciences*, **20**, 335-360.

<S.No.>. **T. L. Saaty** (1986b) Axiomatic foundations of the Analytic Hierarchy Process. *Management Science*, **32**, 841-855.

<S.No.>. **Vargas, L.G.** (1990) An overview of the Analytic Hierarchy Process and its applications. *European Journal of Operational Research*, **48**, 2-8.

For papers by two authors:

<S.No.>. **Triantaphyllou, E.** and **S.H. Mann** (1990) An evaluation of the eigenvalue approach for determining the membership values in fuzzy sets. *Fuzzy Sets and Systems*, **35**, 295-301.

For papers with more than two authors:

<S.No.>. **Stehr-Green, P.A., J. Farrar, V. Burse, W. Royce, and J. Wohlleb** (1988) A survey of measured levels and dietary sources of selected organochlorine pesticide residues and metabolites in human sera from a rural population. *Journal of Public Health*, **78**, 828-830.

Note: Indicate the names of all authors, if feasible, and avoid the use of *et al* (to indicate the presence of two or more co-authors) after the first author's name.

For books:

<S.No.> **Dubois, D. and H. Prade** *Fuzzy Sets and Systems: Theory and Applications*, Academic Press, New York, 1981.

For articles in edited books/volumes:

<S.No.>. **Pimental, D.** *Energy Flow in agroecosystems*. pp. 121-132. *In* **R. Lowrance, B.R. Stinner,** and **G.J. Horse** (eds.) *Agricultural ecosystems*. John Wiley, Somerset, New Jersey, 1984.

For papers presented at Conferences:

<S.No.>. **Young, E.F.** and **H.I. Miller** (1988) "Old" biotechnology to "new" biotechnology: Continuum or disjunction? Proceedings of *International Biosymposium for Advancement of Biotechnology*, Tokyo, October, 63-85.

ANNEXURE 11

TABLES AND FIGURES SHOULD BE SELF-EXPLANATORY AS FAR AS POSSIBLE.

Table 7.1 Percentage of Samples with Discretized Priority Vector Rankings Different from Original Priority Vector Rankings. Results of the Simulation Experiment.

Size of the matrix	Simulation experiment results using Saaty's scale	Simulation experiment results using Saaty's scale with in-between values 1, 1.5, 2 so on	Simulation experiment results using Saaty's scale with in-between values 1, 1.25, 1.5 so on
2	35.17	21.05	12.09
3	42.62	28.12	16.86
4	51.24	34.24	20.68
5	59.62	41.04	24.83
6	66.21	46.20	29.10
7	71.81	51.53	32.98
8	76.72	56.62	37.10
9	80.60	61.36	40.83

ANNEXURE 12

The comments given below discuss the kinds of mistakes and errors that can creep in while presenting figures.

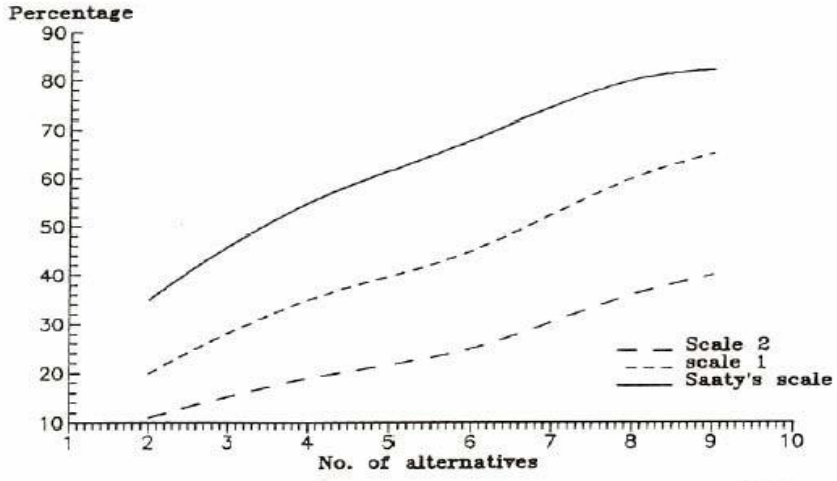

Fig. 3.1 Comparative Analysis of Different Scales

Comments on the presentation of the above figure:

1. The caption is in a different font compared to the labels for the X and Y axes. The captions for each plot should be in the same order (top to bottom) as the plots. For example, the order of presentation should be Saaty's scale followed by Scale 1 and then Scale 2. This is the order of the plots from top to bottom.

