

**CURRICULUM**  
**OF**  
**ENTOMOLOGY**

**(2010)**



**HIGHER EDUCATION COMMISSION**  
**ISLAMABAD**

# **CURRICULUM DIVISION, HEC**

Dr. Syed Sohail H. Naqvi	Executive Director
Prof. Dr. Altaf Ali G. Shaikh	Member (Acad)
Mr. Muhammad Javed Khan	Adviser (Academic)
Ms. Ghayyur Fatima	Director (Curri)
Dr. M. Tahir Ali Shah	Deputy Director (Curri)

Composed by: Mr. Zulfiqar Ali, HEC, Islamabad

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## PREFACE

The curriculum of subject is described as a throbbing pulse of a nation. By viewing curriculum one can judge the stage of development and its pace of socio-economic development of a nation. With the advent of new technology, the world has turned into a global village. In view of tremendous research taking place world over new ideas and information pours in like of a stream of fresh water, making it imperative to update the curricula after regular intervals, for introducing latest development and innovation in the relevant field of knowledge.

In exercise of the powers conferred under Section 3 Sub-Section 2 (ii) of Act of Parliament No. X of 1976 titled “**Supervision of Curricula and Textbooks and Maintenance of Standard of Education**” the erstwhile University Grants Commission was designated as competent authority to develop review and revise curricula beyond Class-XII. With the repeal of UGC Act, the same function was assigned to the Higher Education Commission under its Ordinance of 2002 Section 10 Sub-Section 1 (v).

In compliance with the above provisions, the HEC undertakes revamping and refurbishing of curricula after regular intervals in a democratic manner involving universities/DAIs, research and development institutions and local Chamber of Commerce and Industry. The intellectual inputs by expatriate Pakistanis working in universities and R&D institutions of technically advanced countries are also invited to contribute and their views are incorporated where considered appropriate by the National Curriculum Revision Committee (NCRC).

To bring international compatibility to qualifications held from Pakistani universities/DAIs for promotion of students mobility and job seekers around the globe, a Committee comprising of Conveners of the National Curriculum Revision Committee of HEC met in 2009 and developed a unified template for standardized 4-years/8-semester BS degree programmes. This unified template was aimed to inculcate broader base of knowledge in the subjects like English, Sociology, Philosophy, Economics etc in addition to major discipline of study. The Bachelor (BS) degree course requires to be completed in 4-years/8-semester, and shall require qualifying of 130-140 credit hours of which 77% of the curriculum will constitute discipline specific and remaining 23% will comprise compulsory and general courses.

In line with above, NCRC comprising senior university faculty and experts from various stakeholders and the respective accreditation councils has finalized the curriculum for BS and MS (Entomology). The same is being recommended for adoption by the universities/DAIs channelizing through relevant statutory bodies of the universities.

**PROF. DR. ALTAF ALI G. SHAIKH**  
**Member Academics**

**March 2010**

# CURRICULUM DEVELOPMENT

## INTRODUCTION

The meeting of National Curriculum Revision Committee for BS (4 years)/ MS (2 years) courses of Agriculture in Entomology was held on 15-17 March, 2010 at HEC Regional Centre, Lahore to revise and finalize the curricula at Graduate (4 years Programme) and Post-Graduate (MS) level. Following attended the meeting:-

Dr. Mohammad Khan Lohar,  
Professor,  
Department of Entomology,  
Sindh Agriculture University,  
Tandojam. Convener/  
President :

Dr. Imtiaz Ali Khan,  
Associate Professor,  
Chairman Department of Entomology,  
NWFP Agricultural University,  
Peshawar. Member

Prof. Dr. Muhammad Aslam,  
Chairman,  
Department of Entomology,  
Pir Mehr Ali Shah, Arid Agriculture University,  
Rawalpindi. Member

Ms. Bushra Siddique,  
Lecturer,  
Department of Entomology,  
University of College of Agriculture,  
The Islamia University,  
Bahawalpur. Member

Mr. Imran Ali Sani,  
Lecturer, Department of Entomology,  
Baluchistan Agriculture College,  
Chaman Road,  
Beleli Quetta. Member

Prof. Dr. Muhammad Afzal, Department of Entomology, Principal University College of Agriculture, University of Sargodha, Sargodha.	Member
Dr. Mansoor-ul-Hasan, Associate Professor, Department of Agri. Entomology, University of Agriculture, Faisalabad.	Member
Prof. Dr. Muhammad Naeem, Dean, Faculty of Crop Protection Sciences, NWFP Agricultural University, Peshawar.	Member
Prof. Dr. M. Rafique Khan, Department of Entomology, University of AJK, Rawala Kot.	Member
Prof. Dr. Muhammad Aslam, Department of Crop Protection, University College of Agriculture, B.Z. University Multan.	Member
Mr. Naseer Alam Khan, Secretary NAEAC, National Agriculture Education Accreditation Council, Ministry of Planning Commission, P – Block Pak Secretariat, Islamabad.	Member
Mr. Saifullah Talpur, Principal Scientific Officer, National IPM Program, National Agriculture Research Centre, Park Road, Islamabad.	Member
Dr. Farkhanda Manzoor, Department of Zoology, Lahore College for Women University, Lahore.	Member
Prof. Dr. Syed Anser Rizvi, Department of Zoology – Entomology, University of Karachi, Karachi.	Member

Dr. Muhammad Ashfaq,  
Foreign Professor,  
NIBGE, Faisalabad.

Member

Dr. Mushtaq A. Saleem,  
Professor of Agri. Entomology/  
Head, Department of Crop Protection/  
Principal University College of Agriculture,  
B.Z. University, Multan.

Member /  
Secretary

The meeting started with recitation of a few Verses from the Holy Quran by Mr. Bashir Ahmed, Director HEC Regional Center Lahore. Miss Ghayyur Fatima, Director Curriculum, HEC Islamabad in her inaugural speech highlighted the aims and objectives of the National Curriculum Revision Committee. She emphasized that the main purpose of revision and devising the curriculum is to bring it at par with the international standard and meet the demand of local market comprising public and private sector. She also stressed the need of new curriculum to facilitate colleges / universities / institutes for teaching Entomology according to the requirements of the agricultural departments / universities of Pakistan. She requested the experts to adhere to the template already proposed in the earlier meeting of Deans / Heads at the HEC. They unanimously nominated Prof. Dr. Muhammad Khan Lohar, Chairman, Department of Entomology, Sindh Agri. University Tandojam as Convener/ President and Dr. Mushtaq A. Saleem, Professor of Agri Entomology/Head Department of Crop Protection/Principal, University College of Agri. B. Z. University Multan as Secretary of the meeting. Both the Professors thanked the participants and pledged that in drafting the course, the opinion of each and every member would be given utmost importance.

Before formal session, the members were requested to deliberate on the different issues of curriculum revision of Entomology. Accordingly each honorable member actively participated and proposed the desired amendments keeping in view the above mentioned objectives of HEC.

The Committee unanimously decided the template for 4 year B.Sc (Hons.) Agriculture in Entomology with the following number of credit hours.

<b>Semester</b>	<b>Credit Hours</b>	<b>Total</b>
1+2+3+4	18+18+18+18	72
5+6+7+8	15+16+16+13	60
Total= 132 Credit Hours		

It was also requested that the universities may add 3 courses of 8 credit hours thus making grand total of not exceeding 140 credit hours keeping in view their available facilities and expertise. The Committee further improved the objectives, course contents pertaining to theory and practical and books recommended for each subject to be taught to the students of B.Sc (Hons.)

Agri Entomology, M.Sc. (Hons.) Agri. Entomology and Ph.D Agri. Entomology.

### **AIMS AND OBJECTIVE:**

1. Entomology, the study of insects has developed into a very large division of the animal sciences owing to their huge proportion in the animal kingdom and their importance in the applied fields. Substantial changes were made throughout the curriculum which has been updated/expanded.
2. The main objective was to provide broad and balanced courses of Entomology. The intimacy between insect and environment was emphasized to the entomological research in many direction which later proved of immense value in the indigenous control measures so as to provide more food for the ever-growing population of Pakistan.

### **Scheme of Study for 4-Year B.Sc. (Hons.) Agriculture**

Mathematics / Biology	6 Credits
Statistics 1 & 2	6
Computer / IT	3
Pakistan Studies	2
Islamiat	2
Communications Skills	3
English	3
Basic Agriculture	3
<b>Sub-Total</b>	<b>28</b>

One subject from each of the following disciplines

Agronomy	3
Plant Breeding & Genetics	3
Entomology	3
Plant Pathology	3
Food Technology	3
Horticulture	3
Soil Sciences	3
Agriculture Economics	3
<b>Sub-Total</b>	<b>24</b>

Additional courses from disciplines mentioned below and above

Applied Entomology (Compulsory)	3
Agriculture Extension	3
Forestry & Range Management	3



Animal Science	3
Marketing & Agri Business	3
Agriculture Engineering	3
Rural Development	3
Water Management	3
Any other course	
<b>Sub-Total</b>	<b>24</b>

Semester 1,2,3,4 shall each contain not more than 18 credit hours (a total of maximum of 72 credit hours).

Semester 5, 6, 7, 8 (Including Internship/Project of 4 credit hours) shall be 60 credit hours; while 3 courses (8 credit hours) from additional courses may be adjusted in semester 5 to 8.

**Grand Total (72+60+8)            140**

# **DETAIL OF COURSES**

## **ENTOMOLOGY For B.Sc. (Hons.) Agriculture**

### **ENT-401 INTRODUCTORY ENTOMOLOGY 3(2+1)**

#### **OBJECTIVES:**

1. To familiarize the students with insects and arachnids and their external and internal features
2. To equip the students to identify insects and arachnids of economic importance.
3. To acquire working skills for collecting, mounting, and preserving insects

#### **THEORY:**

Introduction; phylum Arthropoda and its classification; morphology, anatomy and physiology of a typical insect, metamorphosis and its types; insect classification, salient characters of insect orders; families of economic importance with examples of each family.

#### **PRACTICAL:**

Characters of classes of Arthropoda; collection and preservation of insects; morphology and dissection of a typical insect (digestive, reproductive, excretory, nervous, circulatory and tracheal systems); temporary mounts of different types of appendages of insects; types of metamorphosis.

#### **BOOKS RECOMMENDED:**

1. Ahmad, I. 2010. Hashriat "Insects". National Book Foundation, Lahore
2. Awastheir, V.B. 2009. Introduction to General and Applied Entomology. Scientific Publisher, Jodhpur, India.
3. Dhaliwal, G.S. 2007. An Outline of Entomology. Kalyani Publishers, Ludhiana.
4. Elzinga, R.J. 2003. Fundamentals of Entomology. Prentice Hall.
5. Lohar, M.K. 2001. Introductory Entomology. Department of Entomology, Sindh Agriculture University Tandojam Sindh, Pakistan.
6. Richards, O.W. and Davies, R. G. 2004. Imm's General Text-book of Entomology, Vol. I. and II, 10<sup>th</sup> Ed. Chapman & Hall, London, N.Y.
7. Triplehorn, C.A. and Jhonson, N.F. 2005. Borror and DeLong's Introduction to the study of Insects. Brooks Cole. 7<sup>th</sup> Ed.
8. Trigunayat, M.M. 2009. A Manual of Practical Entomology. 2<sup>nd</sup> Edition Scientific Publisher (India) Judhupur.

9. Yousuf, M. Tayyab, M. and Shazia, Y. 2007. Manual of Introductory Entomology, University of Agriculture, Faisalabad.

## **ENT-402 APPLIED ENTOMOLOGY 3(2+1)**

### **OBJECTIVES:**

1. To equip the students with knowledge of insect pests of crops, vegetables, fruits, stored grains, household and structural pests.
2. To familiarize the students with identification of insect pests and their control methods and pesticide application equipments.
3. To introduce the students with entomological cottage industry.
4. To increase the productivity of agricultural crops through insect pest control.

### **THEORY:**

Introduction; causes of success and economic importance of insects; principles and methods of insect control i.e. cultural, biological, physical, mechanical, reproductive, legislative, chemical and bio-technological control; introduction to IPM; insecticides, their classification, formulations and application equipments; identification, life histories, mode of damage and control of important insect pests of various crops, fruits, vegetables, stored grains, household, termites and locust; entomological industries: apiculture, sericulture and lac-culture.

### **PRACTICAL:**

Collection, identification and mode of damage of insect pests of various crops, fruits, vegetables, stored grains and household; insecticide formulations, their dilutions and safe handling; use of application equipments, practical instructions in apiculture, sericulture and lac-culture.

### **BOOKS RECOMMENDED:**

1. Atwal, A.S. 2005. Agricultural Pests of Southeast Asia and their Management. Kalyani Publishers, Ludhiana.
2. Awastheir, V.B. 2009. Introduction to General and Applied Entomology. Scientific Publisher, Jodhpur, India.
3. Duncton, P.A. 2007. The Insect: Beneficial and Harmful Aspects. Kalyani Publishers Ludhiana.
4. Lohar, M. K. 2001. Applied Entomology, 2<sup>nd</sup> Ed. Department of Entomology, Sindh Agriculture University Tandojam Singh, Pakistan.
5. Mathews, G.A. 2004. Pesticide Application Methods, 3<sup>rd</sup>. Ed. John Wiley & Sons, Inc. N.Y.
6. Pedigo, L.P. 2007. Entomology and pest management 5<sup>th</sup> Ed. Prentice Hall, Intl. Limited, London.

