

# 3<sup>rd</sup> Year Microbiology Course 2011/2012

## Important Dates:

### First Semester 2011/2012

Teaching commences Monday, 5<sup>th</sup> September, 2011

Teaching ends Saturday, 26<sup>th</sup> November, 2011

Study Week Monday, 28<sup>th</sup> November, 2011

Examinations begin Monday, 5<sup>th</sup> December, 2011

Examinations end Friday, 16<sup>th</sup> December, 2011

Christmas Vacation Saturday, 17<sup>th</sup> December, 2011 – Sunday, 8<sup>th</sup> January, 2012

### Second Semester

Teaching begins Monday, 9<sup>th</sup> January, 2012

Teaching ends for Easter and teaching is finished for the Semester Saturday, 31<sup>st</sup> March, 2012

Easter Vacation and Study Week Sunday, 1<sup>st</sup> April - Saturday 21<sup>st</sup> April, 2012

Examinations begin Monday 23<sup>rd</sup> April, 2012

Examinations end Friday, 18<sup>th</sup> May, 2012

Easter in 2012 is on 8<sup>th</sup> April

## THIRD SCIENCE MICROBIOLOGY LECTURE COURSE - MI316 and MI317

**Course Co-ordinator: DR. TOM BARRY**

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**Note:** This document can be accessed at the Department of Microbiology Website NUIG:  
[www.nuigalway.ie/microbiology](http://www.nuigalway.ie/microbiology)

# **IMPORTANT COURSE INFORMATION**

## **A: LECTURE COURSE AND PRACTICAL TIMETABLE**

### **1: THIRD SCIENCE MICROBIOLOGY LECTURE TIME TABLE**

<b>Monday</b>	<b>12 - 1 pm.</b>
<b>Tuesday</b>	<b>2 - 3 pm</b>
<b>Wednesday</b>	<b>12 - 1 pm</b>
<b>Thursday</b>	<b>9 -10 am</b>

All lectures are held in the Tyndall Lecture Theatre, Dept. of Microbiology, NUI,G.

### **2: THIRD SCIENCE MICROBIOLOGY PRACTICAL COURSE TIMETABLE:**

<b>Tuesday</b>	<b>3 - 6 pm</b>
<b>Thursday</b>	<b>10 - 1 pm</b>

Upstairs and downstairs practical laboratories, Dept. of Microbiology, NUI,G.

\*\* Please note that, due to high class numbers, there will be three (A, B, C) separate groups for practical classes. Details of repeat practical sessions and tutorial-based practicals will be available in 2nd week of term.

## **B: TEXTBOOKS**

**BIOLOGY OF MICROORGANISMS - BROCK**, PUBLISHER: PATIENCE HALL,  
(Latest Edition).

**RECOMENDED TEXTBOOKS** are given after each lecture series outline below or will be recommended by the lecturer and copies of these textbooks are in the library.

**HANDOUTS:** Each lecturer will provide the class with handouts which will cover the topic area taught by that lecturer.

## **C: EXAMINATION MARKING SCHEME**

**1: SEMESTER I (CHRISTMAS) - THEORY WRITTEN PAPER: 35%**

**2: SEMESTER II (SUMMER) - THEORY WRITTEN PAPER: 35%**

**3: PRACTICALS: 30%**

Practical marking scheme is broken down as follows: 15% for continuous assessment and 15% for a practical written paper examination which will be held after the Semester II written paper examination (Summer).

## **D: EXAMINATION GRADES (Given after Christmas)**

A	= 70 TO 100% - 1 <sup>ST</sup> CLASS HONOUR
B	= 62 TO 69% - 2 <sup>ND</sup> CLASS GRADE 1 HONOUR
B-	= 55 TO 61% - 2 <sup>ND</sup> CLASS GRADE 2 HONOUR
C	= 50 TO 54% - PASS
D	= 40 TO 49% - PASS
E+	= 35 TO 39% - FAIL
E-	= 30 TO 34% - FAIL
F	= 0 TO 29% - FAIL