2. The labels for the X and Y axes have not been placed uniformly. The X-axis label is centered while the Y-axis label is on the top.

   The labels should be centered on the axes as far as possible.

3. There is virtually no correspondence between the figure title and the labels for the axes, i.e. it is very difficult to understand what the author wants to convey through the figure.

4. The Y-axis label says 'Percentage'. It would have been clearer if the author specified 'what' percentage is being shown on the Y-axis.

5. In the indication of the graphical representation of the three scales:
   (a) Scale 2 is presented before (above) Scale 1.
   (b) Scale 2 begins with a capital 'S', while scale 1 begins with a small 's'. Such non-uniform presentations should be avoided.
   (c) As far as possible indicate different scales (if presented in a single graph) alongside the plots.

ANNEXURE 13

CURRICULUM VITAE

1. **NAME** : R. Vijay Kumar

2. **DATE OF BIRTH** : 21 June 1966

3. **EDUCATIONAL QUALIFICATIONS**

1988 Bachelor of Engineering (B.E.)

Institution	:	Andhra University, Visakhapatnam
Specialization	:	Civil Engineering

1990 Master of Technology (M.Tech.)

Institution	:	Indian Institute of Technology, Bombay
Specialization	:	Industrial Engineering and Operations Research

Doctor of Philosophy (Ph.D.)

Institution	:	Indian Institute of Technology, Madras
Registration Date	:	17-07-1991

ANNEXURE 14B

GENERAL TEST COMMITTEE

CHAIRPERSON:	<Name> <Designation> <Department>
GUIDE(S):	<Name> <Designation> <Department>
	<Name> (if candidate has more than one guide) <Designation> <Department>
MEMBERS:	<Name> (Departmental member) <Designation> <Department>
	<Name> (member from other Department/ Institution) <Designation> <Department>

ANNEXURE 15

FORWARDING NOTE FOR THESIS SUBMISSION - M.S.

1.	Name of the Scholar						
2.	Mail ID of the Scholar						
3.	Contact number of the scholar						
4.	Roll No.						
5.	Registration Date						
6.	Type of Registration	Regular	External	QIP	Project	Staff	Others
7.	**General Test Committee Members**						
	Members Name	e-mail ID		Contact Phone / Mobile number etc.			
	Chairperson						
	Guide						
	Co-Guide						
	Member						
	Member						
	Member						
	Member						
	Member						
8.	Title of Thesis						

9.	Courses Prescribed & Completed (@) : (Continue on reverse if necessary)				
	S.No.	**Course No.**	**Course Title**	**Grade**	**Period of the course done**
	Core				
	a.				
	b.				
	c.				
	d.				
	e.				
	Elective				
	a.				
	b.				
	c.				
	d				
	e				
	(@) courses approved by the Chairperson, GTC **The courses taken above by the scholar will be entered in the grade sheet for the award of degree**				

10.	Details of Seminar:	
	Date	Topic of Seminar Talk
	a.	

11.	Publication Details as per the format given below: **Title, journal name, author(s) (sequence as in publication), year, volume, page from – page to, DOI, publisher, Indexed in (Scopus/Web of Science/PubMed/IEEE/any other/none) type of journal (subscription/hybrid/fully open access)** Enclose copy of at least one paper either published or accepted in a refereed journal.
12.	Certification by Guide(s): **All the information has been verified by me/us and is found to be correct. The thesis has been checked for plagiarism. The thesis is ready for submission.** Date: Signature of the Guide(s)
13.	Remarks of the HoD - **Certified that the publications submitted by the scholar are from the research carried out by the scholar at IIT Madras, and that the candidate meets all requirements for thesis submission.** Date: Head of the Department

ANNEXURE 16

(Undertaking by the Scholar on Check against Plagiarism)

This is to certify that the Thesis titled, ……<thesis title (file_name.pdf)>……..submitted by me to the Indian Institute of Technology Madras, for the award of M.S. is a bonafide record of the research work done by me under the supervision of ……<Name(s) of Guide(s)>…… .

By signing this, I certify the following about my Thesis titled <Thesis title>:

- The research reported in this Thesis is original.
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- This check resulted in a match of……. %, out of which the match with publications based on the work reported in the Thesis is ……..%.
- No alterations were made to the Thesis after carrying out the Turnitin check.