7. Pfadt, E.R. 1985. Fundamentals of Applied Entomology, 4<sup>th</sup> Ed. The McMillan Co., N. Y.
8. Robinson, D.H. 2006. Entomology Principles and Practices. Agro-bios.
9. Shah, H.A. and Saleem, M.A. 2002, Applied Entomology, 3<sup>rd</sup> Ed. Izhar sons Printers, Lahore.
10. Srivastava, K.P. 2005. Text Book of Applied Entomology. Kalyani Publishers, New Delhi

## B. SPECIALIZATION IN ENTOMOLOGY

The Committee has proposed the following "TITLES" with credit hours for specialization in Entomology during 3<sup>rd</sup> year (5th and 6th semesters) and 4th year (7th and 8th semesters). These are the "CORE" courses, comprising 56-61 credit hours, including 4 credit hours of internship. To fulfill minimum requirements for the completion of the degree, each university may incorporate more courses according to their needs into their scheme of studies (curricula), thus making grand total not exceeding 140 credit hours.

The semester wise split of CORE courses is as under:-

### SCHEME OF STUDIES 5<sup>TH</sup> TO 8<sup>TH</sup> SEMESTER

Course	Title	Cr. Hr.	Status
ENT-501	Insect Morphology	3(2+1)	M
ENT-503	Principles of Insect Taxonomy	3(2+1)	M
ENT-505	Insect Ecology	3(2+1)	M
ENT-507	Insect Pests of Household, Man and	3(2+1)	M
ENT-509	Insect Behavior	3(2+1)	M
	<b>Sub Total</b>	<b>15</b>	

### 6<sup>TH</sup> SEMESTER

Course	Title	Cr. Hr.	Status
ENT-502	Insect Physiology	3(2+1)	M
ENT-504	Insect Biodiversity and Evolution	3(2+1)	M
ENT-506	Agricultural Pests and their	4(3+1)	M
ENT-508	Stored Product Pests and their	3(2+1)	M
ENT-510	Beneficial Insects	3(2+1)	M
	<b>Sub Total</b>	<b>16</b>	

## 7<sup>TH</sup> SEMESTER

<b>Course</b>	<b>Title</b>	<b>Cr. Hr.</b>	<b>Status</b>
ENT-601	Integrated Pest Management	4(3+1)	M
ENT-603	Plant Resistance to Insect Pests	3(2+1)	M
ENT-605	Insecticides and their Application	3(2+1)	M
ENT-607	Range and Forest Entomology	3(2+1)	M
ENT-609	Agriculture and Environmental	3(2+1)	M
	<b>Sub Total</b>	<b>16</b>	

## 8<sup>TH</sup> SEMESTER

		<b>Cr. Hr.</b>	<b>Status</b>
ENT-	Scientific Writing and Presentation	3(2+1)	M
ENT-	Apiculture	3(2+1)	M
ENT-	Biological Control of Insect Pests	3(2+1)	M
ENT-	Internship / Project	4(0+4)	M
	<b>Sub Total</b>	<b>13</b>	

**Total of 15+16+16+13 = 60**

**Grand Total =**

**Note:** *University may add 3 courses carrying 8 Credit Hours according to their specialty and facilities. Thus making grand total not exceeding 140 credit hours.*

# DETAIL OF COURSES

## 5<sup>TH</sup> SEMESTER

### ENT-501 INSECT MORPHOLOGY 3(2+1)

#### OBJECTIVES:

- To provide students with an understanding of the comparative morphology of insect organ systems.
- To help students understand how the morphology of a structure is related to its function.

#### THEORY:

Introduction; integument and its derivatives; body regions; segmentation, sclerites, sulci and appendages of head, thorax and abdomen in economically important insect orders; endoskeleton and internal organ systems; exocrine and endocrine organs.

#### PRACTICAL:

Structure of integument and its derivatives; comparative external and internal morphology of economically important insect orders; preparation for illustrations.

#### BOOKS RECOMMENDED:

1. Chapman, R. F. 1998. The insects: Structure and Function (4<sup>th</sup> Ed.). Hodder and Stoughton Education Ltd., U.K.
2. Dunston P.A. 2004. The Insect Structure, Function and Bio-Diversity. Kalyani Publishers, Ludhiana.
3. Richard, O.W. and Davies, R.G. 1984. Imm's General Textbook of Entomology, Vol. I, revised. 10<sup>th</sup> Ed. (Structure, Physiology & Development). Chapman and Hall, London, N.Y.
4. Snodgrass, R. 1935. Principles of Insect Morphology. Cornell Univ. Press., U.S.A.

### ENT-503 PRINCIPLES OF INSECT TAXONOMY 3(2+1)

#### OBJECTIVES:

To provide basic concepts of taxonomic hierarchy, identification, taxonomic characters, variations, taxonomic keys and preparation of taxonomic papers.

## **THEORY:**

Introduction; history, functions and concepts; tasks of a taxonomist; taxonomic categories; taxonomic procedures: collection and methods of sampling, identification, taxonomic characters, variations in population; descriptions, taxonomic keys, various kind of species and phylogenies, preparation of taxonomic papers; code of zoological nomenclature, introduction to numerical and molecular taxonomy; cladistics.

## **PRACTICAL:**

Methods of collection, preservation and labeling of insects; preparation of taxonomic keys; identification of insects; cataloguing and writing descriptions of identified insects; preparation of phenograms and phylogenetic trees using morpho-metrics.

## **BOOKS RECOMMENDED:**

1. Daly, H.V. Doyen, J.T. Purcell, A.H. and Daly, B.B. 1998. Introduction to Insect Biology and Diversity. Oxford University Press.
2. Manzoor, F. 2006. Morphometric Studies on Termite Genus *Odontotermes*. Published by, Higher Education Commission, Islamabad.
3. Mayer, E. and Ashlock, P.D. 1991. Principles of Systematic Zoology, 2<sup>nd</sup>.Ed. McGraw Hill Inc. New York.
4. Triplehorn, C.A. and Jhonson, N.F. 2005. Borror and DeLong's Introduction to the study of Insects. Brooks Cole. 7<sup>th</sup> Ed.
5. Wheeler, Q.D. 2008. The New Taxonomy. CRC Press London, New York.

## **ENT-505 INSECT ECOLOGY**

**3(2+1)**

## **OBJECTIVES:**

The basic aim of this course is to teach the basic concepts of insect ecology, succession, population, ecosystem, insect behavior and insect-ecosystem interactions

## **THEORY:**

Overview of insect ecology; divisions of ecology; habitat and niche; intra and interspecific interactions; natural and agro-ecosystems; flow of energy in ecosystem; trophic relations: food chain, food web and food mesh concepts; ecological succession; population and its characteristics like natality, mortality, dispersal, key factors, density dependence and density independence, introduction to life tables and diversity indices.

## **PRACTICAL:**

Maintenance and measurement of temperature, humidity and light with different instruments; population estimation and construction of life tables.

## **BOOKS RECOMMENDED:**

1. Bourtzis, K. and Miller, T. 2003. Insects Symbiosis. CRC Press.
2. Huffaker, C.B. and Robert, L.R. 1984. Ecological Entomology. Wiley Intersciences.
3. Price, P.W. 1984. Insect Ecology. John Wiley and Sons, N.Y.
4. Rockwood, L.L. 2006. Introduction to Population Ecology. Wiley, John & Sons.
5. Schowalter, T.D. 2006 Insect Ecology: An Ecosystem approach. 2<sup>nd</sup> Ed. Press is an imprint of Elsevier.
6. Southwood, T.R.E. and Henderson, P.A. 2000. Ecological Methods. 3<sup>rd</sup> Ed. Blackwell Science.
7. Symondson, W.O.C. and Liddell, J.E. 1996. The Ecology of Agricultural Pests, Biochemical Approaches. Chapman and Hall, London, UK.
8. Vandermeer, J.H. and Goldberg, D.E. 2003. Population Ecology: First Principles, Princeton University Press.
9. Yazdani, S.S. and Agarwal, M.I. 1997. Elements of Insect Ecology. Narosa Publishing House, New Delhi.

## **ENT-507 INSECT PESTS OF HOUSEHOLD, MAN AND ANIMALS**

**3(2+1)**

### **OBJECTIVES:**

To impart knowledge about collection, identification, biology and control of different insects of household, man and animals

### **THEORY:**

Introduction; identification, biology and control of different insect pests like ants, termites, cockroaches, silver-fish, cricket, powder-post beetle, carpet beetle, cloth-moths, psocids, lice, bed-bugs, fleas, mosquitoes, house flies, sand flies, stable flies, flesh flies, blow flies, tsetse flies, black flies, midges etc.

### **PRACTICAL:**

Collection, identification, and demonstration of control of different household, man and animal insect pests.



## **BOOKS RECOMMENDED:**

1. Aldridge, B. 2004. Medical Entomology. Text book of Public Health and Veterinary Sciences. Chapman and Hall, London.
2. Agarwal, S. 2009. Insect Pests of Cereals and their Management. Oxford Book Co. India
3. Atwal, A.S. 2005. Agricultural Pests of Southeast Asia and their Management. Kalyani Publishers, Ludhiana.
4. Fernald, H.T. 2008. Applied Entomology, An Introductory Textbook of Insects in their Relation to Man. Kessinger Publishing (Amazon).
5. James, M.T. and Harwood, R.F. 1969. Herm's Medical Entomology. The Macmillan Company Canada.
6. Lohar, M.K. 2001. General Entomology. Department of Entomology. Sindh Agriculture University Tandojam Sindh, Pakistan. Pakistan.
7. Metcalf C.L. 1984. Destructive and Useful Insects. Their Habits and Control 4<sup>th</sup> Ed. McGraw Hill Book Co. Inc. N.Y.
8. Pfadt. R. E. 1985 Fundamental of Applied Entomology. 4<sup>th</sup> Ed. The McMillan Co., N.Y

## **ENT-509 INSECT BEHAVIOUR 3(2+1)**

### **OBJECTIVES:**

To provide the basic concepts of insect behaviour, learning, periodicity, communication, territoriality, migration etc.

### **THEORY:**

Types of behaviour: reflexes, orientation (kinesis and taxes); learning; periodicity; patterns of behaviour; communications; visual; auditory; tactile; chemical. territoriality; nervous, endrocrine, genetic and biological functions of behaviour, host finding, feeding and reproductive behaviour, escape, defence, offence and predation; dispersal and migration; dormancy.

### **PRACTICAL:**

Communication, especially chemical communication, mating behaviour, host finding behaviour and social behaviour in lab or in field conditions

### **BOOKS RECOMMENDED:**

1. Febre, J.H. 1993. Insect Behaviour. Discovery Publishing House.
2. Fellows, N. and Holloway, G. 2005. Insect Evolutionary Behaviour. CABI
3. Goulson, D. 2003. Bumble Bees: Behaviour and Ecology. Oxford University Press.
4. Harbone, J.A. 1998. Introduction to Ecological Biochemistry. Academic Press. London.

5. Parihar, R. 2001. Reproductive Behaviour and Biology of Sex. Dominant Publishers and Distributors, Delhi.
6. Prakash, M. 2008. Encyclopedia of Entomology II: Insect Behaviour. Discovery Publishing House, PVT. LTD. Darya Ganj, New Delhi.
7. Vijay, K. 2008. Insect Behaviour. Vista International Publication House.

## 6<sup>TH</sup> SEMESTER

**ENT-502**

**INSECT PHYSIOLOGY**

**3(2+1)**

### **OBJECTIVES:**

The course will cover study of insect development and physiology of exoskeleton, endoskeleton and different systems; hormones and pheromones.

### **THEORY:**

Introduction; embryonic and post-embryonic development, physiology of integument, digestive, tracheal, circulatory, excretory, reproductive, muscular and nervous systems; sense organs and perception; sound and light production, thermoregulation; production and function of hormones and pheromones.

### **PRACTICAL:**

Study of cuticular proteins; physiology of digestion, tracheal, circulation, excretion, reproduction, musculature and sensation; hormones and pheromones.

### **BOOKS RECOMMENDED:**

1. Ashfaq, A. and Sohail, A. 2002. Manual of Insect Physiology. Pakistan Science Foundation.
2. Chapman, R.F. 1998. The Insects: Structure and Function. 4<sup>th</sup> Ed. Hodder and Stoughton Educational Ltd., U.K.
3. Klowden, M.J. 2002. Physiological Systems in Insects. Academic Press.
4. Litwack, G. 2005. Insect Hormones (Vitamins and Hormones). Elsevier Academic Press, California.
5. Liu, N. 2008. Recent Advances in Insect Physiology, Toxicology and Molecular Biology. Research Signpost Publishers.
6. Patanaik, B.D. 2002. Physiology of Insects. Dominant Publishers and Distributors, Dehli, India.
7. Wigglesworth, V.B. 1972. Principles of Insect Physiology. 7<sup>th</sup> Ed. Meltron & Co. Ltd. U.K.
8. Yadave, M. 2003. Physiology of Insects. Discovery Publishing House, New Delhi

**ENT-504 INSECT BIODIVERSITY AND EVOLUTION**  
**3(2+1)**

**OBJECTIVES:**

To introduce the students with the basics of biodiversity and evolution of insects, classification, phylogenetic affinities of different orders, radiation, diversity, habitat as affected by different environmental conditions.

**THEORY:**

Introduction; schemes of classification; phylogenetic affinities of different orders; insect adaptation in various geographical regions; speciation and biodiversity; insect adaptive radiation and diversity; classification of insect orders up to family level with particular reference to insect fauna of Pakistan; progress and extinction, gene library.

**PRACTICAL:**

Assessment and analysis of existing phylogenetic arrangement of different insect orders; cladistics of different insect groups with special reference to their origin and zoogeographical distribution and analysis with different available software.

