

UNIVERSITY OF MUMBAI



Syllabus for the S.Y.B.Sc.

Program: B.Sc.

Course: Microbiology

(Credit Based Semester and Grading System with
effect from the academic year 2012–2013)

SEMESTER III

Course Code	UNIT	TOPICS	Credits	L / Week
USMB-301		CONCEPTS IN IMMUNOLOGY	2	
	I	Innate Immunity and Immune System		1
	II	Antigens and Immunoglobulins		1
	III	Medical Virulence		1
USMB-302		MICROBIAL BIOCHEMISTRY	2	
	I	Chemical Basis of Life		1
	II	Thermodynamics		1
	III	Biostatistics & Estimation of Biomolecules		1
USMB-303		APPLIED MICROBIOLOGY	2	
	I	Instrumentation :		1
	II	Fermentation technology		1
	III	Food Microbiology		1
USMBP-3		Practicals based on above three courses in theory	3	9

SEMESTER IV

Course Code	UNIT	TOPICS	Credits	L / Week
USMB-401		CONCEPTS IN GENETICS	2	
	I	Mendelian Genetics and Genetic information		1
	II	Chromosome Structure of Eukarvotic cell and Genetic Code		1
	III	Taxonomy		1
USMB-402		MICROBIAL BIOCHEMISTRY	2	
	I	Transcription , Translation		1
	II	Introduction to Metabolism		1
	III	Enzymology		1
USMB-403		APPLIED MICROBIOLOGY	2	
	I	Instrumentation :		1
	II	Dairy Microbiology		1
	III	Microbial Biotechnology		1
USMBP-4		Practicals based on above three courses in theory	3	9

S.Y.B.Sc. Microbiology Syllabus
Credit Based and Grading System
To be implemented from the Academic year 2012-2013
SEMESTER III

Course Code	UNIT	TOPICS	Credits	L / Sem
USMB-301		CONCEPTS IN IMMUNOLOGY	2	(45 lectures)
	I	<p><u>Innate Immunity and Immune System</u></p> <p>1.1 Innate immunity (07L)</p> <p>a) Overview of host resistance</p> <p>b) Non specific host resistance</p> <p>c) Natural host resistance – age, stress, diet etc.</p> <p>d) Physical and Mechanical barriers – skin, mucous membrane</p> <p>e) Respiratory system, gastrointestinal tract, genitor-urinary tract, eyes</p> <p>f) Chemical barriers – basic proteins, bacteriocins, β-lysins and other polypeptides</p> <p>1.2 Immune system (08L)</p> <p>a) Cells, Tissues and Organs of the immune system</p> <p>b) Cells of Immune system – Lymphoid cells, mononuclear cells, granulocytes, mast cells, dendritic cells</p> <p>c) Organs and tissues of the immune system – Primary and secondary lymphoid organs / tissues</p> <p>d) Inflammation , fever, phagocytosis</p> <p>e) Natural killer cells, Molecular defense – Cytokines, integrated host defense, immune-compromised host</p>		15 Lectures
	II	<p><u>Antigens and Immunoglobulins</u></p> <p>2.1 Antigens (07L)</p> <p>a) Immunogenicity versus antigenicity</p> <p>b) Factors that influence immunogenicity – foreignness, molecular size, chemical composition, heterogenicity, ability to be processed and presented, contribution of the biological system to immunogenicity – genotype of the recipient, animal, immunogen dosage, route of administration and adjuvants</p> <p>c) Epitopes / antigen determinants</p> <p>d) Haptens and antigenicity</p> <p>e) Immunogenicity of some natural substances – native globular proteins, polysaccharides, lipids, nucleic acids</p> <p>Types of antigens – heterophile antigens, isophile antigens, sequestered antigens, super antigens, bacterial and viral antigens</p> <p>2.2 Immunoglobulins (08L)</p> <p>a) Immunoglobulins – basic and fine structure</p> <p>b) Immunoglobulin classes and biological activities</p> <p>c) Antigenic determinants on immunoglobulins – isotypes, allotypes, idiotypes</p> <p>d) Immunoglobulin receptors</p>		15 Lectures

