

Pondicherry University

Puducherry



M.Sc. Public Health Entomology

2 Year Course

(Semester Pattern)

Regulations and Syllabus
2013 - 2014 onwards

M.Sc., Public Health Entomology

(TWO YEAR-FULL TIME SEMESTER PROGRAMME)

The Master's degree programme in Public Health Entomology (M.Sc., PHE) of Pondicherry University is offered by Vector Control Research Centre, Puducherry.

About the Centre

Vector Control Research Centre (VCRC), established in Puducherry in July 1975, is one of the permanent institutes of the Indian Council of Medical Research, New Delhi, under the Department of Health Research, Ministry of Health & Family Welfare, Govt. of India. VCRC is engaged in basic and applied research with the primary objective of finding newer methods and developing strategies for the control of vectors and vector borne diseases. The World Health Organization (WHO) has designated the VCRC as a collaborating Centre for Research and Training in Lymphatic filariasis and Integrated Methods of Vector Control. It is recognized as a centre of excellence for research and training in vector-borne diseases and control by the Ministry of Health & Family Welfare, Govt. of India.

Scope of the Course:

There is a growing need for entomologists in the field of Public Health in view of emerging and re-emerging vector-borne diseases in India and other tropical countries. Most of the posts of Entomologists in many States of India are lying vacant. Apart from the State Health Departments, National Vector Borne Disease Control Programme (NVBDCP), National Centre for Disease Control (NCDC), National rural Health Mission (NRHM), National Urban Health Mission (NUHM) and ICMR Institutes (VCRC, CRME, NIMR and RMRC) require personnel with knowledge and expertise on epidemiology and prevention/control of vector borne diseases for their programmes pertaining to vector borne diseases. In view of this felt need, a two year M.Sc. Public Health Entomology (PHE) course has been started at VCRC from 2011.

Course Description

This is a unique course in India catering to the national as well as global needs. The course will provide an opportunity for students to gain an in-depth knowledge on Public Health Entomology and intense training on the modern approaches for epidemiology, prevention and control of vectors and vector-borne diseases.

Arthropods affect the health and well-being of human being in a wide variety of ways, by transmitting several of the most devastating infectious diseases. This course provides an

overview of the ways in which arthropods impact public health, laying greater emphasis on insect vectors and vector-borne diseases prevention and control. The course will focus on vectors of local as well as global importance. An epidemiological perspective will be integrated throughout the course. Biology, ecology and application of modern tools in the management of vectors and vector-borne diseases will be discussed in detail. Finally, attention will be given to enable students to develop practical skills needed for operational programmes.

Learning Objectives

By the end of this course, students will be able to:

- i) Describe the basics of arthropods of public health importance
- ii) Identify vector - host - pathogen relationships in arthropod-borne diseases
- iii) Conduct studies on the epidemiology of vector-borne diseases
- iv) Apply modern tools for surveillance and diagnosis of vector-borne diseases
- v) Design appropriate prevention and control measures including rationalization of the use of pesticides in Public health programmes
- vi) Promote Integrated Vector Management

Duration of the Course

The duration of the course is TWO academic years (4 Semesters).

Medium of Instruction

English shall be the medium of instruction for all subjects of study and examinations of the Course.

Admission Procedure

Admission to the above course shall be made by following the admission related procedures prescribed by the Pondicherry University from time to time.

Eligibility for Admission

Candidates who have obtained a degree in B.Sc., in the discipline of Zoology / Botany / Life Sciences / Medical Laboratory Technology / Microbiology / Ecology/ Environmental Science / Biochemistry, or B.V.Sc., or M.B.B.S., or B.E., / B.Tech., degree with Biotechnology as one of the subjects from any University, accepted as equivalent by the academic council of the Pondicherry University, Puducherry with any of the specified groups of options shall be permitted to appear and qualify for the M.Sc. Public Health Entomology degree examination in non-clinical subjects under the School of Medical Sciences after a course of study of two

academic years. A minimum of 50% mark is essential for General/Unreserved/OBC and 40% for SC/ST candidates in their Under Graduate Degree examination, the qualifying examination for admission to the course. The requirement for differently-abled candidates will depend on the category they belong to.

Reservation

The rule of reservation set in force by the Government of India and Pondicherry University, Puducherry shall be followed while allocation of seats during admission from time to time. Sixty Percentage of admission is through competitive examination and remaining each twenty percentage is for candidates from India (in-service) and abroad respectively. Wherever sufficient numbers of candidates are not available in a particular category interchanging will be done.

No. of Seats: 12

Open Competition - 8 (General 50.5%, OBC 27%; SC 15% & ST 7.5%);

In-service/Sponsored - 4 (Indian 2; Foreign 2)

Criteria for Admission

Category I: Open Competition

Candidates seeking admission under this category should have passed any one of the following examinations of any University accepted by the Academic Council of Pondicherry University, Puducherry - B.Sc., in the discipline of Zoology / Botany / Life Sciences / Medical Laboratory Technology / Microbiology / Ecology / Environmental Science / Biochemistry, or B.V.Sc., or M.B.B.S., or B.E., / B.Tech., degree with Biotechnology as one of the subjects.

Category II: In-service (Self supporting / Sponsored)

A. Indian Nationals

In-service candidates employed either in Government or Non-government agencies and sponsored by the employer should have passed the Degree examination in any of the disciplines indicated under Category I from a recognized University. The in-service candidates without sponsorship should send their application with a "No Objection Certificate" from their employer.

B. Foreign Nationals

The applicants under this category possessing qualification as mentioned under the Category I or the qualification for which Equivalent Certificate obtained from Association of Indian Universities, New Delhi and Eligibility Certificate from Pondicherry University are

eligible to apply. Applications of in-service self supporting as well as sponsored/nominated foreign applicants should be routed through the employer or sponsoring/nominating authority/organization. These applicants will be admitted only with valid **student visa** for the entire duration of the study.

Method of Selection

Selection of the candidates under **Category I** will be based on their performance in the common entrance test (two hours duration), **Category II A:** based on an oral interview and **Category II B:** based on a letter of recommendation/ reference from the Head of Department/Institution, last studied, if the candidate is a student **or** the Employer, if he/she is in service.

Both common entrance test and oral interview will be held at VCRC, Puducherry and the date will be intimated to the eligible applicants individually. The list of candidates selected for admission will be published in our website (<http://www.vcrc.res.in>).

For details, please see the prospectus in the website.

Registration

A candidate admitted into the M.Sc. Public Health Entomology Course shall submit the prescribed application form for registration duly filled in along with prescribed fee and declaration in the format, to the Academic Officer of this University through the affiliated institution within 60 days from the cut-off date prescribed for admission.

Fellowship

All the candidates selected under Category-I will be paid a scholarship of Rs.6,000/- per month. The candidates selected under Category-II will be paid a stipend of Rs.3,000/- per month, with the approval of the Admission Committee.

Course Structure

The M.Sc. Programme is divided into two parts. Each part consists of two Semesters as given below.

		Semester-Odd	Semester-Even
Part I	First Year	Semester - 1	Semester - 2
Part II	Second Year	Semester - 3	Semester - 4

Semesters 1-3 (two odd semesters and one even semester) consist of four papers each. Semester 4 comprises of Dissertation. It is mandatory for each student to complete a Dissertation at the end of 4th Semester.

The schedule of papers prescribed for various semesters shall be as follows:

PART I: Semester – 1

- | | | |
|---|----------|---|
| 1 | MPHE 101 | Biology & Ecology of Arthropods of Public Health Importance |
| 2 | MPHE 102 | Morphology, Taxonomy and Bio-diversity of Vectors |
| 3 | MPHE 103 | Physiology and Bio-chemistry of insects of Public Health Importance |
| 4 | MPHE 104 | Biostatistics |

PART I: Semester – 2

- | | | |
|---|----------|---|
| 5 | MPHE 201 | Vector-Borne Parasites and Pathogens of Public Health Importance |
| 6 | MPHE 202 | Application of Molecular Biology, Immunology and Bioinformatics in Public Health Entomology |
| 7 | MPHE 203 | Pesticides used in Public Health |
| 8 | MPHE 204 | Control of Vectors of Public Health Importance |

Field Training

PART II: Semester – 3

- | | | |
|----|----------|---|
| 9 | MPHE 301 | Epidemiology of Vector Borne Diseases |
| 10 | MPHE 302 | Environment and Public Health |
| 11 | MPHE 303 | Integrated Vector Management |
| 12 | MPHE 304 | Vector-Borne Diseases Control Programme |

PART II: Semester – 4

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|----|----------|--------------|
| 13 | MPHE 401 | Dissertation |
|----|----------|--------------|

Field Training

At the end of Semester II, students will be visiting various ICMR Institutes, National Vector Borne Disease Control Programme and other National laboratories for observational training in the R & D activities and hands on training in the operational aspects of vector borne disease control.

At the completion of field visits, the students are required to submit a report and make a presentation of their field training.

Dissertation

All the students must undertake dissertation work at the final semester (IV semester). Each student is individually placed under a faculty at VCRC to work on the dissertation.

This process includes:

- (a) the conceptualization of the independent research that will comprise the dissertation,
- (b) the preparation of and satisfactory defense of the dissertation proposal,
- (c) the collection, analysis and interpretation of data,
- (d) presentation of findings in the dissertation format and oral defense of the dissertation.

Dissertation activity must be completed within prescribed time frame for the semester.