**BOOKS RECOMMENDED:**

1. Afzal, M. and Mufti, S.A. 1998. Natural History Research. Pakistan Scientific and Technological Information Center, Islamabad.
2. Daly, H.V. Doyen, J.T. Purcell, A.H. and Daly B.B. 1998. Introduction to Insect Biology and Diversity. Oxford University Press.
3. Foottit, R.G. and Adler, P.T. 2009. Insect Biodiversity Science and Society. Wiley – Blackwell Publication UK.
4. Gupta, R.K. 2003. Advances in Insect Biodiversity. Agrobios, New Delhi, India.
5. Richards, O.W. and Davies, R.G. 1984. Imm's General Text Book of Entomology. Vol. II. 10<sup>th</sup> Ed. (Revised), Chapman and Hall, London.
6. Wheeler, W.M. 2006. Insects: their origin and evolution. Discovery Publishing House, New Delhi

**ENT-506 AGRICULTURAL PESTS AND THEIR**  
**MANAGEMENT** **4(3+1)**

**OBJECTIVES:**

To provide the concept of pest distribution, host plants, biology, nature of damage and management of insect and mite pests of field crops, vegetables and orchards, other important vertebrate and invertebrate pests.

## **THEORY:**

Introduction; identification, distribution, host plants, biology, damage and control of insect and mite pests of field crops, vegetables and orchards; other important vertebrate and invertebrate pests; implementation of IPM technology to increase per acre yield.

## **PRACTICAL:**

Collection, identification, distribution, host plants, biology, nature of damage and management of insect and mite pests of field crops, vegetables and orchards; other important vertebrate and invertebrate pests; case study of IPM technology.

## **BOOKS RECOMMENDED:**

1. Agarwal, S. 2009. Insect Pests of Cereals and their Management. Oxford Book Co. India
2. Atwal, A.S. and Bains, S.S. 2005. Agricultural Pests of South East Asia and their Management. Kalyani Publishers, Ludhiana.
3. Awasthi, V.B. 2007. Agricultural Insect Pests and their Control. Scientific Publishers (India) Jodhpur.
4. Fenemore, P.G. 2006. Applied Entomology. New age International, Publication.
5. Fernald, H.T. 2008. Applied Entomology, An Introductory Textbook of Insects in their Relation to Man. Kessinger Publishing (Amazon).
6. Gurr, G.M. Wratten, S.D. and Alteri, M.A. 2004. Ecological Engineering for Pest Management: Advances in Halritat Mani Publication for Arthropods. CSIRO, Australia
7. Hashmi, A.A. 1994. Insect Pest Management. Vols. I, II and III. Pakistan Agriculture Research Council, Islamabad, Pakistan.
8. Hill, D. S. 1993. Agricultural Insect Pests of the Tropics and their Control. Cambridge University Press, Cambridge,
9. Lohar, M. K. 2001. Applied Entomology. 2<sup>nd</sup> Ed. Kashif Publications, Hyderabad, Pakistan.
10. Maredia, K.M. Dakouo, D. and Mota-Sanclez, D. 2003. Integrated Pest Management in the Global Arena. CABI publishing UK.
11. Pedigo, L. P. 2007. Entomology and Pest Management. 5<sup>th</sup> Ed. Prentice and Hall, Intl., London.
12. Shah, H.A. and Saleem, M. A. 2000. Applied Entomology. 2<sup>nd</sup> Ed. Izharsons Printers, Lahore

## **ENT-508    STORED PRODUCT PESTS AND THEIR    3(2+1) MANAGEMENT**

### **OBJECTIVES:**

To provide concepts of stored grain pest management, storage principles and storage losses due to insects.

### **THEORY:**

Introduction; identification, biology and management of different stored product pests; principles and types of storages; factors affecting grain and other products in storages; stored product losses and their prevention.

### **PRACTICAL:**

Visits to different godowns and demonstration of sampling methods and estimation; collection, identification and management of different stored product pests; culture of some stored products insect pests under different climatic conditions.

### **BOOKS RECOMMENDED:**

1. Ashfaq, M. Saleem, M. A. and Ahmad, F. 2009. Zari Agnas ki Mahfooz Zakhira Kari (in Urdu). Pak Book Empire, Lahore.
2. Hill, D.S. 2002. Pests of Stored Food Stuff and their Control. Kluwer.
3. Hill, D.S. 2002. Pests of Stored Food Stuffs and Their Control, Springer Publisher.
4. Rees, D. 2009. Insects of Stored Products. Manson Publishing Company.
5. Zaklandvoi, G. A. and Ratanova. V. F. 1987. Stored Grain Pests and their control. Oxonian Press Pvt. Ltd., London.

## **ENT-510    BENEFICIAL INSECTS    3(2+1)**

### **OBJECTIVES:**

To provide the concepts of beneficial insects, insects of medicinal and aesthetic value, insect pollinators, scavengers and weed feeders.

### **THEORY:**

Introduction; insects of medicinal, food and aesthetic value; insect pollinators and environmental indicators; scavengers, entomophagous (predators and parasitoids) and weed-feeding insects; entomological industries; apiculture, sericulture and lac-culture.

## **PRACTICALS:**

Practical instructions in apiculture, sericulture and lac-culture; collection and identification of pollinators, scavengers, entomophagous (predators and parasitoids), medicinal, food, weed feeding and other beneficial insects.

## **BOOKS RECOMMENDED**

1. Aruga, H. 1994. Principles of Sericulture (Translated from Japanese). Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
2. Ashfaq, M. and Suhail, A. 2001. Magasbani kay Jadeed Treeqay (in Urdu), Deptt. of Entomology. U.A. Faisalabad.
3. Ashfaq, M. and Akram, W. 2000. Resham ke Keeray Palna (in Urdu), Deptt. of Entomology. U.A. Faisalabad.
4. Carter G.A. 2004. Bee Keeping. Biotech Books, New Delhi.
5. Ganga, G. and Chetty, J. S. 1997. An Introduction to Sericulture. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi
6. Hashmi, A.A. 1994. Insect Pest Management. Vols. I, II & III. Pakistan Agriculture Research Council, Islamabad.
7. Irshad, M. Khan. M.R. and Rafi. M.A. 2005. Insect Pests and their Parasitoids, Predators and Pathogens in Pakistan. PIPS (Pvt.) Ltd. Islamabad.
8. Krishnawami, S. Narasimhanna, M. N. Suryanarayan, S.K. and Kumaraj, S. 1993. Sericultural Mannual II: Slikworm Rearing. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

## **7<sup>th</sup> SEMESTER**

### **ENT-601 INTEGRATED PEST MANAGEMENT 4(3+1)**

#### **OBJECTIVES:**

To provide the concept of insect sampling, fluctuation and its measurement, principles, and requirements of IPM.

#### **THEORY:**

Introduction; history and concept of Integrated Pest Management (IPM); economics of pest management, population sampling, fluctuation and its measurement; different methods of insect pest scouting and forecasting; losses caused by insect pests to different crops; methods of pest management: cultural, physical, mechanical, legislative, chemical, biological, microbial, biotechnological and genetical measures along with antimetabolites, feeding deterrents, hormones and pheromones.

#### **PRACTICALS:**

Demonstration of cultural practices and different methods of pest scouting and monitoring, nature and extent of damage; assessment of crop losses by different methods; determination of economic threshold levels of

different crop pests; identification of important bio-control agents; installation of light and pheromone traps; familiarity with radiation techniques.

### **BOOKS RECOMMENDED:**

1. Atwal, A.S. and Bains, S.S. 2005. Agricultural Pests of South East Asia and their Management. Kalyani Publishers, Ludhiana.
2. Awasthi, V.B. 2007. Agricultural Insect Pests and their Control. Scientific Publishers (India) Jodhpur.
3. Binns, M.R. 2000. Sampling and Monitoring in Crop Protection. CABI Publishing Co.
4. Dent, D. 1996. Integrated Pest Management. Chapman & Hall, London.
5. Dhaliwal, G.S. and Arora, R. 2006. Integrated Pest Management. Kalyani Pub. Ludhiana.
6. Goodenough, J.L. and Mckineon, J.M. 1992. Basics of Insect Modelling. Amer. Soc. Agri. Engineers, USA.
7. House, P. Stevens, I. and Jones, O. 1998. Insect Pheromones and their use in Pest Management. Chapman and Hall, London.
8. Maredia, K.M. Dakouo, D. and Mota-Sanclez, D. 2003. Integrated Pest Management in the Global Arena. CABI publishing UK.
9. Metcalf, R.L. and Luckmann, W.H, 1994. Introduction to Insect Pest Management. 3<sup>rd</sup> Ed. Intercept Ltd. U.K.
10. Pedigo, L.P. 2007. Entomology and Pest Management. 5<sup>th</sup>Ed. Prentice Hall, Intl. Limited, London.
11. Subba, R.N.S. Balagopalan, C. and Ramakrishna, S.V. (Eds) 1992, New Trends in Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
12. Upadhyay, R. K. Mukerji, K. G. Chamola, B. P. and Dubly, O. P. 1998. Integrated Pest and Disease Management. A.P.H. Publ. Co., New Delhi.
13. Verma, L.R. Verma, A.K. and Gantam, D.C. 2004. Pest Management in Horticultural Crops (Principles & Practices). Asiatech Publishers Inc. New Delhi, India.

### **ENT-603 PLANT RESISTANCE TO INSECT PESTS 3(2+1)**

#### **OBJECTIVES:**

To provide the concept of plant resistance and transgenic crops to insect pests.

#### **THEORY:**

Introduction; techniques of breeding for resistance and transgenic crops to insects; mechanism and factors of resistance; ecological, physiological, asynchrony, induced genetic antixenosis, antibiosis and tolerance; genetic basis of resistance; effect of environment on resistance; biotypes and

resistance; measurement of resistance; development of resistant varieties.

### **PRACTICAL:**

Testing and measurement of relative plant resistance to insects in different crops and transgenic plants; morphological, physiological and bio-chemical plant resistance.

### **BOOKS RECOMMENDED:**

1. Maxwell, F.G. and Jennings, P.R. 1980. Breeding Plants Resistant to Insect Pests. John Wiley and Sons New York.
2. Panda, N. 1980. Principles of Host Plant Resistance to Insect Pests. Allenheld, London.
3. Panda, N. and Khush, G.S. 1995, Host Plant resistance to Insects. IRRI, Biddles Ltd. Guildford, UK.
4. Pedigo, L.P. 2007. Entomology and Pests Management, 5<sup>th</sup>Ed. Prentice Hall, Inc, London
5. Sadasivam, S. and Thayumanavan, B. 2003. Molecular Host Plant Resistance to Pests. Marcel Dekker Inc. New York.

## **ENT-605 INSECTICIDES AND THEIR APPLICATION**

**4(3+1)**

### **OBJECTIVES:**

To provide concept of toxicity and insecticide formulations, mode of action, residues of insecticides and various types of spray equipments.

### **THEORY:**

Introduction; nomenclature, classification on the basis of mode of entry, chemical nature, mode of action, toxicity and insecticides formulations; compatibility, physico-chemical properties, mode of action, residues of insecticides; hazards and safety measures; functioning of various types of hand and power operated equipments for insecticide application.

### **PRACTICALS:**

Computation, preparation and field application of different formulations of insecticides; identification, classification, handling and maintenance of application equipments.



## **BOOKS RECOMMENDED:**

1. Dovener, R.A. Mueninghoff, J.C. and Volgar, G.C. 2002. Pesticides formulation and delivery systems: meeting the challenges of the current crop protection industry. ASTM, USA
2. Dodia, D.A. Petel, I.S. and Petal, G.M. 2008. Botanical Pesticides for Pest Management. Scientific Publisher (India) Jodhpur.
3. Ishaaya, I. and Degheele, D. 1998. Insecticides with Novel Modes of Action: Mechanism and Application. Norosa Publishing House, New Delhi.
4. Mathews G.A. 2002. Pesticide Application Methods. 4<sup>th</sup> Ed. Intercept. UK.
5. Otto, D. and Weber, B. 1991. Insecticides: Mechanism of Action and Resistance. Intercept Ltd., U.K.
6. Roy, N.K. 2006. Chemistry of Pesticides. Asia Printograph Shahdara Delhi.
7. Saleem, M.A. 2004. Principles of Insect Toxicology. Vol.-I. Izhar sons Printers. Lahore.

## **ENT-607 RANGE AND FOREST ENTOMOLOGY 3(2+1)**

### **OBJECTIVE:**

To provide the concept of range and forest entomology in range land and forest ecosystem.

### **THEORY:**

Importance of range and forest entomology in range land and forest ecosystems; insect pests of range and forest trees, their identification, distribution, host plants, biology, nature of damage, estimation of losses and management; competition and complementary role of insects with range livestock.

### **PRACTICAL:**

Survey and collection, preservation and identification of insect pests of range and forest trees; practical study of nature of damage and demonstration of control measure, visit of forest departments.

### **BOOKS RECOMMENDED:**

1. Barbose, P. and Wagner, M.B. 1989. Introduction to Forest and Shade Tree Insects. Academic Press, NY, London
2. Dajoz, R. 2000. Insects and Forests. Intercept Ltd. UK.
3. Jha, K. 2003. Forest Entomology. Ashish Publishing House. India.
4. Jha. L. K. and Sen-Sarma. P.K. 2008. Forest Entomology APH Publishing.

5. Knight, F.B. and Heiknen, H.J.1980. Principles of Forest Entomology. McGraw Hill, Book Co. NY
6. Sathe, T.V. 2009. A Text Book of Forest Entomology. Daya Publishing House Delhi.
7. Thakur, M.I. 2000. Forest Entomology: Ecology and Management. S.A.I. Publishing Co.

## **ENT-609 AGRICULTURE AND ENVIRONMENTAL POLLUTION 3(2+1)**

### **OBJECTIVES:**

To provide the concepts of environmental pollution and deterioration with their effects on agriculture, forest and living organisms etc.

### **THEORY:**

Introduction; general concept of pollutants; sources and nature of pollutants; environmental deterioration, its effect on agriculture; green house effect; types of pollution with reference to agriculture and forest; pesticide and fertilizer pollution; effect of pollution on soil, water, air, plants, living organisms etc; management of pollution.

### **PRACTICAL:**

Identification and determination of sources of pollution in various substrates, viz air, soil and water.