## **E: THEORY EXAMINATION PAPER OUTLINE**

### **1: ENVIRONMENTAL AND INDUSTRIAL MICROBIOLOGY MI316 – SEMESTER 1 PAPER**

**DR. A. KARATZAS** (PUBLIC HEALTH- 10 LECTURES) - 2 QUESTIONS

**DR. C. O'BYRNE** (FOOD MICROBIOLOGY - 10 LECTURES) - 2 QUESTIONS

**DR. G. FLEMING** (FERMENTATION- 10 LECTURES) - 2 QUESTIONS

**DR. T. BARRY** (AQUATIC MICROBIOLOGY - 5 LECTURES) - 1 QUESTION

**DR. V. O' FLAHERTY** (MICROBIAL ECOLOGY - 6 LECTURES) - 1 QUESTION

### **2: MOLECULAR AND CELLULAR MICROBIOLOGY MI317 - SEMESTER II PAPER**

**DR. G. WALL** (VIROLOGY - 8 LECTURES) - 1 QUESTION

**TBA** (GENETIC ENGINEERING - 8 LECTURES) - 1 QUESTIONS

**DR. C. CARROLL** (BACTERIAL GENETICS - 8 LECTURES) - 2 QUESTION

**DR. G. WALL** (IMMUNOLOGY - 12 LECTURES) - 2 QUESTIONS

**DR. T. BARRY** (METABOLISM - 10 LECTURES) - 2 QUESTIONS

**For each theory written examination paper, FIVE QUESTIONS (OUT OF 8) MUST BE ATTEMPTED**

### **WRITTEN PRACTICAL PAPER (SUMMER)**

**\*DR. G. FLEMING** (ANALYTICAL/MATHEMATICAL) - 1 QUESTION (COMPULSORY)

**DR. C. O'BYRNE** - (FOOD MICROBIOLOGY) - 1 QUESTION

**DR. G. FLEMING** - (INDUSTRIAL MICROBIOLOGY) - 1 QUESTION

**DR. F. ABRAM** (ENZYMولوجY) - 1 QUESTION

**TBA** (GENETIC ENGINEERING) - 1 QUESTION

**DR. G. WALL** (IMMUNOLOGY) - 1 QUESTION

**DR. C. CARROLL** (BACTERIAL GENETICS) - 1 QUESTION

**DR.'S T. BARRY AND G. COLLINS** (VIDEOS / TUTORIALS) - 1 QUESTION

**QUESTION 1 is compulsory, THREE other questions must be answered.**

## **F: EXAMINATION QUESTION ANSWERING**

EACH LECTURER WILL INDICATE TO THE STUDENTS WHAT IS REQUIRED FROM THEM IN ANSWERING QUESTIONS AT EXAMINATION TIME. SOME GENERAL GUIDELINES ARE:

READ THE PAPER CAREFULLY AND ANSWER THE QUESTION ASKED IN A MANNER WHICH IS CLEAR AND AS CONCISE AS POSSIBLE.

ENSURE THAT YOU ANSWER THE CORRECT NUMBER OF QUESTIONS REQUESTED BY THE EXAMINATION PAPER.

REMEMBER, FOR WRITTEN PAPERS YOU HAVE ONLY THREE HOURS TO COMPLETE THE EXAMINATION, THEREFORE TIME MANAGEMENT IN ANSWERING YOUR QUESTIONS IS VERY IMPORTANT. IN OTHER WORDS ALLOW SUFFICIENT TIME FOR ANSWERING EACH OF YOUR QUESTIONS

## **G: ENTRY REQUIREMENT TO 4<sup>TH</sup> YEAR MICROBIOLOGY**

Progression to Final Year Honours of the B.Sc. degree on the basis of the Third University Examinations in Science

**While we still guarantee undenominated students who pass Year 3 exams a place in Year 4, the subject that they get will not always be their first choice. We will continue to ask undenominated students in March of Year 3 to indicate their preferred subject for Year 4. They will be offered a place in a Year 4 programme based on the following rule.**

**Students who pass third year as outlined above will be guaranteed a place in 4<sup>th</sup> Year. However, students are not necessarily guaranteed their first choice of subject. If a student achieves 45% overall in his/her third year examinations, he/she will be guaranteed his/her first choice of subject. If a student achieves less than 45% overall in his/her third year examinations, he/she will be allocated a subject from the major subjects taken in third year.**

A student may opt to leave the programme with a BSc (General) Degree once Year 3 exams are passed. The passing criteria have been modified slightly and are included here.