	III	<p>Medical Virulence</p> <p>3.1 Host – Parasite interaction (Attachment and Penetration) Koch’s and River’s postulates (01L)</p> <p>3.2 Microbial virulence factors (06L)</p> <p>a) Enzymes : hyaluronidase, collagenase, streptokinase, coagulase</p> <p>b) Exotoxins : cytolytic toxins, diphtheria, tetanus, botulinum toxin, enterotoxin</p> <p>c) Endotoxins : structure and function, Limulus assay for endotoxin</p> <p>d) Virulent organisms ; salmonella spp., and its virulence factors</p> <p>e) Measuring virulence LD50</p> <p>3.3 Clinical infection in the host (04L)</p> <p>a) Establishment , spread and pathological effects</p> <p>b) Pattern of infection</p> <p>c) Signs and symptoms</p> <p>d) Portal of exit, persistence of microorganisms and pathological conditions</p> <p>3.4 Epidemiology of infectious diseases (04L)</p> <p>a) Epidemiological terminology</p> <p>b) Measuring frequency – The epidemiologist’s tools</p> <p>c) Infectious disease epidemiology</p> <p>d) Recognition of an infectious disease in a population in an epidemic</p> <p>e) Virulence and the mode of transmission</p> <p>f) Emerging and reemerging infectious diseases and pathogens</p> <p>g) Control of epidemics</p> <p>h) Nosocomial infections</p> <p>i) Global travel and health considerations</p>		15 Lectures
USMB - 302	UNIT	MICROBIAL BIOCHEMISTRY	2	(45 lectures)
	I	<p><u>Chemical Basis of Life (15L)</u></p> <p>1.1 a) Cellular foundations: Cells as the structural and functional units. Cellular dimensions are limited by oxygen diffusion. Cytoplasm is highly dynamic,cells build supramolecular structures</p> <p>b) Chemical foundations Compounds of carbon and functional groups,macromolecules as major constituents of cells.</p> <p>c) Three dimensional structures: Configuration and conformation. Dynamic steady state of living cell,never at equilibrium with the surroundings. Transformation of energy and matter from the surroundings.</p>		15 Lectures

		<p>1.2 Types of bonds and their importance: Electrovalence,covalent bond,ester,phosphodiester,thioester,peptide, glycosidic bonds. Water structure and interaction with solute</p> <p>1.3 Carbohydrates:Definition and biological role of Monosaccharides,Oligosaccharides and polysaccharides.</p> <p>1.4 Lipids: Definition, Biological importance (Special reference to cell membrane)and classification.</p> <p>1.5 Amino acids , Peptides and Proteins - Physical and chemical properties.Proteins-three dimensionalstructure Complementary interactions between proteins and ligands</p>		
	II	<p><u>Thermodynamics (15L)</u> Scope of Thermodynamics a)Concept of Free energy, Enthalpy, Delta G, Standard Free Energy change of reaction, Entropy.b)First and Second Law of Thermodynamics c)Open and Closed system d)Structure and Properties of ATP, Standard free energy, Change of hydrolysis of ATP,and other high energy compounds e)Energy yielding mechanisms:Fermentations,Respiration and Photosynthesis . f)Biological Oxidation-reduction reactions.</p>		15 Lectures
	III	<p><u>Estimation of Biomolecules and Biostatistics</u> 3.1 Estimation of Biomolecules (10 Lectures) a)Macromolecular composition of a microbial cell b)Methods of elemental analysis: Carbon by Slyke’s method Nitrogen by Microkjelhdahl method. Phosphorus by Fiske-Subbarow method c)Estimation of Carbohydrates by Phenol and Anthrone method Estimation of Reducing Sugars by DNSA method Detection of Sugars by Aniline-Pthalate method d)Estimation of Proteins by Biuret method Estimation of Amino acids by Ninhydrin method e)Extraction of Lipids by Soxhlet method f)Extraction of Nucleic acids g)Estimation of Nucleic acids by DPA and Orcinol method</p> <p>3.2 Biostatistics (05Lectures) a)Introduction to Biostatistics b)Sample and Population c)Data presentation: Dot diagram, Bar diagram, Histogram, Frequency curve. d)Central Tendency: Mean, Median, Mode Summation, notations. e)Standard Deviation, Variance, Q-Test, t-test and F-test.</p>		15 Lectures
USMB-303	Unit	APPLIED MICROBIOLOGY	2	(45 lectures)
	I	<p>Instrumentation I: 1.1pH meter-(4L)</p>		15 Lectures