Attendance required for appearing for examination

A candidate shall be permitted to appear for the terminal examination in any particular subject only if the candidate secures not less than 80% of the attendance (reckoned in terms of the total number of lectures and seminars conducted in each semester, during his/her course of study). Condonation of shortage of attendance in aggregate up to 15% (for those with $\geq 65\%$ and $\leq 79\%$) during the academic year may be recommended by the College Academic Committee and as per the regulations of University. The candidates with less than 65% of attendance have to redo the course.

Scheme of Examinations

Examinations shall be conducted at the end of each semester as per the Academic Calendar notified by the Pondicherry University.

SCHEME OF EXAMINATION

Sem ester	Subject	Subject Code	Theory				Practical		Total Min.	Total Max.
			UE Min	UE Max.	IA Min.	IA Max.	UE Min.	UE Max.		
I	Biology & Ecology of Arthropods of Public Health Importance	MPHE 101	50	100	25	50	25	50	100	200
	Morphology, Taxonomy and Bio-diversity of Vectors	MPHE 102	50	100	25	50	25	50	100	200
	Physiology and Bio-chemistry of Insects of Public Health Importance	MPHE 103	50	100	25	50	25	50	100	200
	Biostatistics	MPHE 104	50	100	25	50	25	50	100	200
II	Vector-Borne Parasites and Pathogens of Public Health Importance	MPHE 201	50	100	25	50	25	50	100	200
	Application of Molecular Biology, Immunology and Bioinformatics in Public Health Entomology	MPHE 202	50	100	25	50	25	50	100	200
	Pesticides used in Public Health	MPHE 203	50	100	25	50	25	50	100	200
	Control of Vectors of Public Health Importance	MPHE 204	50	100	25	50	25	50	100	200
Field Training										
III	Epidemiology of Vector-borne Diseases	MPHE 301	50	100	25	50	25	50	100	200
	Environment in Public Health	MPHE 302	50	100	25	50	25	50	100	200
	Integrated Vector Management	MPHE 303	50	100	25	50	25	50	100	200
	Vector Borne Diseases Control Programmes	MPHE 304	50	100	25	50	50	25	100	200
IV	Dissertation, Viva-voce and Field Training	MPHE 401	Dissertation		Viva-voce		Field training		100	200
			150		20		30			
Total									1300	2600

UE – University Examination; IA – Internal Assessment

The system of evaluation shall be as follows:

A. Each paper carries 200 marks & will have the following components:		Marks
(i) Internal Assessment		50
(a) Assignment		10
(b) Seminar		10
(c) Attendance		05
(b) Theory Internal Examination		25
(ii) Final Examination		150
(a) Theory		100
(b) Practical (40), Record (5) & viva-voce (5)		50
Total marks for 12 papers (theory & practical) 200 x12		2400
B. Field Training (Report: 20; Presentation: 10)		30
C. Dissertation(150), viva-voce (20)		170
Grand total		2600

Internal assessment will be broadly based on attendance in Theory and Practical classes (5 marks), assignments (10 marks), seminars (10 marks) and tests in the theory (25 marks).

The end semester examinations will comprise theory examination (100 marks), practical examination (40 marks), record (5 marks) and viva-voce (5 marks). These criteria are tentative and could be modified based on guidelines approved by the Pondicherry University, Puducherry.

Field training will be evaluated for 30 marks based on the field report (20 marks) and presentation (10 marks).

As regards Dissertation, the scheme of evaluation shall be as follows:

Dissertation work would be assigned after the completion of Semester III. This component would be evaluated for 150 marks. There shall be a viva-voce examination conducted by a Board of Examiners at the end of Semester IV on the Dissertation that shall be assessed for 20 marks.

Examinations for courses shall be conducted only in the respective odd and even Semesters as per the Scheme of Examinations. Regular as well as Supplementary students shall be permitted to appear/reappear in courses of Odd Semesters only at the end of Odd Semesters and courses of Even Semesters only at the end of Even Semesters respectively. No student shall be allowed to avail of more than two chances to pass a paper inclusive of the first attempt.

Pass Percentage

Minimum marks for pass in the examination shall be 50% separately in Internal Assessment, University Final Theory examination, Practical examination, Dissertation and Field Training.

Award of Degree

Degree will be awarded based on the overall marks secured by the student as given below,

- A candidate who secures an overall average of not less than 75% shall be declared to have passed the examination in First class with Distinction, provided he/she has passed the examination in every subject in the very first appearance.
- A candidate who secures an overall average of not less than 60% shall be declared to have passed the examination in First class provided he/she has passed all the subjects at the first appearance/before the completion of the final semester.
- All other successful candidates shall be declared to have passed in second class.

Span Period

No student shall be permitted as a candidate for the examination for any of the Parts/Semesters after the lapse of three years from the date of admission to the Part-I/ Semester-I of the M.Sc. Public Health Entomology Course.

Internship

After the completion of two year M. Sc., course, one year paid optional internship programme will be available for the candidates on inter-se merit, subject to availability of funds.

Common Facilities

Library

Library meets the information needs of students, research scholars and faculty. The mission of the Library is to enhance learning and facilitating research. There are 15,550 books, 73 Journals (Indian: 37; Foreign: 36), 667 Online Journals, 880 Research publications etc. available on vector borne diseases.

Resource Centre

A resource room is available for students to read magazines, News Letters, scientific reports, and other academic / research papers. Computers are provided, with internet

access. The Centre also provides 100 Mbps internet access through National Knowledge Network (NKN) on 24 x 7 basis.

Hostel

VCRC provides separate hostel for Men and Women students with all basic amenities.

Transport

VCRC offers free transport facilities to the students for field visits.

Clinic

The clinic available inside the VCRC campus provides basic facilities for common ailments for the benefit of students and staff.

Canteen

Canteen is available inside the campus.

Conduct and Discipline

Students enrolled at VCRC must realize their responsibilities to the faculty. Failure to maintain appropriate standards of conduct will attract disciplinary action. Students should always wear the ID card provided to them and should not bring mobile phone to the class rooms.

Ragging in any form is strictly prohibited. If any incident of ragging comes to the notice of the authority, the concerned student shall be given liberty to explain and if the explanation is not found satisfactory, he/she will be expelled from the institution.

Alcohol, cigarettes and other tobacco products are strictly prohibited within the premises of the Institute, and use of anyone is an offence and punishable.

Students should abide by the rules and regulations stipulated by VCRC and Pondicherry University, from time to time.

ACADEMIC FEES*

Sl. No.	Particulars	For Indian Nationals (INR)	For NRI/OCI/ SAARC Nationals (US \$/INR)	Other Foreign Nationals (US \$/INR)
1	Tuition fee (p.a.)	1000	US \$ 250 INR 12500	US \$ 500 INR 25000
2	Registration fee	100	100	100
3	Institution Application fee	100	100	100
4	Caution Deposit (Refundable)	2000	2000	2000
5	Corpus fund (5% of tuition fee) (p.a.)	50	625	1250
6	Library fee (p.a.)	25	25	25
7	Laboratory Fund (p.a.) Computer Lab Fund Wet Lab Fund	500 500	500 500	500 500
8	Matriculation fees for UG/PG qualified candidates (to be collected from all students except those who have qualified from Pondicherry University)	18	18	18
9	University Fee: Recognition Fee: For UG / PG qualified students (i) except students qualified from Pondicherry University (ii) For candidates qualified from outside India	180 450	180 450	180 450
10	Sports fee (p.a.)	25	25	25
11	University Development Fund (One-time payment at the time of admission for all students)	1000	1000	1000
	Total	5948	18023	31148

* Subject to revision from time to time

SYLLABUS

SEMESTER-WISE PAPERS WITH THEIR RESPECTIVE CODES

Code	Name of the Subject/Paper	Semester
MPHE 101	Biology & Ecology of Arthropods of Public Health Importance	I
MPHE 102	Morphology, Taxonomy and Bio-diversity of Vectors	
MPHE 103	Physiology and Bio-chemistry of Insects of Public Health Importance	
MPHE 104	Biostatistics	
MPHE 201	Vector-Borne Parasites and Pathogens of Public Health Importance	II
MPHE 202	Application of Molecular Biology, Immunology and Bioinformatics in Public Health Entomology	
MPHE 203	Pesticides used in Public Health	
MPHE 204	Control of Vectors of Public Health Importance	
Field Training		
MPHE 301	Epidemiology of Vector-Borne Diseases	III
MPHE 302	Environment and Public Health	
MPHE 303	Integrated Vector Management	
MPHE 304	Vector Borne Diseases Control Programmes	
MPHE 401	Dissertation	IV

CREDIT HOURS ALLOTTED TO DIFFERENT PAPERS INCLUDING DISSERTATION

Sl.No.	Subject	Hours		
		Theory	Practical	Credit Hours *
1	Biology & Ecology of Arthropods of Public Health Importance	65	40	4 + 2
2	Morphology, Taxonomy and Bio-diversity of Vectors	65	30	4 + 2
3	Physiology and Biochemistry of Insects of Public Health Importance	70	40	4 + 2
4	Biostatistics	70	40	4+ 2
5	Vector-Borne Parasites and Pathogens of Public Health Importance	65	30	4 + 2
6	Application of Molecular Biology, Immunology and Bioinformatics in Public Health Entomology	65	30	4 + 2
7	Pesticides used in Public Health	70	40	4 + 2
8	Control of Vectors of Public Health Importance	70	35	4 + 2
9	Epidemiology of Vector-Borne Diseases	70	30	4 + 2
10	Environment and Public Health	65	30	4 + 2
11	Integrated Vector Management	70	30	4 + 2
12	Vector Borne Diseases Control Programmes	70	30	4 + 2
13	Dissertation		240	20 + 20
Total		815	645	112

* (Theory + Practical)

MPHE 101: Biology & Ecology of Arthropods of Public Health Importance

THEORY

65 Hrs

Unit I Introduction to Arthropods of public health importance

Arthropods as vectors of human diseases – Arthropods of Public health nuisance – Anthroponotic diseases – Zoonotic diseases

Unit II Mosquitoes

Life cycle – mating, host seeking, feeding, resting, oviposition behaviour – longevity, gonotrophic cycle, fecundity. Salient features and distribution of important vector species of *Anopheles* (*An. stephensi*, *An. culicifacies*, *An. fluviatilis*), *Aedes* (*Ae. aegypti*, *Ae. albopictus*), *Culex* (*Cx. quinquefasciatus*, *Cx. tritaeniorhynchus*), *Mansonia* (*Ma. annulifera*, *Ma. uniformis*).

