

# **COURSE SYNOPSIS**

## **FACULTY OF SUSTAINABLE AGRICULTURE**

### **BACHELOR OF AGRICULTURE SCIENCE (HONS.)**

<u>CODE BPKP</u>	<u>PROGRAMMES OFFERED</u>
<b>HG34</b>	<b>Crop Production</b>
<b>HG35</b>	<b>Horticulture and Landscaping</b>
<b>HG36</b>	<b>Livestock Production</b>

### **RT10402 INTRODUCTION TO AGRICULTURE**

The course introduces students to the importance of agriculture to mankind, history and development of agriculture, current issues and challenges in agriculture ranging from environment, food security and needs, food safety, to biotechnology and genetically modified organisms. Shifts in Malaysian agriculture policies, objectives and strategies over several decades since independence will be highlighted. Sustainable agriculture and management practices which are widely accepted and adopted by farmers and nations around the world will be introduced. Prospects and opportunities in the agriculture sector will also be discussed

#### **References**

- Burton, L. D. & Cooper, E. L. 2010. Agriscience: Fundamentals and Applications. 5th Ed. Delmar Cengage Learning. Cooper, J. 2005. Global Agricultural Policy Reform and Trade: Environmental Gains and Losses. Edward Elgar Pub. Ministry of Agriculture (MOA), Malaysia. 1999. The Third National Agricultural Policy (1998 – 2010). Ministry of Agriculture and Agrobased Industry. 2011. Dasar Agromakanan Negara 2011-2020.
- United Nation Food and Agriculture Organization. 2004. The State of Food and Agriculture: Agriculture Biotechnology: Meeting the needs of the poor? FAO. Chapter 2. 4, 5 & 6.
- vanLoon, G. W., Patil, S. G. & Hugar, L. B. 2005. Agricultural Sustainability: Strategies for Assessment. Sage Publications.

### **RT10303 AGRICULTURAL CHEMISTRY**

This is an introductory course specifically on topics needed for an understanding of the basic chemistry of agriculture. Topics covered will include basic atomic, physical and organic chemistry, mole concept, solutions, states of matter, acids-bases and salts, chemical reactions, water and air chemistry, surface and colloidal chemistry, and agrochemicals (fertilizers and pesticides). Students will be made aware of the use of isotopes and nuclear techniques in agriculture.

#### **References**

- Kobayashi, D. and Watanabe, E. 2014. Handbook on Herbicides: Biological Activity, Classification and Health & Environmental Implications. USA: Nova Science Publishers Inc
- Denniston, K.J., Topping, J.J. and Dorr, D.Q. 2016. General, Organic, and Biochemistry. USA: McGraw-Hill Education - Europe
- Havlin, J.L., Tisdale, S.L., Nelson, W.L. and Beaton, J.D. 2013. Soil Fertility and Fertilizers. USA: Pearson Education (US) Mishra, B. 2012. Fertilizer Technology and Management. India: IK International Publishing House
- Burrows, A., Holman, J., Price, G., Pilling, G. and Parsons, A. 2012. Chemistry<sup>3</sup>: Introducing Inorganic, Organic and Physical Chemistry. USA: Oxford University Press
- Morrison, R.T. and Boyd, R.N. 2016. Organic Chemistry. India: Pearson

### **RT10503 AGRICULTURAL ECOLOGY**

This course will introduce students to the basics and principles of ecology implemented in agriculture systems. The important elements in agricultural ecology include interactions between weather, soils, energy, water, plants and biological populations. Application of the concepts and knowledge in agricultural ecology enables students to practice sustainable agriculture. i.

#### **References**

- Warren, J., Lawson, C. & Belcher, K. 2008. The agri-environment. Cambridge University Press. Gliessman, S.R. 2007. Agroecology: the ecology of sustainable agriculture. Boca Raton; CRC Press.
- Begon, M., Townsend, C.R. & Harper, J.L. 2006. Ecology: from individuals to ecosystems. Blackwell Science, Oxford. Mohd. Razi, I. 2006. Pertanian lestari. DBP, Kuala Lumpur.
- Powers, L.E. & McSorley, R. 2000. Ecological Principles of Agriculture. Africa: Delmar Thompson Learning.

### **RT10203 GENETICS**

This course introduces the basic principles of inheritance in plant and animal organisms. Discussion encompasses the concepts of gene and chromosome, mitosis and meiosis, Mendelian laws of inheritance, factors that contribute to modification of Mendelian patterns, molecular genetics (DNA structure, replication, gene expression and gene mutation) and population genetics. The role of genetics in agriculture will be shown in related topics.

#### **References**

- Griffiths, A. J. F., Wessler, S. R., Carroll, S. B. & Doebley, J. 2012. Introduction to Genetic Analysis. 10th Ed. W.H. Freeman & Co. Ltd.
- Hartwell, L. H., Goldberg, M. L., Fischer, J.A., Hood, L. & Aquadro, C.F. 2015. Genetics: From Genes to Genomes. 5th Ed. McGraw Hill
- Klug, W. S., Cummings, M. R. 2014. Concepts of Genetics. 11th Ed. Pearson. Klug, W. S., Cummings, M. R. 2012. Essential of Genetics. 8th Ed. Prentice Hall.
- Snustad, D.P. & Simmons, M. J. 2005. Principles of Genetics. 6th Ed. John Wiley & Sons, Inc.

### **RT10403 SOIL SCIENCE**

This is a fundamental soil science course which introduces students to the basic physical, chemical, biological and morphological properties of soils and functions in relation to agriculture. Emphasis will be placed in the context of tropical conditions with particular reference to Malaysian soils. Soils will be perceived as a product of various processes acting over time on parent materials. The wide variety of soils resulting from the soil-forming processes and their classification using the standard USDA and local (Malaysian) soil classification systems will be highlighted. The importance of appropriate management and land use practices to ensure conservation and sustainability for agriculture will be discussed..

#### **References**

- Brady, N. C. & Weil, R. R. 2016. The Nature and Properties of Soils. 15th Ed. Pearson. Weil, R. R. 2014. Laboratory Manual for Introductory Soils. 9th Ed. Kendall Hunt Publishing.
- Franzmeier, D. P; Mcfee, W. W; Gravel, J.G. & Kohnke H. 2016. Soil Science Simplified. 5th Ed. Waveland Press.
- Stika, J. & Stika, E. 2016. A Soil Owner's Manual: How to restore and Maintain Soil Health. 1st Ed. CreatSpace Independent Publishing Platform.
- Plaster, E. 2013. Soil Science and Management. 6th Ed. Delmar Cengage Learning.

### **RT20101 FIELDWORK**

This is an on and off campus practical training course to familiarise students with basic tools, skills and knowledge in crop and livestock farming, and landscaping, nursery and field planting techniques will be introduced. Cultural practices such as nursery bed preparation, planting, potting, preparation of soil or planting medium, weeding, fertilizing, watering, pruning, thinning, and composting as well as the handling and care of livestock in pen houses, free range and paddocks will be done.

#### **References**

- Burton, L.DeVere and Cooper,E L.2007.Agriscience.Fundamentals & Applications.4th Edition. Thmpson Delmar Learning, USA
- Payne, W.J.A. and Wilson, R.T. 1999. An Introduction to Animal husbandry in the Tropics. 5th ed. Blackwell Science, UK.

### **RT20303 AGRICULTURAL BIOTECHNOLOGY**

This course will introduce students to the application of recombinant DNA technology to agriculture. Methods of introducing foreign DNA into plant and animal cells and generation of stable transformed plants and animals will be studied. Students consider specific examples of the use of transgenic plants and animals which are resistant to pathogens and tolerant to specific herbicides. Since recombinant agricultural products are released into the environment or consumed as foods, students will be familiarised with environmental safety issues.

#### **References**

- Nair, A.J. 2008. Introduction to Biotechnology and Genetic Engineering. India: Infinity Science Press LLC. Howe, C. 2007. Gene Cloning and Manipulation. 2nd Edition. UK: Cambridge University Press.
- Harry, L. V. 2006. Genetic Engineering: A Reference Handbook. 2nd Edition. England: ABC-CLIO, Inc.
- Slater, A., Scott, N. and Fowler, M. 2003. Plant biotechnology: The genetic manipulation of plants. Oxford University Press Inc. US: New York.
- Barnum, S. R. 2004. Biotechnology: An Introduction. 2nd ed. Brooks Cole

### **RT20102 ORGANIC FARMING**

This is an introductory course to the principles of soil fertility, crop and livestock management by organic methods in contrast to conventional chemical methods of farming. Students will gain an understanding of the role of organic agriculture in society in relation to environmental, social and economic sustainability. This course will cover topics such as meeting crop nutrition needs using organic materials, on-farm compost production, the use of cover crops, organic methods of weed, pest and disease control, organic livestock production, organic certification, and the marketing of organic farm products

#### **References**

- Aini, Z., Sivapragasam, A, Vimala. P. & Mohamad Roff M. N. 2005. Organic Vegetable Cultivation in Malaysia. MARDI. Department of Agriculture, Malaysia. 2003. Standards & Certifications Requirements for the Production of Plant-Based Organic Food Products. Version 1/03.
- Gupter, M. K. 2007. Handbook of organic farming and bio-fertilizers. Jaipur ABD Publishers Halberg, N. 2006. Global Development of Organic Agriculture: Challenges and Prospects. CABI. Sharma, A. K. 2004. A Handbook of Organic Farming. Agribios.

### **RT20203 AGRICULTURAL MICROBIOLOGY**

This course offers the basic knowledge on microbes and their roles in ecosystems. The early parts of the lecture are related to morphology and structures, microbial diversity and growth. Microbial genetics and the manipulation of microbial plasmid in genetic engineering for enhancement of crop and animal production are discussed. Their functions related to the soil fertility and crops productivity is discussed. Roles of microbes in biogeochemical cycles, environments, food production and bioremediation are discussed.

#### **References**

- Tortora, G.J., Funke, B.R. and Case, C.L. (2016) Microbiology: An Introduction (12th Edition). Pearson Education, Inc., USA.
- Jacquelyn, G.B. and Laura, J.B. (2015) Microbiology: Principles and Explorations (9th Edition). John Wiley & Sons, Inc., USA.
- Herren, R.V.(2013)Introduction to Biotechnology:An Agricultural Revolution(2ndEdition). Delmer Cengage Learning, New Your.
- Goldman, E. and Green, L.H. (2015) Practical Handbook of Microbiology (3rd Edition). CRC Press, Florida.

### **RT20402 INDUSTRY REVOLUTION AND BIOMETRY**

This course will introduce and expose the student to the concept and fundamental pillars of IR4.0 in particular the knowledge digitization and machine learning. The student will also be introduced to statistical analysis and its application in agriculture. The course will show how statistics are being used to evaluate the results of agricultural research. The course will cover both descriptive statistics, which summarize the data obtained in research, and inferential statistics, which are used to decide whether the results of research confirm the researcher's hypotheses. Specific topics to be covered include sampling and estimation, hypothesis testing, t-tests, analysis of variance, correlation, regression analysis, and non-parametric methods of statistical analysis.

#### **References**

1. Schwab, K. 2016. The Fourth Industrial Revolution. World Economic Forum. Geneva
2. UMS: Kerangka Revolusi Industri 4.0.
3. Davis, B. 2000. Introduction to Agricultural Statistics. Delmar.
4. Gomez, K. A. and Gomez, A. A. 1984. Statistical Procedures for Agricultural Research. (2nd Edition). John Wiley.
5. Zar, J. H. 2008. Biostatistical Analysis. (5th Edition). Prentice Hall.6. Holmes, D., Moody, P. and Dine, D. 2006. Research Methods for the biosciences. Oxford University Press.

### **RT20603 INTRODUCTION TO AGRICULTURAL ENGINEERING**

Students will learn a wide range of fundamental engineering concepts, principles and applications in agriculture (from land preparation to post-harvest) with a strong emphasis on problem solving. Aspects of mechanics, hydraulics, electric and electronics will be covered. The principles and applications of internal combustion engines, electric motors and pumps will be discussed

#### **References**

- T.P Ojha and A.M. Michael, 2016. Principles of Agricultural Engineering. Eighth Revised Edition. ISBN: 8183602129
- Jagdishwar Sahay, 2014. Elements of Agricultural Engineering. 5th Edition, Standard Publishers Distributors. ISBN 8-8014-044- X.
- Herren, R. V. 2014. Agricultural Mechanics: Fundamentals and Applications. 7th Ed. CENGAGE Learning.
- Segun R. Bello, 2012. Agricultural Engineering: Principles and Practice. Publisher Dominion publishing stores
- S. N. Yadav, 2011. Agricultural Engineering: Fundamentals and Applications. Publisher: Biotech Books. ISBN-10: 8176222224, ISBN-13: 978-8176222228
- Harry L. Field and John B. Solie, 2007. Introduction to Agricultural Engineering Technology-A Problem Solving Approach. 3rd Edition (or latest edition). Springer USA. ISBN: 978-0-387-36913-6, 978-0-387-36915-0

### **RT30402 RESEARCH PROJECT 1**

This course concerns with the theoretical aspects of the scientific approach of carrying out a scientific research project. It covers literature review, project proposal preparation and presentation, and writing of a scientific report.

#### **References**

- Wyrick, J. 2008. Steps to Writing Well. 10th Edition. Thomson, Boston
- Locke, L.F., Spirduso, W.W. & Silverman, S.J. 1987. Proposals that work: a guide for planning dissertations and grant proposals. 2nd Edition. Sage Publications, Newbury Park.
- Wan Chik Ibrahim. 2003. A guide to writing research proposals: the experimental method. Penerbit Universiti Pendidikan Sultan Idris, Tanjung Malim, Perak
- Trimmer, J, 2004. The New Writing with a Purpose. 14th Edition. Houghton-Mifflin, Boston
- Guide to Final Year Project Guide to Dissertation Writing

### **RT30301 AGRO- ENTREPRENEURSHIP PRACTICE 1**

This is a farm practical course dealing with the field practices in crop production, horticulture and livestock production. Students will have the opportunity to get hands on experience of the day to day activities and real problems and challenges that are encountered in the farm and field conditions. Student will work in groups to plan and execute an agro-enterprise until marketing.

#### **References**

- Burton, LDeVere and Cooper, E. L. 2007. Agriscience. Fundamentals & Applications. 4th Edition. Thompson Delmar Learning, USA
- Kay, R.D, Edwards, W M, and Duffy, P. A. 2008. Farm management. McGraw-Hill Boston.