### **BOOKS RECOMMENDED:**

1. Misra, S.G. and Mani, D. 1994. Agricultural Pollution. Vols. 1 & 2, Ashih Publishing House, New Delhi.
2. Parkash, R and Choubey, S. M. 1990. Environmental Pollution and Health Hazards. Publication of Society of Biochemistry of India.
3. Rizvi, S.M.H. 1994. Fundamentals of Environmental Pollution. CBS Publishers and Distributers. 485, Jain Bhawan, Bhola Nath Nagar, Shahdara, Delhi.
4. Ashfaq M. and Saleem, M.A. 2010. Environmental Pollution and Agriculture. Pak Book Empire, Lahore.
5. Suhail, A and Ahmad, S. 2003. A Workbook of Agriculture & Environmental Pollution. Deptt. of Agri. Entomology, University of Agriculture, Faisalabad.

## **ENT-611 SCIENTIFIC WRITING AND PRESENTATION 3(0+3)**

### **OBJECTIVES:**

To familiarize the students to research methods, handling of experimental data and writing of a research report.



2. Bellows, T.S. Fisher, T.W. Caltagirone, L.E. Dahlsten, D.L. Huffaker, C. and Gardh, G. 1999. Handbook of Biological Control: Principles and Applications of Biological Control. Academic Press, USA.
3. Copping, L.G. 2004. The Manual of Biocontrol Agents. BCPC
4. De Bach, P. and Rosen, D. 1991. Biological Control by Natural Enemies. CUP Archive.
5. Hajek, A. 2003. Natural Enemies: An Introduction to Biological Control. Cambridge University Press
6. Hawkins, B.A. and Cornell, H.V. 1999. Theoretical Approaches to Biological Control. Cambridge University Press
7. Heikki, M.T. Hokkeanen, J. Lynch, M. 1996. Biological Control: Benefits and Risks. Cambridge University Press.
8. Irshad, M. 2008. Biological Control of Insects and Weeds in Pakistan. Higher Education Commission, Islamabad, Pakistan.
9. Rechcigl, J.E. and Rechcigl, N.A. 1999. Biological and Biotechnological Control of Insect Pests. CRC Press September
10. Van Driesche, R.G. and Bellows, T.S. 1996. Biological Control. An International Publishing Company, New York.

**ENT- 612**

**APICULTURE**

**3(2+1)**

**OBJECTIVES:**

To provide the concepts of different species of bees and their behavior and to provide awareness of bee keeping, diseases of bees and their management.

**THEORY:**

Introduction, importance, scope of apiculture industry, bee species and their biology, morphology, behavior and products, bee flora their distribution and flowering time; beekeeping equipment, seasonal management, uniting, dividing and preparation for shifting colonies; bee stings, queen rearing and swarming; pest and diseases of bees and their management; honey extraction; factors affecting honey yield; importance of bees in pollination; honey, its properties and uses; granulation, fermentation and storage of honey, uses of other bee products; beekeeping as an enterprise.

**PRACTICALS:**

Practical demonstration of bee colonies, observation of colonies and different casts; beekeeping equipments; preparation of frames and comb foundation for their hives; colony inspection; visit to apiaries.

**BOOKS RECOMMENDED:**

1. Ahmad, R. 1979. A Guide to Bee Keeping in Pakistan. Extension Book.
2. Devillers, J., Phame, M. and Delegue, M. 2002. Honey Bees.

3. Goodwin, R.N. and Van Eaton, C. 1999. Elimination of American Foulbrood without the use of Drugs. A Practical Manual for Bee Keepers. National Bee Keepers Association of New Zealand, Napier, New Zealand.
4. Hooper, T. 1991. Guide to Bees and Honey. BAS Printers Ltd. Hampshir, UK.

## **8<sup>TH</sup> SEMESTER**

**ENT-608                      INTERNSHIP                      4(0+4)**

(Including report writing and presentation)

### **Evaluation Chart**

1.     25% To the supervisor of host institution.
2.     25% Reporting, collection and presentation, evaluated by the proposed committee.
3.     25% Written examination conducted by the proposed committee: 50 from academics and 50% from internship report.
4.     25% Oral examination conducted by proposed internal examiner, external examiner / committee.

# CURRICULUM FOR M.Sc. (Hons.) Agri. ENTOMOLOGY

## SCHEME OF STUDIES

### NOTE:

1. For the award of degree for M.Sc.(Hons.) Agri. Entomology, thesis carries 6 credit hours.
2. Minimum credit hours should be 30 including minor subjects which shall not exceed one-third.
3. Total credit hours should not exceed 36 including thesis.

The following titles are recommended for Post-graduate courses for all the universities. However, each university shall be free to add more or re-arrange these in accordance with the facilities available. A student will take only those courses which the Supervisory Committee recommends for him/her.

<b>S.No.</b>	<b>Course No.</b>	<b>Title</b>	<b>Credit Hours</b>
1.	ENT-701	Research Methods in Entomology	3(2+1)
2.	ENT-702	Origin and Phylogeny of Insects	3(3+0)
3.	ENT-703	Environmental Entomology	2(2+0)
4.	ENT-704	Advanced Insect Morphology	3(2+1)
5.	ENT-705	Advanced Insect Ecology	3(2+1)
6.	ENT-706	Numerical Taxonomy	3(2+1)
7.	ENT-707	Advanced Insect Physiology and	3(2+1)
8.	ENT-708	Insect Molecular Biology	3(2+1)
9.	ENT-709	Insecticide Resistance and Management	3(2+1)
10.	ENT-710	Insects in Relation to Plant Diseases	3(2+1)
11.	ENT-711	Medical and Veterinary Entomology	3(2+1)
12.	ENT-712	Acarology	3(2+1)
13.	ENT-713	Classification of Immature Insects	3(2+1)
14.	ENT-714	Insecticide Toxicology	3(2+1)
15.	ENT-715	Insect Nutrition	2(1+1)
16.	ENT-716	Insecticide and Public Health	2(2-0)
17.	ENT-717	Advances in Biological Control of Insect	3(2+1)
18.	ENT-718	Advanced Insect Behaviour	3(2+1)
19.	ENT-719	Special Problem	1(1+0)

20.	ENT-720	Seminar	1(1+0)
21.	ENT-721	Insecticides Application Equipment	3(2+1)
22.	ENT-722	Advances in Pest Management Research	2(2+0)
23.	ENT-723	Insect Cytogenetics and Cytotaxonomy	3(2+1)
24.	ENT-724	Insect Pathology	3(2+1)
25.	ENT-725	Insect Biochemistry	3(2+1)
26.	ENT-726	Chemical Ecology	2(2+0)
27.	ENT-726	Forensic Entomology	2(2+0)

## DETAIL OF COURSES

### ENT-701 RESEARCH METHODS IN ENTOMOLOGY 4(2+2)

#### OBJECTIVE:

To enable students get familiarized with modern equipments used in Entomological Research and provide concept of software in data analysis.

#### THEORY:

Introduction; techniques and apparatus employed in entomological research: temporary and permanent mounts, microtomy, use of ocular grid, micrometry and scientific photography; bio-assay techniques; atomic absorption spectrophotometer, gas chromatography, high performance liquid chromatography, UV-visual spectrophotometer, amino acid analyzer, electrophoresis, PCR, recombinant DNA techniques, ultra-centrifugation, scanning and transmission, electron microscopy and computer software in entomology; methods of sampling, analysis of data and report writing; lab/field experimental techniques.

#### PRACTICALS:

Insect sampling, collection and preservation techniques; culturing devices; exercises in microtomy, preparation of permanent slides, soft wares for morphometrics and data analysis; scientific photography; electron microscopy; maintenance and measurement of microclimate; use of different equipment in entomological experiments, tabulation, analysis and interpretation of data; bioassay; demonstration of insect DNA amplification through PCR methods.

#### BOOKS RECOMMENDED:

1. Bancroft, J.D. and Stevens, A. 1990. Theory and Practice of Histological Techniques. Chaschill Livingstone, London.
2. Binns, M.R. 2000. Sampling and Monitoring in Crop Protection. CABI Publishing Company
3. Cappiello, A. 2007. Advance in LC-MS Instrumentation. Elsevier Publishers, USA.
4. Erlich, H. 1992. PCR Technology: Principles and Applications for Amplification. W.H. Freeman & Company, New York.
5. Singh, P. and Moore, R.F. 1985. Handbook of Insect Rearing. Vol, I & II, Elsevier, U.S.A.



**OBJECTIVES:**

To provide the basic concept of insect origin in the time dimension.

**THEORY:**

Introduction; evolutionary groups of insects; geological time table in relation to origin; evolutionary history of insects; theories of origin of insects; mechanisms of evolution: cytological, cytotaxonomic and embryological evidences; phylogenetic theories; origin of species and higher categories; phylogenetic arrangement of orders and families; variation; fossil history of insects.

**BOOKS RECOMMENDED:**

1. Dodson, E.C. and Dodson, I. 1986. Evolution, Process and Product. 4<sup>th</sup> Ed. I.W.S. Publishers.
2. Grimaldi, D. and Engel, M.S. 2005. Evolution of Insects. Cambridge University Press.
3. Hennig, W, 1981. Insect Phylogeny. Wiley Intersciences, London.
4. Kapoor, V.C. 1987. Origin and Evolution of Insects. Kalyani Publishers, New Delhi.
5. Triplehorn, C.A. and Johnson, N.F. 2005. Borror and DeLong's Introduction to the Study of Insects. Books Cole. 7th Ed.
6. Wiley, E.C. 1981. Phylogenetics. The Theory and Practice of Phylogenetic Systematics. John Wiley and Sons Inc., New York.

**OBJECTIVES:**

To provide the basic concept of impact of environment on insects, and insects as indices of environmental changes.

**THEORY:**

Introduction; diversity of insects in different ecosystems; interactions of various groups of insects with biological, chemical and physical constituents of the environment; physical and chemical characterization of environmental contaminants, impact of pollutants on insects and non-target organisms at different levels; biological responses to pollutants and biogeochemical cycles; insects as indicators of levels of pollution.

## **BOOKS RECOMMENDED:**

1. Cbiran, D.D. 2010. Environmental Science. 8<sup>th</sup> Edition Jones and Bartlett Publishers, London
2. Gregory, K.J. Simmons, I.G. Brazel, A.J. Day, W.J. Keller, E.A. Sylverter, A.G. and Yanez. A,A. 2009. Environmental Science: a Students companion. SAGE London.
3. Huffaker, C.B. 1999. Ecological Entomology. John Wiley Sons.
4. McEwen, F.L. and Stephenson, G.I. 1979. The Use and Significance of Pesticides in the Environment. John Wiley and Sons Inc., N.Y.
5. Perry, A.S. 1998. Insecticides in Agriculture and Environment: Retrospects and Prospects. Elsevier, New York.
6. Ashfaq, M. and Saleem, M.A. 2010. Environmental Pollution and Agriculture. Pak Book Empire, Lahore, Pakistan.
7. Yazdani, S.S. and Agarwal, M. I. 1997. Elements of Insect Ecology. Narosa Publishing House, New Delhi.

## **ENT-704    ADVANCED INSECT MORPHOLOGY    3(2+1)**

### **OBJECTIVES:**

To provide the concept of structure and function of various organs and organ systems of insects.

### **THEORY:**

Introduction; study and structure of integument, sclerites and processes (setae, spines, spurs, scales, etc.); structure of insect head and its endo-skeleton; appendages and modifications of insects mouth-parts; segmentation of head, thorax and their appendages; endo-thorax, origin and modification of wings, wing coupling apparatus, wing development, modification of insect leg, abdomen and its appendages, insect genitalia, its origin and development in various insect orders and families; proctiger and caudal appendages, insect soft-parts including digestive, circulatory, respiratory, excretory, nervous, muscular and reproductive organs, scent, sound and light producing apparatus; tricho-bothria in adult and immature insects; thermoregulatory, visual, auditory and glandular organs in insects.

### **PRACTICAL:**

Comparative structure of insect head, thorax, abdomen and their appendages in different insect orders; preparation of temporary and permanent mounts of different body parts and integument; origin and comparative structure of genitalia in various insect orders, examination of different types of setae, spines, spurs and scales in insects; dissection of soft-parts and organ systems; study of visual, auditory, thermoregulatory,

scent, sound producing and luminous organs.

### **BOOKS RECOMMENDED:**

1. Chapman, R.F. 2002. The Insects: Structure and Function. 3<sup>rd</sup> Ed. Hodder and Stoughton Ltd., U.K.
2. Duporte, E.M. 1977. Manual of Insect Morphology. Reinhold Publishing Corp., N.Y.
3. Matsuda, R. 1970-75. Morphology and Evolution of Insect Head, Thorax, Abdoman. Mem. Ent. Soc. Canada.
4. Matsuda, R.. 1975. Morphology and Evolution of Abdomen. Pergamon Press.
5. Rockstein, M. (Edit.). 1973-1974. Advances in Insect Physiology. Vols. 1-6 2<sup>nd</sup> Edition. Academic Press, N.Y.
6. Snodgrass, R. 1993. Principles of Insect Morphology. Cornell Uni. Press, U.S.A.

## **ENT-705    ADVANCED INSECT ECOLOGY    3(2+1)**

### **OBJECTIVES:**

To provide the basic concepts of population growth of insects in different environmental parameters and to simulate the population structures in marine climatic conditions to software technology.

### **THEORY:**

Population growth, theories, life-tables, key factors, analysis, regression, co-existence, co-habitation, competition and mutual displacement, variation, speciation and diversity. A mathematical approach to the dynamics of single and multi-species populations and communities with analytical and simulation model techniques: mathematical and statistical techniques applied to population systems and community ecologies; critical survey of models of population growth, niche matrices, competition, predation, ecological genetics, species diversity and distribution, and ecological succession.

### **PRACTICAL:**

Use of computer simulations in population of agricultural pests: computer modeling used by Ecologists to clarify and interpret large field data by clustering, transforming, matrices and multi-variate analysis.