**NOTE THERE ARE NO QUOTAS IMPOSED BY THE DEPARTMENT WITH REGARD TO THE NUMBER OF STUDENTS GAINING ENTRY INTO 4<sup>TH</sup> YEAR MICROBIOLOGY.**

## **Calculation of 4<sup>th</sup> Year (Honours) Degree Results**

**For students in Third Year from 2009/2010: The overall degree result will be based on 80% of 4th Year results + 15 % of 3rd Year results + 5% of 2nd Year results.**

## **H: STUDENT PROBLEMS / ILL HEALTH**

STUDENTS ARE REQUESTED TO INFORM THE DEPARTMENT (THE SECRETARY, ROOM 202, UPSTAIRS IN THE DEPT. OF MICROBIOLOGY), IF THEY ENCOUNTER ANY PROBLEMS OR ILL HEALTH WHICH RESULTS IN NON-ATTENDANCE DURING THE COURSE OF THE ACADEMIC YEAR. STUDENTS ARE REQUESTED TO PROVIDE A COPY OF ANY SICK CERTIFICATES / NOTES FROM THE DOCTOR OR CLINIC ATTENDED. **ALL STUDENT MATTERS OF THIS NATURE ARE TREATED IN THE STRICTEST OF CONFIDENCE.**

## **I: QUALITY REVIEW AND CLASS REPRESENTATIVES**

THE DEPARTMENT IS CONSTANTLY STRIVING TO MAINTAIN HIGH STANDARDS OF EDUCATION IN MICROBIOLOGY. TO HELP US MAINTAIN THESE STANDARDS, QUESTIONNAIRES WILL BE GIVEN TO STUDENTS AFTER THE COMPLETION OF SEMESTER I AND SEMESTER II LECTURES IN ORDER TO EVALUATE THE OVERALL COURSE PERFORMANCE. YOUR HELP IS VERY MUCH APPRECIATED IN FILLING OUT THESE QUESTIONNAIRES. CLASS REPRESENTATIVES WILL BE SELECTED, 1 FROM THE BIOTECHNOLOGY STREAM, 2 FROM THE NON-DENOMINATED STREAM AND 1 STUDENT THAT HAS TRANSFERRED FROM AN INSTITUTE OF TECHNOLOGY TO NON-DENOMINATED STREAM, AND INFORMAL MEETINGS WITH THE COURSE DIRECTOR WILL TAKE PLACE AFTER THE COMPLETION OF SEMESTERS I AND II.

**SEMESTER 1 – MI316**  
**INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY**

**1: INTRODUCTION: DR. T. BARRY - Sept. 6<sup>th</sup> (2pm)**

This lecture is designed to provide students with an overview of the third year course both theoretical and practical for Semester I and Semester II. Also covered are the requirements and standards that students must attain at the end of third year in order to successfully enter fourth year microbiology. Relevant topics for discussion are lecture timetable, practicals, continuous assessment, examination questioning and answering, examination marking breakdown, quality review of the course, third year mark contribution to overall degree mark, etc.

**2: INDUSTRIAL MICROBIOLOGY AND APPLIED STERILITY/ASEPSIS – DR. GERARD FLEMING (10 LECTURES). Sept. 7<sup>th</sup> to Sept. 22<sup>nd</sup>**

**Lecture 1: The Scope:** This course seeks to introduce students to those aspects of applied microbiology which they are likely to encounter in microbially-based/medicare industries. Knowledge of the techniques of sterilisation and inhibition are essential for good practice in any microbiology laboratory.

Outline of major groups of industrial fermentations.

**Lecture 2: Research, development, and scale-up:**

Typical objectives - qualitative and quantitative (titre, yield and volumetric productivity) and restraints.

Primary and secondary screening- the use of shake flasks, lab. fermenters and pilot plant. New approaches to screening.

**Lectures 3 and 4: Organisms:**

Choice and storage.

Process improvement by strain selection-avoiding induction, repression and inhibition-use of auxotrophs

**Lecture 5: Media:**

Economic considerations - crude v defined - carbon sources - nitrogen sources- vitamins and growth factors- minerals - inducers - precursors - inhibitors.

**Lecture 6 and 7: Process manipulation:**

What is a bioprocessor (fermenter) - pH, temperature, foam/antifoams and agitation/aeration.

Industrial batch cultures - inoculation development and fermentation

build up - when to harvest- fed batch cultures  
Continuous cultures with and without recycling.

**Lecture 8: Sterility and Asepsis - Definitions and reasons:**

Why bother?

Tackling the problem – organisms, treatment and environment.

**Lecture 9: Basic heat treatments:**

Basic kinetics - k and  $\lambda$  -effect of spores and mixed populations

Steam and its characteristics- the danger of steam/air mixes,

Autoclaves, basic and advanced- autoclave monitoring.