	<p>The standard hydrogen electrode, Reference electrode, Glass electrode ,Measurement of pH</p> <p>1.2Colorimeter -(04L) Principle: Working of Colorimeter, Beer’s Law, Beer and Lambert’s Law, Application of colorimetry in Biological Sciences.</p> <p>1.3Electrophoresis -(07L) Principle, Types and Instrumentation Application in Separation of Proteins, Nucleic acids, Fingerprinting and sequencing</p>		
	<p>II Fermentation technology</p> <p>a. Screening –Primary and Secondary. b. Fermentation Media. c. Preparation of inoculum. d. Types of Fermentations –Aerobic, Anaerobic, Surface, Submerged, Batch, Continuous, Solid substrate e. Fermenter Design.</p>		15 Lectures
	<p>III Food Microbiology</p> <p>a. Scope of Food Microbiology and role of microbiologist in food Industry b. General Principles of Spoilage and Contamination of Food c. General principles of Preservation of Food</p>		15 Lectures
USMBP-3	Practicals based on above three courses in theory	3	135 L / Sem
	SECTION I		45L
	<p>1) Phagocytosis (Demonstration) 2) Preparation of “H” and “O” antigens 3) Study of virulence factors – Enzymes – Streptokinase, Coagulase, Hemolysin, Lecithinase 4) Use of selective and differential solid media : SIBA, XLD, MacConkey’s, SMA, CLED, TCBS, Hoyle’s tellurite agar 5) Use of biochemical media for identification of pathogens – Oxidase, PPA, TSI, Bile solubility, Optochin, Bacitracin 6) Pyocin typing 7) Assignments – Epidemiology – Tuberculosis, AIDS, Malaria, Campylobacter, Legionella infections, Listerias</p>		
USMBP-3	Section –II		45L
	<p>1) Qualitative test for Carbohydrates-Benedicts ,Molisch 2) Qualitative test for Proteins-Biuret 3) Qualitative test for Amino acids –Ninhydrin 4) Production of Biomass-Fungal,Bacterial ,Yeast. 5) Determination of Dry and Weight Weight. 6) Problems based on Bioenergetics 7) Estimation of Amino acids by Ninhydrin method 8) Estimation of Proteins by Biuret method 9) Estimation of Reducing Sugars by DNSA method 10) Problems based on Biostatistics:- i. Linear Regression(LB) ii. Non linear regression(MM) iii. Use of EXCEL /Similar packages</p>		

USMBP-3	Section-III		45L
	<ol style="list-style-type: none"> 1) Use of pH meter 2) Determination of λ max of a colored solution 3) Verification of Beer and Lambert's Law Linear Range, Extinction coefficient and Molar Extinction coefficient. 4) Electrophoresis of proteins-vertical gels 5) Electrophoresis of DNA 6) Isolation of antibiotic producer and determination of antibacterial spectrum (Wilkin's agar overlay, Agar streak and Agar strip) 7) Auxanography 8) TDP and TDT 9) Food Preservative –Sugar and Salt (MIC) 10) Selective isolation of food spoilage organisms 		

SEMESTER IV

Course Code	UNIT	TOPICS	Credits	L /Sem
USMB-401		CONCEPTS IN GENETICS	2	(45 lectures)
	I	Mendelian Genetics and Genetic information 1.1 Mendelian Genetics (02L) (a) Genetic terminology, gametes, cross, zygote, gene, locus, alleles, genotype, phenotype (b) Mendel's experimental design (c) Mendel's Principle of Segregation, Principles of Independent Assortment 1.2 Genetic Information (13L) (a) Gene and its function, central Dogma of life (b) Prokaryotic, Structure of DNA, Double helix, different forms of DNA structure, important features of DNA structure, hybridization of nucleic acids, Circularity, Supercoiling, topoisomerases. Basic proteins in bacterial chromosome c) Genetic elements; The chromosome, Non chromosomal genetic elements, viruses and plasmids, transposable elements		15 Lectures
	II	Chromosome Structure of Eukaryotic cell and Genetic Code 2.1 Chromosome structure of Eukaryotic cell (10L) (a) Physical properties, concept of linkage groups, Linearity of the chromosome (b) Chromatin structure, euchromatin, heterochromatin (c) Role of histones and non histone proteins (d) Structure of the condensed chromatin (e) Nucleosomes, centomere, kinetochores, telomeres (f) Differences in the chromosomal structure of		15 Lectures