### **BOOKS RECOMMENDED:**

1. Atwal, A.S. and Bains, S.S. 2005. Applied Animal Ecology. Kalyani Publishers, Ludhiana.
2. Bernstein, R. 2003. Population Ecology: An Introduction to Computer Simulations. Willy, New York.
3. Blackith, R.E. and Rayment, R.A. 1984. Multivariate Morphometrics.

Academic Press, London.

4. Price, P.W. 2003. Insect Ecology. 3rd Ed. Wiley Interscience Publishers, N.Y.
5. Rockwood, L.L. 2006. Introduction to Population Ecology. Wiley, John & Sons, Incorporated.
6. Southwood, T.R.E. and Henderson, P.A. 2000. Ecological Methods. 3<sup>rd</sup> Ed. Wiley-Blackwell.
7. Vandermeer, J.H. and Goldberg, D.E. 2003. Population Ecology: First Principles. Princeton University Press.

## **ENT-706 NUMERICAL TAXONOMY 2(1+1)**

### **OBJECTIVE:**

To provide awareness of mathematical modeling of the origin of various insect groups and their relationship.

### **THEORY:**

Introduction; aims and principles of numerical taxonomy; data and its types; taxonomic characters, their selection, coding and weightage; handling of data; taxonomic evidence, estimation of taxonomic resemblance, construction of a taxonomic system; theory of ranking; population analysis by different methods; phenetic analysis; comparison of faunal elements and contemporary approach to classification; phenograms/ dendrograms.

### **PRACTICAL:**

Characterization, coding and preparation of matrices, generation of phenograms by applying coefficients of association, correlation and taxonomic distance formulae; construction of phenograms/ dendrograms.

### **BOOKS RECOMMENDED:**

1. Clifford, H.T. and Stephenson, W. 1986. An Introduction to Numerical Classification. Academic Press, New York, London.
2. Dung, G. and Everitt, B.S. 1982. An Introduction to Mathematical Taxonomy. Cambridge Uni. Press, Cambridge.
3. Duncan, T. and Stuessy, T.F. (Eds.) 1985. Cladistics. Theory & Methodology. New York, Van Nostrand Reinhold, Press.
4. Blackith, R.E. and Rayment, R.A. 1984. Multivariate Morphometrics. Academic Press, London.
5. Sneath, P.H.A. and Sokal, R.P. 1973. Numerical Taxonomy. W. R. Freeman & San-Francisco, U.S.A.
6. Wheeler, Q.D. 2008. The New Taxonomy. CRC Press London, New York.

7. ENT-707      **ADVANCED INSECT PHYSIOLOGY AND EMBRYOLOGY**      3(2+1)

**OBJECTIVES:**

To provide concepts of comparative soft parts, their functions and origin in different insect orders and families.

**THEORY:**

Introduction; advances in physiology of integument, growth, development, diapause, digestion, respiration, circulation, excretion, reproduction, reception and perception; neuro-muscular physiology; enzymatic functions, biological clocks; embryonic development and organogenesis in different groups of insects; study of comparative embryology in different groups of insects, physiology of locomotion and resistance; hormones, pheromones, glandular secretion, thermoregulation, sound and light production.

**PRACTICAL:**

Hormonal control of insect growth, development and breaking of diapause; digestion in different parts of alimentary canal and salivary glands; oxygen consumption, carbon dioxide production and determination of respiratory quotient; qualitative and quantitative analysis of haemocytes; estimation of blood proteins, uric acid in excreta and water loss; pheromones as sex attractants; determination of visual, gustatory, olfactory, acoustic, thermoregulatory responses and experiment on wing beat frequency.

**BOOKS RECOMMENDED:**

1. Berridge, M.J. and Treherne, J.E. 1982. Advances in Insect Physiology. Vol 16, Academic Press Inc.
2. Blum, M.S. 1985. Fundamentals of Insect Physiology. John Wiley and Sons, N.Y.
3. Chapman, R.F. 1998. The Insects; Structure and Function. 4<sup>th</sup> Ed. American Elsevier Publishing Co., Inc. N.Y.
4. Howse, P. Stevens, I. and Jones, O. 1998. Insect Pheromones and their Use in Pest Management. Chapman and Hall, London.
5. Kerkut, G.A. and Gilbert, L.I. 1985. Comprehensive Insect Physiology, Biochemistry and Pharmacology. Vols. 1-12, Pergamon Press, Oxford, New York, Toronto, Sydney, Paris, Frankfurt.
6. Rockstein, M. (Edit.). 1973-1974. Advances in Insect Physiology Vols. 1-6 2<sup>nd</sup> Ed. Academic Press, N.Y.
7. Wigglesworth, V.B. 1984. Insect Physiology, Springer.

**OBJECTIVES:**

To provide the modern molecular concepts of Insect Genome System and its applications in Bio-diversity studies.

**THEORY:**

Introduction; insect genomes; nucleus, chromosomes, DNA and RNA; Gene structure and function; gene transcription and translation; concept of introns and exons; central dogma of molecular biology; polymerase chain reaction (PCR), gene cloning and sequencing; restriction analysis, gene libraries; DNA for insect species identifications and insect population diversity; DNA for phylogenetic analysis and construction of phylogenies; RAPD, RFLP and PCR-RFLP; linkage and chromosomal mapping, genes regulatory processes, mutagenesis; molecular basis of insect functions (insect behavior, insecticidal resistance), gene knock-ins and knock-outs by RNA interference, DNA and protein sequence alignments and use of bioinformatics tools.

**PRACTICALS:**

Demonstration of insect DNA extractions, PCR amplification, gene cloning and plasmid DNA extractions, DNA hybridization (Southern and northern blots); RAPD, RFLP analysis techniques, use of Bio-Informatics software tools.

**BOOKS RECOMMENDED:**

1. Gilbert, L. 2005. Comprehensive Molecular Insect Science. 1-7 Vol.
2. Glick, B.R. and Pasternek, J..J. 1998. Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press. Washington D.C.
3. Hall, B.G. 2007. Phylogenetic Trees Made Easy: A How to Manual. 3<sup>rd</sup> Ed. Sinauer Associates.
4. Handler, A. M. James, A.A. (Eds.).2004. Insect Transgenesis: Methods and Applications, Comprehensive review of insect gene transfer, its methodologies, applications and risk assessment and regulatory issues. CRC Press.
5. Hoy, M.A.2000. Insect Transgenesis: Methods and Application. CRC Press.

**OBJECTIVES:**

To provide the modern concepts of insecticide resistance and genotoxicity in various insect populations.

**THEORY:**

Introduction; development and types of resistance; mechanism of resistance: morphological, physiological, biochemical and genetic; metabolism of insecticides; detoxification mechanism in insects: phase-I reactions such as oxidation, hydrolysis, reduction and dehydrochlorination etc.; phase-II reaction such as conjugation; multiple pathways, induction of detoxification enzymes; management of resistance; genotoxicity.

**PRACTICALS:**

Collection of potentially resistant strains of insects from the insecticide sprayed fields; detection of level of resistance in resistant strains in *Drosophila* and other insect populations; biochemical basis of resistance; demonstration of resistance breaking techniques.

**BOOKS RECOMMENDED:**

1. Denholm, I. 1999. Insecticide Resistance from Mechanism to Management. Prentice Hall. London.
2. Green, M.B. LeBaron, H.M. and Moberg, W.K. (Eds.). 1990. Managing Resistance to Agrochemicals. American Chemical Society. Washington.
3. Gupta, H.C.L. 1999. Insecticides: Toxicology and Uses. Agrotech Publishing Academy, Udaipur.
4. Onstand, D.W. 2007. Insect Resistance Management. Academic Press.
5. Pedigo, L.P. 2007. Entomology and Pest Management 5<sup>th</sup> Ed. Prentice Hall, Intl. Limited, London.
6. Peshin, R. 2009. Evaluation of Insecticide Resistance Management Program: Theory and Practice.
7. Roush, R.T. and Tabashnik, B.E. (Eds.). 1990. Pesticide Resistance in Arthropodes. Chapman & Hall. New York.
8. Saleem, M. A. 2005. Insecticides Resistance and Management. B.Z. University Press, Multan.
9. Tlo, D. and Webbler, B. 1992. Insecticides Mechanism of Action of Resistance. Intercept Ltd. UK.
10. US National Academy of Sciences. 1986. Pesticide Resistance: Strategies and Tactics for Management. National Academy Press. Washington.
11. Walia, S. and Parmar, B.S. 1995. Pesticide, Crop Protection and

- Environment. Oxford & IBH Publishing Co. New Delhi, Calcutta.
12. Watson, D.L. and Brown, A.W. 1997. Pesticide Management and Insecticide Resistance. Academic Press Inc. USA.
  13. Wilkinson, C.F. 1976. Insecticides Biochemistry and Physiology. Heyden, London, New York, Rheine.

**ENT-710      INSECTS IN RELATION TO PLANT      3(2+1)**  
**DISEASES**

**OBJECTIVES:**

To provide the broad overview of insects in relation to plant diseases with special emphasis on vectorial status.

**THEORY:**

Introduction; identification, biology of insect and mite vectors of plant diseases; mode of transmission of plant pathogens by insects and mites; study of causal organisms, etiology, symptoms and control of important fungal, bacterial and viral diseases of crop plants transmitted by insects and mites.

**PRACTICAL:**

Identification of insect and mite vectors and pathogens; rearing and handling of insect vectors for plant pathological studies. Study of mode of transmission of plant pathogens by insect and mite vectors.

**BOOKS RECOMMENDED:**

1. Boucias, D.G. 1998. Principles of Insect Pathology. Chapman Hall, London.
2. Jeppson, L.R. Keifer, H.H. and Baker, E. W. 1975. Mites Injurious to Economic Plants. Univ. Calif. Press.
3. Leach, J.B. 2007. Insect Transmission of Plant Diseases. Biotech Books. Delhi, India.
4. Tanada, Y. 1992. Insect Pathology. Academic Press.

**ENT-711      MEDICAL AND VETERINARY ENTOMOLOGY      3(2+1)**

**OBJECTIVES:**

To provide the modern concepts of identification, biology, epidemiology of insects and other arthropods of medical importance.



## **THEORY:**

Introduction; epidemiology; identification, biology and control of insects and other arthropods of medical and veterinary importance; insect and some other arthropods transmitted diseases, their symptoms and diagnosis; venoms, defense secretions and allergens.

## **PRACTICAL:**

Collection, identification and control of different insects and arthropod pests of medical and veterinary importance in relation to diseases of man and domestic animals.

## **BOOKS RECOMMENDED:**

1. Aldridge, B. 2004. Medical Entomology: Text Book of Public Health and Veterinary. Chapman and Hall, London.
2. Busvine, J.R. 1980. Insects and Hygiene. 3<sup>rd</sup> Ed. Chapman and Hall, London.
3. Harwood, R.F. and James, M.T. 1979. Entomology in Human and Animal Health. 7<sup>th</sup> Ed. Macmillan Publishing Co., Inc., N.Y.
4. James, M.T. and Hardwood, R.F. 1969. Herms Medical Entomology. The Macmillan Company Canada.
5. Kettle, D.S. 1995. Medical and Veterinary Entomology. (2<sup>nd</sup> Ed.), CAB International, UK.
6. Mullen, G. 2009. Medical and Veterinary Entomology. 2nd Ed. Academic Press.
7. Service, M. 2004. Medical Entomology for Students. Cambridge University Press.

## **ENT-712 ACAROLOGY 3(2+1)**

### **OBJECTIVES:**

To provide awareness of the importance of mites and their impacts on crops, vegetables, fruits and stored products.

### **THEORY:**

Introduction; methods of collection, rearing and preservation of different spiders, mites and other related organisms; external and internal morphology; physiology, reproduction and development; mites as pests of important crops, vegetables, fruit trees, stored products and their management; parasitic and predatory mites; losses caused by and control of mite pests; ecology and dispersal; methods of estimation of mite population; classification of mites; mites and plant diseases; resistance mechanism in mites.

## **PRACTICAL:**

Collection, preservation, sampling and rearing techniques and identification of phytophagous, predatory, parasitic and stored grain mites and spiders; preparation of permanent slides of mites and spiders; estimation of mite population and losses in crops, vegetables, fruit plants and stored grains.

## **BOOKS RECOMMENDED:**

1. Chhillar, B.S. and Gulati, R. 2007. Agricultural Acarology. Daya Publishing House.
2. Evans, G.O. 1992. Principles of Acarology. C.A.B. International Cambridge University Press, Cambridge.
3. Helle, W. and Sabelis, M.W. (Edit.), 1985. Spider Mites, Their Biology, Natural Enemies and Control. Vols. IA. and IB. Elsevier Oxford, U. K.
4. Khuro, R.D. 1998. Introduction to Acarology. Kashif Publications, Hyderabad (Sindh), Pakistan.
5. Krantz, G.W. 1978. A Manual of Acarology. 2<sup>nd</sup> Ed. Oregon State Univ. Book Store Inc., Corvallis, Oregon, USA.
6. Krantz, G.W. and Walter, D.E. 2009. A Manual of Acarology. Texas Tech. University Press.
7. Rodriguez, J.G. (Edit.), 1979. Recent Advances in Acarology. Vol. I & II. Academic. Press Inc., N.Y.
8. Schuster, R. and Murply, P.W. 1991. The Acari, Reproduction, Development and Life History Strategies. Champman & Hall, USA.
9. Woolley, T.A. 1988-01. Acarology, Mites and Human Welfare. JohnWiley & Sons.
10. Zhang, Z.Q. 2003. Mites of Green Houses: Identification Biology and Control. Elsevier, New York.

## **ENT-713 CLASSIFICATION OF IMMATURE INSECTS 3(2+1)**

### **OBJECTIVES:**

To impart knowledge of important structure of eggs and immature stages of insects of different orders.