**Lecture 10: Large (industrial) scale heat sterilisation:**

Moist heat sterilisation and industrial fermentations-the options.

Designing batch sterilisation for large volumes of thermolabile liquids (Richards' rapid method).

HTST (high temperature/short time) treatments, theory and practice - continuous sterilisers and pasteurisers.

Sterility, asepsis, and fermenter design and operation.

**Sterilisation by radiation / Disinfectants and antiseptics**

Uses of UV and non-ionising radiation.

Filtration

Depth and absolute filters - filter testing. Types and uses.

Ethylene oxide (gas) sterilisation.

**Recommended Text:** Principles of Fermentation Technology by P.F. Stanbury, A Whitaker and S.J. Hall (2nd ed.) Pergamon Press, 1995.

**3. AQUATIC MICROBIOLOGY – Dr. TOM BARRY (6 LECTURES).**

**SEPT, 26<sup>th</sup> to Oct 4<sup>th</sup>.**

**Lecture 1: Microbial Ecology of Aqueous Environments.** Uses, sources and barriers to the use of water. Categories of pollutants. Water bacteria. Water as a vector of disease. Typical water-borne diseases caused by bacteria and viruses.

**Lecture 2: Biological Indicators of Pollution.** Membrane Filtration / MPN methodologies for detection of indicator organisms. Emerging rapid technologies for enumeration and confirmation including IDEX, MUG agar and Biolog systems. Water standards.

**Lecture 3/4: Eutrophication.** Causes and effects. Oligotrophic v's eutrophic lakes. Production and respiration. Seasonal / temperature effects. Roles played by N and P in eutrophication.

**Lecture 5/6: Physical Methods for Detection of Pollution.** TOC and COD estimation. Principle of BOD test. Determination of BOD using gold-standard Winkler method and D.O. meter. Troubleshooting. BOD water standards.

#### 4. FOOD MICROBIOLOGY – DR. C. O’BYRNE (10 LECTURES).

Oct. 5<sup>th</sup> to Oct. 20<sup>th</sup>

- Lecture 1:** **Historical overview of food microbiology.** The role played by Antony van Leeuwenhoek and Louis Pasteur in identifying the link between microorganisms and processes of decay and putrefaction. The theory of spontaneous generation.
- Lecture 2:** **Microbiology of beer production.** The process of beer production: Malting, milling, mashing, wort boiling, fermentation, post-fermentation treatment. Biochemical changes that take place during the fermentation.
- Lecture 3:** **Microbiology of wine production.** The producing process for red and white wine: Crushing, partial fermentation (red), removal of grape solids, fermentation, racking off, malolactic fermentation, fining and clarification. Contribution of yeasts and bacteria to the flavour of the wine. Microbiological quality problems in wine.
- Lecture 4:** **Microbiology of cheese production.** An overview of the cheese making process. Production of curds: the biochemistry of milk coagulation, the role of the starter culture. The role of the secondary flora in producing flavour and texture in cheese. Problems with bacteriophage. Bacteriophage resistance mechanisms in lactic acid bacteria.
- Lecture 5:** **Factors that influence the growth of microorganisms in food.** The inhibitory basis for high salt (low water activity), low pH, extremes of temperature and REDOX potential.
- Lecture 6:** **Food poisoning 1.** Definitions of food-borne infections, intoxications and toxicoinfections. Food-borne disease statistics from the US. Key microorganisms implicated in food-borne disease. Relative importance of bacteria, viruses and fungi.
- Lecture 7&8:** **Food poisoning 2: Food-borne intoxications.** A closer look at selected bacterial agents implicated in food borne intoxications: *Staphylococcus aureus*, *Closteridium botulinum*. Fungi involved in food-borne intoxications.
- Lecture 9:** **Food poisoning 3: Food-borne infections.** *Campylobacter* and *Salmonella*.
- Lecture 10:** **Food poisoning 4: Food-borne toxicoinfections.** *Bacillus cereus* and *Closteridium perfringens*.

**Recommended text:** Microbiology of Foods by Ayres, Mundt and Sandine,  
Freeman & Co. (Most recent edition)

*or*

Modern Food Microbiology by J.M. Jay, Van Nostrand (Most recent edition)

## **5. MICROBIAL ECOLOGY - PROF. V. O'FLAHERTY (6 LECTURES).**

**OCT 24<sup>th</sup> to NOV 2<sup>rd</sup>**

**Lecture 1:** Microbial Communities and Ecosystems: Microbes in the natural world - diversity, transformations and significance.