Unit III Sand flies and other Dipterans of public health importance

Life cycle: Sandflies, Black flies, Horse flies, Tsetse flies, House flies, Myiasis causing flies, Biting midges.

Unit IV Fleas, bugs and lice

Life cycle: Fleas (species of *Xenopsylla* and *Ctenocephalides*), Triatomine bug, bed bug, head and body louse.

Unit V Ticks and Mites

Life cycle: Ixodid (*Haemaphysalis*, *Ixodes*, *Dermacentor*, *Rhipicephalus*, *Amblyomma*), Argasid (*Argas*, *Ornithodoros*) and Mites (*Sarcoptes*, *Leptotrombidium*, *Dermatophagoides*).

Unit VI Vector Ecology and Population Dynamics

Introduction to vector ecology and Ecosystem, habits and habitat – Population interaction with abiotic and biotic factors – Dispersal and Migration. Natality, mortality, survivorship, age distribution – Life table analysis.

PRACTICALS

40 Hrs

1. Rearing techniques of vector species (*Anopheles stephensi*)
2. Life table construction and analysis (*Culex quinquefasciatus*)
3. Demonstration of life cycle stages of mosquitoes.
4. Dissection and mounting of mouth parts: Sandfly, mosquito.
5. Dissection and mounting of male genitalia and pharyngeal armature of Sandfly and mosquito
6. Dissection and mounting of spermatheca of mosquito
7. Dissection and mounting of spiracular plate, cephalopharyngeal skeleton of house fly
8. Analysis of field water for important physical and chemical parameters.
9. Analysis of abiotic factors affecting adult survival.

Suggested Readings:

Books

1. Ananthkrishnan, T.N (1982). Bioresources Ecology. Oxford & IBH Publishing Co., New Delhi.
2. Advances in Parasitology Vols. 1-4 (2011). Annual Reviews Inc.
3. Annual Review of Ecology, Evolution & Systematics (2011). Annual Reviews Inc.
4. Annual Review of Entomology (2011). Annual Reviews Inc.
5. Chaterjee, K.D. (1981) Parasitology : Protozoology and Helminthology : Introduction to Clinical Medicine. Ed 12.Chaterjee Medical Publishers.
6. Harwood R.F. and James M.T. (1979). Entomology in Human and animal health. Macmillan Publishing Co., Inc, London; 7 Ed pp 548.
7. Imms, A. D. (1977). A general text book of Entomology. ELBS, London.
8. Indian Council of Medical Research (2012). Perspectives of Indian Medicinal plants in the management of lymphatic filariasis. ICMR.
9. Kochchar, S.K. (2009). A Text Book of Parasitology. Wisdom Press Krebs, C.J. (1972). Ecology: The experimental analysis of distribution and abundance. Harper and Row Publishers, New York.
10. Laird, M. (1988). The natural history of larval mosquito habitats. Academic Press Ltd., New York.
11. Marquardt, W.C. (2005). Biology of disease vectors (2nd Edition). Doody Enterprises, Inc., USA.
12. Mullen, G. and Durden L. (2009). Medical and veterinary entomology, Academic press, London ISBN 0 12 510451 0.
13. Nicholas R. H. Burgess. (1981). Arthropods of Medical importance, Published by Noble Books Ltd. Hampshire.
14. Odum, E.P. (1971). Fundamentals of Ecology. Saunders College Publishing, Philadelphia.
15. Odum, E.P. (1983). Basic Ecology. Saunders College Publishing, Philadelphia.

16. Price, P.W. (1971). *Insect Ecology*. John Wiley & Sons, New York.
17. Rao, T. R. (1984). *The Anophelines of India*. Malaria Research Centre, ICMR, New Delhi.
18. Richard P. Meyer, and Minoo B. Madon. (2002). *Arthropods of public health significance in California, Training Manual*. Mosquito and vector control association of California, 660 J Street, Suite 480, Sacramento, CA 95814.
19. Roy D. N. and Brown A.W.A. (1970). *Entomology (Medical and Veterinary) including insecticides & insects & Rat control*; The Bangalore Printing & Publishing Co. Ltd., Bangalore.
20. Sharma, Sanjay, Banerjee & Sudhakar. (2012) *Exploring Biology Vol I. & II*. Arihand Prakashan, Meerut.
21. Service M. W. (1996). *Medical Entomology for students*. Chapman & Hall, London.
22. Service, M. W. (1984). *Mosquito Ecology- Field sampling methods*. Applied Science Publishing Ltd., London.
23. Service, M.W. (1993). *Mosquito Ecology- Field sampling methods*. Chapman & Hall, New York.
24. Smith, T.M. and Smith, R.L. (2006) *Element of Ecology*. Ed 6. Peassion.
25. South wood, T.R.E. (1987). *Ecological methods with particular reference to the study of insect populations*. Chapman & Hall, New York.
26. Speight, M.R., Hunter, M.D. & Watt, A.D. (1999). *Ecology of Insects- Concepts and Applications*. Blackwell Science Ltd., London.
27. Theroux, F.R., Eldridge, E.F. and Mallmann, W.L. (1943). *Laboratory manual for chemical and bacterial analysis of water and sewage*. McGraw Hill Book Co., New York.
28. Ward, J.V. (1992). *Aquatic Insect Ecology*. John Wiley & Sons, Inc., USA.
29. Williams, D.D. & Feltmate, B.W. (1992). *Aquatic Insects*. C.A.B. International, UK.

Reports

1. Kalra, N. L. and Bang, Y. H. (1988). *Manual on entomology in visceral leishmaniasis*. World Health Organization, Regional Office for South East Asia, New Delhi, 88.
2. Rozendaal, J.A. (1997). *Vector Control - Methods for Use by Individuals and Communities*, World Health Organization, Geneva.
3. World Health Organization, (1989). *Geographical distribution of arthropod-borne disease and their principal vectors*, WHO/VBC/89.967, Geneva.
4. World Health Organization, (1991). *Insect and rodent control through environmental management: A community action programme*. ISBN 92 4 154411, 2.
5. World Health Organization. (2008). *Public Health significance of urban pests*. ISBN 978 -92-890-7188-8.
6. World Health Organization, (2006). *Vector-Borne diseases in India*. Report of a Brainstorming session. 9 Nov. WHO/SEARO & Govt. of India pp1 -7.

MPHE102: Morphology, Taxonomy and Bio-diversity of Vectors

THEORY

65 Hrs

Unit I Morphology of medically important insects and other arthropods

Head: antenna – mouth parts, Thorax: wings – wing venation – legs – general structure, Abdomen: Appendages – cerci – external genitalia.

Unit II Taxonomic concepts and Classification of Arthropoda

Type concept – Population concept – Levels of Taxonomy: alpha – beta – gamma taxonomy. Taxonomic hierarchy: Species – Genus – Family – Order – Class – Phylum. Species concept: species – infraspecific categories – Sibling species – subspecies – variants within populations.

Characteristics of different Classes of Arthropoda. Classification of Insecta. Characteristics of Orders: Diptera – Siphonaptera – Anoplura – Hemiptera – Dictyoptera.

Unit III Classification of Diptera, Siphonaptera and Anoplura, Acarina

Characteristics of Families Culicidae – Phlebotomidae – Muscidae – Tabanidae – Calliphoridae. Characteristics of mosquitoes – *Anopheles* – *Culex* – *Aedes* – *Mansonia*. Characteristics of sand flies: *Phlebotomus* – *Sergentomyia*. Characteristics of flies: *Musca* – *Calliphora*.

Characteristics of Family Pulicidae. Characteristics of fleas: *Xenopsylla* – *Pulex* – *Ctenocephalides*. Characteristics of *Pediculus* – *Pthirus*.

Characteristics of families Ixodidae – Argasidae – Trombiculidae – Sarcoptidae, Characteristics of Ticks: *Boophilus* – *Rhipicephalus* – *Haemaphysalis* – *Ornithodoros*, Characteristics of mites: *Leptotrombidium* – *Sarcoptes*.

Unit IV Collection and preservation techniques

Mosquitoes– sand flies – fleas – lice – ticks – flies: adult collection methods - traps - larval collection methods – wet preservation – dry preservation.

Unit V Biodiversity

Concepts and characteristics of biodiversity – Biodiversity hotspots – Biosphere – Species documentation – Diversity indices – Invasive species. Relationship between anthropogenic stressors – vector biodiversity.