		prokaryotic, eukaryotic cells and viruses 2.2 Genetic Code (05L) (a) Historical perspective (b) Features of the genetic code, Triplet nature, degeneracy, universality, non overlapping, comma less, wobble hypothesis etc. c) Exceptions to the code – list different code sand variations		
	III	Taxonomy 3.1 Species ; The Units of Classification, Characterization of Species, The Naming of Species 3.2 The problems of Taxonomic arrangement : The phylogenetic Approach to Taxonomy, Numerical taxonomy 3.3 New approach to Bacterial Taxonomy : DNA composition, Nucleic acid hybridization, Tm, N.A. Sequencing, RNA fingerprinting and sequencing, Ribotyping, Fatty acid analyses. 3.4 Bergey’s manual		15 Lectures
USMB -402		MICROBIAL BIOCHEMISTRY	2	(45 lectures)
	I	<u>Transcription , Translation</u> 1.1 RNA Synthesis (7 L) a. RNA Metabolism:DNA dependent synthesis of RNA- RNAPolymerase, Promoters,Regulation of transcription at various levels. b. Specific sequences signal termination of RNA synthesis. c. RNA polymerases in Eukaryotic cells. d. Protein factors required for RNA polymerase II. e. Inhibition of DNA dependent RNA polymerase f. RNA dependent synthesis of RNA 1.2 Protein synthesis (8L) Stages of Protein synthesis:- a. Activation of aminoacids b. Initiation c. Elongation d. Termination and release e. Folding and post translational processing		15 Lectures
	II	<u>Introduction to Metabolism</u> 2.1 Metabolism:Catabolism,Anabolism and link between the two. 2.2 Concept of biochemical pathways-precursors, intermediate and end products 2.3 Constitutive and Inducible pathways. 2.4 Types of Biochemical Pathways:Linear ,Branched and Cyclic. (EMP,TCA as examples) 2.5 Amphibolic and Anaplerotic reactions.Glyoxyllate bypass. 2.6 Pool of Basic building blocks ATP and reducing power.		15 Lectures

	III	Enzymology 3.1 Basic Concepts: Apoenzyme, Haloenzyme, prosthetic group and cofactors, Allosteric enzymes 3.2 Classification of enzymes 3.3 Michaelis - Mentons Equation-Derivation, LB equation and plot. 3.4 Effect of enzyme concentration, Substrate concentration, Ph, temperature on enzyme activity 3.5 Multi-Substrate Reactions: Ordered, Random and Pingpong reaction 3.6 Inhibitors of Enzyme :Reversible and irreversible, Competitive, Non- Competitive and Un-competitive inhibition. 3.7 Koshland-Nemethy and Filmer Model, Monod, Wyman and Changux Model 3.8 Principles of enzyme purification.		15 Lectures
		APPLIED MICROBIOLOGY	2	
USMB 403	I	Instrumentation II : 1.1 Chromatography (10L) a. General principles. b. Paper Chromatography and Thin layer Chromatography. c. GLC and HPLC. d. Absorption Chromatography. e. Ion Exchange Chromatography. f. Gel Filtration Chromatography. g. Affinity Chromatography. 1.2 Centrifugation (05L) a. 1. Preparative Centrifuge and its Applications. b. Analytical Centrifuge and its Applications		15 Lectures
	II	Dairy Microbiology 2.1 Microbial flora of Milk, Normal and Abnormal flora, their sources and changes induced by them. 2.2 Milk Borne Pathogens. 2.3 Processing and analysis of Milk, Grading of Milk, Platform test, Dye reduction test, DMC, SPC, LPC, Thermoturic count, Psychrophilic count, Pasteurization, HTLT, LTHT and Phosphatase test 2.4 Shelf life, Packaging, Storage and Distribution. 2.5 Milk products: Preparation of powdered and sweetened condensed milk, butter, cheese (types and production of cheddar and cottage cheese.) Yogurt (Types and production). Other milk products and names of organisms associated with them.		15 Lectures
	III	Microbial Biotechnology 3.1 Introduction Biotechnology as an interdisciplinary science, Biosafety. 3.2 Energy and Biotechnology – Biofuels, sources of biomass,		15 Lectures