**Lectures 2 and 3:** Community organisation and interactions - biofilms, bioaggregates.

**Lecture 4:** Experimental Ecology: What are the approaches used to study microbial communities and ecosystems? How can we identify viable cells in the environment?

**Lecture 5 / 6:** Microbes in natural and engineered ecosystems.

## **6. PUBLIC HEALTH AND MICROBIOLOGY – DR. A. KARATZAS (10 LECTURES). Nov. 3<sup>rd</sup> to Nov. 17<sup>th</sup>**

**Lectures 1 & 2: Historical perspectives.** Historical relationships between human populations and infectious diseases. Agriculture and urbanization in infectious disease development. Trend towards symbiotic relationships. Development of natural resistance. Trade, migration and colonization by human populations in disease spread and epidemics.

**Lecture 3: Development of epidemics and pandemics.** Lessons from bubonic plague, smallpox and influenza.

**Lecture 4: Microbes and infection.** The development of germ theory. Koch's postulates. Prerequisite of pathogens for disease but contribution of additional factors for disease development. Infectious diseases and vectors.

**Lecture 5: Acute versus chronic infectious diseases.** *Campylobacter jejuni* and *Helicobacter pylori* as bacterial models.

**Lecture 6: Food and water-borne epidemics.** *E. coli* O157:H7 and Cholera

**Lecture 7: Sexually transmitted diseases 1.** HIV

**Lecture 8: Sexually transmitted diseases 2.** Syphilis, Chlamydia

**Lecture 9: Nosocomial infections.** MRSA, *C. difficile*.

**Lecture 10: Antibiotics and antibiotic resistance.** Modes of action of antimicrobials.

## **7. SEMESTER I RECAP - OVERVIEW / PRE-SEMSTER 1 EXAMINATION DISCUSSION / QUALITY REVIEW - SEMSTER I QUESTIONNAIRE - Dr. THOMAS BARRY (1 LECTURE). Nov. 21<sup>st</sup>**

**SEMESTER 2 – MI317**  
**MOLECULAR AND CELL MICROBIOLOGY**

**1. VIROLOGY – Dr. G. WALL (8 LECTURES). Jan. 9<sup>th</sup> to Jan. 19<sup>th</sup>**

**Lecture 1**

How we classify viruses. Virologists use viral characteristics such as genetic material to put them into different classes / divisions. Students are introduced to the Baltimore scheme of classification.

**Lecture 2**

The oncogenic viruses. How the identification of viral oncogenes has helped to define the molecular basis of cancer. Students are introduced to the functions of proto-oncogenes. We examine some specific viruses involved in the development of cancers and a description of changes in the cell in tumour development.

**Lecture 3**

An examination of the association between infection with Epstein Barr virus and the development of Burkitt's lymphoma and nasopharyngeal carcinoma. The relationship between viruses and cervical cancer.

**Lectures 4 & 5**

The processes that 'switch on' oncogenes turning a proto-oncogene into a cellular-oncogene. We examine the actions of chronic transforming retroviruses, chromosomal transformation (using chronic myeloid leukaemia as a model) and activation by point mutation.

**Lecture 6**

We use bladder cancer to illustrate point mutations in oncogene activation. How lung cancer can arise. The consequences of amplification and deletion of proto-oncogenes. We also explore tumour-suppressor gene activity.

**Lectures 7 & 8**

Oncogene re-arrangements. The functions of oncogene and proto-oncogene protein products and how they each contribute to the multi-step process of the development of a cancer.

**2: THE PRINCIPALS OF EUKARYOTIC AND BACTERIAL GENETIC ENGINEERING - TBA (8 LECTURES). Jan 23<sup>rd</sup> to Feb 2<sup>nd</sup>.**

**Lecture 1: General introduction to genetic engineering.** The structure and function of eukaryotic and bacterial nucleic acids. Comparison of eukaryotic and bacterial genome organisation.

**Lecture 2: Comparison and function of eukaryotic and bacterial gene structure and organisation:** i.e., the role of promoters, exons, introns, operons, 5' and 3' untranslated sequences.

**Lecture 3: Gene transcription and protein translation** - post-transcriptional RNA modification.

**Lecture 4: Use of restriction enzymes and nucleic acid modifying enzymes.** The immobilisation of nucleic acids to membranes- Southern and Northern blotting.