Unit VI Molecular taxonomy

Theory and practice of molecular taxonomy – Introduction to Molecular techniques in taxonomy.

PRACTICALS

30 Hrs

1. Demonstration of mouth parts and wings of medically important insects.
2. Identification of *Culex quinquefasciatus*, *Cx. tritaeniorhynchus*, *Anopheles stephensi*, *Aedes aegypti*, *Ae. albopictus*, *Mansonia annulifera*, *Ma. uniformis*.
3. Identification of *Phlebotomus papatasi*, *Ph. argentipes*, *Chrysomya bezziana*.
4. Identification of *Xenopsylla astia*, *Xe. brasiliensis*, *Xe. cheopis*, *Pthirus pubis*, *Pediculus capitis*.
5. Identification of *Boophilus*, *Rhipicephalus*, *Haemaphysalis*, *Ornithodoros*.
6. Demonstration of RFLP, RAPD and SNPs for mosquito identification.
7. Demonstration of DNA bar coding.
8. Design of DNA probes for mosquito vector identification

Suggested Readings:

Books

1. Annual Review of Eco, Evo & Systematics (2011). Annual Reviews Inc.
2. Annual Review of Entomology (2011). Annual Reviews Inc.
3. Barraud P.J. (1934). The fauna of British India, including Ceylon and Burma. Diptera, Family Culicidae, Tribes Megarhini and Culicine. Today & Tomorrow's Printers & Publihers. Published under the authority of the Secretary of State for India in Council. Pp371.
4. Black IV, W. C. and Mustermann, L. E. (1996). Molecular taxonomy and systematics of arthropod vectors. In: The Biology of Disease Vectors (eds. B.J. Beaty and W.C. Marquardt). Pp.438-70. University Press of Colarado, USA.
5. Burgess, N.R.H and Cowan, G.O. (1993). A colour atlas of medical entomology. Chapman and Hall, London.
6. Christophers S.R. (1933). The fauna of British India, including Ceylon and Burma. Diptera, Family Culicidae, Tribe Anophelini. Today & Tomorrow's Printers & Publihers. Published under the authority of the Secretary of State for India in Council.
7. Ernst Mayr, E. G. Linsley and R. L. Usinger. (1953). Methods and Principles of Systematic Zoology. McGraw-Hill Book Company, London.
8. Gullan, P.J. and Cranston, P.S. (1994). The Insects - An Outline of Entomology. Blackwell Publishing Ltd, USA.
9. Harold Oldroyd. (1973). Collecting, preserving and studying insects. Hutchinson, London.

10. Kenneth G. V. Smith. (1973). Insects and other Arthropods of Medical Importance. The Trustees of the British Museum, London.
11. Nicholl, D.S.T. (2010). An introduction to Genetic Engineering. Ed 3. Cambridge University Press.
12. Robert G. Foottit and Peter H. Adler. (2009). Insect Biodiversity - Science and Society. Ed.. Wiley-Blackwell, London.
13. Roy, D.N. and Brown, A.W.A. (1970). Entomology (Medical and Veterinary) including insecticides & insects & Rat control. The Bangalore Printing & Publishing Co. Ltd., Bangalore.
14. Service, M.W. (1980). A Guide to Medical Entomology. McGraw-Hill Book Company, London.
15. Smith, T.M. and Smith, R.L. (2006) Element of Ecology. Ed 6. Peassion William S. Romoser. (1973). The Science of Entomology. Macmillan Publishing Co. London.

MPHE 103: Physiology and Biochemistry of Insects of Public Health Importance

THEORY

70 Hrs

Unit I Integumentary system

Formation of insect cuticle – Biochemical composition of various layers – Physiology of moulting – Secretion and composition of moulting fluid – Moulting associated enzymes and hormones.

Unit II Digestion and nutrition

Structural regions of the gut with reference to gut barriers in vectors – Mouth parts of mosquitoes (larva and adult) – Feeding mechanisms in mosquito larva and adult – Digestive enzymes – Peritrophic membrane formation and function in haematophagous insects – Blood digestion in haematophagous insects – Nutritional requirements and metabolic pathways (protein, lipid & carbohydrate) in haematophagous insects.

Unit III Respiratory and Circulatory system

Structural regions, adaptations, and functional properties with special reference to aquatic forms of mosquitoes – Cyclic or discontinuous respiration – Respiratory metabolism and cytochrome oxidase system.

Circulatory system structure – Mechanism and neuronal/hormonal control of circulation – Haemolymph constituents and functions – Haemocytes, haemopoietic organelles and immune molecules – Phenoloxidase system, melanization and encapsulation.

Unit IV Excretion and osmoregulation

Structural design of organs of excretion with special reference to aquatic stages of mosquitoes – Excretion in haematophagous insects – Osmoregulation in terrestrial and aquatic insects – Physiology of osmoregulation in aquatic stages of mosquitoes.

Unit V Nervous system and sense organs

Regions of nervous system – Physiology and co-ordination of nervous system components, sense organs – Circadian rhythm in mosquitoes – Sensory physiology of host – seeking behaviour in mosquitoes – Pheromones/kairomones and control of behavior of insects, including vector insects.

Unit VI Reproduction and development

Egg development and abdominal conditions in mosquitoes – Autogeny, gonotrophic cycle and physiological age determination in mosquitoes – Reproductive organs of mosquitoes (male & female) – Types of ovarioles – Vitellogenesis and spermatogenesis – Fertilization, zygote formation and embryogenesis – Metamorphosis – Endocrine control of development and maturation.

PRACTICALS

40 Hrs

1. Qualitative analysis of protein, lipid and chitin in insect integument.
2. Qualitative analysis of digestive enzymes in the gut of insect
3. Total protein estimation in the ovary of mosquitoes.
4. Haemolymph collection, staining and identification of haemocytes of mosquitoes.
5. Protein profiling of mosquito haemolymph through SDS-PAGE and HPLC.
6. Gel elution of protein through Electro elution method.
7. Membrane feeding of mosquitoes and determination of Sella's abdominal conditions.
8. Physiological age determination of mosquitoes by examination of the ovarian features.
9. Demonstration of ametabolous, hemimetabolous, and holometabolous conditions.
10. Demonstration of oviposition attractancy in mosquitoes by exposing gravid females to oviposition attractants.
11. Demonstration of juvenile hormone activity on mosquito immatures by exposing to JH analogues.

Suggested Readings:

Books

1. Annual Review of Biochemistry (2011). Annual Reviews Inc.
2. Annual Review of Cell & Dev. Biology (2011). Annual Reviews Inc.
3. Annual Review of Entomology (2011). Annual Reviews Inc.
4. Annual Review of Immunology (2011). Annual Reviews Inc.
5. Advances in Insect Physiology (2011). Annual Reviews Inc.
6. Advances in Insect Physiology (All Volumes since 1964). Academic Press, New York.
7. Chapman, R.F. (1998). The Insects: Structure and function. Cambridge University Press, UK.
8. Clements, A.N. (1974). Physiology of Mosquitoes. Macmillan Co., New York.
9. Clements, A.N. (1992). The biology of mosquitoes, Volume I: Development, nutrition and reproduction. Chapman & Hall, UK.
10. Clements, A.N. (1999). The biology of mosquitoes, Volume II: Sensory reception and behaviour. Oxon, UK.

11. Gupta, R.K. (2012). Objective in chemistry Vol. I & II. Arihand Prakashan, Meerut.
12. Mani, M.S. (1973). General Entomology Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
13. Nation, J.L. (2002). Insect Physiology and Biochemistry. CRC Press, Florida.
14. Pattabiraman, T.N. (2008) Laboratory Manual and Practical Biochemistry a lab manual.
All India Publishers and Distributors.
15. Wigglesworth, V.B. (1977). The Principles of Insect Physiology. ELBS, London.
16. Wigglesworth, V.B. (1984). Insect Physiology. Chapman & Hall, New York.

MPHE 104: Biostatistics

THEORY

70 Hrs

Unit I Descriptive statistics

Data types: Qualitative – Quantitative, Tables – Graphs – Averages (mean, median, mode, Geometric Mean, Harmonic Mean) – Dispersions: range, inter quartile range – mean deviation – variance – standard deviation – standard error - Coefficient of dispersion.

Unit II Sampling methods

Population - sample – parameter - statistic - sampling frame – sampling unit - Methods of sampling: probability sampling – simple random – systematic – stratified – cluster; non-probability sampling – quota, convenience, snow ball and purposive/judgment; determination of sample size.

Unit III Correlation and regression

Scatter diagram – Pearson's correlation coefficient – rank correlation – least square regression – Probit - logistic regression analysis - calculation of LC_{50} / LC_{90} values - relative potency.

Unit IV Basics of probability distributions

Concepts of probability: Sample space – events – mutually exclusive and independent events, addition and multiplication laws of probability - Binomial – Poisson – negative binomial and normal distributions.

Unit V Tests of significance

Null and alternative hypotheses - level of significance - type I – type II errors - Chi-square tests, Parametric (t-tests; one and two way ANOVA) – Non-parametric test (Sign test, Mann-Whitney U-test; Kruskal – Wallis one – way ANOVA).