	ethanol and methane from biomass, Hydrogen production. 3.3 Biotechnology and Health care – Use of probes in disease diagnosis and use of monoclonal antibodies in disease diagnosis and treatment. 3.4 Bio fertilizer, Bio pesticide and Vermicomposting. 3.5 Bioleaching, Biosensors and biochips.		
USMB P-4	Practicals based on above three courses in theory	3	135 L/Sem
USMB P-4	Section I		45 L
	<ol style="list-style-type: none"> 1. Problems on Mendelian genetics 2. Extraction of DNA from onion and <i>E. coli</i> (plasmid DNA, Mini prep) 3. Mitosis and Meiosis 4. Isolation and Identification of microorganisms from soil 		
	Section -II		45L
	<ol style="list-style-type: none"> 1. Qualitative test for RNA AND DNA-Orcinol ,DPA 2. Estimation of DNA by DPA method 3. Estimation of RNA by Orcinol method 4. Purification of Enzyme- 5. Ammonium Sulfate precipitation and Dialysis 6. Measurement of enzyme activity before and after purification (DNSA Method) 7. Effect of Variables on Enzyme activity (Invertase from yeast) Temperature, pH, Substrate concentration, Enzyme concentration, Determination of Km of Invertase 8. (Lineweaver-Burke plot, Michaelis-Menten graph) 		
USMB P-4	Section-III		45L
	<ol style="list-style-type: none"> 1. Study Of Centrifuge, Density gradient centrifugation (Yeast & Bacteria) 2. Paper Chromatography Of Amino Acids 3. TLC Of Sugars 4. Column Chromatography DEAE, Cellulose. 5. Microbial analysis of Milk-DMC, SPC, Coliform count, spore bearers, RRT, MBRT 6. Isolation of Azotobacter and Rhizobia. Preparation of Bio fertilizer 7. Demonstration of Vermicomposting 8. Visit to Biogas Plant 		

References

Course: USMB-301 and USMB-401

1. Immunology, A Text Book. C.V. Rao, Narosa Publishing House, Mumbai. 2005
2. Text Book of Microbiology, 5th Edition. R. Ananthnarayan and C.K. Jayaram Paniker. Orient Longman. Hyderabad 1997
3. Immunology, Pathak and Palan
4. Genetics. 5th Edition. Peter Russell. Addison Wesley Longman Inc. . New York 1998.
5. Microbiology. 5th Edition. Prescott, Harley and Klein. McGraw Hill. New York. 2002
6. General Microbiology. 5th Edition. R.Y. Stainier, J. Ingraham, M. Wheelis and P.R. Painter. Prentice Hall. New Jersey. 2007
7. The Elements of Immunology – Fahim H. Khan, Pearson Education

Course: USMB-302 and USMB-402

1. Methods In Microbiology. Vol. 5B. Norris and Ribbon. Academic Press .
2. Microbiology An Introduction. 6th Edition. Tortora, Funke and Case. Addison Wesley Longman Inc. 1998.
3. Lehninger. Principles of Biochemistry. 4th Edition. D. Nelson and M. Cox. W.H. Freeman and Company. New York 2005
4. Outlines of Biochemistry 5/E, Conn P. Stumpf, G. Bruening and R. Doi. John Wiley & Sons. New York 1995
5. Enzymes, Biochemistry, Biotechnology and Clinical Chemistry. T. Palmer. East West Press Ltd. New Delhi. 2004
6. Bacterial Metabolism. 2nd Edition. G. Gottschalk. Springer. 2004
7. Basic Biotechnology. 2nd Edition. C. Ratledge and B. Kristinsen. Cambridge University. Press. 2006

Course: USMB-303 and USMB-403

1. Food Microbiology. 2nd Edition. M. Adams and M. Moss. Panima Publishing House. New Delhi. 2004.
2. Biotechnology Fundamentals And Applications. 3rd Edition. S. Purohit Agrobios, India. 2001.
3. Milk and Milk Products. 4th Edition. C. Eckles, W. Combs and H. Macy TMH New Delhi. 1986.
4. Industrial Microbiology. L. Casida. New Age International Publishers. New Delhi.
5. Industrial Microbiology. A.H. Patel. MacMillan. New Delhi. 1984.
6. Practical Biochemistry. Wilson and Walker.
7. Instrumentation in Biochemistry. William and Wilson.
8. A Text Book of Biotechnology. R.C. Dubey.
9. Biotechnology. B.D. Singh.
10. Food Microbiology. James Jay.

