Hamidah binti Abdullah received her Bachelor in Chemical Engineering (2005) and Master in Science (2008) from Universiti Sains Malaysia (USM) before becoming a lecturer in the Faculty of Chemical & Natural Resources Engineering, Universiti Malaysia Pahang (UMP) in 2008. Currently, she is pursuing her PhD study in Chemical & Process Engineering at Universiti Kebangsaan Malaysia (UKM). She has five years of experiences in teaching Chemical Reaction Engineering subject. Her research interests and publications are in the area of catalyst and photocatalysis.

Rohaida Che Maa is a senior lecturer in the Faculty of Chemical & Natural Resources Engineering, Universiti Malaysia Pahang (UMP). She also has experience in teaching in Kulliyyah of Science, International Islamic University Malaysia. She completed all her degrees in Universiti Teknologi Malaysia (UTM) — B. Sc. (2005), M. Sc. (2007), and PhD (2016). She specialises in the production of enzyme through recombinant cell, synthesis of product using enzyme technology and fermentation process in bioreactor. She has authored and co-authored over 10 publications in several high impact journals including Biochemical Engineering Journal and Process Biochemistry. She is also a writer for the Module of Research Methodology (Engineering) under Institut Pengajian Siswazah Universiti Malaysia Pahang (IPS, UMP). Her research interests and publications include the enzyme and immobilisation technology, fabrication of bioreactor, and application of recombinant cell.

Nurul Sa’adah binti Sulaiman received the B. Eng and MSc. in Chemical Engineering from Universiti Sains Malaysia (USM) in 2008 and 2009, respectively and PhD degree in 2017 from Universiti of Aberdeen. She joined Universiti Malaysia Pahang (UMP) as a lecturer in 2009. Her main research interests are risk analysis, risk management, and oil and gas pipeline integrity.

Sumaiya Zainal Abidin is a senior lecturer in the Faculty of Chemical & Natural Resources Engineering, Universiti Malaysia Pahang (UMP). She received her B. Eng (Chemical Engineering) and MSc (Chemical Engineering) from Universiti Putra Malaysia (UPM) and further obtained her PhD (Chemical Engineering) from Loughborough University. She has been working in UMP since June 2006 and appointed as URP Lead Coordinator since September 2012. Over the years, she managed to secure several international, national, and internal grants as a principal researcher. Her research focuses on reaction and separation engineering which includes renewable energy, catalysis, biotests and biodiesel, fats crystallisation, development of drug deliver carrier, and rare earth separation technology. She has published her work in various impact factor journals including Minerals Engineering, Fuel, Particuology, Industrial Crops and Products, and Industrial and Engineering Chemistry Research. She is currently a research fellow for the Centre of Excellence for Advanced Research in Fluid Flow (CARIFF).

Nurul Aini Mohamed Razali is a senior lecturer in the Faculty of Chemical & Natural Resources Engineering, Universiti Malaysia Pahang (UMP). She received her Bachelor’s and Master’s degrees from Universiti Teknologi Malaysia (UTM) in 2007 and 2010, respectively, and completed her PhD in Universiti Sains Malaysia (USM) in 2014. She joined UMP since February 2014 and has been appointed as Undergraduate Research Project coordinator in October 2014. Her main research interests are in the area of catalysis, renewable energy, nanomaterials, and reaction engineering. She has published widely in international journals and conferences.
FKKSA
UNDERGRADUATE RESEARCH PROJECT MODULE
FKKSA
UNDERGRADUATE RESEARCH PROJECT MODULE

SUMAIYA ZAINAL ABIDIN
NURUL AINI MOHAMED RAZALI
ROHAIDA CHE MAN
NURUL SA’AAADAH SULAIMAN
HAMIDAH ABDULLAH

Publisher
Universiti Malaysia Pahang
Kuantan
2017
Assalamualaikum w.b.t.
In the name of Allah, The Most Gracious The Most Merciful. Peace and blessings upon our prophet Muhammad SAW.
Alhamdulillah, praise to Allah for the completion of the 1st edition of the FKKSA Undergraduate Research Project Module. I would like to congratulate the URP committee, UMP publisher and everyone who have contributed towards publication of this module. This module would not have been possible without your valuable assistance and supports. This module provides a useful guidance in standardizing the URP outcome assessments. Therefore, to all URP students, I hope that you can utilize the guideline to produce the best quality of research proposal, partial thesis, technical paper, final thesis and research poster. All the best in your undergraduate research project!
Best wishes,
PROFESSOR ZULKAFLI HASSAN
CEng. FEI SPE
Dean,
Faculty of Chemical and Natural Resources Engineering,
Universiti Malaysia Pahang

Published By:
Publisher
Universiti Malaysia Pahang
Lebuhraya Tun Razak, 26300 Gambang
Kuantan, Pahang Darul Makmur
Tel: 09-549 3273 Fax: 09-549 3281

Layout & Printing:
Percetakan Muafakat Jaya Sdn. Bhd (105038-M)
6, Jalan Perdagangan 16, Taman Universiti Industrial Park,
81300, Skudai Johor.
Tel: 07-520 6740 Fax: 07-520 6741
GREETINGS

Assalamualaikum w.b.t.