PRACTICALS

40 Hrs

1. Descriptive statistical measures (e.g. mosquito larval, parasite counts, etc.)
2. Charts and graphs (e.g. meteorological data, species composition by space and time)
3. Determinations of sample size for cross sectional, prospective, case-control studies.
4. Sampling design - immature and adult mosquitoes.
5. Ordinary least- square linear regression (e.g. vector infection vs. human infection).
6. Student's t-tests for paired and un-paired samples.
7. Chi-square test (2×2 ; $2 \times n$) comparing proportions (e.g., susceptibility status by species)
8. One-way/two-way ANOVA (e.g. bioassay data by species /larval density by type of habitats and collection methods).
9. Probit model to biological assay data and lethal concentrations.

Suggested Readings:

Books

1. Altman, D. G. (1991). Practical Statistics for Medical Research. Chapman and Hall, London.
2. Bourke, G. J., Daly L. E. and McGilvray, J. (1985). Interpretation and uses of Medical Statistics. Blackwell Scientific publications.
3. Gupta, R.K. (2012). Courses in mathematics. Tata McGraw-Hills.
4. Snedcor, G. W. and Cochran, W.G. (1985). Statistical Methods. IOWA State University Press.
5. P.S.S. Sundara Rao and J. Richard (2004). An Introduction to Biostatistics. Principle – Hall of India Pvt. Ltd, New Delhi.

MPHE 201: Vector-Borne Parasites and Pathogens of Public Health Importance

THEORY

65 Hrs

Unit I Malarial Parasites

History and geographic distribution of human malaria (Global and India) – Taxonomic position of different malaria parasites – Distinguishing characters of different species of human malarial parasites – Life cycle and host-parasite interactions – Brief description of zoonotic malarial parasites.

Unit II Lymphatic Filarial Parasites

History and geographic distribution of lymphatic filariasis (Global and India) – Taxonomic position of different human filarial parasites – Distinguishing characters of different species/strains – Life cycle and host-parasite interactions – Endosymbionts and their significance – Brief description of zoonotic parasites and animal models.

Unit III Onchocercal, Schistosomal, Loa Loa, Mansonella and Dracunculid Parasites

Geographic distribution – Taxonomic position of different human parasite species – Vectors of different parasites – Distinguishing characters of different species – Life cycle and transmission – Intermediate hosts.

Unit IV Arboviral pathogens

Classification of Arboviruses – Dengue, Chikungunya, Japanese encephalitis, Kyasanur Forest Disease (KFD), West Nile, and Yellow fever viruses – Geographic distribution – Viral structure and replication – Transmission and maintenance cycle.

Unit V Bacterial and rickettsial pathogens

Bacterial pathogens – Leptospirosis – plague – rickettsial pathogens – scrub typhus – endemic typhus – vectors and animal reservoirs.

Unit VI Leishmaniasis, Trypanosomiasis and Babesiosis

Geographical distribution – Different species and differentiating features – life cycle and transmission.

PRACTICALS

30 Hrs

1. Preparation of stains- JSB I and II, Leishman and Giemsa.
2. Preparation of blood smears (thick and thin) and staining with JSB. Leishman and Giemsa For detection of malarial parasites.
3. Identification of human malaria parasite – species through examination of blood smears:
(I) *Plasmodium vivax* (II) *P. falciparum* (III) *P. malariae* (IV) *P. ovale*
4. Dissection of salivary glands and midgut for demonstration of parasite infection.
5. Staining and examination of blood smears for detection of microfilariae.
6. Dissection and examination of mosquitoes for filarial parasite (*Wuchereria bancrofti* and *Brugia malayi*) infection & infectivity rate.
7. Membrane filtration technique for detection of microfilariae.
8. Demonstration of various stages of filarial parasites and differentiation of species.
9. Demonstration of Dracunculid worm – Leptospira bacterium – Leishmania parasite – Trypanosome parasites – Babesiosis parasites.
10. Demonstration of arbo-viral particles – IFA test and RT-PCR.
11. Weil-felix test for scrub typhus

Suggested Readings:

Books

1. Advances in Parasitology Vol. 1-4 (2011). Annual Reviews Inc.
2. Brenner, R.R. and Shoka, A.M. (1987). Chagas' disease vectors. Volume I and II by CRC press, Florida.
3. Bruce-Chwatt, L.J. (1985). Essential Malariology, The Alden Press, Oxford.
4. Burton J. Bogistch, Clint E. Carter, Thomas N. Oeltmann. (2005). Human Parasitology. Third Edition, Elsevier Academic press.
5. Chaterjee, K.D. (1981). Parasitology: Protozoology and Helminthology: Introduction to Clinical Medicine. Ed 12. Chaterjee Medical Publishers.
6. Davis A. Warrell and Herbert M. Gilles. (2002). Essential Malariology, Fourth Edition. Arnold pub. Oxford.
7. Douglas D. Richman, Richard J. Whitley. (2002). Clinical Virology - 2nd Edition.
8. Kalra, N. L. and Bang Y. H. (1988). Manual on Entomology in Visceral Leishmaniasis, SEA/VBC/35.WHO.
9. Kochchar, S.K. (2009). A Text Book of Parasitology. Wisdom Press.
10. Manabu Sasa, (1976). Human filariasis- A global survey of epidemiology and control. University of Tokyo press.
11. Manson- Bahr, R. E.C. and Bell, D.R. (1987). Manson's Tropical Disease. ELBS.T. B.
12. Methods in Microbiology (2011) Elsevier. Academic Press.
13. Mukherjee, K.L & Ghosh, S. (2010). Medical Laboratory Technology Vol.I, II & III : Procedure Manual for routine diagnostic Test Ed 2. Tata McGraw-Hills.

14. Mulligan H.W. (1970). The African Trypanosomiasis edited by Ministry of overseas Development, Boston.
15. Nutman. (2002). Lymphatic filariasis. Imperial College.
16. Peters N. and Killick-Kendrick. (1987). Leishmaniasis in Biology and medicine. Vol. 1 - 3 Academic Press.
17. Warnsdorfer W.H. and Sri. Mc Gregor, I. (1998). Malaria: Principles and Practice of Malariology. Vol. I and II, Churchill Livingstone, New York.
18. WHO, (1985). Bench Aids for the diagnosis of malaria.

MPHE 202: Application of Molecular biology, Immunology and Bioinformatics in Public Health Entomology

THEORY

65 Hrs

Unit I Basics of Nucleic acid structure & Function

Structure of DNA & RNA – DNA replication – Transcription – Translation – Gene expression and regulation.

Unit II Genome organization

Organisation of eukaryotic genome – components of eukaryotic chromatin and chromosome – structure – genome organization of *Anopheles* – genome organization of malarial and filarial parasites – Genome of plasmid and mitochondria; Gene transfer in microorganisms – conjugation – transformation – transduction.

Unit III Gene cloning, Characterization and its application

Amplification of DNA by PCR – restriction endonucleases – ligation – transformation – restriction mapping of DNA fragments – construction of genomic and cDNA libraries and screening for genes of interest – site directed mutagenesis – preparation of radio labeled DNA and RNA probes for molecular diagnosis of parasites and vectors by Southern and Northern hybridization, DNA sequencing. Transgenic mosquitoes.

Unit IV Gene polymorphism and Molecular markers for diagnosis

Genetic polymorphism of vector and parasites – strain identification – PCR assays – types genotyping of parasites – population genetics and molecular phylogeny of Anopheline vectors and malaria parasites using molecular markers – RAPD – RFLP – AFLP and Microsatellites.

Unit V Bioinformatics

Basic knowledge of computer aided biology, genome characteristics, databases – search and retrieval – sequence alignment and annotation – comparative genomics – principles – phylogenetic analysis. Proteomics – protein structure prediction and applications in vector borne disease.

Unit VI Immunology

Innate and acquired immunity – antigen/antibody and their reactions – cellular and humoral immunity – production of monoclonal and polyclonal antibodies – immuno diagnostics for Vector Borne Diseases – Insect cell culture and its applications.

PRACTICALS

30 Hrs

1. Isolation of nucleic acids from parasite and mosquito vector.
2. Isolation of plasmid DNA.
3. Quantification of nucleic acids.
4. Agarose gel electrophoresis of nucleic acids.
5. Primers designing for amplification of DNA fragments.
6. Gel purification of nucleic acids.
7. RAPD and RFLP analysis.
8. Antigen-Antibody reactions (agglutination – blood grouping, precipitation – Immuno-diffusion, ELISA – Og4C3 (Filariasis), RDT (Malaria), ICT (filariasis, Dengue), SDS-PAGE, Western blot, Immunoblot.
9. Bioinformatics databases (Nucleic acid, protein and structure databases) and data retrieval
10. Homology search by BLAST.
11. DNA/Protein sequence analysis and phylogenetic analysis using BioEdit, ClustalW, ClustalX and Mega.

Suggested Readings:**Books**

1. Albert L. Lehninger, David Lee Nelson, Michael M. Cox. (2008). Principles of biochemistry. Mcgraw HILL.
2. Andreas D. Baxevanis and B.F. Fancis Ouellette (2002). Bioinformatics: A practical guide to the analysis of genes and proteins 2nd edition Wiley Interscience.
3. Annual Review of Immunology (2011). Annual Reviews Inc.
4. Benjamin Lewin (2004). Gene VIII., Pearson Education, Limited.
5. Bioinformatics and functional genomics, John Wiley 2nd edition Wiley – Blackwell 2009.
6. David Freifelder, George Malacinski. (2005). Essentials of Molecular Biology. - 4th edition.
7. David Webster. (2000). Protein Structure prediction: Methods and Protocols, Human Press.
8. Genomes, T. A. Brown. (2006). 2nd edition, Garland Science publisher.
9. Goldsby RA et al. (2006). Kuby Immunology (with web support) W.H. Freeman Co. 6th ed.
10. Goldsby RA et al. (2006). Roitt's Essential Immunology. Delves PJ, et al. Wiley Blackwell, 11th ed.
11. Lesk, A.M. (2009). An Introduction to Bioinformatics. Ed 2. Oxford Principles of Gene Manipulation: An Introduction to Genetic Engineering. R.W. Old and S. B Primrose, 6th edition, Blackwell Science Inc.
12. Mukherjee, K.L & Ghosh, S. (2010). Medical Laboratory Technology Vol.I, II & III: Procedure Manual for routine diagnostic Test Ed 2. Tata McGraw-Hills.
13. Nicholl, D.S.T (2010). An introduction to Genetic Engineering. Ed 3. Cambridge University Press.