### **RT30302 EXPERIMENTAL DESIGN AND ANALYSIS**

Students will learn concepts, principles and methods/steps in setting up an agricultural experiment. Students will also learn statistical analysis based on the experimental design used. The experimental designs included are Completely Randomized, Randomized Complete Block, Latin Square and Split Plot Designs as well as factorial experiments. Suitable ways and methods of analyzing data for these experimental designs will also be taught.

#### **References**

- Glass D. J. 2014. Experimental Design for Biologists. Second Edition. Cold Spring Harbor Laboratory Press. Pallant, J. 2016. SPSS Survival Manual. 6th Ed UK Higher Education OUP Psychology
- Welham, S.J; Gezan, S.A; Clark, S.J & Mead, A. 2014. Statistical Methods in Biology: Design and Analysis of Experiments and Regression. Chapman and Hall/CRC Press
- Slaughter, S. J. & Delwiche, L.D. 2016. The Little SAS Book: A Primer. 5th Ed SAS Institute Inc.
- Coakes, S.J. 2012. SPSS version 20.0 for Windows. Analysis without anguish. John Wiley & Sons

### **RT30103 AGRICULTURAL EXTENSION**

This course teaches students on the concepts, philosophy and methodology of agricultural extension. They would also be exposed to the scope of agricultural extension. They would also undertake practical extension training/fieldwork in a number of communities and report their personal experiences during those training.

#### **References**

- Pacey, A. & Thrupp, L. A., 1989. Farmer First: Farmer Innovation and Agricultural Research. Intermediate technology Publications.
- Seevers, B. 1997. Education through Cooperative Extension. Thomson Delmar Swanson, B. E. 1985. Agricultural Extension: A Reference Manual (F2673). 2nd Ed. FAO.
- Van Den Ban, A. W. & Hawkins, H. S. 1996. Agricultural Extension. 2nd Sub Ed. Blackwell Science.
- Veldhuizen, L. V., Bayer, W. A., Zeeuco, D. H. 1998. Developing Technology With Farmers: A Trainer's Guide for Participatory Learning. Zed Books.
- Schiefer, G., Helbig, R. & Rickert, U. 1999. Perspectives of Modern Information and Communication Systems in Agriculture. Universität Bonn-ILB.

### **RT30202 SCIENTIFIC WRITING AND COMMUNICATION**

This course provides students the opportunity to acquire the necessary knowledge and skills in scientific writing and communication, such as, writing a research proposal, a dissertation, or a journal article in accordance with the specified format.

#### **References**

- Hofmann, A., 2015. *Writing in the Biological Sciences: A Comprehensive Resource for Scientific Communication* (2<sup>nd</sup> Edition). Oxford University Press.
- Nair, V.D. and Nair, P.K.R., 2014. *Scientific Writing and Communication in Agriculture and Natural Resources*. Springer.
- Hofmann, A., 2013. *Scientific Writing and Communication: Papers, Proposals, and Presentation* (2<sup>nd</sup> Edition). Oxford University Press.
- Lourens, A. 2007. *Scientific Writing Skills: Guidelines for Writing Theses and Dissertations*. SUN Press.

### **RT30401 AGRO-ENTREPRENEURSHIP PRACTICE 2**

This is a farm practical course dealing with the field practices in crop production, horticulture and livestock production. Students will have the opportunity to get hands on experience of the day to day activities and real problems and challenges that are encountered in the farm and field conditions. Student will work in groups to plan and execute an agro-enterprise until marketing.

#### **References**

- Burton, L. De Vere and Cooper, E. L. 2007. *Agriscience. Fundamentals & Applications*. Edition. Thompson Delmar Learning, USA
- Kay, R. D., Edwards, W. M., and Duffy, P. A. 2008. *Farm management*. McGraw-Hill Boston

### **RT40012 INDUSTRIAL TRAINING**

Industrial Training is to experience and understand real life situations in industrial organizations and their related environments and accelerating the learning process of how student's knowledge could be used in a realistic way. In addition to that, industrial training also makes one understand the formal and informal relationships in an industrial organization so as to promote favourable human relations and teamwork. Besides, it provides the exposure to practice and apply the acquired knowledge hands-on in the working environment. Moreover, students can gain hands-on experience that is related to the students majoring so that the student can relate to and widen the skills that have been learnt while being in university. Furthermore, students implement what they have learned and learn more throughout this training. During industrial training students can learn the accepted safety practices in the industry. Students can also develop a sense of responsibility towards society.

### **RT40103 PRECISION FARMING**

This course introduces students to the concepts, technologies and applications involved in precision agriculture. This entails the theory and use of some high-technology equipment for assessing field conditions and applying inputs such as seeds, fertilizers and chemicals for weed, pest & disease management. Students will also be exposed to precision technologies in livestock production such as in feeding, reproduction and health management. The course will also cover parameter measurements with ICT through various sampling and mapping procedures for soil nutrients and crop yield using geo-statistics, spatial patterns, GNSS, DGPS, GIS, remote sensing and aerial photography. The use of enabling hardware and software in precision farming applications will be some of the hands-on experience in which students will participate.

### References

- Schimmelpfennig, David. 2016. *Farm Profits and Adoption of Precision Agriculture*. ERR-217 U.S. Department of Agriculture, Economic Research Service Oct 2016. CRC Press Taylor and Francis Group LLC.
- Qin Zhang (Ed.) 2016. *Precision Agriculture Technology for Crop Farming*. CRC Press, ISBN-13: 978-1482251074, ISBN-10: 1482251078
- Brett Whelan and James Taylor, 2013. *Precision Agriculture for Grain Production Systems*. CSIRO Publishing, ISBN-13: 978-0643107472, ISBN-10: 0643107479
- Ancha Srinivasan (Ed.). *Handbook of Precision Agriculture: Principles and Applications*. 1st Edition, Haworth Press, ISBN-13: 978-1560229551, ISBN-10: 1560229551
- Rattan Lal and B.A. Stewart, 2015. *Soil-Specific Farming: Precision Agriculture*. CRC Press, Reference - 431 Pages - 119 B/W Illustrations. ISBN 9781482245332 - CAT# K23532. Series: Advances in Soil Science
- Hermann J. Heege (Ed), 2013. *Precision in Crop Farming*. Springer ISBN 978-94-007-6759-1' 978-94-007-6760-7.

### **RT40204 RESEARCH PROJECT 2**

This course concerns with the practical aspects of scientific research. It involves execution of the research plans that have been developed and evaluated in Research Project 1 (RT30102). The students will undertake an independent lab and/or field work on the approved thesis topic in consultation with his/her supervisor/adviser. The results will be subsequently analysed, discussed and combined with the previous report (RT30102), and finally presented as a dissertation of 12,000 – 15,000 words.

### References

- Russey, W. E., Hans F. E. & Claus Bliefert. 2006. How to write a successful science thesis: the concise guide for students. Wiley, Weinheim.
- Wyrick, J. 2008. Steps to Writing Well, 10th Ed Thomson, Boston
- Barrass, R. 2005. Students must write: a guide to better writing in coursework and examinations. 3rd Ed. Routledge, London
- McLaren, M. C. 2008. A guide to effective writing. UPM Press, Serdang, Malaysia
- Guide to Final Year Project Guide to Dissertation Writing

### **RT40303 AGRICULTURAL ECONOMICS AND AGRIBUSINESS**

This course discusses the basic agricultural economic principles to assist the students to make decision how to choose the combination of inputs and outputs that will generate the most profit to their businesses. This course also will teach the students how to manage an agribusiness, and explain how to start-up, run and manage their own agribusiness specifically in financial management. Additionally, the students will be taught and guided to prepare a business plan. It also includes chapters on the basic principles of agriculture marketing, investment analysis, and economic activity and analysis.

### References

- Beierlein, J. G., Schneeberger, K. C. & Osburn, D. D. 2007. Principles of Agribusiness Management. 4th Ed. Waveland Pr Inc. Drummond, H. E. & Goodwin, J. W. 2003. Agricultural Economics. 2nd Ed. Prentice Hall. Gray, L. C. 2007. Introduction to Agricultural Economics. Macritchie Press.
- Norwood, B. & Lusk, J. 2007. Agricultural Marketing and Price Analysis. Prentice Hall.
- Ricketts, C. & Ricketts, K. 2009. Agribusiness: Fundamentals and Applications. (2nd Edition). Ney York: Delmar



**RT40402 ISSUES AND CURRENT DEVELOPMENTS IN AGRICULTURE**

This is a seminar course on current global, regional or local issues and development in agriculture which will be presented by policy makers, representatives of Government implementing agencies, industries, financial institutions as well as from experts, renowned researchers and academics.

## **CROP PRODUCTION PROGRAMME (HG34)**

### **RC10102 PLANT NUTRITION**

An introductory course concerning a fundamental understanding of soil fertility, plant nutrition and soil nutrient management. This will include the roles and functions of nutrients to plants, deficiency & toxicity symptoms, nutrient availability and uptake by plants from the environment (aerial, soil and soil-less). Types of chemical/inorganic and organic fertilizers, an appreciation of the importance of good fertilizer management in various soils and plant production systems and how soil pH influences nutrient uptake will be discussed. Students will learn how to calculate fertilizer application amounts for any given crop based on fertilizer recommendation rates.

#### **References**

- Barker, A.V. and Pilbeam, D.J. 2015. *Handbook of Plant Nutrition*. 2<sup>nd</sup> Edition CRC Press. Benton J. 2012. *Plant Nutrition and Soil Fertility Manual*. 2<sup>nd</sup> Edition. CRC Press.
- Halvin, J.L., Beaton, J.D., Tisdale, S.L. and Nelson, W.L. 2005. *Soil Fertility and Fertilizers: An Introduction to Nutrient Management*. 7<sup>th</sup> Edition. Prentice Hall.
- Marschaner, H. 2011. *Mineral Nutrition of Higher Plants*. 3<sup>rd</sup> Edition. Academic Press, New York. Mengel, K. and Kirkby, E. A. 2001. *Principles of plant nutrition*. 5<sup>th</sup> Edition. Kluwer Academic Press.

### **RH10203 PLANT PHYSIOLOGY**

Plant physiology is an examination of plant function ranging in complexity from individual cells up to the whole plant. As relatively immobile organisms, plants must adapt to the prevailing environment and consequently have unique mechanisms to deal with non-ideal growing conditions. Both normal growth and development as well as how the plant responds and adapts to adverse conditions are major themes in plant physiology research. This course will focus on the major physiological processes occurring in plants grown under ideal conditions as well touch on the physiology of stress-adaptation.

#### **References**

- Jain, V.K. 2015. *Fundamentals of Plant Physiology*. India: S. Chand Publishing
- Marschner, H. 2011. *Marschner's Mineral Nutrition of Higher Plants*. 3<sup>rd</sup> Edition. USA: Academic Press
- Lowenfels, J. 2013. *Teaming with Nutrients: The Organic Gardeners Guide to Optimizing Plant Nutrition*. USA: Timber Press
- Ricardo, A. 2012. *Plant Responses to Drought Stress: from Morphological to Molecular Features*. Germany: Springer-Verlag Berlin and Heidelberg GmbH & Co.
- Sadras, V.O. and Calderini, D. 2014. *Crop Physiology: Applications for Genetic Improvement and Agronomy*. USA: Academic Press
- Sharma, R. 2016. *An Introduction to Plant Physiology*. India: Campus Books International

### **RH20103 PLANT BREEDING**

This course emphasizes the basic principles and concepts of genetic improvement of agricultural crops through application of basic qualitative and quantitative genetic principles. Different plant breeding methodologies relative to the mode of reproduction of plants will be discussed. Application of tools such as mutation, wide hybridization, tissue culture, genetic engineering and molecular markers, in the breeding of plants will also be discussed.

### References

- Acquah, G. 2012. *Principles of Plant Genetics and Breeding*. 2<sup>nd</sup> Edition. Wiley-Blackwell Publishing, UK Brown, J & Caligari, P.D.S. 2008. *An Introduction to Plant Breeding*. Blackwell Publishing. Oxford, UK.
- Yap, T. C., Mak, C & Mohd Said Saad. 1984. *Prinsip-prinsip Pembiakbakaan Tanaman*. DBP. Kuala Lumpur
- Allard, R.W. 1999. *Principles of Plant Breeding*. 2<sup>nd</sup> Edition. John Wiley and Sons. New York
- Sleper, D.A and Poehlman, J.M. 2014. *Breeding Fields Crops*. Wiley-Blackwell

### **RC20203 WEED SCIENCE**

This course is a study of weeds and their control. Principles including weed plant classification, weed biology and ecology, and plant and herbicide chemistry will be taught. Practices which prevent, control and eliminate weeds will be discussed. Herbicide formulations and safe herbicide use will be taught.

### References

- Hakansson, S. 2003. *Weeds and Weed Management on Arable Land: an Ecological Approach*. CABI. Inderjit, (editor). 2004. *Weed Biology and Management (Bioelectric Engineering)*. Springer.
- Monaco, T. J., Weller, S. C. & Ashton, F. M. 2002. *Weed Science: Principles and Practices*. 4th ed. John Wiley & Sons.
- Naylor, R. E. L. 2002. *Weed Management Handbook*. 9th ed. Blackwell.
- Zimdahl, R. L. 2004. *Weed-crop Competition: a review*. 2nd ed. Wiley-Blackwell.

### **RH20303 PLANT PROPOGATION AND NURSERY MANAGEMENT**

This course stresses on the principles and techniques of propagation of agricultural plants, using seeds (sexual) and vegetative (asexual) plant parts. Students will also be introduced to in vitro micro-propagation for mass plant propagation, including media composition and preparation. General nursery practices and maintenance are highlighted.