**Lecture 5: Genomic and cDNA library construction.** Screening of libraries for genes / cDNA transcripts of interest - Nucleic acid and antibody screening techniques.

**Lecture 6: Principles of The Polymerase Chain Reaction and Reverse Transcriptase - PCR** - uses and applications in eukaryotic and microbial research, diagnostics, industry medicine and health care related applications.

**Lecture 7: Applications of genetic engineering:** to biotechnology, the food industry, environment, pharmaceutical and health care industry.

**Lecture 8: Ethics:** Ethical issues which have arisen as a consequence of this new technology.

**3: BASIC AND APPLIED IMMUNOLOGY – Dr. G. WALL (10 LECTURES).**  
Feb. 6<sup>th</sup> to Feb. 21<sup>st</sup>.

**Lecture 1: Non-specific immunity (1):** Genetic resistance, strain resistance, physiological state of the host, mechanical and chemical barriers and the protective role of host flora. Phagocytosis: macrophages and polymorphs.

**Lecture 2: Non-specific immunity (2):** The process of phagocytosis. Inflammation: acute and chronic.

**Lecture 3: Non-specific immunity (3):** Antimicrobial factors. Complement: role, classical pathway and alternative pathway. Interferons.

**Lectures 4 & 5: Acquired immunity:** Introduction. Actively acquired vs. passively acquired. Development of the immune response. Properties of antigens: structure, immunogenicity, adjuvants, haptens.

**Lecture 6: Properties of antibodies:** General structure and antibody classes. Kinetics of the immune response.

**Lecture 7: B cell activity in humoral immunity:** B cells. B cell differentiation. Polyclonal and monoclonal antibodies. Basis of antibody diversity.

**Lecture 8: Cell-mediated immunity:** T cells: properties, antigen recognition and role. Effector and regulator T cells. Lymphokines.

**Lecture 9: Hypersensitivity:** Antibody-mediated allergy, antibody-dependent cytotoxicity/cytolyticity, immune complex disorders, delayed hypersensitivity.

**Lectures 10: In vitro antibody tests (1):** Conditions influencing reactions, diagnosis of disease, other applications. Agglutination test: slide agglutination, tube agglutination, and haemagglutination.

**Lecture 11: In vitro antibody tests (2):** Precipitin tests: ring test, single diffusion and double diffusion methods. Immunoelectrophoresis.

**Lecture 12: In vitro antibody tests (3):** Radioimmunoassay, enzyme-linked immunosorbent assay, complement fixation tests, immunomicroscopic techniques.

**4: CLASSICAL BACTERIAL GENETICS - DR. C. CARROLL (8 LECTURES).  
Feb. 22<sup>nd</sup> to Mar. 6<sup>th</sup>**

**Lecture 1: Mutagenesis - Spontaneous and Induced**

Chemical: Base pair analoges ; 2Ap, 5Bu  
Base pair modifiers  
Alkylating agents  
Irradiation: Pyrimidine Dimers  
Mutator Gene: Exonucleases  
Transposon: Insertional gene inactivation  
Conditional lethal Mutants

**Lecture 2: Insertion sequences: Structure**

**Transposons:** Structure  
Transposition: Conservative and replicative.  
Induced Chromosomal aberrations

**Lecture 3: Isolation of Mutants:**Differential and Selective: (Replica plating).

**Lecture 4: Characterization of Mutant Phenotypes.**

Determination of gene marker location.  
Merodiploids  
Complementation test (Cis-Trans)  
Recombination

**Lecture 5: Genetic Mapping using Hfr Strains.**

Hfr strains  
Mapping by Gradient of Transmission  
Mapping by Interrupted Mating  
Working examples of mapping.

**Lecture 6: Genetic Mapping by Phage Transduction**

Transduction  
Co-transduction  
Working examples of mapping.

**Lecture 7: Recombination**

General Recombination: Holliday Model  
Meselson and Radding Model  
Role of Rec proteins (Mutants).  
Specialised Recombination: Site specific Recombination.

**Lecture 8: Control of Gene Expression**

Constitutive and Inducible gene expression  
Transcription  
Gene Activators and Repressors.  
Positive and Negative Control  
Attenuation Control

**Recommended Text:** Genetic Elements in *E. coli* by Smith-Keary.

**5: MICROBIAL METABOLISM - DR. T. BARRY (10 LECTURES).**

Mar 7<sup>th</sup> to Mar 26<sup>th</sup>.