MPHE 203: Pesticides used in Public Health

THEORY

70 Hrs

Unit I Introduction to pesticides

Pesticides in public health – Isolation and development of pesticides of plant and animal origin - Use of pesticides – History of Insecticides– Definition of various terms – Advantages of chemical control and its utility in vector control – Classification of insecticides – Chemical Pesticides – Biolarvicides – Insect growth regulators – Mode of action – Pesticide formulations: Types of formulations – conventional and newer formulations (nano based) - Selection of formulations – Adjuvant – Combining insecticides: Physical and Chemical incompatibility.

Unit II Pesticide Application Equipments

Equipments: Types – Application – Types of nozzle – Determination of droplet size – classification of different sprays – Application procedures: Application rates – conversion factors – preparation of spray suspension – conversion tables for dosages – Area measurement and dosage determination.

Unit III Pesticide Regulation

Pesticide regulation policies – International policies: The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) – Registration – Approval criteria for registration – Pesticide issues and related legislation – Regional Policies: Pesticide problems in Asia – Policy and monitoring guidelines – National Policies: Insecticide Act in India – CIB – Registration – Licensing – Notification of poisoning and cancellation of registration – Offences and Punishment.

Unit IV Management of Public Health Pesticides

Elements of management of public health pesticides: Product registration – Procurement – Label – Storage and transport – Distribution – Application – Disposal – surveillance of pesticide poisoning – Quality control; Safe use of pesticides: general principles of safety measures – medical surveillance; Operative procedures: Preparation of spray materials – House treatment with residual spraying – Larvicidal – Rodenticidal – Herbicidal treatments – Diagnosis and treatment of poisoning.

Unit V Evaluation of Newer Insecticides/ Insecticides Formulation

WHO evaluation scheme – Evaluation of chemical Larvicides/IGRs/biolarvicides: Phase I: Laboratory studies – Phase II: Small-scale field trials – Phase III: Medium and large scale field trials – Effect on non target organisms – Operational and community acceptability –

Evaluation: Repellents – Adulticides – insecticide treated Nets and Fabrics – Evaluation indicators: Process indicators – Impact indicators – outcome indicators.

Unit VI Insecticide Resistance and Management

Present status of insecticide resistance – Impact of insecticide resistance on the control of vectors – Socio economic impact of resistance (Administrative, operational, Financial, Social and Agricultural implications) – Detection and monitoring of vector resistance – Insecticide targets and mechanism of resistance – Resistance management.

PRACTICALS

40 Hrs

1. Handling of different pesticide application equipments-Pneumatic sprayer for indoor residual sprayer, Knapsack sprayer for larviciding, thermal fogger for space spraying.
2. Droplet size determination.
3. Determination of larval susceptibility to different insecticides: Preparation of stock solutions and various concentrations; Methods of testing.
4. Determination of adult susceptibility to different insecticides: Preparation of insecticide impregnated papers; methods of testing using WHO test kit.
5. Determination of adult susceptibility of house flies by topical application.
6. Laboratory evaluation of insecticides against different surfaces.
7. Evaluation of vaporizers/ aerosols/fumigants (vapour borne toxicity).
8. Evaluation of larvicides/ biolarvicides/insect growth regulators under field conditions.
9. Maintenance of spray equipments.
10. Residue analysis (Colorimetric methods; HPLC Technique).

Suggested readings:

Books

1. Indian Council of Medical Research (2012). Quality Standards Indian Medicinal Plants, ICMR.
2. Indian Council of Medical Research (2012). Perspectives of Indian Medicinal plants in the management of lymphatic filariasis, ICMR.
3. Indian Council of Medical Research (2012). Phytochemical Reference standard of selected medicinal plants, ICMR.
4. Service M.W. (1996). Medical Entomology for students. Chapman & Hall, London.
5. Jorgen Stenersen (2004). Chemical pesticides, mode of action and toxicology by CRC, Press, London.
6. Cremllyn R. (1979). Pesticides preparation and mode of action. John Wiley and Sons, Ltd., New York.

7. Haskell P. T. (1985). Pesticides application: Principles and practices. Clarendon Press. Oxford.
8. Bert L. Bolimont. (2000). The standard pesticides user's guide. 5th edition, Prentice Hall Inc. New Jersey.
9. Law of insecticides, Fertilizer (control) order and seeds along with The Essential commodities act (1955). By Publishers editorial board, 12th edition. Asia Law house, Hyderabad.
10. Kenneth A. Hassall (1982). The chemistry of pesticides. The Macmiller Press Ltd., Hong Kong.

Reports

1. Rozendaal, A.J. (1997). Vector Control. Methods for use by individuals and communities. World Health Organization, Geneva.
2. World Health Organization (1997). Chemical methods for the control of vectors and pests of public health importance, Geneva. WHO/CTD/WHOPES/97.2.
3. World Health Organization (2005). Guidelines for laboratory and field testing of mosquito larvicides WHO/CDS/WHOPES/GCDPP/2005.13.
4. World Health Organization (1990). Pesticide application equipment for vector control. Twelfth Report of the WHO experts Committee on Vector Biology and Control. Technical Report Series 791. Geneva.
5. World Health Organization (2009). Guidelines for efficacy testing of insecticides for indoor and outdoor ground-applied space spray application. WHO/HTM/NTD/WHOPES/2009.2.
6. World Health Organization (2006). Guidelines for testing mosquito adulticides for indoor residual spraying and treatment of mosquito nets. WHO/CDS/NTD/WHOPES/GCDPP/2006.3.
7. World Health Organization (2005). Guidelines for laboratory and field testing of long-lasting insecticidal mosquito nets. WHO/CDS/WHOPES/GCDPP/2005-11.
8. World Health Organization (2009). Guidelines for efficacy testing of house hold insecticide products. WHO/HTM/NTD/WHOPES/2009.3.
9. World Health Organization (2009). Guidelines for efficacy testing of mosquito repellents for human skin. WHO/HTM/NTD/WHOPES/2009.4.
10. World Health Organization (1975). Manual on practical entomology in malaria. Part II. Methods and Techniques. Geneva.
11. WHO (1985). Specification for pesticides used in public health. Insecticides-Molluscicides-Repellents-Methods. 6th edition, WHO. Geneva.

MPHE 204: Control of Vectors of Public Health Importance

THEORY

70 Hrs

Unit I Introduction to vector control

Vector control: Principle – Aims – objectives – goals – Importance and advantages – History and background – Alternatives to the use of insecticides – Vector control at individual or at community or at both levels – Selection of appropriate control measures – Personal protection measures – Types of vector control-Selective, integrated and comprehensive vector control - Recent trends in control of vectors of public health importance – use of *Wolbachia* and transgenic mosquitoes.

Unit II Control of mosquitoes and flies (Black flies, Sand flies, Biting midges, Tabanids, Stable flies)

Selection of suitable site specific control measures-Personal protection measures – zooprophyllaxis – Insecticide treated fabrics – Long lasting insecticide treated mosquito nets (LLINs) – Insecticide spraying (larviciding – indoor residual spraying – space spraying) – Alternatives – biological control – environmental management including source reduction.

Unit III Control of Tsetse flies and Triatomine bugs

Tsetse fly: Prevention and control – Traps and insecticide impregnated screens – Insecticide spraying (ground and aerial). Triatomine bugs: Introduction to control measures – Application of insecticides – insecticides and formulations – House modification/improvement – improvement of Peri-domestic environment – insecticide treated bed nets – fumigant canisters.

Unit IV Control of bedbugs, fleas, lice, ticks, mites and others

Bedbugs: Detection – repellents – household measures – insecticide treated bed nets – smoke generators – smoke density – residual insecticide spraying; prevention and control of fleas: human, rat, cat, dog fleas – lice (head, crab or pubic and body lice) – ticks: hard and soft ticks, and mites: trombiculid, scabies, dust and domestic mites – Cyclops – fresh water snails – rodents (physical, trapping, application of baits) – venomous arthropods.

Unit V Control of cockroaches and house flies

Cockroaches: Environmental management: cleanliness and hygiene, reduction of accessibility chemical and biological control – baits and traps – repellents – modern methods.

House flies: Inspection – Exclusion: Environmental sanitation and hygiene – habitat destruction – prevention of fly pathogen contact – food protection – prevention of man – fly contact – Mechanical – Biological and Chemical control.

PRACTICALS

35 Hrs

1. Characterization of mosquito breeding habitats.
2. Demonstration of environmental control measures.
3. Demonstration of application of bio-control agents.
4. Demonstration of personal protection materials / measures.
5. Demonstration of Insecticide treatment of mosquito nets/curtains + Cone bioassays
6. Demonstration of indoor residual spraying.
7. Demonstration of space spraying.
8. Demonstration of collection and control of mites.
9. Use of bait formulations for housefly and cockroach control.
10. Demonstration of housefly control using chemical and biological methods.
11. Demonstration of rodent control.