### References

- Adkins, S.W., Ashmore S.E. and Navie S.C. 2005. *Seeds: biology, development and ecology*. International workshop on seeds. CABI
- Evans, D.E., Coleman, J.O.D. and Kearns, A. 2003. *Plant Cell Culture*. BIOS Scientific Publishers, London Kester, D.E., Davies Jr., F.T. and Geneve, R.L. 2002. *Plant Propagation: Principles and Practices*. Prentice Hall Mason, J. 2004. *Nursery management*. Landlinks Press
- Razdan, M.K. 2003. *Introduction to Plant Tissue Culture*. Science Publishers Inc. 2nd ed. Enfield, NH. USA

### **RC20403 CROP PEST MANAGEMENT**

This course will emphasize various techniques for management of all classes of crop pests. The techniques of pest management involve cultural control, physical, chemical, genetics, host-plant resistance, insect resistance, and others. An application of integrated approaches using least destructive, economically and environmental friendly methods, and protection of non-target organisms will also be taught. Toxicology and classification of pesticides, chemical residue risks to land and aquatic environments, international quarantine system and local rules and regulations of quarantine system for controlling the spread of plant pests and diseases will also be taught. Identification and symptoms of injury of major species of pests such as insects, mammalia, gastropoda and others, which damage major agriculture crops and control measures will be introduced in this course.

### **References**

- Gupta, H. C. L. 2005. Management of Insect Pests of Horticultural Crops. Agrotech Publishing Academy..ISBN-10: 8185680949
- Khoo, K. C., Ooi, P. & Ho, C. T. 1991. Crop Pests and Their Management in Malaysia. Tropical Press and Publication.
- Ignacimuthu, S. & Jayaraj, S. 2005. Sustainable Insect Pest Management. Alpha Science International Ltd.
- Onstad, D. W. 2007. Insect Resistance Management: Biology, Economics and Prediction. Academic Press. Pedigo, L.P. & Rice, M. 2008. Entomology and Pest Management. 6th ed. Prentice Hall.

### **RC20803 PASTURE AND FODDER PRODUCTION**

This course introduces the production of forages including grasses, leguminous and non-leguminous plants and fodder as ruminant feed. Commonly sown forages will be introduced while the establishment, growth, harvest, maintenance, renovation and succession will be taught. The establishment of forages under cut-and-carry fodder system and pasture grazing system, as well as integration will be discussed. The relationship between pasture and fodder production with animal production system will be detailed. Exposure to the quality of forages as affected by various factors will be given. The conservation of excess forages or the maintaining of the quality of forages will also be included. Finally, the methods and analyses in determining the quality of forages will also be a part of this course.

### **References**

- Collins, M., Barnes, R.F., Nelson, C.J. and Moore, K.J. 2017. Forages, volume 1: an introduction to grassland agriculture (Vol. 1). John Wiley & Sons.
- Ball, D.M., Hoveland, C.S. and Lacefield, G.D. 2015. Southern forages, modern concept for forage crop management. IPIN: Norcross.
- Lazier, J.R. and Ahmad, N. 2016. Tropical Forage Legumes: Harnessing the Potential of Desmanthus and Other Genera for Heavy Clay Soils. CABI.
- Singh, K.S. 2014. Forage Conservation Techniques. New India Publishing Agency.
- Flack, S. 2016. The art and science of grazing: how grass farmers can create sustainable systems for healthy animals and farm ecosystems. Chelsea Green Publishing.

### **RH30103 FARM MECHANIZATION**

This course introduces the principles, design and operation of common types of farm machinery and mechanisms; familiarizes students with agricultural mechanization policy and strategy and its implications on agricultural development; teaches students financial costing and accounting of agricultural machinery, and analyses factors that affect economic operation for effective management decisions.

**References**

- Donnell Hunt and David Wilson, 2016. Farm Power and Machinery Management, 11th Edition. Waveland Press Inc. ISBN-13: 978-1478626961, ISBN-10:1478626968
- Brian Bell, 2016. Farm Machinery. Publisher: Old Pond Publishing Ltd; 6th revised edition, 312 pages. ISBN-10: 1910456063, ISBN-13: 978-1910456064
- Jemima Dunne (Ed.) 2015. The Tractor Book. Publisher Dorling Kindersley Ltd. 256 pages, ISBN10 0241014824, ISBN13 9780241014820
- Segun R. Bello, 2012. Agricultural Machinery & Mechanization: Mechanization, Machinery, landform, tillage, farm operations. Dominion publishing stores, 422 pages.
- S. N. Yadav , 2011. Agricultural Engineering: Fundamentals and Applications. Publisher: Biotech Books. ISBN-10: 8176222224, ISBN-13: 978-8176222228

**RC30303 SEED TECHNOLOGY**

Seed development after fertilisation, seed structures and dispersal are taught. The physiology of seed germination, viability tests and seedling vigour are highlighted. Categories of seeds for human consumption, livestock feeds and as planting materials, seed production, collection, cleaning, processing, and storage (of orthodox and recalcitrant seeds) and cryo-preservation are included. Seed testing laboratories and protocol for seed purity and standards set by A.O.S.A. are included. Controlled pollination in the production of breeder seeds is also taught. Seed certification for commercial seed producers and the network in seed trade are integral parts of the course.

**References**

- Bewley, J.D., Black, M. And Halmer, P. 2006. *The Encyclopedia of Seeds: Science, Technology and Uses*. CABI Publishing.
- Black, M. and Bewley, D. 2002. *Seed Technology and Its Biological Basis*. Sheffield Academic Press.
- Black, M. J., Bradford, K.J. and Vaquez-Ramos, J. 2000. *Seed Biology: Advances and Applications*. CABI Publishing.
- Desai, B.B. 2004. Seed Handbook: Biology, Production, Processing and Storage, 2<sup>nd</sup> edn. CRC. McDonald, M. B. and Kwoong, F.Y 2004. Flower Seeds: Biology and Technology, CABI Publishing.

**RC30402 CEREAL CROPS**

This course will cover the management practices and infrastructure requirements related to the cultivation of major cereal crops such as rice, maize, sorghum and others. Post-harvest handling, storage and processing of products will be mentioned. Utilisation of crop products for human consumption, snack food industries and industrial applications are taught.

**References**

- Acquaah, G. 2005. *Principles of Crop Production: Theory, Techniques and Technology*. Pearson Prentice Hall
- Benentzen, J., and Hake, S. 2009. *Handbook of Maize: It's Biology*. Springer.
- Kang, M.S. and Priyadarshan, P.M. 2007. *Breeding Major Food Staples*. Blackwell Publishing.
- Sleper, D.A and Poehlman, J.M. 2014. *Breeding Fields Crops*. Wiley-Blackwell
- Ullrich, S.E. 2010. *Barley: Production, Improvement and Uses*. Wiley-Blackwell

**RC30503 PLANTATION CROPS**

This course will cover the management of plantation crops such as rubber, cocoa, coconut, sugarcane, coffee, tea, pepper and others. Discussion includes basic planting practices, crop management and processing of produce. An understanding of the botanical characteristics, ecology, propagation and nursery techniques, land management, estate infrastructure and maintenance will be emphasized.

**References**

- Bartley, B.G.D. 2005. *The genetic diversity of cacao and its utilization*. CABI  
Chopra, V.L. and Peter, K.V. 2005. *Handbook of industrial crops*. Haworth  
Ravindran, P.N. 2005. *Black Pepper, Piper Nigrum*. CRC.  
Wintgens, J.N. 2004. *Coffee: growing, processing, sustainable production*. Wiley-VCH  
Sethuraj, M.R. and Mathew, N.M. 1992. *Natural rubber: biology, cultivation and technology*. Elsevier

**RC30602 ROOT CROPS**

This course emphasizes the classification, ecology and methods of propagation and planting of root crops such as tapioca, sweet potatoes, potatoes, taro, yams and others. The management, harvesting, and processing of tubers into starch are discussed. Utilisation of tubers and starch for food, confectionery, snacks and industrial applications are highlighted.

**References**

- Bradshaw, J. E. 2010. *Handbook of Plant Breeding: Root and Tuber Crops*. Springer. New York.  
Gopal, J. & Khurana, S.M. 2006. *Handbook of Potato Production, Improvement and Postharvest Management*. CRC.  
Hanson, B. & Buchanan, S. 2007. *Buried Treasures: Tasty Tubers of the World*. Brooklyn Botanic Garden.  
Nayar, N.M. 2007. *Tuber Crops*. Blackwell.  
Lebot, V. 2009. *Tropical Root and Tuber Crops: Cassava, Sweet Potato, Yams and Aroids*. CABI. United Kingdom.

**RC30703 PLANT PATHOLOGY**

This course introduces to students the fundamental concepts of plant pathology. At the early week of semester the modes of action of abiotic and biotic agents to cause diseases to plants are discussed. Genetics, physiological and biochemical aspects of pathogens and host plant interactions are discussed. At the later stage of this course, non-chemical and chemical controls of plant diseases are discussed.

**References**

- Agrios, G. N. 2005. *Plant Pathology*. 5th edition Oxford, Singapore. Academic Press.  
Strange, R. N. 2003. *Introduction to Plant Pathology*. England, Willey.  
Mansfield, J. M. 2000. Antimicrobial Compounds and Resistance. In: Slusarenko, A. Fraser, R.S.S. And Van Loo, L.C (eds) (2000) *Mechanism of Resistance to Plant Diseases*. Netherlands, Kluwer Academic Publishers.  
Ploetz, R.C. 2003. *Diseases of tropical fruits crops*. Oxon, United  
Persley, D. 1993. *Diseases of fruits crops*. Queensland. Department of Primary Industry Queensland.

**RC30802 OIL PALM MANAGEMENT**

In this course students will be taught about the oil palm industry in Malaysia, the botany of the plant and the characteristics of different clones. Nursery management, land clearing, field operations, infrastructure development and planting techniques will be discussed. Aspects of hand pollination to produce Tenera clonal seeds (Durax Pisifera crosses) and production of pre-germinated seeds are taught. Harvesting of fresh fruit bunches (FFB), bunch analysis, oil extraction and utilisation of Crude Palm Oil (CPO), Crude Palm Kernel Oil (CPKO) and by-products in related industries are highlighted.

**References**

- Corley R.H.V. and Tinker, P. B. H. 2003. *The Oil Palm. 3rd Edition, Blackwell Science.*
- Eshan Abd. Ghani, Zin Zawawi Zakaria & Mohd. Basri Wahid. 2004. *Perusahaan Sawit Di Malaysia. Satu Panduan MPOB. Fairhurst,*
- T. & Hardter, R. 2003. *Oil Palm: Management for Large and Sustainable Yields. PPI/PPIC and IPI, Sinagapore.*
- Gurmit Singh, Lim Kim Huan, Teo Leng & Lee Kolo, D. 1999. *Oil Palm and the Environment. Incorporated Society of Planters. Turner,*
- P.D. & Gilbanks, R.A. 2003. *Oil Palm Cultivation and Management. 2nd Edition. Incorporated Society of Planters.*

**RC40202 FOOD PROCESSING AND PRESERVATION**

This course concerns the principles and methods of processing and preservation used in the food industry. Technologies involving heating, chilling, freezing, dehydration, salt, sugar, acids, chemical preservatives, ionizing radiations and novel methods; processing methods such as refrigeration, evaporation, fermentation, extrusion, chemical and physical separation, and particle size reduction will be taught.

**References**

- Fellows, P. 2009. *Food Processing Technology: Principles & Practice. 3<sup>rd</sup> Edition.* Woodhead, Cambridge, England Lelieveld, H. L. M. 2003. *Hygiene in food processing.* Woodhead Pub. Ltd, Cambridge. Fennema, O. R. 1996. *Food Chemistry. 3<sup>rd</sup> Ed.,* Marcel-Dekker Publ. Inc., New York. Kyzlink, V. 1990. *Principles of food Preservations.* Elsevier Science Publ. Co. Inc. New York.
- Soleha Ishak. 1995. *Pengawetan Makanan Secara Pengeringan.* Dewan Bahasa dan Pustaka, Kuala Lumpur.

**RH40302 POST-HARVEST TECHNOLOGY**

The course will highlight topics related to the causes, principles and practices that result in post-harvest losses and appropriate methods to reduce these losses. The biophysical and biochemical changes in agricultural produce and factors that influence the quality of produce during storage will be discussed.

**References**

- Yeoshua, S. B. 2005. *Environmentally friendly technologies for agricultural produce quality.* Boca Raton: CRC Press.
- Chakraverty, A., Mujumdar, A.S. & Ramaswamy, H.S 2003. *Handbook of postharvest technology: cereals, fruits, vegetables, tea and spices.* Boca Raton: CRC Press.
- Golob, P., Farrell, G. & Orchard, J.E. 2002. *Crop post-harvest and technology. Volume 1: Principles and Practice.* Texas: CHIPS.
- Kilcast, D. & Subramaniam, P. 2001. *The stability and shelf life of foods.* Texas: CHIPS.
- Thompson, A.K., 1996. *Postharvest Technology of fruits and Vegetable.* Westport, Connecticut: AVI Publishing Co., Ltd.

## ELECTIVE COURSE

### **RC30302 FARM IRRIGATION SYSTEMS**

This course deals with the principles and practices of irrigation science and management for efficient use of water through various methods and systems of irrigation application. The course provides the skills necessary for the design and management of effective and efficient on-farm irrigation systems. The soil-plant –water-atmosphere relations, crop water requirements and the removal of surplus water from farm fields (drainage) will also be covered. Emphasis will be placed on automated systems and components.

#### **References**

- Aleix Campo (Ed.), 2017. Irrigation and Agricultural Drainage Engineering. 294 pages. Scitus Academics LLC. ISBN-10: 168117541X, ISBN-13: 978-1681175416
- Balram Panigrahi and Megh R. Goyal, 2016. Soil and Water Engineering: Principles and Applications of Modeling. Apple Academic Press, 550 Pages - 18 Color & 136 B/W Illustrations, ISBN 9781771883924 - CAT# N11672.
- Peter Waller, Muluneh Yitayew, 2015. Irrigation and Drainage Engineering. 742 pages. Springer International Publishing. 978-3319056999, 978-3319056982
- Ranjit Kumar Biswas, 2015. Irrigation and Agricultural Drainage Engineering. 595 pages. New India Publishing Agency. ISBN-10: 938330524X, ISBN-13: 978-9383305247
- Balram Panigrahi, 2013. A Handbook on Irrigation and Drainage. 620 pages. New India Publishing Agency. ISBN-10: 9381450889, ISBN-13: 978-9381450888.
- DID Malaysia, 2009. Irrigation and Agricultural Drainage. DID Manual No.5. 1172 pages. Department of Irrigation and Drainage Malaysia.