Modality of Assessment :

Internal Assessment - 40%

40 marks.

a) Theory

40 marks

Sr No	Evaluation type	Marks
1	Two Assignments/Case study/Project	20
2	One class Test (multiple choice questions / objective)	10
3	Active participation in routine class instructional deliveries(case studies/ seminars//presentation)	05
4	Overall conduct as a responsible student, manners, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	05

b) Practicals

20 marks

Sr No	Evaluation type	Marks
1	Two best practicals	10
2	Journal	05
3	Viva	05

B) External examination - 60 %

Semester End Theory Assessment - 60%

60 marks

- i. Duration - These examinations shall be of two hours duration.
- ii. Theory question paper pattern :-
 1. There shall be four questions each of 15 marks. On each unit there will be one question & fourth one will be based on all the three units .
 2. All questions shall be compulsory with internal choice within the questions. Each question will be of 20 to 23 marks with options.
 3. Questions may be sub divided into sub questions a, b, c, d & e only & the allocation of marks depends on the weightage of the topic.

Practical Examination Pattern:

Semester III:

Course : USMBP- 3	Internal	External	Total
SECTION- I	20 marks	30 marks	50 marks
SECTION - II	20 marks	30 marks	50 marks
SECTION - III	20 marks	30 marks	50 marks

Semester IV:

Course : USMBP- 4	Internal	External	Total
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SECTION- I	20 marks	30 marks	50 marks
SECTION - II	20 marks	30 marks	50 marks
SECTION - III	20 marks	30 marks	50 marks

Internal Practical Examination (20 marks)

Semester I-Internal Practical Examination				
USMBP -3	Journal-Marks	Assignment /Viva Seminar Marks	Pract test-02 Marks	Total
SECTION- I	05	05	10	20
SECTION – II	05	05	10	20
SECTION – III	05	05	10	20
Semester II-Internal Practical Examination				
USMBP -4	Journal-Marks	Assignment /Viva Seminar Marks	Pract test-02 Marks	Total
SECTION- I	05	05	10	20
SECTION – II	05	05	10	20
SECTION – III	05	05	10	20

Overall Examination Pattern

	Section I/ PaperI			Section II/PaperII			Section III/PaperIII		
	Internal	External	Total	Internal	External	Total	Internal	External	Total
Theory	40	60	100	40	60	100	40	60	100
Practicals	20	30	50	20	30	50	20	30	50

External Practical Examination -Semester III

USMBP-3	
SECTION -I	Marks -30
SECTION –II	Marks -30
SECTION -III	Marks -30
External Practical Examination -Semester IV	
USMBP-4	
SECTION -I	Marks -30
SECTION -II	Marks -30
SECTION -III	Marks -30

External Practical Examination Pattern

SEMESTER –III

USMBP-3

No	Section –I	Marks
1	Isolate the given mixture of microorganisms by using a selective media/differential media.	10
2	Identification of virulence factor/pathogen by a suitable biochemical test	10
3	Quiz/spots	10
	Section –II	
1	Chemical Assay [Estimation of Proteins / Reducing Sugars /Amino acids]	20
2	Qualitative test/Biostatistics problem/Bioenergetics problem/Quiz /Spots	10
	Section –III	
1	Major technique[TDP/TDT/Sugar tolerance /Salt tolerance]	20
2	Minor technique /Spots /Quiz	10

External Practical Examination Pattern

SEMESTER –IV**USMBP-4**

No	Section -I	Marks
1	Problems on Mendelian genetics	10
2	DNA Extraction/Mitosis/Meiosis/Bacillus isolation from soil	20
	Section -II	
1	Major technique[Estimation of DNA by DPA method, RNA by Orcinol method, Km]	20
2	Qualitative test/Quiz /Spots	10
	Section -III	
1	Major technique[SPC, Coliform count]	20
2	Minor technique [Azo,Rhizo,Chromatography/DMC/RRT/MBRT]/Spots /Quiz	10