### **THEORY:**

Introduction; study of eggs and immature stages of insects; types of eggs and chaetotaxi of various immature stages for their identification purposes; development of keys for identification of eggs and immature stages of economically important orders up to family level, classification and phylogeny of various insect groups through their eggs and immature stages.

### **PRACTICAL:**

Collection, preservation, preparation and identification of egg types and

immature stages up to family level; study of chaetotaxi; use of keys for identification of eggs, larvae and immature stages and construction of cladograms by using the above characters.

### **BOOKS RECOMMENDED:**

1. Chu, H.F. 1983. How to know the Immature Insects. W.M.C. Brown Co., Publishers, Iowa, USA.
2. Johnson, F.N. and Triplehorn, A.C. 2004. Introduction to The Study of Insects. 7<sup>th</sup> Ed. Books Cole.
3. Lawrence, J.F. Hastings, A.M. Dallintz, M.J. Palmy, T.A. and Zurcher, E.J. 1999. Beetle larvae of the world. CSIRO. Australia.
4. Peterson, A.R. 1960. Larvae of Insects. Part-II, 4<sup>th</sup> Ed. Edwards Brothers Inc., Arbor, Michigan.
5. Peterson, A.R. 1962. Larvae of Insects. Part-I, 4<sup>th</sup> Ed. Edwards Brothers Inc., Arbor, Michigan.
6. Stehr, F. 1991. Immature Insects. Vol. I&II. Kendall - Hunt Publishing, U.S.A.

## **ENT-714                    INSECTICIDE TOXICOLOGY    3(2+1)**

### **OBJECTIVES:**

To impart knowledge about toxicity of important groups of insecticides in insects and higher animals with reference to their biochemical and genetic basis of mechanism of action.

### **THEORY:**

Introduction; general concepts of insecticide toxicology; theory and principles of bioassay; chemistry and comparative toxicology of some common insecticides; mechanism of action of major groups of insecticides; mammalian and phytotoxicity of insecticides; enzyme activation and inhibition by insecticides at various levels; detoxification mechanisms; joint action of insecticides, (synergism and antagonism); handling and standardization of insects in insecticide tests; methods for testing of formulations of different groups of insecticides under field and laboratory conditions.

### **PRACTICAL:**

Laboratory equipment used in toxicology experiments; gross symptoms produced by representative insecticide groups; relationship between dosages and responses; use of time-mortality determination in comparing the relative toxicity of insecticides; preparation of spectral transmittance and concentration transmittance curves; bioassay of insecticides.

### **BOOKS RECOMMENDED:**

1. Gupta, H.C.L. 2001. Insecticides: Toxicology and Uses. Agrotech Publishing Academy, Udaipur.
2. Hassal, K.A. 1990. The Biochemistry and Uses of Pesticides:

Structure, Metabolism, Mode of Action and Uses in Crop Protection. ELBS/Macmillan, U.K.

3. Ishaaya, I. and Degheele, D. 1998. Insecticides with Novel Modes of Action: Mechanism and Application. Norosa Publishing House, New Delhi, Madras, Bombay, Calcutta, London.
4. Robert. I. and Krieger, W.C. 2001. Handbook of Pesticide Toxicology. 2<sup>nd</sup> Ed. Elsevier Inc.
5. Saleem, M.A.2004. Principles of Insect Toxicology. Izhar sons Printers, Lahore.
6. Sree Ramulu, U.S. 1995. Chemistry of Insecticides and Fungicides. (2<sup>nd</sup> Ed.) Oxford & IBH Publishing Co. Pvt. New Delhi, Bombay, Calcutta.
7. Srivastava, R.P. 1989. A Text Book of Insect Toxicology. Himanshuw Publication.
8. Wilkinson, C.F. 1976. Insecticides Biochemistry and Physiology. Heyden, London, New York, Rheine.
9. Yu, S.J. 2008. The Toxicology and Biochemistry of Insecticides. University of Florida, USA.

## **ENT-715 INSECT NUTRITION**

**3(2+1)**

### **OBJECTIVE:**

To impart knowledge on insect synthetic diets for promotion of their natural growth and culture.

### **THEORY:**

Introduction; dietary requirements of insects; micro and macro nutrients with their role in insects diet; artificial diets for insects culture; micro-organisms and insect nutrition, co-efficient of digestion, metabolism and growth; nutrition and host specificity; phago-stimulation.

### **PRACTICAL:**

Preparation of synthetic diets for different groups of insects; rearing of insects on synthetic, semi-synthetic and natural diets; determination of co-efficient of utilization.

### **BOOKS RECOMMENDED:**

1. Cohen, A.C. 2004. Insect Diets: Science and Technology. CRC Press.
2. Gilmour, D. 1965. The Metabolism of Insects. Oliver and Boyed. Edinburgh and London.
3. Rodrigues, J. G. 1972. Insects and Mite Nutrition. Significance and Implications in Ecology and Pest Management. North Holland Publ. Co., Amsterdam, London.
4. Singh, P. 1977. Artificial Diets for Insects, Mites and Spiders. Plenum Publ. Corporation, N.Y.

## **ENT-716 INSECTICIDES AND PUBLIC HEALTH 3(2+1)**

### **OBJECTIVE:**

To provide advance concepts of insect poisoning and residual effects on farmers and their perception on safe use of insecticides.

### **THEORY:**

Insecticides poisoning and its importance to public health; spread of toxic effects of insecticides in farmers, field workers and their domesticated animals; distribution of pesticide residues in soil, ground water, drinking wells and air; symptoms of poisoning due to insecticide residues in blood, fat bodies etc. and the acute diseases they cause; public health and environmental consideration; farmers perception of acute poisoning and safe measures; first aid procedures; laboratory verification; treatment of insecticide poisoning; insecticides monitoring; safe use of insecticides; knowledge of antidotes; transport, storage and disposal of insecticides; registration and labeling.

### **PRACTICAL:**

Determination of pesticide residues in soil, water, vegetables fruits, milk, cereals, human blood, fat bodies and vital organs; questionnaire for finding farmers perception about pesticide poisoning.

### **BOOKS RECOMMENDED:**

1. Dhaliwal, G.S. and Singh B. 2000. Pesticides and Environment. Commonwealth Publishers. New Delhi. India.
2. Gupta, H.C.L. 2001, Insecticides: Toxicology and Uses. Agrotech Publishing Academy, Udaipur
3. Oudejans J.H.1991. Agropesticides and Functions in Integrated Crop Protection. ESCAP. United Nations. Bangkok, Thailand.
4. Ashfaq, M. and Saleem. M.A. 2010. Environmental Pollution and Agriculture. Pak Book Empire, Lahore, Pakistan.

## **ENT-717 ADVANCES IN BIOLOGICAL CONTROL 3(2+1)**

### **OBJECTIVE:**

To provide modern concepts of the principles of biological control, culture, screening, introduction, augmentation and conservation of natural enemies, super, multi and hyper parasitism and their problems in biological control.

## **THEORY:**

Introduction; history, development and scope of biological control with special reference to Pakistan; ecological basis of biological control; biological characteristics of natural enemies (predators, parasitoids, microorganism); scope and problems in introduction, culture, screening, release, augmentation, conservation and establishment of natural enemies; modern tools of estimating parasitism levels, host-parasitoid and host-predator interaction; integration of chemical and biological control; problems of super, multi and hyper-parasitism and predators; current research in biological control

## **PRACTICAL:**

Survey and collection of natural enemies, identification, culture and screening of parasitoids, predators and micro-organisms of economic importance; study of extent of parasitism / predation of different biocontrol agents, parasitism estimates by dissection, host-rearing and PCR.

## **BOOKS RECOMMENDED:**

1. Gunasekaran, M. and Weber, D. 1996. Molecular Biology of the Biological Control of Pests and Diseases of Plants. ESA Publications, U.S.A.
2. Gunaskaran, M. 1995. Molecular Biology of Biological Control of Pests and Diseases. Fisk University.
3. Hajek, A. 2004. Natural Enemies: An Introduction to Biological Control. Cambridge University Press.
4. Irshad, M. 2008. Biological Control of Insects and Weeds in Pakistan. HEC Islamabad.
5. Lentern, J.C.V. 2003. Quality Control and Production of Biocontrol Agents. Theory and testing procedures.
6. Maramorosch, K. 1991. Biotechnology for Biological Control of Pests and Vectors. CRC Press, U.S.A.
7. Pedigo, L.P. 2007. Entomology and pest management. 5<sup>th</sup> Ed. Prentice Hall, Intl. Limited, London.
8. Rechcigl, J.E. Rechcigl, N.A. 1998. Biological and Biotechnological Control of Insects Pests. CRC Press.

**ENT-718    ADVANCED INSECT BEHAVIOUR                    3(2+1)**

## **OBJECTIVE:**

To provide advance knowledge of hormones, pheromones and allomones related to insect behaviour.

## **THEORY:**

Introduction; sensory receptors (mechanoreception, hygromoreception, thermoreception and photoreception); nervous system and behaviour; hormones and behaviour; displacement (causes of migration, classes of migration, adaptive nature of migration); communication (bio-luminescence chemical, acoustic, visual and tactile), orientation, navigation and homing; sexual behaviour and reproduction; host selection and feeding behaviour; defense (behavioral, structural, coloration defenses); population behaviour; solitary and social behaviour; current research in insect behaviour.

## **PRACTICAL:**

Survey and communication behaviour, migration and its types, host selection, hormones and their role in behaviour, pheromones and their role in tactile behaviour, reproductive behaviour.

## **BOOKS RECOMMENDED:**

1. Dentinger, D.L. Giebultowicz, J. and Sanders, D.S. 2001. Insect Timing: Circadian Rhythmicity to Season Availability. Elsevier.
2. Febre, J.H. 1993. Insect Behaviour. Discovery Publishing House.
3. Fellows, M. and Holloway, G. 2005. Insect Evolutionary Behavior. CABI
4. Greenfield M.D. 2002. Signals and Receivers: Mechanism and Evolution of Arthropod Communication. Oxford University Press.
5. Parihar, R. 2001. Reproductive Behaviour and Biology of Sex. Dominant Publishers and Distributors, Delhi.
6. Prakash, M. 2008. (Encyclopedia of Entomology II) Insect Behaviour. Discovery Publishing House, PVT. LTD. Darya Ganj, New Delhi.
7. Research Journals: Journal of Insect Behavior.
8. Ryan, M.F. 2002. Insect Chemoreception Fundamental and Applied. Kluwer.
9. Vijay K. 2008. Insect Behaviour. Vista International Publication House.

<b>ENT-719</b>	<b>SPECIAL PROBLEMS</b>	<b>1(1-0)</b>
<b>ENT-720</b>	<b>SEMINAR</b>	<b>1(1-0)</b>

## **ENT-721 PESTICIDES APPLICATION EQUIPMENT 3(1+2)**

### **OBJECTIVE:**

To provide latest knowledge of pesticides application equipments with special reference to advancement in agriculture.

### **THEORY:**

Introduction; history and scope of development of pesticides application equipment; different systems of application of pesticides; dusting equipment: maintenance and operation of hand dusters, bellow type dusters, rotary hand and power dusters; various types of sprayers; components of a spray machine, maintenance and operation of compression and pump systems, granular applicators; comparative study of ground and aerial application equipments; calibration methods and measurement of droplet size; fog and smoke generators.

### **PRACTICAL:**

Study of different parts, assembling and maintenance of sprayers, dusters and granule applicators; working of different application equipment, study of different types of spray guns, lances, hoses and nozzles; aerosols and aerosol bombs; calibration and measurement of droplet size through knap sack and boom sprayer.

### **BOOKS RECOMMENDED:**

1. Dovener, R.A. Mueninghoff, J.C. and Volgar, G.C. 2002. Pesticides formulation and delivery systems: meeting the challenges of the current crop protection industry. ASTM, USA
2. Mathews, G.A. 1992. Pesticides Application Methods. 4<sup>th</sup> Ed. Longman Inc., N.Y.
3. Mathews, G.A. and Thornhill, E.W. 1995. Pesticide Application Equipments for use in Agriculture. FAO Agriculture Series Bulletin
4. Pedigo, L.P. 2007. Entomology and Pest Management. 5<sup>th</sup> Ed. Prentice Hall, Intl. Limited, London.
5. Pfadt, E.R. 1985. Fundamentals of Applied Entomology. 4<sup>th</sup> Ed. The Macmillan Co., N.Y.
6. Roy, N.K. 2006. Chemistry of Pesticides. Asia Printograph Shahdara Delhi.



**OBJECTIVE:**

To impart knowledge about the Advances in Pest Management Areas with special reference to genetically modified crops, growth regulators and genetic control of pests.

**THEORY:**

Introduction; recent advances in pest scouting, determination of economic thresholds; transgenic and genetically modified crops; genetic control of insect pests; insect growth regulators; stem injection method, pheromones with reference to capillary evaporation in mating disruption technique; remote sensing of insect pests; use of radiation and radioisotopes in Entomology and other recent advances in Pest Management.

**PRACTICAL:**

Determination of pest status through modern scouting techniques for verification of economic threshold, problems of transgenic and genetically modified crops and their insect pests, use of insect growth regulators, stem injection methods, pheromones and mating disruption techniques, use of radiation in male sterilization techniques and their competition with normal males.

**BOOKS RECOMMENDED:**

1. Awasthi, V.B. 2007. Agricultural Insect Pests and their Control. Scientific Publishers (India) Jodhpur.
2. Dent, D. 1996. Integrated Pest Management. Chapman and Hall, London.
3. Gurr, G.M. Wratten, S.D. and Alteri, M.A. 2004. Ecological Engineering for Pest Management: Advances in Halritat Mani Publication for Arthropods. CSIRO, Australia
4. Mayer, C.D. 2004. Biotechnological Approach for the Integrated Management. Wiley Intersciences, London.
5. Maredia, K.M. Dakouo, D. and Mota-Sanclez, D. 2003. Integrated Pest Management in the Global Arena. CABI publishing UK.
6. Metcalf, P.I. 1990 - to date. Advances in Pest Control Research. Vols. I- to date. Inter-sciences Publishers, N.Y.
7. Upadhyay, R.K. Mukerji, K.G. Chawola B.P. and Dubey, O.P. 1998. Integrated Pest and Disease Management. A.P.H. Publishing Corp., New Delhi.