### **RC30502 ADVANCED CROP SCIENCE**

This is an advanced level course which draws on courses done earlier in your program at the plants community scale It requires evaluation, integration and application of principles of crop production to develop understanding of sustainable crop production systems. The application of physiology and agronomy in crop production and the influences of environment on crop growth, and biological and economic yield will be emphasized. The use of crop growth simulation models will be examined.

#### **References**

- SadrasV. And Calderini, D. 2014. *Crop Physiology: Applications for Genetic Improvement and Agronomy*. 2<sup>nd</sup> Ed Academic Press
- Pessarakli, M. 2014. *Handbook of Plant and Crop Physiology*. 3rd Ed. CRC Press
- Soltani, A. and Sinclair, T. R. 2012. *Modeling Physiology of Crop Development, Growth and Yield*. CABI, Wallingford, UK.
- Hawkesford, M.J; Kopriva, S. and De Kok, L.J. 2014. *Nutrient Use Efficiency in Plants: Concepts and Approaches*. Springer
- Fajera, N. K. 2012 *The Role of Plant Roots in Crop Production*. 1st Ed. CRC Press.



**RC30702 SOIL FERTILITY MANAGEMENT**

This course will cover the factors influencing soil fertility, the principles underlying sustainable soil fertility management for agricultural production and environmental guardianship, and the integrated perspectives related to water, nutrients, and organisms in soil. The processes influencing soil health and management applications are discussed from the perspective of major "problem" soil types in Malaysia. (Peat, acid sulphate, BRIS, coastal, sloping & highly weathered soils). Soil conservation methods with particular reference to soil erosion will be covered. Interpretation of analytical data and practical recommendations relating the maintenance and improvement of soil fertility will be covered.

**References**

Brady, N. C. & Weil, R. R. 2016. *The Nature and Properties of Soils*. 15th Ed. Pearson. Osman, K. T. 2013. *Soils: Principles, Properties and Management*. Springer  
Halvin, J.L.; Tisdale, S.L.; Nelson, W.L. & Beaton, J.D. 2013. *Soil Fertility and Fertilizers*. 8th Ed. Pearson.  
Ashraf, M. A.; Othman, R... & Ishak, C. F. 2017. *Soils of Malaysia*. 1st Ed. CRC Press. Benton Jones, J. 2012. *Plant Nutrition and Soil Fertility Manual*. 2nd Ed. CRC Press.

**RC30902 AGRICULTURAL ENTOMOLOGY**

This course will familiarize the students with skills and knowledge on agricultural entomology. Learning of insect life cycle, ecology, reproductive biology and morphological structure will provide training to students on characteristic of major agricultural crop pests in Malaysia. Classification and identification using taxonomic guide key enable students to identify insect up to the level of species. A basic learning of entomology will provide an essential tool of knowledge before a proper control and management of insect pest can be carried out. This course will also expose students to some selected agricultural plant insect pests such as coconut, oil palm, rice, vegetables, fruits and others. An appropriate trapping methods using light traps, baited traps etc. for surveillance and sampling of insect will also be introduced to students.

**References**

Gillot, C. 2005. *Entomology*. Springer, University of Saskatchewan.  
Khoo, K.C., Oii, P.A.C., Tuck, H.C. 1991. *Crop pests and their management in Malaysia*. Tropical Press, Kuala Lumpur.  
Pedigo, L.P. & Rice, M. E. 2002. *Entomology and pest management*. Prentice Hall, Pearson. Thacker, J.R.M. 2002. *An introduction to arthropod pest control*. Cambridge University Press.  
Rechigl, J.E. & Rechgil, N.A. 2000. *Insect pest management: techniques for environmental protection*. Lewis Pub, Boca Raton.

**RC31002 SOILLESS CULTURE**

This course will provide students with good background of the principles, practices, techniques, infrastructures and technologies of growing plants without soil. It covers species in several important systems such as water culture, sand culture, gravel culture, aeroponics, tube culture, nutriculture, etc. Management of soilless culture production system will also be discussed include use of organic, inorganic production and vertical farming.

**References**

Meier Schwarz. 1995. *Soilless Culture Management*. Berlin : Springer-Verlag  
Michael Raviv, J. Heinrich Lieth. 2008. *Soilless culture: Theory and Practice*. Amsterdam; Boston: Elsevier science. Jones, J. B. Jr. 2004. *Hydroponics: A Practical Guide for the Soilless Grower*. 2nd Ed. CRC Press  
J. Benton Jones, Jr. 2005. *Hydroponics : a practical guide for the soilless grower*. Boca Raton, FL.: CRC Press.  
Bandyopadhyay, P. C. 2010. *Fertigation : Fundamentals and Applications*. D. P. House  
B.K. Ramachandrappa, H. V. Nanjapp. 2008. *Fertigation Technology*. Jodhpur: Agrobios (India).

**RC31102 HERBS AND SPICES CROPS**

This course emphasizes to the herb and spice crops in propagation, cultivation management in farm, harvest, postharvest handling and processing aspects. The estimate cost of production and income of the herb and spice crops along with their importance in agricultural sector in our country will be discussed.

**References**

- Jaganath, I. B., & Ng, L. T. (2000). Herbs. The Green Pharmacy of Malaysia. Kuala Lumpur, Vinpress and Malaysia Agricultural Research and Development Institute, 95-99.
- Musa, Y., Ghawas, M.M., & Mansur, P. (2005). Penanaman Tumbuhan Ubatan dan Beraroma. Institut Penyelidikan dan Kemajuan Pertanian Malaysia, MARDI
- Nair, K.P. (2013). The agronomy and economy of turmeric and ginger: invaluable medicinal spice crops. Elsevier Science. Pp 537
- Peter, K. V. (Second Edition.). (2012). Handbook of herbs and spices. Woodhead Publishing Limited. Vol 1 & 2
- Shanmugavelu, K. G., Kumar, N., & Peter, K. V. (2002). Production technology of spices and plantation crops. Agrobios

**RC31202 LEGUMES AND MISCELLANEOUS CROPS**

The botany of grain legumes (groundnut, soybean, etc) and miscellaneous crops (kenaf, jatropha etc) are outlined. The importance of legumes in nitrogen fixation; the grain for food, and animal feed are emphasized. Discussions include planting practices and crop maintenance, harvesting and storage of the produce. Intercropping of legumes with other food crops and the use of legume plant residue for green manure are included. Utilization of legume grains and other products are stressed.

**References**

- Maiti, R. and Wesche-Ebeling, P. (eds) (2002) The Peanut (*Arachis hypogea* L.) Crop. Science Publishers, Inc. Hanson, B. & Buchanan, S. 2007. *Buried Treasures: Tasty Tubers of the World*. Brooklyn Botanic Garden
- Martin, J.H., Waldren, R.P. and Stamp, D.L. (2006) *Principles of Field Crop Production*. Pearson Prentice Hall
- van Schoonhoven, A. and Voysest, O. (eds) (1991) *Common Beans – Research for Crop Improvement*. CABI & CIAT
- Singh, R.P., Shankar, N. and Jaiwal, P.K. (eds) (2006) *Nitrogen Nutrition in Plant Productivity*. Studium Press LLC
- Yadav, S.S., McNeil, D.L. and Stevenson, P.C. (eds) (2007) *Lentil – An Ancient Crop for Modern Times*. Springer

**RC31302 MANAGEMENT OF SMALL AND MEDIUM ENTERPRISE**

This course focuses on how entrepreneurs of small and medium size enterprises (SMEs) start-up, run and manage the competitive advantage of their business. The current SME development programmes by Malaysian government through its various ministries and agencies will also be introduced to the students. The current issues and challenges facing the SMEs in Malaysia also covered in this course.

**References**

- Mohd Khairuddin, H. 2007. *SMEs in Malaysia: A Brief Handbook*. Petaling Jaya: August Publishing
- Mohd Khairuddin, H. & Syed Azizi, W. 2002. *Small and Medium-Sized Enterprises in Malaysia: Development Issues*. Petaling Jaya, Selangor: Prentice Hall
- Bank Negara Malaysia. 2006. *Small and Medium Enterprise (SME) Annual Report 2005 & 2007*. National SME Development Council. SME Annual Report 2008.
- Ricketts, C. & Ricketts, K. 2009. *Agribusiness: Fundamentals and Applications*. (2<sup>nd</sup> Edition). New York: Delmar
- Schaper, M.& Volery,T.2007.*Entrepreneurship and Small Business*. (2<sup>nd</sup> Pacific Rim Edition). John Wiley & Sons Australia, Ltd.

**RC31402 WATER RESOURCE MANAGEMENT**

This course provides a broad overview on water resources, quantity, quality, uses and management in relation to agriculture. The hydrologic cycle, biophysical principles and the effects of changing climate / environment factors on water resources and sustainable practices in use of water resources for agriculture will be stressed. Current issues regarding water use in agriculture will be discussed.

**References**

- Balram Panigrahi and Megh R. Goyal, 2016. *Soil and Water Engineering: Principles and Applications of Modeling*. Apple Academic Press, 550 Pages - 18 Color & 136 B/W Illustrations, ISBN 9781771883924 - CAT# N11672.
- Cornelio Alberto Zolin and Renato de A. R. Rodrigues, 2015. *Impact of Climate Change on Water Resources in Agriculture*. CRC Press. 232 Pages - 18 Color & 16 B/W Illustrations. ISBN 9781498706148 - CAT# K24813
- Manish Kumar (Ed.) 2012. *Problems, Perspectives and Challenges of Agricultural Water Management*. Publisher: InTech, ISBN 978-953-51-0117-8, 468 pages. DOI: 10.5772/2488
- Megh R. Goyal, 2015. *Water and Fertigation Management in Micro Irrigation*. Apple Academic Press. 356 Pages - 150 B/W Illustrations, ISBN 9781771881067 - CAT# N11242.
- James S. Shortle and Ronald C. Griffin (Eds.) 2001. *Irrigated Agriculture and the Environment. The Management of Water Resources Series*. Publisher Edward Elgar Publishing Ltd, ISBN10: 1840645032, ISBN13: 9781840645033
- Thomas Bournaris, Julio Berbel, Basil Manos and Davide Viaggi, 2014. *Economics of Water Management in Agriculture*. CRC Press, 370 Pages - 16 Color & 62 B/W Illustrations, ISBN 9781482238396 - CAT# K23223

**RC31502 PLANT SYSTEMATICS**

This course introduces students to conventional taxonomy, description, identification, nomenclature, and classification of plants. They will be guided to understand the reconstruction of phylogeny or evolutionary history of plant life. The course is divided into four parts: introduction to systematic, evolution and diversity of plants, systematic evidence and descriptive terminology, and resources in plant systematic. Emphasis is given on the application of systematic approach to identify and select plants, from the pool of genetically related agricultural and horticultural plants, or hybrids, for further trait and quality enhancement.

**References**

- Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F., and Donoghue, M.J., 2015. *Plant systematics: A Phylogenetic Approach*. Sinauer Associates, Sunderland, Massachusetts.

Stuessy, T., Crawford, D.J., Soltis, D.E., and Soltis, P.L., 2014. *Plant Systematics: The Origin, Interpretation, and Ordering of Plant Diversity*. Koeltz Scientific Books.

Belostotsky, D.A., 2009. *Plant Systems Biology: Methods in Molecular Biology*. Humana Press.

Stace, C.A., 1992. *Plant Taxonomy and Biosystematics*. Cambridge University Press, London.

Stuessy, T.F., 1990. *Plant Taxonomy: The Systematic Evaluation of Comparative Data*. Columbia University Press, New York.

### **RC31602 INTRODUCTION TO AQUA-AGRI ENTREPRENEURSHIP**

The course introduces students to the value chain of aqua-agri entrepreneurship. Topics taught entail importance of distinguishing the high impact projects in aqua-agriculture, stimulators for aqua-agri entrepreneurship development, critically linkages between various organization/stakeholders in the chain, profiling of aqua-agri business chains, selected market channels and inter-sectoral networks in the pipeline of entrepreneurship. Students will experience to use value chain analysis as a method to understand aqua-agri pipelines from a holistic view. This course will also expose students to identify opportunities in aqua-agri entrepreneurship.

#### **References**

Cass, F., P. Ho., J. Eyferth and E.B. Vermeer (eds). 2004. *Rural development in transitional China: the new agriculture*. London

*Climate change and global food security* edited by R. Lal (et al) Publisher Boca Raton, FL: Taylor & Francis, 2005.

Anon, 1999. *Food security: the new millennium*. Publisher Penang: Consumers International

FAO. 2006. *The State of food and agriculture, 2006: food aid for food security*. Rome: Food and Agriculture Organisation of the United States

Anon. 2005. *Economics reforms and food security: the impact of trade and technology in South Asia*. CRC Press

### **RH30502 PLANT MOLECULAR BIOLOGY**

This course will touch on the function and structure of the transposable elements and gene tagging, plant and organ development, genome chloroplasts, and lipid biosynthesis. It will also introduce the available and recent techniques used for isolation of proteins and nucleic acids, analysis of gene expression, DNA manipulation and transformation, and transfection and regeneration. These techniques are commonly applied in the agricultural and plant sciences, especially for crop improvement, genetic engineering, gene expression and its manipulation.

#### **References**

Kurnaz, A. 2015. *Techniques in Genetic Engineering*. CRC Press.

Leland, H., Goldberg, M.L., Fischer, J.A., Hood, L. & Aquadro, C.F. 2015. *Genetics: From genes to genome*, 5th edition. McGraw-Hill Education.

Primrose, S.B. & Twyman, R. 2016. *Principles of Gene Manipulation and Genomics*. Wiley.

Stewart, C.N. 2016. *Plant Biotechnology and Genetics: Principles, Techniques, and applications*, 2nd Edition. Wiley.

Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. & Losick, R. 2014. *Molecular Biology of the Gene*, 7th Edition. Pearson Education Ltd.

### **RH30802 PLANT TISSUE CULTURE**

This course emphasizes on the theory, application, and techniques useful for propagating tissues in the research laboratory. Topics selected for study include sterile techniques, media preparation, establishment and maintenance of explant, callus and suspension cultures and growth measurement of cell, tissue, and organ culture.