Suggested Readings:

Books

1. Cox, F. E. G. Modern Parasitology (1993). A Text Book of Parasitology. Edition: 2. Blackwell Science Ltd. Oxford.
2. De Barjac (1990). Bacterial control of mosquitoes & black flies: biochemistry, genetics & applications of *Bacillus thuringiensis israelensis* & *Bacillus sphaericus*.
3. Indian Council of Medical Research (2012). Phytochemical Reference standard of selected medicinal plants, ICMR.
4. Indian Council of Medical Research (2012). Perspectives of Indian Medicinal plants in the management of lymphatic filariasis, ICMR.
5. Indian Council of Medical Research (2012). Quality Standards Indian Medicinal Plants, ICMR.
6. Lacey, L. A. and Undeen, A.H. (1986). Microbial Control of Black Flies and Mosquitoes. Annual Review of Entomology, 31: 265-296.
7. Marquardt, W. H. (2004). Biology of disease vectors (2nd Ed.).
8. Mukherjee, K.L & Ghosh, S. (2010). Medical Laboratory Technology Vol.I, II & III: Procedure Manual for routine diagnostic Test Ed 2. Tata McGraw-Hills.
9. Potts, W.H. Glossinidae (tsetse flies) (1973). In: Smith, K.G.V. (ed.): Insects and other Arthropods of Medical Importance. British Museum (Natural History), London.

10. Wall, R., Shearer, D. (2001). *Veterinary ectoparasites: biology, pathology and control*. Blackwell Science.
11. Wall, R., Shearer, D. (1997). *Adult flies (Diptera)*. In: Wall, R., Shearer, D. (eds.): *Veterinary Entomology*. Chapman & Hall, London.

Reports

1. Rozendaal, J. A. (1997). *Vector Control. Methods for use by individuals and communities*. World Health Organization, Geneva.
2. Samba E.M. (1994). *The Onchocerciasis Control Programme in West Africa. An example of effective public health management*. Geneva, World Health Organization (Public Health in action, No. 1).
3. World Health Organization (1990). *Control of the leishmaniasis: report of a WHO Expert Committee*, Geneva. (WHO Technical Report Series, No. 793).
4. World Health Organization (1986). *Epidemiology and control of African trypanosomiasis. Report of a WHO Expert Committee*, Geneva. (WHO Technical Report Series, No. 739).

MPHE 301: Epidemiology of Vector Borne Diseases

THEORY

70 Hrs

Unit I Introduction to Epidemiology

Epidemiology – definition – scope and applications – cycles of disease – endemic, epidemic, pandemic – emerging and re-emerging vector borne diseases - pathogen/parasite factors – vector factors – environmental factors epidemiologic triad – study population – sampled population.

Unit II Epidemiological Studies

Descriptive studies – case reports/case series – ecological and cross sectional studies – Analytical studies – observational (case control, cohort) – experimental (clinical/community trials).

Unit III Vector and disease surveillance

Surveillance concepts – survey methods – special surveys (extensive and intensive) – Epidemic/outbreak investigations Surveillance tools – Notifiable diseases and their surveillance – Yellow fever – Plague – Cholera – Public health emergencies of international concern (PHEIC) - Application of Geographic Information System (GIS) and Remote Sensing.

Unit IV Epidemiological measures

Epidemiological measures – incidence – prevalence – risk difference – relative risk – Odds ratio – attributable risk – standardization of rates (direct/indirect) – screening for diseases (types and uses, sensitivity, specificity, positive and negative predictive values).

Malaria: Basic reproduction rate – vectorial capacity – vector competence – inoculation rate – stability index – Human Blood Index (HBI) – Annual Parasite Incidence (API) – Slide Positivity Rate (SPR) – Slide Falciparum Rate (SFR) – Annual Blood Examination Rate (ABER) – Acute Encephalitis Syndrome (AES) – endemicity.

Filariasis: infection and infectivity – Microfilaria (Mf) prevalence – Annual Transmission Potential (ATP) – Risk of Infection Index (RII).

Arboviral Diseases: Vector indices (dusk index, house Index, container Index, Breteau Index, pupal Index) – Minimum Infection Rate (MIR).

Unit V Modes of disease transmission

Intermediate and definite hosts; Transmission types – cyclic and secular trend of diseases – biological/mechanical – contact – inter-seasonal maintenance.

PRACTICALS

30 Hrs

1. Demonstration of survey methods - *Aedes, Anopheles, Culex* (Adult and immature).
2. Determination of Entomological Indices - Vectorial capacity (Malaria).
3. Estimation of *Stegomyia* Indices: House, Container, Breteau and Pupal Index.
4. Determination of Epidemiological Indices: Prevalence, Incidence for Malaria, Filariasis and Dengue (PHC Data/ Field surveys).
5. Disease epidemic/ outbreaks – Case studies – Investigation and Report writing.
6. Visit to sea port/air port health office to study formalized surveillance and reporting system.
7. Rodent Ecto-Parasitic (REP) Survey.

Suggested Readings

Books

1. Beaglehole, R., Bonita, R., Kjellstrom, T (1993). Basic Epidemiology. World Health Organisation, Geneva.
2. Bonita, R., Beaglehole, R. and Kjellstrom, T. (2006). Basic Epidemiology. WHO, Geneva.
3. Daniels, S.R. and Flanders W.D. (2000). Medical Epidemiology. McGraw Hill. Medical Publishing Division, London.
4. Harwood R.F. and James M.T. (1979). Entomology in Human and animal health. Macmillan Publishing Co.Inc, London. 7 Ed.
5. Mullen, G. and Durden L. (2009). Medical and veterinary entomology. Academic press, London.
6. Nicholas R. H. Burgess. (1981). Arthropods of Medical importance, Published by Noble Books Ltd, Hampshire.
7. Norman Vetter Ian Matthews (1999). Epidemiology and Public Health Medicine. Publishers: Churchill Livingstone/Harcourt Publishing Limited, London.
8. Park, K. (2009). Park's text book of Preventive and Social Medicine. Banarsidas Bhanot Publishers, India.
9. Richard P. Meyer, and Minoo B. Madon. (2002). Arthropods of public health significance in California, Training Manual. Mosquito and vector control association of California, CA 95814.

10. Roy D.N. and Brown A.W.A. (1970). Entomology (Medical and Veterinary) including insecticides & insects & Rat control; The Bangalore Printing & Publishing Co. Ltd., Bangalore.
11. Thomas C. Timmereck (1998). An introduction to Epidemiology Jones and Barlett Publishers, London.

Reports

1. World Health Organization (2008). Public Health significance of urban pests. WHO, Europe.

MPHE302: Environment and Public Health

THEORY

65 Hrs

Unit I Environment and Health

Environment and Health Definitions – Eco health - Role of Vectors and Pests – water pollution – impact on vector proliferation – environmental pollution and health hazards – pollution abatement – biological, physical and chemical methods.

Unit II Environment Risk Factors

Environmental conditions and Spatial spread of vector borne diseases – Vulnerable populations – Environmental risk factors and risk assessment: urbanization and industrialization – impact on Health – direct and indirect - Climate change – global warming and impact.

Unit III Environmental Health in Emergencies and Disasters

Health in emergency – Rescue & Relief Operations - Emergency Medical Relief (EMR) – Surveillance Network – Risk of outbreaks of water borne – Fly borne and vector borne diseases - Bioterrorism/ Biological warfare- Agenda for development Programme - Role of environmental management in preventing epidemics of VBDs.

Unit IV Public Health Promotion

Public Health Surveillance – Opportunities and needs for community in Health promotion – Basic sanitation – Hygiene and personal protection – Human wastes and Health – Solid waste and Waste water management.

Unit V Application of GIS in Public Health Service

Introduction to GIS – Spatial dimension of health – GIS for Health Service – GIS and Remote Sensing in model prediction for vector borne diseases and early warning system.

Unit VI Managing Health, Environmental Linkages & Health Policy

Environmental and health impact assessment – Current practice and problems in Health Impact Assessment (HIA) and Environmental Impact Assessment (EIA) – Healthy public policy in practice.

PRACTICALS

30 Hrs

1. Visit to Pollution control Board - identify the operational aspects on solid waste and waste water management.
2. Training on GIS technology and usage of GPS for different situations.
3. Environmental and entomological risk assessment for vector-borne diseases in a selected site.

Suggested Readings:

Books

1. Melnick, A. L. (2002). Introduction to Geographic Information Systems in Public Health Aspen Publishers, Maryland ISBN 0 8342 1878 X.
2. Richard P. Meyer and Minoo B. Madon. (2002). Arthropods of public health significance in California, Training Manual. Mosquito and Vector Control Association of California, 660 J Street, Suite 480, Sacramento, CA 95814.
3. Walton Purdom, P. (1971). Environmental health, Edited by Academic press, INC, London.