In the name of Allah, The Most Gracious The Most Merciful. Peace and blessings upon our prophet Muhammad SAW.

Alhamdulillah, praise to Allah for the completion of the 1st edition of the FKKSA Undergraduate Research Project Module. I would like to congratulate the URP committee, UMP publisher and everyone who have contributed towards publication of this module. This module would not have been possible without your valuable assistance and supports.

This module provides a useful guidance in standardizing the URP outcome assessments. Therefore, to all URP students, I hope that you can utilize the guideline to produce the best quality of research proposal, partial thesis, technical paper, final thesis and research poster. All the best in your undergraduate research project!

Best wishes,

PROFESSOR ZULKAFLI HASSAN CEng. FEI SPE
Dean,
Faculty of Chemical and Natural Resources Engineering,
Universiti Malaysia Pahang
PREFACE

Assalamualaikum w.b.t.

Alhamdulillah, thanks to Allah the Al-Mighty, with His blessing, our team has finally come out with our first FKKSA Undergraduate Research Project Module under Faculty of Chemical and Natural Resources Engineering (FKKSA). This module was mainly written for FKKSA students taking the Undergraduate Research Project (URP) subjects (i.e. BKC3922 and BKC4944) and it was specifically developed to standardize the outcome of the assessments among the FKKSA students. This book is also designed as a logbook for students to record their research progress.

This module is divided into 2 parts; the URP 1 and URP 2 and each part is sub-divided into 4 chapters i.e. workflow, formats and organization, rubrics and log book. This module will be used for two semesters of URP. We hope this module could benefits the students and guide them to complete their undergraduate research project.

Last but not least, URP team would like to thank everyone who helped and contributed to make this module a success. A special thanks to all URP coordinators for the hard work, determination and dedication that successfully lead to completion of the module. The team also would like to take the opportunity to express our appreciation to our family members that continuously giving care and supports. Thank you!

Wassalam,

Sumaiya Zainal Abidin
Chief Author
On behalf of URP Coordinators
TABLE OF CONTENT

STUDENT’S DETAIL .................................................................................................................. ii
GREETINGS.............................................................................................................................. iii
PREFACE ................................................................................................................................. iv
TABLE OF CONTENT .............................................................................................................. v
LIST OF FIGURES ..................................................................................................................... ix
LIST OF TABLES ...................................................................................................................... x
UNDERGRADUATE RESEARCH PROJECT 1 ........................................................................... 1

CHAPTER 1 INTRODUCTION ................................................................................................. 2

CHAPTER 2 PROCESS WORKFLOW ....................................................................................... 3

CHAPTER 3 FORMATING AND ORGANIZATION RESEARCH PROPOSAL AND PARTIAL
THESIS ..................................................................................................................................... 5

3.1 Formating ......................................................................................................................... 5
   3.1.1 Font .............................................................................................................................. 5
   3.1.2 Spacing ....................................................................................................................... 5
   3.1.3 Pagination .................................................................................................................. 5
   3.1.4 Alignment ................................................................................................................... 6
   3.1.5 Headings .................................................................................................................... 6
   3.1.6 Figure and Table ....................................................................................................... 6
   3.1.7 Equation .................................................................................................................... 6

3.2 Organization ..................................................................................................................... 7
   3.2.1 Front page ................................................................................................................... 7
   3.2.2 Abstract ..................................................................................................................... 7
   3.2.3 Abstrak ...................................................................................................................... 8
   3.2.4 Table of Content ...................................................................................................... 8
   3.2.5 List of Tables .............................................................................................................. 8
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2.6  List of Figures</td>
<td>8</td>
</tr>
<tr>
<td>3.2.7  List of Symbols</td>
<td>8</td>
</tr>
<tr>
<td>3.2.8  List of Abbreviations</td>
<td>8</td>
</tr>
<tr>
<td>3.2.9  Chapter 1 - Introduction</td>
<td>8</td>
</tr>
<tr>
<td>3.2.10 Chapter 2 - Literature Review</td>
<td>8</td>
</tr>
<tr>
<td>3.2.11 Chapter 3 - Materials and Methods</td>
<td>9</td>
</tr>
<tr>
<td>3.2.12 References</td>
<td>9</td>
</tr>
<tr>
<td>3.3   Proposal Presentation</td>
<td>10</td>
</tr>
<tr>
<td>CHAPTER 4 ASSESSMENTS’ RUBRICS</td>
<td>11</td>
</tr>
<tr>
<td>CHAPTER 5 URP 1 LOGBOOK</td>
<td>20</td>
</tr>
<tr>
<td>UNDERGRADUATE RESEARCH PROJECT 2</td>
<td>56</td>
</tr>
<tr>
<td>CHAPTER 6 INTRODUCTION</td>
<td>57</td>
</tr>
<tr>
<td>CHAPTER 7 PROCESS WORKFLOW</td>
<td>58</td>
</tr>
<tr>
<td>CHAPTER 8 TECHNICAL PAPER FORMATING AND ORGANIZATION</td>
<td>60</td>
</tr>
<tr>
<td>8.1   Introduction</td>
<td>60</td>
</tr>
<tr>
<td>8.2   Title</td>
<td>60</td>
</tr>
<tr>
<td>8.3   Author Names and Affiliations</td>
<td>60</td>
</tr>
<tr>
<td>8.4   Corresponding Author</td>
<td>61</td>
</tr>
<tr>
<td>8.5   Abstract</td>
<td>61</td>
</tr>
<tr>
<td>8.6   Keyword</td>
<td>61</td>
</tr>
<tr>
<td>8.7   Body Structure</td>
<td>62</td>
</tr>
<tr>
<td>8.8   Equations</td>
<td>62</td>
</tr>
<tr>
<td>8.9   Figures and Tables</td>
<td>63</td>
</tr>
<tr>
<td>8.10  References</td>
<td>64</td>
</tr>
<tr>
<td>8.11  Acknowledgement</td>
<td>65</td>
</tr>
<tr>
<td>CHAPTER 9 THESIS FORMAT AND ORGANIZATION</td>
<td>66</td>
</tr>
<tr>
<td>9.1   Formating</td>
<td>66</td>
</tr>
</tbody>
</table>
9.1.1 Font ................................................................. 66
9.1.2 Spacing............................................................. 66
9.1.3 Pagination........................................................ 66
9.1.4 Alignment.......................................................... 67
9.1.5 Headings............................................................ 67
9.1.6 Figures and Tables.............................................. 67
9.1.7 Equations............................................................ 67