#### **References**

- Anis, M. (2016). Plant Tissue Culture: Propagation, Conservation and Crop Improvement. N. Ahmad (Ed.). Springer Singapore.
- Bhatia, S., Sharma, K., Dahiya, R., & Bera, T. (2015). Modern Applications of Plant Biotechnology in Pharmaceutical Sciences. Academic Press.
- Kleyn, J., Bridgen, M., & Scoggins, H. (2013). Plants from Test Tubes: An Introduction to Micropropagation. Fourth Edition. Timber press, Inc.
- Smith, R.H. (2013). Plant Tissue Culture, Techniques and Experiments. Third Edition. Academic Press, Elsevier
- Trigiano, R. N., & Gray, D. J. (Eds.). (2011). Plant tissue culture, development, and biotechnology. CRC Press.
- Gayatri, M. C., & Kavyashree, R. (2015). Plant Tissue Culture: Protocols in Plant Biotechnology. Alpha Science International.

### **RH30902 CONTROLLED ENVIRONMENT AGRICULTURE**

In this course, students will learn about the principles, methods, and techniques related to the production of crops under protected/greenhouse conditions. The measurements and control of environmental factors affecting plant growth and development under controlled environment will be studied. Factors such as light intensity, light quality, temperatures, relative humidity, carbon dioxide, water, air current will be covered. Cultural practices for plant protection, nutrient and water delivery systems and control systems will be highlighted. Students will learn application of instrumentation in greenhouses and basic technical aspects of greenhouse design and construction. Hands-on experience will be a major aspect of this course.

#### **References**

- Shortle, J. S. 2001. Environment Policies for Agriculture Pollution Control. USA
- Hanan, J.J. 1997. Greenhouses: Advanced Technology for Protected Horticulture. CRC.
- Jones, J.B. 2004. Hydroponics: A Practical Guide for the Soilless Grower, 2nd edn. CRC.
- Nelson, P.V. 2003. Greenhouse Operation and Management, 6th edn. Prentice Hall.
- Schwarz, M. 1995. Soilless Culture Management. Berlin: Springer-Verlag.

### **RH31302 MUSHROOM TECHNOLOGY**

This is an applied course. Students will initially be introduced to the introduction, history, scope of edible mushroom cultivation. Types of edible mushroom and certain mushroom species will be used as case study such as *Calocybe indica*, *Volvariella Volvacea*, *Pleurotus sp.*, *Agaricus bisporus*, *Shiitake*. Lab practicals involve preparation of pure culture, preparation of media (potato dextrose agar and oatmeal agar media), sterilization, and preparation of test tube slants to store mother culture.

**References**

Nita Bahl 1988. Hand book of Mushrooms, II edition, Vol.I & II.

Paul Stamets, J.S. and Chilton, J.S. 2004. Mushroom Cultivator: A practical guide to growing mushrooms at home, Agarikon Press.

Shu-Ting Chang, Philip G. Miles, Chang, S.T. 2004. Mushrooms: Cultivation, nutritional value, medicinal effect and environmental impact, 2nd Ed, CRC press.

Tewari and Pankaj Kapoor S.C. 1988 Mushroom cultivation, Mittal Publications, Delhi. Gogoi, R. 2006. Mushroom Cultivation Technology. Publisher: Scientific Publishers,India

## **HORTICULTURE AND LANDSCAPING PROGRAMME (HG35)**

### **RC10102 PLANT NUTRITION**

An introductory course concerning a fundamental understanding of soil fertility, plant nutrition and soil nutrient management. This will include the roles and functions of nutrients to plants, deficiency & toxicity symptoms, nutrient availability and uptake by plants from the environment (aerial, soil and soil-less). Types of chemical/inorganic and organic fertilizers, an appreciation of the importance of good fertilizer management in various soils and plant production systems and how soil pH influences nutrient uptake will be discussed. Students will be able to calculate fertilizer application amounts for any given crop based on fertilizer recommendation rates.

#### **References**

- Foth, H. D. & Ellis, B. G. 1998. Soil Fertility. John Wiley and Sons.
- Halvin, J. L., Tisdale, S. L., Nelson, W. L. & Beaton, J. D. 2004. Soil Fertility and Fertilizers: An Introduction to Nutrient Management. 7th Ed. Prentice Hall.
- Jones, J. B. Jr. 1998. Plant Nutrition Manual. CRC Press.
- Marschaner, H. 1995. Mineral Nutrition of Higher Plants. Academic Press.
- Mengel, K. & Kirjby, E. A. 2001. Principles of Plant Nutrition. 5th ed. Kluwer Academic Press.

### **RH10203 PLANT PHYSIOLOGY**

Plant physiology is an examination of plant function ranging in complexity from individual cells up to the whole plant. As relatively immobile organisms, plants must adapt to the prevailing environment and consequently have unique mechanisms to deal with non-ideal growing conditions. Both normal growth and development as well as how the plant responds and adapts to adverse conditions are major themes in plant physiology research. This course will focus on the major physiological processes occurring in plants grown under ideal conditions as well as touch on the physiological adaptations under stress conditions.

#### **References**

- Jain, V.K. 2015. Fundamentals of Plant Physiology. India: S. Chand Publishing
- Marschner, H. 2011. Marschner's Mineral Nutrition of Higher Plants. 3<sup>rd</sup> Edition. USA: Academic Press
- Lowenfels, J. 2013. Teaming with Nutrients: The Organic Gardeners Guide to Optimizing Plant Nutrition. USA: Timber Press
- Ricardo, A. 2012. Plant Responses to Drought Stress: from Morphological to Molecular Features. Germany: Springer-Verlag Berlin and Heidelberg GmbH & Co.
- Sadras, V.O. and Calderini, D. 2014. Crop Physiology: Applications for Genetic Improvement and Agronomy. USA: Academic Press
- Sharma, R. 2016. An Introduction to Plant Physiology. India: Campus Books International

### **RH20103 PLANT BREEDING**

This course emphasizes the basic principles and concepts of genetic improvement of agricultural and horticultural plants through application of basic qualitative and quantitative genetic principles. Different plant breeding methodologies relative to the mode of reproduction of plants will be discussed. Application of modern tools such as tissue culture and genetic engineering, in the breeding of plants will also be discussed.

**References**

- Acquah, G. 2007. *Principles of Plant Genetics and Breeding*. Blackwell Publishing.
- Allard, R. W. 1999. *Principles of Plant Breeding*. 2nd ed. John Wiley and Sons.
- Brown, J. & Caligari, P. D. S. 2008. *An Introduction to Plant Breeding*. Blackwell Publishing. Oxford.
- Poehlman, J. M. 1986. *Pembiakbakaan Tanaman Ladang*. Jilid I. DBP.
- Yap, T. C., Mak, C. & Mohd Said Saad. 1984. *Prinsip-prinsip Pembiakbakaan Tanaman*. DBP.

**RC20203 WEED SCIENCE**

This course is a study of weeds and their control. Principles including weed plant classification, weed biology and ecology, and plant and herbicide chemistry will be taught. Practices which prevent, control and eliminate weeds will be discussed. Herbicide formulations and safe herbicide use will be taught.

**References**

- Hakansson, S. 2003. *Weeds and Weed Management on Arable Land: an Ecological Approach*. CABI.
- Inderjit, (editor). 2004. *Weed Biology and Management (Bioelectric Engineering)*. Springer.
- Monaco, T. J., Weller, S. C. & Ashton, F. M. 2002. *Weed Science: Principles and Practices*. 4<sup>th</sup> ed. John Wiley & Sons.
- Naylor, R. E. L. 2002. *Weed Management Handbook*. 9<sup>th</sup> ed. Blackwell.
- Zimdahl, R. L. 2004. *Weed-crop Competition: a review*. 2<sup>nd</sup> ed. Wiley-Blackwell.

**RH20303 PLANT PROPOGATION AND NURSERY MANAGEMENT**

This course introduces the basic principles and techniques of plant propagations by sexual (seed) and asexual (vegetative)

including plant tissue culture. In this course, the nursery management and maintenance aspects will be emphasized.

**References**

- Adkins, S. W. & Ashmore S. E. 2007. *Seeds: Biology, Development and Ecology*. CABI.
- Evans, D. E., Coleman, J. O. D. & Kearns, A. 2003. *Plant Cell Culture*. BIOS Scientific Publishers.
- Guy W. Adriance, and Fred R. Brison. 2010. *Propagation of horticultural plants*. India : Axix Books (India)
- Hartmann, H.T., Kester, D. E., Davies Jr., F. T. & Geneve, R. L. 2014. *Hartmann and Kester's Plant Propagation: Principles and Practices* Eight Edition. Prentice Hall.
- Mason, J. 2004. *Nursery Management*. 2nd ed. (Landlinks Press). CSIRO Publishing.
- Razdan, M. K. 2003. *Introduction to Plant Tissue Culture*. 2nd ed. Science Publishers Inc. Enfield, NH. Sofia, Bulgaria. 2011.
- Propagation of ornamental plants*. Salvia Press Ltd

**RC20403 CROP PEST MANAGEMENT**

This course will emphasize various techniques for management of all classes of crop pests. The techniques of pest management involve cultural control, physical, chemical, genetics, host-plant resistance, insect resistance, and others. An application of integrated approaches using least destructive, economically and environmental friendly methods, and protection of non-target organisms will also be taught. Toxicology and classification of pesticides, chemical residue risks to land and aquatic environments, international quarantine system and local rules and regulations of quarantine system for controlling the spread of plant pests and diseases will also be taught. Identification and symptoms of injury of major species of pests such as insects, mammalia, gastropoda and others, which damage major agriculture crops and control measures will be introduced in this course.



**References**

Gupta, H. C. L. 2005. Management of Insect Pests of Horticultural Crops. Agrotech Publishing Academy. Ignacimuthu, S. & Jayaraj, S. 2005. Sustainable Insect Pest Management. Alpha Science International Ltd.

Khoo, K. C., Ooi, P. & Ho, C. T. 1991. Crop Pests and Their Management in Malaysia. Tropical Press and Publication.

Onstad, D. W. 2007. Insect Resistance Management: Biology, Economics and Prediction. Academic Press. Pedigo, L.P. & Rice, M. 2008. Entomology and Pest Management. 6th ed. Prentice Hall.

**RH20603 TURF MANAGEMENT**

This course provides and shares knowledge and skills on planting and maintenance of turfgrass. The lecture and practical will cover topics on importance of turfgrass and its associated industry, types of turfgrass in Malaysia, identification, selection, planting, primary maintenance, and secondary maintenance of turfgrass. This course will also cover turfgrass management for golf course, urban landscape and recreational areas.

**References**

Christians, N.E., Patton, A.J. and Law, Q.D., 2016. Fundamentals of Turfgrass Management (5<sup>th</sup> Edition). Wiley. Turgeon, A.J., 2011. Turfgrass Management (9<sup>th</sup> Edition). Pearson.

Turgeon, A.J., McCarty, L.B. and Christians, N., 2009. Weed Control in Turf and Ornamentals. Prentice Hall. Christians, N.E. and Agnew, M.L., 2007. The Mathematics of Turfgrass Maintenance. John Wiley and Sons, Inc.

Wiecko, G., 2006. Fundamental of Tropical Turf Management. CABI Publishing.

Beard, J.B., 2002. Turf Management for Golf Courses. United States Golf Association.

**RH30103 FARM MECHANIZATION**

This course introduces the principles, design and operation of common types of farm machinery and mechanisms; familiarizes students with agricultural mechanization policy and strategy and its implications on agricultural development; teaches students financial costing and accounting of agricultural machinery, and analyses factors that affect economic operation for effective management decisions.

**References**

Donnell Hunt and David Wilson, 2016. Farm Power and Machinery Management, 11th Edition. Waveland Press Inc. ISBN-13: 978-1478626961, ISBN-10:1478626968

Brian Bell, 2016. Farm Machinery. Publisher: Old Pond Publishing Ltd; 6th revised edition, 312 pages. ISBN-10: 1910456063, ISBN-13: 978-1910456064

Jemima Dunne (Ed.) 2015. The Tractor Book. Publisher Dorling Kindersley Ltd. 256 pages, ISBN10 0241014824, ISBN13 9780241014820

Segun R. Bello, 2012. Agricultural Machinery & Mechanization: Mechanization, Machinery, landform, tillage, farm operations. Dominion publishing stores, 422 pages.

S. N. Yadav , 2011. Agricultural Engineering: Fundamentals and Applications. Publisher: Biotech Books. ISBN-10: 8176222224, ISBN-13: 978-8176222228

**RH30302 OLERICULTURE**

This course provides knowledge on principles and practices in the production and management of highland and lowland vegetable crops. It covers species in several important families such as leguminosae, solaceae. Cucurbitaceae, cruciferae, malvaceae and liliaceae. Management factors to be discussed include use of organic and inorganic fertilizers, pest and disease control, weed control and fertigation. The use of hydroponics and net-houses for vegetable production will also be discussed.

**References**

- Maynard, D. N. & Hochmuth, G. J. 2007. Knott's Handbook for Vegetable Growers. 5th ed. John Wiley & Sons, Inc. Dixon, G. R. & Dickson, M. H. 2007. Vegetable Brassicas and Related Crucifers. CABI Publishing.
- Rai, N and Yadav, D. S. 2005. Advance in Vegetable Production. Researchco Book Centre.
- Aini, Z., Sivapragasam, A., Vimala, P. and Mohamad Roff, M. N. 2005. Organic Vegetable Cultivation. Jones, J. B. Jr. 2004. Hydroponics: A Practical Guide for the Soilless Grower. 2nd Ed. CRC Press
- Hui, Y. H., Ghazala, S., Graham, D. M., Murrell, K. D. & Nip, Wai-Kit. 2003. Handbook of Vegetabe Preservation and Processing (Food Science and Technologi). Marcel Dekker.
- Thompson, A. K. 2003. Fruit and Vegetables Harvesting, Handling and Storage. 2nd ed. Blackwell Publishing Ltd. MARDI. 2000. Panduan Pengeluaran Sayur-Sayuran MARDI Serdang.
- Rubatzky, Vincent E and Mas Yamaguchi. 1999. World vegetables: principles, production and nutritive values. New York: Chapman Hall.

**RH30503 LANDSCAPE HORTICULTURE**

This course introduces the knowledge in landscape design which includes basic elements of landscape, spatial design and the application of sustainable landscape practices. It also explores sustainability issues, historical, psychological, cultural and art in the natural and built environment.

**References**

- Dee, C. (2001). Form and Fabric in Landscape Architecture: A Visual Introduction. London: Spon Press.
- Venhaus, H. (2012). Designing the Sustainable Site: Integrated Design Strategies for Small-scale Sites and Residential Landscapes. New Jersey: John Wiley & Sons, Inc.
- Booth, N.K. (1983). Basic Elements of Landscape Architectural Design. Illinios: Waveland Press, Inc.