Reports

1. World Health Organization (2002). Environmental health in emergencies and disasters a practical guide edited by B. Wisner and J. Adams WHO.
2. World Health Organization (2008). Health Environment: Managing the linkages for sustainable development. A toolkit for decision makers: SynProject report. WHO/ UNEP, ISBN 97892 4 1563 727, www.who.int/heli Health and environment linkages initiative (HELI).
3. World Health Organization (1991). Insect and rodent control through environmental management: A community action programme WHO.
4. World Health Organization (2008). Public Health significance of urban pests (WHO - Europe 2008) ISBN 978 -92-890-7188-8.
5. Sustainable Development and Health for all: Building the capacity of National Health authorities, WHO – SEARO, 1999, No.30.
6. Health Villages: A guide for communities and community health workers (2002), WHO, Geneva.

MPHE 303: Integrated Vector Management

THEORY

70 Hrs

Unit I Principles of Integrated Vector Management (IVM)

General introduction – concept and definition of IVM – feasibility, merits and limitations – success stories – India, Thailand & Sri Lanka.

Unit II Key elements of IVM

Key elements of IVM – role of vector control in controlling/preventing vector borne diseases – planning IVM – situation analysis and needs assessment – implementation plan – monitoring and evaluation.

Unit III Ecosystem and vector borne diseases

Responses to vector borne disease in an ecosystem frame work – food chain and food web – prey and predator interactions – water management – eco-epidemiological approach to address multiple vector borne diseases.

Unit IV Evidence based integration of vector control options

Principles of vector control – personal protection measures – evidence based decision making process for integration of vector control options. Transgenic mosquitoes – ecological concern.

Unit V Inter-sectoral collaboration

Partnership – mechanisms of achieving inter-sectoral collaboration – methods and process to ensure sustainability of partnership – importance of Public Health Acts in IVM strategy.

Unit VI Social Mobilization for IVM

KAP assessment – health awareness and behavior – strategies for promoting community involvement – Communication for Behavioural Impact (COMBI) and Behavioural Change Communication – experiences in the control of vector borne diseases.

Unit VII Public Health and Agriculture practices

Public Health and Agriculture practices – healthy public policies – water, fertilizers and pesticides effects on insects – integration of IPM and IVM – IPM farmer's field schools and achievements.

PRACTICALS

30 Hrs

1. Situation analysis and needs assessment for planning IVM in a given locality.
2. Survey on health awareness and behavior in a given community.
3. Construction of food chain-food web and energy flow in a pond/rice field ecosystem
4. Visit to IVM partners / stakeholders.
5. Visit to Farmers' Field School – identification and calculation of ratio between beneficial and harmful insects/predators.
6. Demonstration of community mobilization techniques.

Suggested Readings:

Books

1. A Field Guide to Designing a Health Communication Strategy (2003). Population Communication Services, Johns Hopkins Bloomberg, School of Public Health/Centre for Communication Programmes.

Reports

1. Berg H van den, Das P K, von Hilderbrand A, Rangunathan V. (2008). Evaluation of the Integrated Pest and Vector Management (IPVM) project in Sri Lanka Mission Report WHO.
2. Chanda, E. et al. (2008). Integrated vector management: The Zambian experience. Malaria Journal, 7:164 World Health Organization, Regional Office for the Eastern Mediterranean.
3. Diarmid Campbell-Lendrum, David Molyneux. (2004). Ecosystems and Vector-borne Disease Control, Implementation of Integrated Vector Management in the WHO-African Region: Progress Report 2000-2003.
4. Guidelines for integrated vector management for control of dengue/dengue haemorrhagic fever, NVBDCP, 2008.
5. Implementing Integrated Vector Management (IVM) at District Level in South-east-Region - A step by step approach, WHO, 2007.
6. Morner F, Bos R, Fredrix M. (2002). Reducing and eliminating the use of persistent organic pesticides: guidance on alternative strategies for sustainable pest and vector management. Geneva, Inter organization Programme for the Sound Management of Chemicals (www.chem.unep.ch/pops/pdf/redelipops/redelipops.pdf).
7. Rozendaal, J.A. (1997). Vector Control - Methods for Use by Individuals and Communities, World Health Organization, Geneva.
8. World Health Organization (2007). Global plan to combat neglected tropical diseases, 2008-2015. Geneva, World Health Organization (WHO/CDS/NTD/2007.3).

9. World Health Organization (2004). Global Strategic Framework for Integrated Vector Management 2004. World Health Organization Geneva (WHO/CDS/CPE/PVC/2004.10).
10. World Health Organization (2003). Guidelines for Integrated Vector Management.
11. World Health Organization (1983). Integrated Vector Control, WHO. Technical Report Series No.688.
12. World Health Organization (2004). Integrated Vector Management - Strategic Framework for the Eastern Mediterranean Region 2004-2010. World Health Organization Regional Office for the Eastern Mediterranean Cairo 2004.
13. World Health Organization (2005). Malaria control today Current WHO Recommendations working document March 2005 Roll Back Malaria Department World Health Organization Geneva Switzerland 2005.
14. World Health Organization (2008). Position statement on Integrated Vector Management WHO/HTM/NTD/VEM/2008.2.
15. World Health Organization (2007). Report of the WHO consultation on integrated vector management (IVM). WHO headquarters, Geneva, Switzerland.
16. World Health Organization (1982). Urban vector and pest control, WHO, Technical Report Series, 767, 1988.
17. World Health Organization (2004). Will Parks and Linda Lloyd. Planning social mobilization and communication for dengue fever prevention and control A STEP-BY-STEP GUIDE. WHO/CDS/WMC/2004.2.

MPHE 304: Vector Borne Diseases Control Programmes

THEORY

70 Hrs

Unit I National Vector borne diseases Control Programme (NVBDCP)

Introduction to Millennium Development Goals – National Health Policy - Strategy under NVBDCP - Disease management - Integrated Vector management (for transmission risk reduction) - Supportive Interventions – Behaviour Change Communication (BCC) - Public Private Partnership (PPP) - Monitoring and Evaluation – Integrated Disease Surveillance Project (IDSP) - Health Information Management System (HIMS) – International health regulations

Unit II National Malaria Control Programme

Magnitude of the problem - Early case Detection and Prompt Treatment (EDPT) - Drug Distribution Centers (DDCs) and Fever Treatment Depots (FTDs) - Chemoprophylaxis - Malaria control strategies - Modified Plan of Operation (MPO) - Urban Malaria Scheme (UMS) - *P. falciparum* containment Programme (PfCP) – Roll back malaria (RBM) - Management of drug resistance - Monitoring and control of epidemics and focal outbreaks – Future interventions – Malaria Vaccines under trials.

Unit III National Filaria Control Programme

History – Organization - current burden - case detection and treatment - Vector control strategies – Elimination of lymphatic filariasis (ELF) – Global Programme for ELF (GPELF) - Monitoring and Evaluation.

Unit IV Kala-azar Control Programme

Trend of Kala-azar in India – Endemic areas – Diagnostic & Treatment guidelines – intervention strategies – elimination programme.

Unit V National programme for arbo-viral diseases

Trends in the outbreaks of dengue/chikungunya – National guidelines for prevention and control – Diagnosis and Case management

Japanese encephalitis – Endemic and Epidemic situations – Immunization Programme – Acute Encephalitis Syndrome (AES) - Diagnosis and Case management

Unit VI National Health Mission

National Rural Health Mission (NRHM): District Health Plan - Strengthening of Vector Borne Disease Control Programme through Accredited Social Health Activist (ASHA) - Health Sub Centres (HSCs) - Primary Health Centres (PHCs) - Community Health Centres (CHCs) - National Urban Health Mission (NUHM): Health concerns of the urban poor - Existing facilities - Urban Social Health Activist (USHA) - Ensuring Community Participation in planning and management.

PRACTICALS

30 Hrs

1. Case detection and treatment of malaria.
2. Case detection and treatment of filariasis.
3. Filariasis morbidity management methods.
4. Demonstration of Dengue and JE - clinical features.
5. Case reporting procedures.
6. Visits to District Health Office/ Primary Health Centre: National Programme - Organization – Functioning.

Suggested Readings:

Books

1. Bruce-Chwatt, L.J. (1985). Essential Malariology, The Alden Press, Oxford.
2. Davis Warrell and Herbert M. Gilles. (2002). Essential Malariology, Fourth Edition. Arnold pub.
3. Manson - Bahr, R. E.C. and Bell, D.R. (1987). Manson's Tropical Disease. ELBS.
4. Nutman T. B. (2002). Lymphatic filariasis.
5. Richard L. Guerrant, David H., Walker and Peter F.Weller. (1999). Tropical infectious diseases, Principles, Pathogens and Practice Vol. -1.
6. Richman, D., Richard J. Whitley. (2002). Clinical Virology - 2nd Edition Douglas.
7. Robert G. Webster and Allan Gramoff. (1994). Encyclopedia of Virology - Academic Press.
8. Stephen H. Gillespie and Richard D. Pearson. (2001). Principles and practice of Clinical Parasitology. John Willey and Sons, Ltd.
9. Warnsdorfer, W.H. and Sri..Mc Gregor, I. (1988). Malaria: Principles and Practice of Malariology. Vol. I and II, Churchill Livingstone, New York.

Reports

1. World Health Organization (1985). Bench Aids for the diagnosis of malaria.
2. World Malaria Report (2010). WHO, Geneva.
3. Sustainable Development and Health for all: Building the capacity of National Health authorities, WHO – SEARO, 1999, No.30.

4. Health Villages: A guide for communities and community health workers (2002), WHO, Geneva.
5. <http://dx.doi.org/10.7713/ijms.2012.0089>
6. NVBDCP: <http://www.nvbdc.gov.in>
7. NRHM: <http://www.mohfw.nic.in>