9.2 Organization ................................................................ 68

9.2.1 Front Page .......................................................... 69
9.2.2 Title Page............................................................. 69
9.2.3 Thesis Confidential Status...................................... 69
9.2.4 Supervisor’s Declaration......................................... 69
9.2.5 Student’s Declaration............................................ 69
9.2.6 Dedication ............................................................ 69
9.2.7 Acknowledgement ............................................... 69
9.2.8 Abstract .............................................................. 69
9.2.9 Abstrak ............................................................... 70
9.2.10 Table of Content............................................... 70
9.2.11 List of Tables..................................................... 70
9.2.12 List of Figures..................................................... 70
9.2.13 List of Symbols................................................... 70
9.2.14 List of Abbreviations.......................................... 70
9.2.15 Chapter 1 - Introduction..................................... 70
9.2.16 Chapter 2 - Literature Review............................. 70
9.2.17 Chapter 3 - Materials and Methods...................... 71
9.2.18 Chapter 4 - Results and Discussions..................... 71
9.2.19 Conclusions and Recommendations...................... 71
9.2.20 References .............................................................................. 71
9.2.21 Appendices ............................................................................ 72

CHAPTER 10 POSTER FORMAT AND ORGANIZATION ...................... 73
10.1 Introduction ............................................................................ 73
10.2 Poster size ............................................................................. 73
10.3 Overall font ........................................................................... 73
10.4 Heading part .......................................................................... 73
   10.4.1 University Logos .............................................................. 73
   10.4.2 Title ................................................................................ 73
   10.4.3 Authors’ Names ............................................................... 73
   10.4.4 Corresponding Author ...................................................... 74
   10.4.5 Affiliation ....................................................................... 74
10.5 Body Structure ....................................................................... 74

CHAPTER 11 ASSESSMENTS’ RUBRICS ........................................... 77
11.1 Introduction ........................................................................... 77

CHAPTER 12 URP 2 LOGBOOK ....................................................... 86

APPENDIX A.1 TEMPLATE FOR PROPOSAL REPORT, PARTIAL THESIS &
THESIS ............................................................................................... 122
APPENDIX A.2 TEMPLATE FOR TECHNICAL PAPER ....................... 122
APPENDIX A.3 APPROVAL FORMS ................................................. 127
APPENDIX A.4 EVALUATION FORM FOR URP 1 .......................... 136
APPENDIX A.5 EVALUATION FORM FOR URP 2 .......................... 154
APPENDIX A.6 FRONT COVER ....................................................... 176
LIST OF FIGURES

Figure 2.1 Work flow for URP 1 4
Figure 4.1 Rubrics for research proposal 14
Figure 4.2 Rubrics for research proposal presentation 15
Figure 4.3 Rubrics for partial thesis 17
Figure 4.4 Rubrics for lifelong learning evaluation 18
Figure 7.1 Work flow for undergraduate research project 2 (URP 2) 59
Figure 10.1 The poster layout and design 76
Figure 11.1 Rubrics for thesis 79
Figure 11.2 Rubric for lifelong learning 80
Figure 11.3 Rubrics for technical paper 82
Figure 11.4 Rubrics for modeling handling 82
Figure 11.5 Rubrics for research poster presentation 83
Figure 11.6 Rubrics for laboratory handling 84
LIST OF TABLES

Table 3.1  Arrangement of subjects in a research proposal and partial thesis. 7
Table 4.1  Marks allocation for URP 1 assessments 13
Table 8.1  Prediction of power number of a Rushton turbine 64
Table 9.1  Arrangement of subjects in a thesis. 68
Table 11.1 Marks distribution for URP 2 78