**RH30602 FLORICULTURE AND ORNAMENTALS**

This course discusses identification, usage, propagation, and cultural requirements of flowering plants, trees, shrubs, vines, and ground covers used in Malaysian landscapes. It also includes the physiological principles and commercial practices involved in the production of potted and bedded plants, as well as greenhouse production systems.

**References**

- Still, S. M. 1994. Manual of Herbaceous Ornamental Plants. 4th Ed. Stipes Publishing LCC. Wilkins, F. H. & Dole J. M. 2004. Floriculture: Principle and Species. 2nd Ed. Prentice Hall. Larson, R. A. 1992. Introduction to Floriculture. 2nd Edition. Academic press.
- Thomas, G. S. 2004. Ornamental Shrubs, Climbers and Bamboo. Frances Lincoln Publishers.
- Grounds, R. 2005. Grasses: Choosing and Using These Ornamental Plants in the Garden (The Royal Horticulture Society). Quadrille Publishing Ltd.

**RC30703 PLANT PATHOLOGY**

This course introduces the concepts of plant pathology due to abiotic and biotic agents. Further discussion will include the attack mechanisms and disease symptoms by biotic agents such as viruses, bacteria, fungi, phytoplasms and plant parasites, as well as plant reactions toward pathogens attack. Other areas of emphasis are plant-pathogen genetic interactions, plant disease epidemiology, non-chemical and chemical controls of plant diseases.

**References**

- Agrios, G. N. 2005. Plant Pathology. 5th edition Oxford, Singapore. Academic Press.
- Strange, R. N. 2003. Introduction to Plant Pathology. England, Willey.
- Mansfield, J. M. 2000. Antimicrobial Compounds and Resistance. In: Slusarenko, A. Fraser, R.S.S. And Van Loo, L.C (eds) (2000) Mechanism of Resistance to Plant Diseases. Netherlands, Kluwer Academic Publishers.
- Ploetz, R.C. 2003. Diseases of tropical fruits crops. Oxon, United
- Persley, D. 1993. Diseases of fruits crops. Queensland. Department of Primary Industry Queensland.

**RH30803 LANDSCAPE DESIGN**

This course provides students with an understanding and application of principles and elements of landscape design. Theory and practices of landscape design from around the world are introduced; with the focus on parks and sustainable design strategies.

**References**

- Quartino, D. S. 2011. *1000 Tips by 100 Landscape Architects*. LOFT Publications S.L.
- Gillette, J et al edited by Treib, M. 2011. *Meaning in Landscape Architecture and Gardens, Four Essays, Four Commentaries*. Routledge London & New York.
- Dargan, H. & Dargan, M. P. 2007. *Timeless Landscape Design: The Four-Part Master Plan*. Gibbs Smith, Publisher. Boo, C. M., Hor, K. O. & Ou-yang, C. L. 2006. *1001 Garden Plants in Singapore*. NParks' Publication.
- Lawson, B., 2004. *What Designers Know*. Architectural Press, Oxford, UK.

**RH31002 POMOLOGY**

This course provides knowledge on aspects of fruit production from planting to harvesting with special emphasis on local fruits. Discussion will include collection and cultivation of potential indigenous fruit species for future propagation and breeding purposes.

**References**

- Barrett, D. M., Somogyi, L. & Ramaswamy, H. S. 2004. Processing Fruits: Science and Technology. 2nd Ed. CRC Press.
- Hui, Y. H., Barta, J., Cano, M. P., Gusek, T. W., Sidhu, J. S. & Sinha, N. K. 2006. Handbook of Fruits and Fruit Processing. Blackwell Publishing Ltd.
- Rieger, M. & Basra, A. 2006. Introduction to Fruit Crops (Crop Science). CRC Press.
- Thompson, A. K. 2003. Fruit and Vegetables Harvesting, Handling and Storage. 2nd ed. Blackwell Publishing Ltd.
- Waugh, F. A. 2007. Beginners' Guide To Fruit Growing - The Elementary Practices Of Propagation, Planting, Culture, Fertilization, Pruning, Spraying, Etc. Ford. Press.

### **RH40302 POST-HARVEST TECHNOLOGY**

The course will highlight topics related to the causes, principles and practices that result in post-harvest losses and appropriate methods to reduce these losses. The biophysical and biochemical changes in agricultural produce and factors that influence the quality of produce during storage will be discussed.

#### **References**

- Golob, P., Farrell, G. & Orchard, J. E. 2002. Crop Post-harvest. Volume 1: Principles and Practice. Wiley- Blackwell.
- Joshi, V. K. & Verma, L. R. 2002. Postharvest Technology of Fruits and Vegetables. Indus Publishing Company.
- Kilcast, D. & Subramaniam, P. 2001. The Stability and Shelf Life of Foods. CHIPS.
- Thompson, A. K. 2003. Fruit and Vegetables Harvesting, Handling and Storage. 2nd ed. Blackwell Publishing Ltd.
- Yeoshua, S. B. 2005. Environmentally Friendly Technologies for Agricultural Produce Quality. CRC Press.

### **RH40202 GARDEN PLANNING AND MANAGEMENT**

The course exposes the students to the sustainable planning and management of a garden or a park. Students are challenged to produce a Management Plan based on practices and policies from around the world; as implemented by national parks and botanical gardens locally and globally.

#### **References**

- Wright, A. 2013. Future Park : Imagining Tomorrow's Urban Parks. Csiro Publishing
- Davis, K., 2008. *A CBD Manual for Botanic Gardens*. Botanic Gardens Conservation International, Richmond, UK.
- Ahern, J., Leduc, E. & York, M. L., 2007. *Biodiversity Planning and Design: Sustainable Practices*. Island Press.
- Watkins, J. & Wright, T., 2007. *The Management & Maintenance of Historic Parks, Gardens & Landscapes: The English Heritage Handbook*. Frances Lincoln Publishers.
- Moughtin, C. & Shirley, P., 2005. *Urban Design: Green Dimensions*, 2nd Edition. Architectural Press, Oxford, UK

## **ELECTIVE COURSE**

### **RH30502 PLANT MOLECULAR BIOLOGY**

This course will touch on the function and structure of the transposable elements and gene tagging, plant and organ development, genome chloroplasts, and lipid biosynthesis. It will also introduce the available and recent techniques used for isolation of proteins and nucleic acids, analysis of gene expression, DNA manipulation and transformation, and transfection and regeneration. These techniques are commonly applied in the agricultural and plant sciences, especially for crop improvement, genetic engineering, gene expression and its manipulation.

#### **References**

- Henry, R.J. 1997. *Practical Applications of Plant Molecular Biology*. Garland Science.
- Jones, P., Jones, P. G. & Sutton, J. M. (eds.) 1997. *Plant Molecular Biology: Essential Techniques*. John Wiley & Sons.
- Karp, G. 2005. *Cell and Molecular Biology: Concept and experiments*. 4th ed. John Wiley & Sons, Inc.
- Lewin, B. 2004. *Gene VIII*. Pearson Education International. Schuler, M. A. 2005. *Methods in Plant Molecular Biology*. Elsevier.

### **RH30702 FOOD BIOPROCESSING**

This course provides an overview of relations between biotechnology, its role and importance in bioprocess of the processing industry. A perspective of bioprocess advances in food production and processing will be discussed to develop and broaden students' knowledge in technological aspects and some related issues.

#### **References**

- Bisswanger, H. 2004. *Practical Enzymology*. Germany: Wiley-VCH Verlag GmbH and Co.
- Goldberg, I. and Williams, R. (Editors) 1991. *Biotechnology and Food Ingredients*. New York: Van Nostrand Reinhold.
- Lee, B.H. 1996. *Fundamental of Food Biotechnology*. New York: VCH Publishers.
- Lee, Y.K. 2003. *Microbial Biotechnology: Principles and Application*. Singapore: World Scientific Publishing.
- Stanbury, P.F., Whitaker, A. and Hall, S.J. 2000. *Principles of Fermentation Technology*. Oxford: Butterworth-Heinemann.
- Thompson, P.B. 1997. *Food Biotechnology in Ethical Perspective*. London: Blackie Academic and Professional.

### **RH30802 PLANT TISSUE CULTURE**

This course emphasizes on the theory, application, and techniques useful for propagating tissues in the research laboratory. Topics selected for study include sterile techniques, media preparation, establishment and maintenance of explant, callus and suspension cultures and growth measurement of cell, tissue, and organ culture.

#### **References**

- Anis, M. (2016). *Plant Tissue Culture: Propagation, Conservation and Crop Improvement*. N. Ahmad (Ed.). Springer Singapore.
- Bhatia, S., Sharma, K., Dahiya, R., & Bera, T. (2015). *Modern Applications of Plant Biotechnology in Pharmaceutical Sciences*. Academic Press.
- Kleyn, J., Bridgen, M., & Scoggins, H. (2013). *Plants from Test Tubes: An Introduction to Micropropagation*. Fourth Edition. Timber press, Inc.
- Smith, R.H. (2013). *Plant Tissue Culture, Techniques and Experiments*. Third Edition. Academic Press, Elsevier

Trigiano, R. N., & Gray, D. J. (Eds.). (2011). Plant tissue culture, development, and biotechnology. CRC Press.  
Gayatri, M. C., & Kavyashree, R. (2015). Plant Tissue Culture: Protocols in Plant Biotechnology. Alpha Science International.

### **RH30902 CONTROLLED ENVIRONMENT AGRICULTURE**

This course will discuss the principles and concepts of crop production in protected environments such as using plastic tunnels or hydroponics to grow high value crops. The growth environment (temperature, light, humidity, nutrient supply) are computer controlled and can be varied to produce a suitable growth environment for temperate, sub-tropical and tropical crop species. Crop management and system automation practised in protected environments will be discussed. Culture of selected high value fruits, vegetables and ornamentals will also be highlighted.

#### **References**

Shortle, J. S. 2001. Environment Policies for Agriculture Pollution Control. USA  
Hanan, J.J. 1997. Greenhouses: Advanced Technology for Protected Horticulture. CRC. Jones, J.B. 2004. Hydroponics: A Practical Guide for the Soilless Grower, 2nd edn. CRC. Nelson, P.V. 2003. Greenhouse Operation and Management, 6th edn. Prentice Hall. Schwarz, M. 1995. Soilless Culture Management. Berlin: Springer-Verlag.

### **RH31102 LANDSCAPE CONSTRUCTION AND MANAGEMENT**

This course emphasizes on the second stage of landscape improvement; from preconstruction activities to details of works associated with landscape construction. It features the opportunity for students to get hands-on training on small-scale landscape construction and management projects.

#### **References**

Giles, F. 1999. Landscape Construction: Procedures, Techniques, and design. 4th Sub-ed. Stipes Publishing, LLC. Littlewood, M. 1993. Landscape Detailing Volume 1: Enclosure. 3rd Ed. Routledge.  
Littlewood, M. 1993. Landscape Detailing Volume 2: Surfaces. 3rd Ed. Routledge. Littlewood, M. 1993. Landscape Detailing Volume 3: Structures. 3rd Ed. Routledge. Littlewood, M. 2001. Landscape Detailing Volume 4: Water. Routledge. Sauter, D. 2011. Landscape Construction. 3rd Ed. Delmar.

### **RC30302 FARM IRRIGATION SYSTEMS**

This course deals with the principles and practices of irrigation science and management for efficient use of water through various methods and systems of irrigation application. The course provides the skills necessary for the design and management of effective and efficient on-farm irrigation systems. The soil-plant –water-atmosphere relations, crop water requirements and the removal of surplus water from farm fields (drainage) will also be covered. Emphasis will be placed on automated systems and components.

#### **References**

Alex Campo (Ed.), 2017. Irrigation and Agricultural Drainage Engineering. 294 pages. Scitus Academics LLC. ISBN-10: 168117541X, ISBN-13: 978-1681175416  
Balam Panigrahi and Megh R. Goyal, 2016. Soil and Water Engineering: Principles and Applications of Modeling. Apple Academic Press, 550 Pages - 18 Color & 136 B/W Illustrations, ISBN 9781771883924 - CAT# N11672.  
Peter Waller, Muluneh Yitayew, 2015. Irrigation and Drainage Engineering. 742 pages. Springer International Publishing. 978-3319056999, 978-3319056982  
Ranjit Kumar Biswas, 2015. Irrigation and Agricultural Drainage Engineering. 595 pages. New India Publishing

Agency. ISBN-10: 938330524X, ISBN-13: 978-9383305247

Balram Panigrahi, 2013. A Handbook on Irrigation and Drainage. 620 pages. New India Publishing Agency. ISBN-10: 9381450889, ISBN-13: 978-9381450888.

DID Malaysia, 2009. Irrigation and Agricultural Drainage. DID Manual No.5. 1172 pages. Department of Irrigation and Drainage Malaysia.

### **RC30702 SOIL FERTILITY MANAGEMENT**

This course deals with cycling of nutrient elements, evaluation of soil fertility status and fertilizer requirements.

Interpretation of analytical data and practical recommendations relating the maintenance and improvement of soil fertility will be covered. Management of soils in Malaysia (Peat, acid sulphate, BRIS, tin-tailing, coastal, sloping & highly weathered soils) will be emphasized. Soil conservation methods with particular reference to soil erosion will be covered.

#### **References**

Brady, N. C. & Weil, R. R. 2016. *The Nature and Properties of Soils*. 15th Ed. Pearson. Osman, K . T. 2013. *Soils: Principles, Properties and Management*. Springer

Halvin, J.L.;Tisdale, S.L.; Nelson, W.L. & Beaton, J.D. 2013. *Soil Fertility and Fertilizers*. 8th Ed.Pearson. Ashraf, M. A.;

Othman, R.. & Ishak, C. F. 2017. *Soils of Malaysia*. 1st Ed.CRC Press.

Benton Jones, J. 2012. *Plant Nutrition and Soil Fertility Manual*. 2nd Ed.CRC Press.

### **RC30902 AGRICULTURAL ENTOMOLOGY**

This course will familiarize the students with skills and knowledge on agricultural entomology. Knowledge about insect life cycle, ecology, reproductive biology and morphological structure will provide training to students on the characteristics of major agricultural plant pests in Malaysia. Classification and identification using systematic guide key enable students to identify insects up to the species level. A basic knowledge of entomology will provide an essential understanding for proper control and management of insect pests. This course will also expose students to common agricultural insect pests of rubber, coconut, oil palm, cocoa, coffee, corn, tobacco, sugar cane, vegetables, fruits, storage products, ornamental plants and others.