If this undertaking is later found to be false, it may be a sufficient reason for the withdrawal of the M.S. degree.

Signature ……
Date ……..
Name of the Scholar ……
Roll No. ……..

Certificate from the Guide:

I certify that I have gone through the entire Turnitin Report. No unacceptable similarity was found through the plagiarism check using Turnitin.

Name of the Research Guide(s) ……
Signature (s)…….
Department of …….
Date: ……

ANNEXURE 17

DECLARATION BY THE RESEARCH SCHOLAR

This is to declare that the thesis entitled "**TITLE OF YOUR THESIS**" submitted by me to the Indian Institute of Technology Madras, Chennai for the award of degree of **MASTER OF SCIENCE BY RESEARCH** is a bona fide record of research work carried out by me under the supervision of **Dr. Name_of_your_guide,** Department of _____. The contents of the thesis have not been submitted and will not be submitted to any other Institute or University for the award of any degree or diploma.

Chennai- 600 036 Signature of the Research Scholar

Date :

(Name_of_the_res_schol.)

Forwarded

Research Guide

(Name_of_the_guide)

ANNEXURE 18

PROFORMA TO BE SUBMITTED BY THE MS SCHOLARS AT THE TIME OF SUBMITTING A5 THESIS

I.	**ACADEMIC DETAILS**		
1.	Name of the Scholar	**:**	……
2.	Roll No.	**:**	…… Sex : Male / Female
3.	Department	**:**	……
4.	Name of the Guide (s)	**:**	……
5.	Programme	**:**	M.S.
6.	Category (HTRA / NHTRA / Project / UGC / CSIR / External / Part-time / QIP / Others)	**:**	
7.	Category (GEN / OBC / SC / ST)	**:**	
8.	Date of Registration**:** ……		
9..	Date of Submission of Thesis**:** ……..…	10.	Date of Viva voce / Final GTC: ……
II.	**PLACEMENT DETAILS**		
1.	Whether got placement	**:**	YES ☐ NO ☐
2.	**IF Yes**		Campus interview ☐ Direct placement ☐ PDF ☐ Industry ☐ Government ☐ Faculty ☐ Others ☐
3.	Salary / Fellowship Amount	**:**	……...
4.	Name of the Organisation & Address		……... …… ……

III.	**Two-line summary of thesis (for convocation purpose; Please add this in CD of thesis also)**		
IV.	**PERSONAL DETAILS**		
1.	Email id (i.e. in regular use)	**:**	……
2.	Mobile No./Phone No.	**:**	……
3.	Address for communication *(Full address with PIN Code)*	**:**	……... ……... …… ……
4.	Permanent Address *(Full address with PIN Code)*	**:**	……... ……... …… ……
	DATE :		**SIGNATURE**

APPENDIX I

GUIDELINES FOR CHECK AGAINST PLAGIARISM:

A. Scholars are required to do *a 'Turnitin'* check for the entire Thesis. (Note that chapter-wise *Turnitin* check is not required).

B. As per acceptable UGC guidelines, plagiarism settings for consecutive-words match <14 and similarity should be less than 10%. *(Refer to Appendix, pg.4, more further details)*

C. Research Guides are required to do a *'Turnitin'* check on Post-Viva / Final GTC Thesis (Final version, i.e., A5 Thesis) must be checked before submission to the academic section.

D. Plagiarism report **must be submitted** at the time of A4 thesis submission.

E. Plagiarism report **must be submitted again** after the viva voce / Final GTC examination, incorporating the revision of the thesis work indicated by the thesis examiner(s), if revisions are major.

F. Format for revised 'Check against Plagiarism' Certificate is given in Annexure 16. *(Refer Appendix II)*

APPENDIX II

UGC regulations relating to plagiarism with the objective of developing institutional mechanisms to eliminate instances of plagiarism in higher education system of the country, UGC has regulations for Promotion of Academic Integrity and Prevention of Plagiarism in Higher Educational Institutions since 31st July 2018.