**Lecture 1: Review** of microbial metabolism covered in second year - catabolism.

Introduction to anabolism / microbial biosynthesis - microbial biodiversity. Antibiotics - definition. Introduction to antibiotics that target metabolic systems.

**Lecture 2: Biosynthesis of cellular macromolecules** - The biosynthesis of carbohydrates and lipids. Antibiotics that target cell wall biosynthesis.

**Lecture 3: Biosynthesis of amino acids and nucleic acids.** Antibiotic action toward inhibition of protein synthesis, replication and nucleic acid transcription.

**Lecture 4: Introduction to microbial anaplerotic pathways.**

**Lecture 5: Review of chemo-organotrophic growth and catabolism on carbohydrates.** Introduction to metabolic systems of growth of chemo-organotrophic bacteria on nutrients other than carbohydrates.

**Lecture 6: Chemo-organotrophic bacterial growth:** on proteins / amino acids.  
Chemo-organotrophic growth on lipids.

**Lecture 7: Chemo-organotrophic bacterial growth on hydrocarbons and aromatic compounds.** Utilisation of these bacteria in bioremediation and the oil industry.

**Lecture 8: Chemo-organotrophic bacterial growth on:** 1 and 2 carbon compounds. Utilisation of methanogenic metabolizing bacteria.

**Lecture 9: Anaplerotic mechanisms:** pertaining to growth on nutrients other than carbohydrates. Co-ordination of metabolic systems in the cell.

**Lecture 10: Bacteria in natural environments** - Microbial Biodiversity.

Microbial interactions under aerobic conditions. Microbial metabolic interactions of anaerobic and extreme habitat conditions.

**Recommended Text:** Microbial Physiology - Third Edition: Moat and Foster - Wiley and Liss publications.

**6. SEMESTER II RECAP - OVERVIEW / PRE-SEMSTER II EXAMINATION DISCUSSION / QUALITY REVIEW - SEMSTER II QUESTIONNAIRE - Dr. THOMAS BARRY (1 LECTURE). Mar 27th**

**THIRD SCIENCE MICROBIOLOGY  
PRACTICAL COURSE OUTLINE:  
SEMESTERS 1/2**

**FOOD MICROBIOLOGY – DR. C. O’BYRNE.**

1. Assessment of the microbial quality of a butcher and supermarket chicken.
2. Microbial analysis of fresh filleted fish using three different extraction methods.
3. Microbial analysis of raw and pasteurised milk.
4. Microbial analysis of mussel tissue and sea water.
5. Determination of the nasal carriage rate of *Staphylococcus*

**INDUSTRIAL MICROBIOLOGY - DR. G. FLEMMING.**

1. Determination of antibiotic concentration using the Agar-Cup test.
2. The Kelsey-Sykes capacity use dilution test for disinfectants.

**ENZYMولوجY - DR. F. ABRAM.**

1. Determination of the activity and specific activity of invertase from a yeast source.
2. Determination of the activity and specific activity of  $\beta$ -galactosidase from a bacterial source.

**IMMUNOLOGY - TBA.**

1. Use of test kits to demonstrate various types of serological reactions.
2. SDS-PAGE of whole-cell and proteinase K extracts of *E.coli* K12.

**GENETIC ENGINEERING – TBA.**

1. Transformation of *E.coli* using calcium chloride treated cells.
2. Mini-plasmid DNA preparations and agarose gel electrophoresis.
3. Restriction enzyme digestion and agarose gel electrophoresis.
4. DNA ligation and agarose gel electrophoresis.
5. Polymerase chain reaction and agarose electrophoresis.

**BACTERIAL GENETICS - DR. C. CARROLL.**

1. Transposon mutagenesis.

The transposon TN916 will be used to generate mutations in bacteria. The transposon will be transferred via conjugation from donor to recipient cells. The resultant recipient cells will be screened for intra-genic insertional mutations.

**SKILLS FOR RESEARCH - DR. T. BARRY.**

What is a scientific paper. Why scientists publish papers. Scientific paper review by the students. Scientific writing skills. Structured review essay.

## THIRD SCIENCE MICROBIOLOGY PRACTICALS

The 3<sup>rd</sup> year Microbiology class has been divided into three groups, **A, B & C**. Practicals will take place in the 2<sup>nd</sup> Year lab (Room 225/Upstairs) and the 3<sup>rd</sup> Year lab (Room 100p/Downstairs).