#### **References**

Gillot, C. 2005. *Entomology*. Springer, University of Saskatchewan.

Khoo, K.C., Oii, P.A.C., Tuck, H.C. 1991. *Crop pests and their management in Malaysia*. Tropical Press, Kuala Lumpur.

Pedigo, L.P. & Rice, M. E. 2002. *Entomology and pest management*. Prentice Hall, Pearson. Thacker, J.R.M. 2002.

*An introduction to arthropod pest control*. Cambridge University

Press. Alford, D.V. 2007. Pests of fruit crops: a colour handbook. Manson Pub, London.

### **RC31002 SOILLESS CULTURE**

The principles, practices, techniques, infrastructure and technology in the production of crops without soil (soil-less culture) will be covered. The course will emphasize the production of high value short term fruit, vegetable and ornamental crops without soil.

#### **References**

Benton Jones, J. 2005. Hydroponics: a practical guide for the soilless grower. 2nd ed. Boca Raton, CRC Press. Ho, B. L.

2000. Hydroponics simplified. Universiti Malaysia Sabah Press. Kota Kinabalu.

Kenyon, S. 1982. Hydroponics for the home gardener (Rev.ed.). Van Nostrand Reinhold Ontario, Canada.

**RC30303 SEED TECHNOLOGY**

Seed development after fertilisation, seed structures and dispersal are taught. The physiology of seed germination, viability tests and seedling vigour are highlighted. Categories of seeds for human consumption, livestock feeds and as planting materials. Seed production, collection, cleaning, processing, and storage (of orthodox and recalcitrant seeds) and cryo-preservation are included. Seed testing laboratories and protocol for seed purity and standards set by A.O.S.A. are included. Controlled pollination in the production of breeder seeds is also taught. Seed certification for commercial seed producers and the network in seed trade are integral parts of the course.

**References**

Bewley, J.D., Black, M. And Halmer, P. 2006. *The Encyclopedia of Seeds: Science, Technology and Uses*. CABI Publishing.  
Black, M. and Bewley, D. 2002. *Seed Technology and Its Biological Basis*. Sheffield Academic Press.  
Black, M. J., Bradford, K.J. and Vaquez-Ramos, J. 2000. *Seed Biology: Advances and Applications*. CABI Publishing.  
Desai, B.B. 2004. *Seed Handbook: Biology, Production, Processing and Storage*, 2nd edn. CRC.  
McDonald, M. B. and Kwoong, F.Y 2004. *Flower Seeds: Biology and Technology*, CABI Publishing.

**RC31302 MANAGEMENT OF SMALL AND MEDIUM INDUSTRIES**

This course focuses on how entrepreneurs of small and medium size enterprises (SMEs) perceive the processes associated with strategic management, what decisions and actions they adopt to ensure competitive advantage, how business strategies are formulated and implemented in SMEs, and the strategic role of entrepreneurship within small businesses. The course also discusses how SMEs should operate for maximum competitive advantage, and consider the gap between ideal theory and practice. Policy issues and challenges facing the SMEs in Malaysia also covered in this course. By the end of the course students should be able to understand most of the strategic management process of SMEs.

**References**

Analoui, F. & Karami, A. 2003. *Strategic Management in Small and Medium Enterprises*. London: Cengage Learning EMEA  
Moha Asri Abdullah. 1999. *Small and Medium Enterprises in Malaysia: Policy Issues and Challenges*. Aldershot: Ashgate.  
Mohd. Khairuddin Hashim. 2002. *Small and Medium-Sized Enterprises in Malaysia: Development Issues*. Petaling Jaya, Selangor: Prentice Hall.  
Gerald I. Susman. 2007. *Small and Medium-sized Enterprises and the Global Economy*. Edward Elgar Publishing.



**RC31402 WATER RESOURCE MANAGEMENT**

This course provides a broad overview on water resources, quantity, quality, uses and management in relation to agriculture. The hydrologic cycle, biophysical principles and the effects of changing climate / environment factors on water resources and sustainable practices in use of water resources for agriculture will be stressed. Current issues regarding water use in agriculture will be discussed.

**References**

- Balram Panigrahi and Megh R. Goyal, 2016. *Soil and Water Engineering: Principles and Applications of Modeling*. Apple Academic Press, 550 Pages - 18 Color & 136 B/W Illustrations, ISBN 9781771883924 - CAT# N11672.
- Cornelio Alberto Zolin and Renato de A. R. Rodrigues, 2015. *Impact of Climate Change on Water Resources in Agriculture*. CRC Press. 232 Pages - 18 Color & 16 B/W Illustrations. ISBN 9781498706148 - CAT# K24813
- Manish Kumar (Ed.) 2012. *Problems, Perspectives and Challenges of Agricultural Water Management*. Publisher: InTech, ISBN 978-953-51-0117-8, 468 pages. DOI: 10.5772/2488
- Megh R. Goyal, 2015. *Water and Fertigation Management in Micro Irrigation*. Apple Academic Press. 356 Pages - 150 B/W Illustrations, ISBN 9781771881067 - CAT# N11242.
- James S. Shortle and Ronald C. Griffin (Eds.) 2001. *Irrigated Agriculture and the Environment*. The Management of Water Resources Series. Publisher Edward Elgar Publishing Ltd, ISBN10: 1840645032, ISBN13: 9781840645033
- Thomas Bournaris, Julio Berbel, Basil Manos and Davide Viaggi, 2014. *Economics of Water Management in Agriculture*. CRC Press, 370 Pages - 16 Color & 62 B/W Illustrations, ISBN 9781482238396 - CAT# K23223

**RC31502 PLANT SYSTEMATICS**

This course introduces students to traditional taxonomy, the description, identification, nomenclature, and classification of plants. They will be guided to understand the reconstruction of phylogeny, or evolutionary history, of plant life. The course is divided into four parts: introduction to systematic, evolution and diversity of plants, systematic evidence and descriptive terminology, and resources in plant systematic. Emphasis is given on the application of systematic approach to identify and select plants, from the pool of genetically related agricultural and horticultural plants, or hybrids, for further trait and quality enhancement.

**References**

- Belostotsky, D.A., 2009. *Plant Systems Biology: Methods in Molecular Biology*. Humana Press.
- Judd, W.S. (et al.), 2008. *Plant systematics: A Phylogenetic Approach*. Sinauer Associates, Sunderland, Massachusetts.
- Pandey, A.K., Wen, J., Dogra, J.V.V. (Eds.), 2006. *Plant Taxonomy: Advances Relevance*. CBS Publishers & Distributors, New Delhi, India.
- Simpson, M.G., 2006. *Plant Systematics*. Elsevier Academic Press, London.
- Stace, C.A., 1992. *Plant Taxonomy and Biosystematics*. Cambridge University Press, London.
- Stuessy, T.F., 1990. *Plant Taxonomy: The Systematic Evaluation of Comparative Data*. Columbia University Press, New York.

**RC31602 INTRODUCTION TO AQUA-AGRI ENTREPRENEURSHIP**

The course introduces students to the value chain of aqua-agri entrepreneurship. Topics taught entail importance of distinguishing the high impact projects in aqua-agriculture, stimulators for aqua-agri entrepreneurship development, critically linkages between various organization/stakeholders in the chain, profiling of aqua-agri business chains, selected market channels and inter-sectoral networks in the pipeline of entrepreneurship. Students will experience to use value chain analysis as a method to understand aqua-agri pipelines from a holistic view. This course will also expose students to identify opportunities in aqua-agri entrepreneurship.

**References**

- Cass,F., P. Ho., J. Eyferth and E.B.Vermeer (edts). 2004. *Rural development in transitional China: the new agriculture*. London
- Climate change and global food security/* edited by R. Lal...(et al) Publisher Boca Raton, FL: Taylor & Francis, 2005.
- Anon,  
1999. *Food security: the new millennium*. Publisher Penang: Consumers International
- FAO. 2006. *The State of food and agriculture, 2006: food aid for food security?* Rome: Food and Agriculture Organisation of the United States
- Anon. 2005. *Economics reforms and food security: the impact of trade and technology in South Asia*. CRC Press

**RC31102 HERB AND SPICE CROPS**

This course emphasizes to the herb and spice crops in propagation, cultivation management in farm, harvest, postharvest handling and processing aspects. The estimate cost of production and income of the herb and spice crops along with their importance in agricultural sector in our country will be discussed.

**References**

- Jaganath, I. B., & Ng, L. T. (2000). Herbs. *The Green Pharmacy of Malaysia*. Kuala Lumpur, Vinpress and Malaysia Agricultural Research and Development Institute, 95-99.
- Musa, Y., Ghawas, M.M., & Mansur, P. (2005). Penanaman Tumbuhan Ubatan dan Beraroma. Institut Penyelidikan dan Kemajuan Pertanian Malaysia, MARDI
- Nair,K.P.(2013).*The agronomy and economy of turmeric and ginger:invaluable medicinal spice crops*. Elsevier Science.Pp 537
- Peter, K. V. (Second Edition.). (2012). *Handbook of herbs and spices*. Woodhead Publishing Limited.Vol 1 & 2
- Shanmugavelu, K. G., Kumar, N., & Peter, K. V. (2002). *Production technology of spices and plantation crops*. Agrobios

## **LIVESTOCK PRODUCTION PROGRAMME (HG36)**

### **RL10303 INTRODUCTION TO LIVESTOCK PRODUCTION**

This course discusses the scope of the livestock industry, career opportunities in animal sciences, principles of breeding, physiology and nutrition in relation to production, latest technologies in animal production with emphasis on recent livestock production systems, focusing on ways to increase productivity to provide affordable and sufficient livestock products. It also covers topics on processing and marketing of animal products.

#### **References**

- Robert E. Taylor and Thomas G. Field. 2015. *Scientific Farm Animal Production: An Introduction (11th Edition)*. Pearson.
- Frank Flanders and James R. Gillespie. 2015. *Modern Livestock & Poultry Production 9th Edition*. Cengage Learning
- Frank Flanders and James R. Gillespie. 2015. *Lab Manual for Flanders' Modern Livestock & Poultry Production, 9th Edition*. Delmar Cengage Learning.
- Andy D. Herring. 2014. *Beef Cattle Production Systems*. CABI
- Sunil Kumar. 2013. *Livestock Production and Management: Recent Trends and Future Prospects*. New India Pub. Agency.

### **RL10404 ANIMAL ANATOMY AND PHYSIOLOGY**

This course covers animal anatomy and physiology. Various systems such as the skeletal, muscular, respiratory, circulatory, nervous, endocrines, urinary and digestive systems will be discussed. The course includes the basic principles of physiology, preservation of tissues/ organs and will use tools such as anatomical models and preserved specimens.

#### **References**

- Richard W. Hill and Gordon A. Wyse. 2016. *Animal Physiology*. Oxford University Press.
- Thomas P. Colville and Joanna M. Bassert. 2015. *Clinical Anatomy and Physiology for Veterinary Technicians, 3rd Edition*. Mosby.
- Victoria Aspinall and Melanie Cappello. 2015. *Introduction to Veterinary Anatomy and Physiology Textbook, 3rd Edition*. Butterworth-Heinemann.
- Michael Akers R and Michael Denbow D. 2013. *Anatomy and Physiology of Domestic Animals*, Blackwell Publishing. Sally J.
- Bowden VN. 2012. *Introduction to Veterinary Anatomy and Physiology Workbook. 2<sup>nd</sup> Edition*. Butterworth-Heinemann.

### **RL20103 ANIMAL BREEDING**

This course introduces students the principles of animal breeding and basic concepts in animal genetics. It covers topics on genetics and statistical basis of animal improvement, selection of breeding program, and transmission of characteristics. The genetic improvements of livestock by means of breeding systems, selection methods and performance testing will be discussed.

#### **References**

1. Crew, F. A. 2006. *Animal Genetics: The Science of Animal Breeding*. Read Books Publisher; 1 edition.
2. Bourdon, Richard M. 1999. *Understanding Animal Breeding, 2nd Edition*. Prentice Hall.
3. Clark, A. E. 1998. *Animal Breeding: Technology for the 21st Century (Modern Genetics)* CRC.
4. Malcolm Willis, M.B. 1998. *Dalton's Introduction to Animal Breeding*. Blackwell Publishing Ltd.
5. Payne, W. J. A., Hodges, J. 1997. *Tropical cattle: Origin, Breed and Breeding policies*. Blackwell Publishing LTD.
6. Comstock, Ralph E. 1996. *Quantitative genetics with special reference to plant and animal breeding*. Blackwell Publishing, LTD.

**RL20403 ANIMAL BEHAVIOUR AND WELFARE**

This course will introduce students to various concepts of animal behaviour and welfare with emphasis on the farm animals. It will cover concepts underlying behaviour, their causes, and implications on management, health, production, and welfare. It will include topics on development of behaviour, social behaviour, mating systems and reproduction, biological rhythms, human-animal interactions, animal handling and atypical behaviour.

**References**

- Aubrey Manning and Marian Stamp Dawkins. 2012. An introduction to animal behaviour. CAMBRIDGE UNIVERSITY PRESS ) Katherine A. Houpt. 2018. Domestic Animal Behavior for Veterinarians and Animal Scientists. John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, USA
- Temple Grandin and Mark J. Deesing. 2014. Genetics and the Behavior of Domestic Animals. Elsevier's Science & Technology, Oxford, UK
- ) Akta 772: Akta Kebajikan Haiwan. 2015. Undang Undang Malaysia

**RL20603 ANIMAL NUTRITION**

This course will introduce students the importance of nutrition in farm animal, principles of nutrition in getting maximum output from farm animals. The common feed being used in the industry in feeding ruminants and monogastrics is introduced. The topics will highlight the importance of each nutrient in animal feed and their digestion and metabolism. This course will introduce the basic sciences and principles in evaluation of animal feedstuff and relate it to the livestock industry of the country.