The regulations are available at the UGC website:
https://www.ugc.ac.in/pdfnews/7771545_academic-integrity-Regulation2018.pdf

Relevant passages from the regulations:

1. To create awareness the higher educational institute (HEI) shall
    - Include elements of responsible conduct of research and publication ethics in Orientation and Refresher Courses organized for faculty and staff members of the HEI.
    - Train student, faculty, researcher and staff for using plagiarism detection tools and reference management tools.
    - Establish facility equipped with modern technologies for detection of plagiarism.
2. To establish institutional mechanisms

HEI shall declare and implement the technology-based mechanism using appropriate software so as to ensure that documents such as thesis, dissertation, publications or any other such documents are free of plagiarism at the time of their submission.

- The mechanism as defined at (a) above shall be made accessible to all engaged in research work including student, faculty, researcher, and staff etc.
- Every student submitting a thesis, dissertation, or any other such documents to the HEI shall submit an undertaking indicating that the document has been prepared by him or her and that the document is his/her original work and free of any plagiarism.
- The undertaking shall include the fact that the document has been duly checked through a Plagiarism detection tool approved by the HEI.

- HEI shall develop a policy on plagiarism and get it approved by its relevant statutory bodies/authorities. The approved policy shall be placed on the homepage of the HEI website.
- Each supervisor shall submit a certificate indicating that the work done by the researcher under him / her is plagiarism free.
- HEI shall submit to INFLIBNET soft copies of all Masters, Research program's dissertations and thesis within a month after the award of degrees for hosting in the digital repository under the "Shodh Ganga e-repository".
- HEI shall create Institutional Repository on institute website which shall include dissertation / thesis / paper / publication and other in-house publications.

3. To detect and discourage through punishment

The similarity checks for plagiarism shall exclude the following:

- All quoted work reproduced with all necessary permission and/or attribution.
- All references, bibliography, table of content, preface and acknowledgements.
- All generic terms, laws, standard symbols and standards equations.

Note: The research work carried out by the student, faculty, researcher and staff shall be based on original ideas, which shall include abstract, summary, hypothesis, observations, results, conclusions and recommendations only and shall not have any similarities. It shall exclude a common knowledge or coincidental terms, up to fourteen (14) consecutive words.

- Plagiarism would be quantified into following levels in ascending order of severity for the purpose of its definition:

Level 0: Similarities upto 10% - Minor similarities, no penalty
Level 1: Similarities above 10% to 40%
Level 2: Similarities above 40% to 60%
Level 3: Similarities above 60%

APPENDIX III

EXAMPLES OF JOURNAL AND PUBLISHING HOUSES POLICIES ON PUBLISHING WORK THAT APPEARS IN ARCHIVED THESIS.

Every journal has a different policy regarding the reuse of already published material. Some journals make a distinction between an "Accepted Manuscript" and "final publisher Version of Record."

Others require students to request permission to use already published material in their thesis. Permission is usually always granted, but the request still has to be made. Some examples of policy are provided here.

In figure 3, the terms of reuse for the Publishing company OSA is given (ref:

https://www.osapublishing.org/submit/review/copyright_permissions.cfm#permissions).

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OSA's policies afford authors, their employers, and third parties the right to reuse the author's Accepted Manuscript (AM) or the final publisher Version of Record (VoR) of the article as outlined below:

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Posting by authors on arXiv or other preprint servers after publication (posting of preprints before or during consideration is also allowed)	AM	VoR	VoR
Posting by authors on a non-commercial personal website or closed institutional repository (access to the repository is limited solely to the institutions' employees and direct affiliates (e.g., students, faculty), and the repository does not depend on payment for access, such as subscription or membership fees)	AM	VoR	VoR
Posting by authors on an open institutional repository or funder repository	AM after 12 month embargo	VoR	VoR
Reproduction by authors or third party users for non-commercial personal or academic purposes (includes the uses listed above and e.g. creation of derivative works, translation, text and data mining)	Authors as above, otherwise by permission only. Contact copyright@osa.org.	VoR	VoR
Any other purpose, including commercial reuse on such sites as ResearchGate, Academia.edu, etc. and/or for sales and marketing purposes	By permission only. Contact copyright@osa.org.	By permission only. Contact copyright@osa.org	VoR

Figure 3 OSA's policy on sharing different versions of a manuscript

Figure 4 gives details about Elsevier's policies on using one's published material in one's own thesis
and what is permitted regarding posting to a university repository.

The information was taken from:

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Figure 4 Elsevier's policies regarding an author's use of or sharing of their own published

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****