**Tuesday Session 3.00pm – 6.00pm and Thursday session 10.00am – 1.00pm**

**Students attend both sessions**

The schedule below gives the locations and dates for the various groups throughout the year.

Students in the group **not** assigned to either lab for a given practical block will have alternative practical- related teaching in the Tyndall lecture theatre on **Tuesday afternoons only from 3.00-5.00pm**.

Follow your assigned group for both semesters.

### 2011 / 2012; First Semester and Second Semester

	<b>2<sup>nd</sup> Year Laboratory (UPSTAIRS)</b>	<b>3<sup>rd</sup> Year Laboratory (DOWNSTAIRS)</b>	<b>Tyndall Theatre Session*</b>
<b>DATES</b>			
	<b>Food Microbiology</b>	<b>Skills for Research</b>	<b>Video/Seminar</b>
20, 22, 27, 29 September	<b>A</b>	<b>B</b>	<b>C</b>
4, 6, 11, 13 October	<b>C</b>	<b>A</b>	<b>B</b>
18, 20, 25, 27 October	<b>B</b>	<b>C</b>	<b>A</b>

	<b>2<sup>nd</sup> Year Laboratory (UPSTAIRS)</b>	<b>3<sup>rd</sup> Year Laboratory (DOWNSTAIRS)</b>	<b>Tyndall Theatre Session*</b>
<b>DATES</b>			
	<b>Indst. Microbiology &amp; Enzymology</b>	<b>Genetic Engineering</b>	<b>Video/Seminar</b>
1, 3, 8, 10 November	<b>A</b>	<b>B</b>	<b>C</b>
10, 12, 17, 19 January	<b>C</b>	<b>A</b>	<b>B</b>
24, 26, 31 Jan, 2 February	<b>B</b>	<b>C</b>	<b>A</b>

	<b>2<sup>nd</sup> Year Laboratory (UPSTAIRS)</b>	<b>3<sup>rd</sup> Year Laboratory (DOWNSTAIRS)</b>	<b>Tyndall Theatre Session*</b>
<b>DATES</b>			
	<b>Immunology/ Serology</b>	<b>Genetics</b>	<b>Video/Seminar</b>
7, 9, 14 February	<b>A</b>	<b>B</b>	<b>C</b>
16, 21, 23 February	<b>C</b>	<b>A</b>	<b>B</b>
28 Feb, 1, 6 March	<b>B</b>	<b>C</b>	<b>A</b>

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\* \* See separate schedule for details

## Tyndall Theatre Sessions 2011 – 2012 (Third Science Practicals)

The following is a schedule of topics to be covered in Semester I and Semester II for those groups **not** in the laboratory.

**Venue;** Tyndall Theatre

**Time;** Tuesday Afternoon Only (3 – 5pm.)

	<b>GROUP</b>	<b>DATE</b>	<b>TOPIC</b>	
<b><u>Semester I</u></b>	C	Sept 20 <sup>th</sup>	Video 1	
	C	Sept 27 <sup>th</sup>	Video 2	
	B	Oct 4 <sup>th</sup>	Video 1	
	B	Oct 11 <sup>th</sup>	Video 2	
	A	Oct 18 <sup>th</sup>	Video 1	
	A	Oct 25 <sup>th</sup>	Video 2	
	C	Nov 1 <sup>st</sup>	Video 3	
	C	Nov 8 <sup>th</sup>	Video 4	
	<b><u>Semester II</u></b>	B	Jan 10 <sup>th</sup>	Video 3
		B	Jan 17 <sup>th</sup>	Video 4
A		Jan 24 <sup>th</sup>	Video 3	
A		Jan 31 <sup>st</sup>	Video 4	
C		Feb 7 <sup>th</sup>	Video 5	
B		Feb 21 <sup>st</sup>	Video 5	
A		Feb 28 <sup>th</sup>	Video 5	

### **TOPIC DETAIL**

Video 1; **Smallpox on Death Row** (BBC HORIZON 1997)

Video 2; **Virus that Cures** (BBC HORIZON 1997)

Video 3; **Aliens from Mars** (BBC HORIZON 1996)

Video 4; **TB – The Forgotten Plague** (BBC HORIZON 1993)

Video 5; **Mould, the Myth & the Microbe** (BBC HORIZON 1991)