**References**

- Eisemann Joan and Kim Sung Woo. 2014. *Animal Nutrition 1st Edition*. Kendall Hunt Publishing.
- Woody Lane. 2014. *From the Feed Trough: Essays and Insights on Livestock Nutrition in a Complex World*. Lane Livestock Services.
- Jurgens, Marshall H. Animal feeding and nutrition (11th Edition). Kendall Hunt, 2012. Pond, Wilson G., David Dryden, Gordon McL. Animal nutrition science. Cabi, 2008.
- C. Church, Kevin R. Pond, and Patricia A. Schoknecht. Basic animal nutrition and feeding. John Wiley & Sons, 2004.
- McDonald, Peter. Animal nutrition. Pearson education, 2002.

**RL20803 PASTURE AND FODDER MANAGEMENT**

This course introduces the production of forages including grasses, leguminous and non-leguminous plants and fodder as ruminant feed. Commonly sown forages will be introduced while the establishment, growth, harvest, maintenance, renovation and succession will be taught. The establishment of forages under cut-and-carry fodder system and pasture grazing system, as well as integration will be discussed. The relationship between pasture and fodder production with animal production system will be detailed. Exposure to the quality of forages as affected by various factors will be given. The conservation of excess forages or the maintaining of the quality of forages will also be included. Last but not least, the methods and analyses in determining the quality of forages will also be a part of this course.

**References**

- Collins, M., Barnes, R.F., Nelson, C.J. and Moore, K.J. 2017. Forages, volume 1: an introduction to grassland agriculture (Vol. 1). John Wiley & Sons.
- Ball, D.M., Hoveland, C.S. and Lacefield, G.D. 2015. Southern forages, modern concept for forage crop management. IPIN: Norcross.
- Lazier, J.R. and Ahmad, N. 2016. Tropical Forage Legumes: Harnessing the Potential of Desmanthus and Other Genera for Heavy Clay Soils. CABI.

Singh, K.S. 2014. Forage Conservation Techniques. New India Publishing Agency.

Flack, S. 2016. The art and science of grazing: how grass farmers can create sustainable systems for healthy animals and farm ecosystems. Chelsea Green Publishing.

### **RL21203 POULTRY PRODUCTION**

This course covers all aspects of poultry husbandry practices including breeding, nutrition, management, housing, equipment, health and welfare. Emphasis will be on broiler and layer production.

#### **References**

M.G. Kains and Jackson Chambers. 2017. *Profitable Poultry Production*. CreateSpace Independent Publishing. Harry M.

Lamon. 2016. *Practical Poultry Production*. Fb & C Limited.

Frank Flanders, James R. Gillespie. 2015. *Modern Livestock & Poultry Production*. Cengage Learning.

Damerow, G. 2013. *Hatching & Brooding Your Own Chicks: Turkeys, Ducks, Geese, Guinea Fowl*. Storey Publishing, LLC.

Donald D. Bell and William D. Weaver. 2012. *Commercial Chicken Meat and Egg Production*. Springer.

### **RL30303 MONOGASTRIC LIVESTOCK PRODUCTION**

This course covers all aspects of swine husbandry practices including breeding, nutrition, management, housing, equipment, health and welfare. Emphasis will be on breeds, selection and judging, housing and equipment and marketing of swine. The course will also give some introduction to other monogastric farm animals such as horses and rabbit production.

#### **References**

Edward Stahl and Jackson Chambers. 2015. *Commercial Rabbit Farming*. CreateSpace Independent Publishing. Neville

Beynon. 2014. *Pigs: A Guide to Management*. Crowood Press.

James I. McNitt and Steven D. Lukefahr. 2013. *Rabbit Production*. CABI.

Lee I. Chiba. 2013. *Sustainable Swine Nutrition*. Wiley-Blackwell.

Wilson G. Pond. 2012. *Swine Production and Nutrition (Animal Science Textbook Series)*. Springer.

### **RL30403 BEEF AND DAIRY PRODUCTION**

This course includes important aspects of dairy and beef cattle management from birth to adult, various breeds of dairy and beef cattle, selection and judging dairy and beef cattle. It will include breeding, nutrition and management, milking management, dairy herd health, dairy housing & equipment, marketing of milk, beef cattle health management, beef cattle housing and equipment and marketing of beef.

#### **References**

Thomas G. Field. 2017. *Beef Production and Management Decisions*. Pearson Edu.

John R. Campbell, Robert T. Marshall. 2016. *Dairy Production and Processing: The Science of Milk and Milk Products*. Waveland Press.

Lewis Kahn, David Cottle. 2014. *Beef Cattle Production and Trade*. CSIRO Pub. Andy D. Herring. 2014. *Beef Cattle Production Systems*. CABI

Peter de Jong. 2013. *Sustainable Dairy Production*. Wiley.

### **RL30503 LIVESTOCK FEED PROCESSING**

This course deals with how agricultural products, by-products or wastes are processed into products that can be efficiently used by the ruminant and monogastric animals. Students will have exposure to different types of equipment and machinery used for processing, preservation of feeds and pellet making and also for analysis of feedstuff.

#### **References**

- P. K Malik, R. Bhatta, J. Takahashi, R. Kohn, C. S Prasad. 2015. *Livestock Production and Climate Change*. CABI. Aaron A. Altschul and Aaron M. Altschul. 2013. *New Protein Foods: Animal Protein Supplies*. Academic Press.
- Abd El-Hakim Saad. 2012. *The Optimum Use Of Non-Conventional Protein Source For Feeding Broiler: Effect of using non- conventional feed Formulations on the performance of broiler chicks*. LAP LAMBERT Academic Publishing.
- Michael Youn. 2012. *Poultry Farming & Feed Formulations*. Koros Press.
- Sarah R. Borgearo. 2011. *Animal Feed: Types, Nutrition and Safety*. Nova Science Pub.

### **RL30603 ANIMAL DISEASES AND HEALTH CARE**

This course deals with common diseases (infectious and non-infectious) of livestock, aetiology, symptoms, effect on animal production, treatment and prevention. It will include topics such as proper handling and care of animals, hygiene, sanitation, vaccination schedule, immunization, and health monitoring.

### **RL31103 SMALL RUMINANT PRODUCTION**

This course covers all aspects of small ruminant (sheep, goats and deer) husbandry practices, including breeding, nutrition, management, housing, equipment, health and welfare. Various breeds of sheep, goats and deer will be discussed. Emphasis will be given to ways of increasing the production of milk, meat and wool and the marketing of the products.

#### **References**

- Mulugeta Ayalew. 2016. *Sheep and Goat Production Text Book*. LAP LAMBERT Academic Publishing.
- Mr Shakeel Nouman. 2014. *Dairy Goat Production: Farmers Handbook*. CreateSpace Independent Publishing. A. K. Goel and M. K. Tripathi. 2013. *Small Ruminant Production & Health*. Satish Serial Publishing House
- A. Sahoo. 2012. *Trends in Small Ruminant Production: Perspectives and Prospects*. Satish Serial Publishing House
- S. Gebrekiristos and B. Duguma. 2012. *Small Ruminant Production Systems in South Western Ethiopia*. LAP LAMBERT

### **RL40103 HANDLING AND PROCESSING LIVESTOCK PRODUCTS**

This course will introduce students to the understanding of the ante- and post-mortem effects on livestock products quality. The topics include products collection, preservation, processing, marketing and safety, carcass evaluation, meat hygiene, meat selection, identification of standard cuts, meat curing and other meat preservation methods, meat structure and water holding capacity of meats. Post-harvest decontamination techniques such as chemical dehairing, hot water rinse, steam pasteurization, steam vacuum, chemical rinsing, and lactoferrin and combined treatments—“Hurdle Technology” will be discussed. This course covers livestock by- products processing and utilization. The contents cover both edible and non-edible products of poultry and livestock. Medical and pharmaceutical processing and utilization, processing of leather, meat balls, woolens, slated eggs, animal feeds and others will be discussed.

### **References**

- Hilton C. Deeth and Michael J. Lewis. 2017. *High Temperature Processing of Milk and Milk Products*. Wiley.
- John R. Campbell and Robert T. Marshall. 2016. *Dairy Production and Processing: The Science of Milk and Milk Products*. Waveland Press
- Ramesh C. Chandan and Arun Kilara. 2015. *Dairy Processing and Quality Assurance*. Wiley. G. J. Mountney. 2013. *Poultry Meat and Egg Production*. Springer
- Vikas Nanda. 2013. *Meat, Egg and Poultry Science & Technology*. I K International Publishing House
- Y. H. Hui. 2012. *Handbook of Meat and Meat Processing, Second Edition*. CRC Press

### **RL40703 LIVESTOCK WASTE MANAGEMENT**

This course covers various systems of collection, storage, treatment, transport and utilization of livestock and other agricultural organic wastes and wastewaters. Types of anaerobic digesters, gas utilization options, safety and management of digester and gas utilization equipment are discussed. The course will also discuss the physical, chemical and biological properties of livestock wastes, their impacts on the environment and measures to minimize the impact on the environment.

### **References**

- Agnieszka Makara and Zygmunt Kowalski. 2016. *Innovative Bio-Products for Agriculture: Pig Manure Utilization and Treatment (Agricultural Issues and Policies)*. Nova Science Pub Inc.
- Tassew Mohammed. 2015. *Sustainable utilization of livestock manures and Academic success*. LAP LAMBERT Academic Publishing.
- Sven G. Sommer and Morten L. Christensen. 2013. *Animal Manure Recycling: Treatment and Management*. Wiley.
- Sven G. Sommer. 2013. *Ammonia volatilisation from livestock slurries and mineral fertilisers*. University Press of Southern Denmark.
- James M. MacDonald and Marc O. Ribaldo. 2012. *Manure Use for Fertilizer and for Energy*. Report to Congress. CreateSpace Independent Publishing.

## **ELECTIVE COURSES**

### **RL30402 LIVESTOCK SELECTION AND EVALUATION**

The course will introduce students the principles and concepts of selection and evaluation of animals. It will include the various method of selection and evaluation which being practiced in the livestock production. The course will include identification of physical characteristics of different types of livestock.

#### **References**

1. Hunsley, R. E. 2001. *Livestock Judging, Selection and Evaluation*. Interstate Press, Inc.
2. W. Malcolm Berson. 1992. *Livestock Judging, Selection and Evaluation/Grades 9-12* Vero Media Inc; 4th edition
3. James R. Gillespie and Frank B. Flanders. 2010. *Modern Livestock & Poultry Production*. 8th. Edition. Thomson Delmar Learning.
4. Yapp, W.W. 1959. *Dairy Cattle, Judging and Selection*. John Wiley and Sons, Inc., New York, N. Y.

### **RL30702 ANIMAL ENVIRONMENTAL PHYSIOLOGY**

The course aims to study the effects of the environment on the physiology of mammals with emphasis on stress, behaviour, water and electrolyte balance and other adaptations to environmental variations. Attention will be placed on the problems associated with the improvement of livestock production in tropical climates. This course aims to develop an understanding of the environmental needs of animals including climate, social stress and shelter requirements and it should enable students to appreciate the use of animal behaviour as a measure of stress and welfare.

#### **References**

- Veerasamy Sejian and Raghavendra Bhatta. 2017. *Sheep Production Adapting to Climate Change*. Springer.
- Olga A. Smirnova. 2016. *Environmental Radiation Effects on Mammals: A Dynamical Modeling Approach*. Springer. V.
- Sejian and J. Gaughan. 2015. *Climate Change Impact on Livestock: Adaptation and Mitigation*. Springer
- R. J. Collier and J. L. Collier. 2012. *Environmental Physiology of Livestock*. Wiley.
- Anjali Aggarwal and Ramesh Upadhyay. 2012. *Heat Stress and Animal Productivity*. Springer.

### **RL30902 ALTERNATIVE ANIMALS**

This course will cover the various aspects of production of alternative animals such as rabbits, ostriches and ducks. It will focus on husbandry practices including breeding, nutrition, management, housing, equipment, health and welfare of alternative animals. Visit to local farms and analyzing farmer's problems will also be a part of the course.

#### **References**

- Lisa Steele. 2015. *Duck Eggs Daily: Raising Happy, Healthy Ducks...Naturally*. St. Lynn's Press. Khalid Mahrose. 2014. *Ostrich Farming in Egypt*. LAP LAMBERT Academic Publishing.
- Robin Winter. 2013. *Deer Farming: From Dream to Reality*. Winters Myst Publishing. James I. McNitt and Steven D. Lukefahr. 2013. *Rabbit Production*. CABI
- Variou. 2011. *The Production of Duck Eggs - A Collection of Articles on Incubators, Hatching, Collection and Other Aspects of Egg Production*. Hoar Press



**RL31002 ANIMAL BIOTECHNOLOGY**

The course will introduce students the concepts of biotechnology specifically on assisted reproductive technologies used in livestock production. It will include artificial insemination; estrous synchronization; superovulation; *in vitro* fertilization; embryo transfer; sexing of embryos and other manipulations of embryos. The topics on genetic engineering and cloning will also be discussed.

**References**

1. David Clark and Nanette Pazdernik, *Biotechnology*, Academic Press, 2008
2. H. Joe Bearden and John W. Fuquay, *Applied Animal Reproduction*, Prentice Hall, 1997.
3. Gordon, I. *Laboratory Production of Cattle Embryos*. 1994. CAB International, Wallingford, UK.
4. Hafez, E. S. E. *Reproduction in Farm Animals*. 1993. Lea and Febiger, Philadelphia, PA.
5. Knobil, E. and Neill, J. D. *The Physiology of Reproduction*. Vol. 1. 1994. Raven Press, New York, NY.  
Senger, P. E. *Pathways to Pregnancy and Parturition*. 1998. Current Conceptions, Pullman, WA

**RC30103 FARM MECHANIZATION**

This course introduces the principles behind the design and operation of common types of farm machinery and mechanisms; familiarizes students with agricultural mechanisation policy and strategy and its implications on agricultural development; teaches students financial costing and accounting of agricultural machinery and analyses factors that affect economic operation for effective management decisions.

**References**

- Icon Group International. 2017. *The 2018-2023 World Outlook for Farm Machinery and Equipment*. ICON Group International, Inc.
- Fred D. Crawshaw and Emil W. Lehmann. 2015. *Ultimate Guide to Farm Mechanics: A Practical How-To Guide for the Farmer (The Ultimate Guides)*. Skyhorse Publishing.
- Smith Harris. 2013. *Farm Machinery and Equipment*. Style Press.
- Myer Kutz. 2013. *Handbook of Farm, Dairy and Food Machinery Engineering, Second Edition*. Academic Press.