**OBJECTIVE:**

To impart modern knowledge in chromosomal morphology and chromosomal deficiencies in solving the problems of cytotaxonomy

**THEORY:**

Introduction; cell structure through electron microscopy; chromosomal structure, morphology, number, diversity, types and deficiencies; chromosomes and parthenogenesis; chromosomal ecology; modern concept of gene; gene-determined characters; environmental effect on gene expression; sex determination in insects; mutations and variations; use of chromosomes and DNA in taxonomy.

**PRACTICAL:**

Study of a typical insect reproductive cell through phase contrast and electron microscopy, types, morphology, number and chromosomal deficiencies in important insects groups for identification / classification; study of insect resistance through gene markers and their loci; study of different types of genetic variations in insects; genetical identification of species and biotypes.

**BOOKS RECOMMENDED:**

1. Blackman, R.L. Hemitt, G.M. and Ashburner, M. 1980. Insect Cytogenetics. Black-Well Scientific Publications, Oxford, London.
2. Dnyansayer, V.R. 1992. Cytology and Genetics. Tata McGraw-Hill Publishing Co. New Delhi.
3. Hajorie, A.H. 1994. Insect Molecular Genetics. Academic Press, USA.
4. Hoy, M.A. 2003. Insect Molecular Genetics: An Introduction to Principles and Applications.
5. Hoy, M. A. 2000. Insect Transgenesis: Methods and Application. CRC Press.
6. Swanson, C.P. Merz, T. and Young, W.J. 1998. Cytogenetics - The Chromosomes in Division, Inheritance and Evolution. 3<sup>rd</sup> Ed. Prentice-Hall of India Pvt. Ltd. New Delhi.

**OBJECTIVE:**

To impart knowledge in the area of insect diseases against pathogens and micro-biota.

## **THEORY:**

Introduction; history, scope and definition; resistance and immunity in insects against pathogens; types of insect pathogens; transmission, host range, persistence and virulence of insect pathogens; types of injuries and methods of infection by pathogens in insects; pathogenic diseases, their diagnosis and zoonosis; extra-cellular and intracellular micro-biota of healthy insects; control of microbial diseases of useful insects; role of pathogens in IPM.

## **PRACTICAL:**

Isolation, purification, culture and identification of insect pathogens from the diseased insects collected from the fields; diagnosis of different pathogenic diseases; control of microbial diseases of useful insects; determination of extent of pathogenicity.

## **BOOKS RECOMMENDED:**

1. Boucias, D.G. 1998. Principles of Insect Pathology. Chapman Hall, London.
2. Burges, H.D. and Hurrey, N.W. 1972. Microbial Control of Insects and Mites. Academic Press London.
3. Poinar, G.O. Jr. and Thomas, G.M. 1978. Diagnosis for the Identification of Insect Pathogens, Press. N.Y.
4. Tanada, Y. and Kaya, H. K. 1993. Insect Pathology. Academic Press, New York.

## **ENT-725 INSECT BIOCHEMISTRY**

**3(2+1)**

## **OBJECTIVE:**

To create awareness in the area of energy metabolism, nervous impulses and biochemical changes.

## **THEORY:**

Introduction; energy metabolism and production in insects; biochemistry of cuticle, muscles, flight, synaptic transmission, light production, biochromes, hormones and karomonoes; insect growth regulators and diapause in insects; metabolism and role of carbohydrates, proteins and lipids in insects; chemical control of insect behaviour; biochemical defences in insects.

## **PRACTICAL:**

Chemical identification of insect species and biotypes; pheromone extraction, its identification and control in insects; hormonal control of insect growth and development; quantitative analysis of amino acids, proteins, uric acids in haemolymph; amylase etc.

### **BOOKS RECOMMENDED:**

1. Candy, D.J. and Kilby, B.A. 1978. Insect Biochemistry and Function. 2<sup>nd</sup> ed. Chapman and Hall London.
2. Chapman, R.F. 1998. Insects: Structure and Function. 4<sup>th</sup> Ed. American Elsevier. Publ. Co. Inc., New York.
3. Gilmour, D. 1961. The Biochemistry of Insects. Academic Press London
4. Morgan, E.D. 2004 Biosynthesis in insects. T.J. Intl. USA.
5. Rockstein, M. 1978. Biochemistry of Insects. Academic Press, New York, U.S.A
6. Turner, R.B. 1977. Analytical Biochemistry of Insects. Elsevier Scientific Publishing Company New York.

### **ENT-726 CHEMICAL ECOLOGY OF INSECTS 3(3+0)**

#### **OBJECTIVE:**

To provide knowledge in the area of insect behavioral chemical and physical interaction, host selection and sexual communication.

#### **THEORY:**

Introduction, odor dispersion in still air and wind; effect of wind speed and air temperature; chemo- orientation in walking and flying insects; insect-plant interactions; biochemistry of pollination; parasitoids, host relationship, sources of parasitoid behavioral chemicals; chemical and physical interactions; warning coloration and mimicry; warning coloration and predator learning; modes of mimetic resemblance; sexual communication with pheromones and use of insect pheromones in plant protection.

### **BOOKS RECOMMENDED:**

1. Barbosa, P. and D. Letournean. 1989. Novel Aspects of Insect Plant Interactions. John Wiley & Sons . New York.
2. Bell. W.J and R.T. Carde. 1994. Chemical Ecology of insects. Chapman and Hall. London.
3. Harbone, J.A. 1998. Introduction to Ecological Biochemistry. Academic Press. London.
4. Jutsum, A.R. and Gorgen, R.F.S. 1989. Insect Pheromones in Plant Protection. John Wiley & Sons. UK.

## ENT 727 FORENSIC ENTOMOLOGY AND TECHNIQUES

3(2+1)

### OBJECTIVES:

To impart knowledge about various insect groups to solve medico-legal cases and different puzzling crimes.

### THEORY:

History and scope of Forensic Entomology. Study of various insect groups and other arthropods related to medico-legal investigations. Involvement of arthropod in puzzling events of murder, suicide, rape, physical abuse, control and trafficking determination of time or post-mortem intervals and location of the death, techniques for gathering evidences. Review and survey of insect life histories, life cycle and faunal succession of arthropods related to medico-legal cases and survey of the following insects as indicators:

Blow flies (Calliphoridae), Flesh flies (Sarcophagidae), House flies (Muscidae), Cheese flies (Piophilidae), Coffin flies (Phoridae), Lesser corpse flies (Sphaeroceridae), Sun flies (Heleomyzidae), Black soldier flies (Stratiomyidae), Rove beetles (Staphylinidae), Hister beetles (Histeridae), Carrion beetles (Silphidae), Ham beetles (Cleridae), Skin hide beetles (Dermestidae), Scarabs beetles (Scarabaeidae), Wasps (Vespidae), Ants (Formicidae), Bees (Apidae), Cloth moths (Tineidae) as a mammalian hair feeder, Macrocheles mites as feeder in early stages of decomposition, Tyroglyphids as feeder on dry skin in the later stages of decomposition.

Review of classification of ages in decomposition of human and animal remains, uses of insect and arthropods in investigation of the causes of death and the duration of PMI. Forensic entomology in public health, arthropods borne disease litigation and formulation of health policy.

### PRACTICAL:

Sampling, rearing, and preservation techniques in forensic entomology; Study of the decomposition of corpses and dead bodies; Survey, identification and biology of insects and arthropods of forensic importance; Study and analysis of court room proceedings regarding medico-legal cases; Data processing and preparation of project reports.

### BOOKS RECOMMENDED:

1. Byrd, J.H. and Costner, J.L. 2001. Forensic Entomology. CRC Press.
2. Catts, E.P. and Haskell N.H. 1990. Entomology and Death. A Procedural Guide. Joyce's Print Inc. Clemson, SC.
3. Goff, M. L. 2000. A fly for the prosecution: how insect evidence helps solve crimes. Harvard University Press, Cambridge.
4. Greenberg, B. and Kunich, J.C. 2002. Entomology and the Law: Flies as Forensic Indicators, Cambridge University Press, Cambridge.
5. Smith, K.G.V. 1986. A Manual of Forensic Entomology, Comstock's Publishing Associates, Cornell University Press, Ithaca, N.Y.

**M.Sc (Hons.) Thesis**

**(100 marks)**

## RECOMMENDATIONS

1. All the universities should implement the Revised Curriculum (2010) of Entomology in its true spirit.
2. University should arrange all Recommended Books and Software mentioned in the HEC Curriculum available in the libraries.
3. It is strongly recommended by the Committee Members that refresher courses/workshops/trainings/seminars be arranged and funded by the HEC especially in the fields of Molecular Entomology, Biotechnology, Numerical Taxonomy, Toxicology, Acarology and in the areas of Cytotaxonomy and Cladistics.
4. Collaboration between the Faculty Members of different Universities in the field of Entomology to boost their research work in highly specialized and sophisticated areas.
5. HEC should provide opportunities/ resources to the teachers to visit International /National universities/institutions and world natural history museum to study holotypes and update their knowledge in their respective fields.
6. The universities should arrange to provide sufficient number of faculty to teach courses at graduate/post-graduate levels, keeping in view student: teacher ratio per university rules as recommended by HEC.
7. Adequately qualified and trained technicians/ engineers be employed by university for the processing of samples and maintenance of sophisticated laboratory equipments. The in-service technicians/ engineers should also be provided training facilities to update their knowledge.
8. It is recommended that the universities should follow uniform thesis examination policy at post graduate level.

**DETAILS OF COMPULSORY COURSES  
COMPULSORY COURSES IN ENGLISH FOR  
Undergraduate Level**

**English I (Functional English)**

**Credit Hrs. 3(3-0)**

**Objectives:**

Enhance language skills and develop critical thinking.

**Course Contents**

Basics of Grammar

Parts of speech and use of articles

Sentence structure, active and passive voice

Practice in unified sentence

Analysis of phrase, clause and sentence structure

Transitive and intransitive verbs

Punctuation and spelling

**Comprehension**

Answers to questions on a given text

**Discussion**

General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

**Listening**

To be improved by showing documentaries/films carefully selected by subject teachers

**Translation skills**

**Urdu to English**

**Paragraph writing**

Topics to be chosen at the discretion of the teacher

**Presentation skills**

Introduction

*Note: Extensive reading is required for vocabulary building*

## **Recommended books:**

### **1. Functional English**

#### **a) Grammar**

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506

#### **b) Writing**

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.

#### **c) Reading/Comprehension**

1. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

#### **d) Speaking**

## **English II (Communication Skills)**

**Credit Hrs. 3(3-0)**

### **Objectives:**

Enable the students to meet their real life communication needs.

### **Course Contents**

#### **Paragraph writing**

Practice in writing a good, unified and coherent paragraph

#### **Essay writing**

Introduction

#### **CV and job application**

Translation skills

Urdu to English



## **Study skills**

Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

## **Academic skills**

Letter/memo writing, minutes of meetings, use of library and internet

## **Presentation skills**

Personality development (emphasis on content, style and pronunciation)

*Note: documentaries to be shown for discussion and review*

## **Recommended books:**

### **Communication Skills**

#### a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.

#### b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 45-53 (note taking).
2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

#### c) Reading

1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
2. Reading and Study Skills by John Langan
3. Study Skills by Richard Yorke.

# English III (Technical Writing and Presentation Skills)

Credit Hrs: 3(3-0)

## Objectives:

Enhance language skills and develop critical thinking

## Course Contents

### Presentation skills

### Essay writing

Descriptive, narrative, discursive, argumentative

### Academic writing

How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

### Technical Report writing

### Progress report writing

*Note: Extensive reading is required for vocabulary building*

## Recommended books:

Technical Writing and Presentation Skills

### a) Essay Writing and Academic Writing

1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
2. College Writing Skills by John Langan. Mc=Graw-Hill Higher Education. 2004.
3. Patterns of College Writing (4<sup>th</sup> edition) by Laurie G. Kirsner and Stephen R. Mandell. St. Martin's Press.

### b) Presentation Skills

### c) Reading

The Mercury Reader. A Custom Publication. Compiled by norther Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharon. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

**ISLAMIC STUDIES  
(Compulsory)**

**Objectives:**

**Credit Hrs: 2(2-0)**

This course is aimed at:

- 1 To provide Basic information about Islamic Studies
- 2 To enhance understanding of the students regarding Islamic Civilization
- 3 To improve Students skill to perform prayers and other worships
- 4 To enhance the skill of the students for understanding of issues related to faith and religious life.

