

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCES

BACHELOR OF SCIENCE HONOURS DEGREE EXAMINATIONS

DEPARTMENT OF APPLIED BIOLOGY AND BIOCHEMISTRY

THEORY: GENERAL MICROBIOLOGY ILSBB 2105

DECEMBER 2004

2 ^{1/2} HOURS (100 marks)**INSTRUCTIONS**

Answer Four (4) Questions. Each question carries 25 marks. Where a question contains subdivisions, the mark value for each subdivision is given in brackets. Illustrate your answer where appropriate with large, clearly labelled diagrams.

- 1.(a) (i) List six parameters which can be used for monitoring growth of bacteria (3 marks)
- (b) If a population in a bacterial culture increases from 1×10^5 to 1×10^8 cell per ml in five hours, calculate
- (i) the generation time (3 marks)
 - (ii) growth rate (3 marks)
 - (iii) number of generations (3 marks)
- (c) Describe the characteristics of a culture in the logarithmic and stationary phases of growth. (4 marks)
- (d) Outline the factors that affect duration of the lag phase when an organism is inoculated into a fresh medium. (4 marks)
- (e) Discuss diauxy in terms of catabolite repression of enzyme synthesis. (5 marks)
- 2.(a) Discuss group translocation and iron uptake as mechanisms of nutrient transport in microorganisms (12 marks)
- (b) Compare the Gram positive and Gram negative bacterial cell envelopes with respect to the following structures
- (i) outer membrane (2 marks)
 - (ii) peptidoglycan (2 marks)
 - (iii) periplasmic space (2 marks)
 - (iv) cell membrane (2 marks)
- (c) Use typical examples to show how microbial production of enzymes can be used as a basis for/or harnessed in
- (i) laboratory identification/differentiation of microorganisms. (1 mark)
 - (ii) Biodeterioration of materials causing economic loss. (1 mark)
 - (iii) Biodegradation/recycling of complex polymeric organic materials. (1 mark)
 - (iv) Industrial fermentation process (2 marks)

3.(a)	Describe the characteristics of bacteria which belong to the following physiological groups:	
	(i) psychrophiles	(2 marks)
	(ii) osmophiles	(2 marks)
	(iii) acidophilic bacteria	(2 marks)
	(iv) obligate aerobes	(2 marks)
	(v) microaerophilic bacteria	(2 marks)
(b)	What adaptive mechanisms do aerobic bacteria have in order to overcome oxygen toxicity.	(5 marks)
(c)	Briefly describe the physical and chemical factors that affect microbial growth.	(10 marks)
4.(a)	Describe how each of the following factors affect the effectiveness of an antimicrobial agent:	
	(i) temperature	(2 marks)
	(ii) concentration of antimicrobial agent	(3 marks)
	(iii) time of application	(3 marks)
	(iv) bioburden	(2 marks)
(b)	Describe the mode of action of the following groups of drugs:	
	(i) aminoglycosides	(3 marks)
	(ii) β -lactam antibiotics	(4 marks)
	(iii) tetracyclines	(3 marks)
(c) (i)	What is antibiotic resistance?	(1 mark)
(ii)	Discuss mechanisms by which microorganisms acquire resistance to antibiotics?	(4 marks)
5.(a)	Using specific microbiological examples, describe the following associations.	
	(i) symbiosis including mutualism	(5 marks)
	(ii) competition	(5 marks)
	(iii) commensalism	(5 marks)
(b)	What is (i) a pure culture	(2 marks)
	(ii) a mixed culture	(2marks)
(c)	Describe and give examples of cultures that grow in	
	(i) microbial films	(3 marks)
	(ii) pellets	(3 marks)
6.(a) (i)	What is an operon.	(2 marks)
(ii)	Use a diagram to describe the <i>lac</i> operon and briefly explain how it operates.	(8 marks)
(b) (i)	What is end product inhibition?	(2 marks)
(ii)	Use the <i>trp</i> operon to describe the molecular basis of end product repression.	(6 marks)

- (c) Describe substrate utilization, microbial growth and exoenzyme secretion in a named culture under a defined condition favourable to catabolite repression. (7 marks)

END OF EXAMINATION