**Detail of Courses**

**Introduction to Quranic Studies**

- 1) Basic Concepts of Quran
- 2) History of Quran
- 3) Uloom-ul -Quran

**Study of Selected Text of Holly Quran**

- 1) Verses of Surah Al-Baqra Related to Faith(Verse No-284-286)
- 2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi  
(Verse No-1-18)
- 3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful  
(Verse No-1-11)
- 4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
- 5) Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)

**Study of Selected Text of Holly Quran**

- 1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse  
No.6,21,40,56,57,58.)
- 2) Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of  
Judgment
- 3) Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)

**Seerat of Holy Prophet (S.A.W) I**

- 1) Life of Muhammad Bin Abdullah ( Before Prophet Hood)
- 2) Life of Holy Prophet (S.A.W) in Makkah

- 3) Important Lessons Derived from the life of Holy Prophet in Makkah

### **Seerat of Holy Prophet (S.A.W) II**

- 1) Life of Holy Prophet (S.A.W) in Madina
- 2) Important Events of Life Holy Prophet in Madina
- 3) Important Lessons Derived from the life of Holy Prophet in Madina

### **Introduction To Sunnah**

- 1) Basic Concepts of Hadith
- 2) History of Hadith
- 3) Kinds of Hadith
- 4) Uloom –ul-Hadith
- 5) Sunnah & Hadith
- 6) Legal Position of Sunnah

### **Selected Study from Text of Hadith**

#### **Introduction To Islamic Law & Jurisprudence**

- 1) Basic Concepts of Islamic Law & Jurisprudence
- 2) History & Importance of Islamic Law & Jurisprudence
- 3) Sources of Islamic Law & Jurisprudence
- 4) Nature of Differences in Islamic Law
- 5) Islam and Sectarianism

#### **Islamic Culture & Civilization**

- 1) Basic Concepts of Islamic Culture & Civilization
- 2) Historical Development of Islamic Culture & Civilization
- 3) Characteristics of Islamic Culture & Civilization
- 4) Islamic Culture & Civilization and Contemporary Issues

#### **Islam & Science**

- 1) Basic Concepts of Islam & Science
- 2) Contributions of Muslims in the Development of Science
- 3) Quranic & Science

#### **Islamic Economic System**

- 1) Basic Concepts of Islamic Economic System
- 2) Means of Distribution of wealth in Islamic Economics
- 3) Islamic Concept of Riba
- 4) Islamic Ways of Trade & Commerce

## **Political System of Islam**

- 1) Basic Concepts of Islamic Political System
- 2) Islamic Concept of Sovereignty
- 3) Basic Institutions of Govt. in Islam

## **Islamic History**

- 1) Period of Khlaft-E-Rashida
- 2) Period of Ummayyads
- 3) Period of Abbasids

## **Social System of Islam**

- 1) Basic Concepts of Social System of Islam
- 2) Elements of Family
- 3) Ethical Values of Islam

## **Reference Books:**

- 1) Hameed ullah Muhammad, "Emergence of Islam", IRI, Islamabad
- 2) Hameed ullah Muhammad, "Muslim Conduct of State"
- 3) Hameed ullah Muhammad, 'Introduction to Islam
- 4) Mulana Muhammad Yousaf Islahi,"
- 5) Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan.
- 6) Ahmad Hasan, "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad (1993)
- 7) Mir Waliullah, "Muslim Jrisprudence and the Quranic Law of Crimes" Islamic Book Service (1982)
- 8) H.S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989)
- 9) Dr. Muhammad Zia-ul-Haq, "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad (2001)

## **Pakistan Studies (Compulsory)**

### **Introduction/Objectives**

**Credit Hrs: 3(3-0)**

- Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan.
- Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

### **Course Outline**

#### **1. Historical Perspective**

- a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
- b. Factors leading to Muslim separatism
- c. People and Land
  - i. Indus Civilization
  - ii. Muslim advent
  - iii. Location and geo-physical features.

#### **2. Government and Politics in Pakistan**

Political and constitutional phases:

- a. 1947-58
- b. 1958-71
- c. 1971-77
- d. 1977-88
- e. 1988-99
- f. 1999 onward

#### **3. Contemporary Pakistan**

- a. Economic institutions and issues
- b. Society and social structure
- c. Ethnicity
- d. Foreign policy of Pakistan and challenges
- e. Futuristic outlook of Pakistan

### **Recommended Books**

1. Burki, Shahid Javed. *State & Society in Pakistan*, The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy*. Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. *Pakistan's Foreign policy: An Historical analysis*. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. *Pakistan Political Roots & Development*. Lahore, 1994.

5. Wilcox, Wayne. *The Emergence of Bangladesh.*, Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. *Pakistan Kayyun Toota*, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. *Ethno - National Movement in Pakistan*, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. *Enigma of Political Development.* Kent England: WmDawson & sons Ltd, 1980.
9. Zahid, Ansar. *History & Culture of Sindh.* Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. *Political Parties in Pakistan*, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. *The Political System of Pakistan.* Boston: Houghton Mifflin, 1967.
12. Aziz, K.K. *Party, Politics in Pakistan*, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, *Pakistan Under Martial Law*, Lahore: Vanguard, 1987.
14. Haq, Noor ul. *Making of Pakistan: The Military Perspective.* Islamabad: National Commission on Historical and Cultural Research, 1993.

**COMPULSORY MATHEMATICS  
COURSES FOR B.Sc (Hons) AGRICULTURE**

**1. MATHEMATICS I (ALGEBRA)**

**Prerequisite(s):** Mathematics at secondary level

**Credit Hours:** 3 + 0

**Specific Objectives of the Course:**

To prepare the students, not majoring in mathematics, with the essential tools of algebra to apply the concepts and the techniques in their respective disciplines.

**Course Outline:**

*Preliminaries:* Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions.

*Matrices:* Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule.

*Quadratic Equations:* Solution of quadratic equations, qualitative analysis of roots of a quadratic equations, equations reducible to quadratic equations, cube roots of unity, relation between roots and coefficients of quadratic equations.

*Sequences and Series:* Arithmetic progression, geometric progression, harmonic progression.

*Binomial Theorem:* Introduction to mathematical induction, binomial theorem with rational and irrational indices.

*Trigonometry:* Fundamentals of trigonometry, trigonometric identities.

**Recommended Books:**

Dolciani MP, Wooton W, Beckenback EF, Sharron S, *Algebra 2 and Trigonometry*, 1978, Houghton & Mifflin,

Boston (suggested text)

Kaufmann JE, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston

Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6<sup>th</sup> edition), 1986, PWS-Kent Company, Boston



## 2. MATHEMATICS II (CALCULUS)

**Prerequisite(s):** Mathematics I (Algebra)

**Credit Hours:** 3 + 0

### **Specific Objectives of the Course:**

To prepare the students, not majoring in mathematics, with the essential tools of calculus to apply the concepts and the techniques in their respective disciplines.

### **Course Outline:**

*Preliminaries:* Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities.

*Limits and Continuity:* Limit of a function, left-hand and right-hand limits, continuity, continuous functions.

*Derivatives and their Applications:* Differentiable functions, differentiation of polynomial, rational and transcendental functions, derivatives.

*Integration and Definite Integrals:* Techniques of evaluating indefinite integrals, integration by substitution, integration by parts, change of variables in indefinite integrals.

### **Recommended Books:**

Anton H, Bevens I, Davis S, *Calculus: A New Horizon* (8<sup>th</sup> edition), 2005, John Wiley, New York

Stewart J, *Calculus* (3<sup>rd</sup> edition), 1995, Brooks/Cole (suggested text)

Swokowski EW, *Calculus and Analytic Geometry*, 1983, PWS-Kent Company, Boston

Thomas GB, Finney AR, *Calculus* (11<sup>th</sup> edition), 2005, Addison-Wesley, Reading, Ma, USA

### 3. MATHEMATICS III (GEOMETRY)

**Prerequisite(s):** Mathematics II (Calculus)

**Credit Hrs: 3(3-0)**

#### **Specific Objectives of the Course:**

To prepare the students, not majoring in mathematics, with the essential tools of geometry to apply the concepts and the techniques in their respective disciplines.

#### **Course Outline:**

*Geometry in Two Dimensions:* Cartesian-coördinate mesh, slope of a line, equation of a line, parallel and perpendicular lines, various forms of equation of a line, intersection of two lines, angle between two lines, distance between two points, distance between a point and a line.

*Circle:* Equation of a circle, circles determined by various conditions, intersection of lines and circles, locus of a point in various conditions.

*Conic Sections:* Parabola, ellipse, hyperbola, the general-second-degree equation

#### **Recommended Books:**

Abraham S, *Analytic Geometry*, Scott, Freshman and Company, 1969

Kaufmann JE, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston

Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6<sup>th</sup> edition), 1986, PWS-Kent Company, Boston

#### **Note:**

- 1. Two courses will be selected from the following three courses of Mathematics.**
- 2. Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.**

**Statistics-I****Credit 3 (2-1)**

Definition and importance of Statistics in Agriculture, Data Different types of data and variables

Classification and Tabulation of data, Frequency distribution, stem-and-Leaf diagram, Graphical representation of data Histogram, frequency polygon, frequency curve.

Measure of Central tendency, Definition and calculation of Arithmetic mean, Geometric mean, Harmonic mean, Median quantiles and Mode in grouped and ungrouped data.

Measure of Dispersion, Definition and Calculation of Range, quartile deviation, Mean deviation, Standard deviation and variance, coefficient of variation.

**Practicals**

- a. Frequency Distribution
- b. Stem-and-Leaf diagram
- c. Various types of Graphs
- d. Mean, Geometric mean Harmonic Mean,
- e. Median, Quartiles Deviation, mean Deviation.
- f. Standard Deviation, Variance, Coefficient of variation,
- g. Skewness and kurtosis

**Recommended Book**

1. Introduction to Statistical Theory Part- I by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad
3. A. Concise Course in A. Level Statistic with world examples by J. Crawshaw and J. Chambers (1994)
4. Basic Statistics an Inferential Approach 2<sup>nd</sup> Ed. (1986) Fran II. Dietrich-II and Thomas J. Keans

## Statistics-II

Credit 3 (2-1)

Sampling Probability and non-Probability Sampling, Simple random sampling stratified random sampling Systematic sampling error, Sampling distribution of mean and difference between two means. Interference Theory: Estimation and testing of hypothesis, Type—I and type-II error, Testing of hypothesis about mean and difference between two means using Z-test and t-test, Paired t-test, Test of association of attributes using X<sup>2</sup> (chi-square) Testing hypothesis about variance.

### Practicals

- a. Sampling random sampling
- b. Stratified random sampling.
- c. Sampling distribution of mean
- d. Testing of hypotheses regarding population mean
- e. Testing of hypotheses about the difference between population means
- f. Chi-square test
- g. Testing of Correlation Coefficient
- h. Fitting of simple linear regression
- i. One-way ANOVA
- j. Two-way ANOVA

### Recommended Book

1. Introduction to Statistical Theory Part-II by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad
3. Principles and Procedures of Statistics A Bio-meterial approach, 2<sup>nd</sup> Edition, 1980 by R.G.D Steal and James H. Tarric
4. Statistical Procedures for Agricultural Research 2<sup>nd</sup> Edition (1980) by K.A. Gomez and A.A. Gomez

**Note: Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.**

Course Name: **Introduction to Information and Communication Technologies**

**Course Structure:** Lectures: 2 Labs: 1

**Credit Hours:** 3(2-1)

**Pre-requisite:** None

**Semester:** 1

**Course Description:**

This is an introductory course on Information and Communication Technologies. Topics include ICT terminologies, hardware and software components, the internet and world wide web, and ICT based applications.

After completing this course, a student will be able to:

- Understand different terms associated with ICT
- Identify various components of a computer system
- Identify the various categories of software and their usage
- Define the basic terms associated with communications and networking
- Understand different terms associated with the Internet and World Wide Web.
- Use various web tools including Web Browsers, E-mail clients and search utilities.
- Use text processing, spreadsheets and presentation tools
- Understand the enabling/pervasive features of ICT

**Course Contents:**

- : Basic Definitions & Concepts
- : Hardware: Computer Systems & Components
- : Storage Devices, Number Systems
- : Software: Operating Systems, Programming and Application Software
- : Introduction to Programming, Databases and Information Systems
- : Networks
- : Data Communication
- : The Internet, Browsers and Search Engines
- : The Internet: Email, Collaborative Computing and Social Networking
- : The Internet: E-Commerce
- : IT Security and other issues
- : Project Week
- : Review Week

## **Text Books/Reference Books:**

Introduction to Computers by Peter Norton, 6th International Edition  
(McGraw HILL)

Using Information Technology: A Practical Introduction to Computer &  
Communications by Williams Sawyer, 6th Edition (McGraw HILL)

Computers, Communications & information: A user's introduction by Sarah  
E. Hutchinson, Stacey C. Swayer

Fundamentals of Information Technology by Alexis Leon, Mathewsleon Leon  
Press.

## **Functional Biology-I**

*Credit Hours 3+0*

### **Biological Methods**

Principles of Cellular Life

Chemical Basis

Structure and Function

Principles of Metabolism

Energy Acquisition

### **Principles of Inheritance**

Mitosis and Meiosis

Chromosomes

Observable Inheritance Patterns

DNA Structure and Function

RNA and Proteins

Genes

Genetic Engineering and Biotechnology

### **Biodiversity**

Fundamental Concept of Biodiversity

One or two examples of each of the following from commonly found  
organism

Prions

Viruses

Bacteria

Protistans

Algae

Fungi

Plants

Crops

Animals

Invertebrates

Vertebrates

***Reading***

1. Roberts, M.M., Reiss and G.Monger. 2000. Advanced Biology, Nelson.
2. Starr, C, and R, Taggart, 2001. Biology: The Unity and Diversity of Life Brooks and Cole.
3. Campbell, N.A., J.B, Reece, L.G. Mitchell, M.R, Taylor. 2001. Biology: Concepts and Connections. Prentice-Hall.

# Functional Biology-II

## ***Credit Hours 3+0***

### **Myths and Realities of Evolution**

Microevolution

Speciation

Macroevolution

### **Level of Organization**

#### **Plants**

Tissues

Nutrition and Transport

Reproduction

Growth and Development

#### **Animals**

Tissue, Organ System and Homeostasis

Information Flow and Neuron

Nervous System

Circulation and Immunity

Nutrition and Respiration

Reproduction and Development

#### **Ecology and Behavior**

Ecosystems

Biosphere

Social Interactions

Community Interactions

Human Impact on Biosphere

Environment Conservation

### ***Reading***

1. Roberts, M.M., Reiss and G.Monger. 2000. Advanced Biology, Nelson.
2. Starr, C, and R, Taggart, 2001. Biology: The Unity and Diversity of Life Brooks and Cole.



3. Campbell, N.A., J.B, Reece, L.G. Mitchell, M.R, Taylor. 2001. Biology: Concepts and Connections. Prentice-Hall.

*Note: Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.*