BRAINWARE UNIVERSITY

Term End Examination 2020 - 21

Programme – Bachelor of Science (Honours) in Biotechnology

Course Name – Bio-mathematics

Course Code - BBT504C2

Semester / Year - Semester V

Time allotted : 85 Minutes | Full Marks : 70

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A

(Multiple Choice Type Question) 1 x 70=70

1. *(Answer any Seventy)*

(i) Find the median: 3, 13, 7, 5, 21, 23, 39, 23, 40, 23, 14, 12, 56, 23, 2

a) 40 b) 23

c) 21 d) 13

(ii) Find the mode value: 3, 13, 7, 5, 21, 23, 39, 23, 40, 23, 14, 12, 56, 23, 29

a) 40 b) 23

c) 21 d) 29

(iii) In this growth model, growth is slowest at the start and end of a given time period, but steeply rises in the middle. Name the model.

a) Gompertz growth model b) Logistic growth model

c) Malthusian growth model d) None of these

(iv) Find the common ratio of the series 64, 48, 36, 27, ...

a) ¼ b) ¾

c) 0.2 d) 0.6666666666666666

(v) For a population, the intrinsic rate of increase is the ..... per capita growth rate.

a) Minimum b) Maximum

c) Average

d) None of these

(vi) Which of the following is one of the assumptions of the Lotka-Volterra model?

a) Predators have a limited appetite

b) The rate of change of population is inversely proportional to population change

c) Prey population finds ample food all the time

d) None of these

(vii) In Malthusian theory of population growth, family planning, late marriages, and celibacy are .....

a) Assumptions

b) limitations

c) positive check

d) preventative check

(viii) In S-I-S disease transmission model, the recovered people gain .....

a) life-time immunity

b) no immunity

c) temporary immunity

d) None of these

(ix) In the logistic growth model ?P = 1.3P(1 ? P/10), what values of P will cause ?P to be negative?

a) P=10

b) P<10

c) P 10

d) P>10

(x) Find the next number in the sequence: 39, 47, 55, 63, ...

a) 70

b) 71

c) 72

d) 73

(xi) In the Michaelis–Menten enzyme kinetics model, enzyme reactions are not influenced by .....

a) Product concentration

b) Substrate concentration

c) enzyme concentration

d) both (Product concentration) and (enzyme concentration)

(xii) The models P(t) = kP(t?1) and ?P = r P represent growing populations when ..... [Consider P(t) is the population at time 't']

a) $k > 1$ and $r > 0$

b) $k = 1$ and $r > 0$

c) $k < 1$ and $r > 0$

d) $k < 1$ and $r < 0$

(xiii) Suppose a population is described by the model P(t+1) = 1.5P(t). If P(5) = 6, then P(4) = ?

a) 1

b) 2

c) 3

d) 4

(xiv) Epidemiologists are interested in learning about

a) the causes of diseases and how to cure or control them

b) the frequency and geographic distribution of diseases

c) the causal relationships between diseases

d) all of these

(xv) Diseases that are always present in a community, usually at a low, more or less constant frequency are classified as having an _____ pattern.

a) epidemic

b) endemic

c) pandemic

d) None of these

(xvi) An epidemic that becomes unusually widespread and even global in its reach is referred to as a …….

a) Pandemic

b) hyperendemic

c) Spanish flu

d) Both (Pandemic) and (hyperendemic)

(xvii) Which of the following is a steady-state for S-I epidemic model? (p = relative recovery rate, N = total population)

a) S= 0 , I = N

b) S= N , I = 0

c) S= p , I = N-p

d) Both 2nd and (S= N , I = 0) and (S= p , I = N-p)

(xviii) S-I-R model was proposed by ….

a) Kermack and McKendrick
b) Mathew and Perry
c) Watson and Crick
d) Clerk and Subhramaniam

(xix) A chemostat is also known as …..

a) Bactogen
b) Becteriogen
c) Bacterial filter
d) Bacteriogen vessel

(xx) Fouling means ….

a) slow stirring in a chemostat
b) accumulation of unwanted material on the surface of chemostat set up
c) malfunctioning of the pH meter
d) none of these

(xxi) Which one of the following is an assumption of Monod equation?

a) Nutrient depletion occurs continuously as a result of reproduction
b) Growth chamber should be cleaned
c) There should not be any growth-limiting nutrient
d) Flow of air should be considered in the model

(xxii) The geometric growth equation is …….

a) Nt = ?Nt-1
b) Nt = ?Nt+1.
c) Nt-1 = ?Nt+1
d) Nt = ?Nt

(xxiii) A deer population is growing geometrically with ? = 1.1, N0 = 1000. The population in five years will be …….

a) < 990
b) between 990 and 1000
c) between 1300 and 1600
d) > 1600

(xxiv) In absence of prey, a predator equation looks like Q = ?uQ [u = per capita death rate]. What would be the value of u?

a) u < 0
b) u > 1
c) 0 < u
d) u = 0

(xxv) Monod function is ….

a) Monotonically increasing with no limit
b) Monotonically increasing with specific limit
c) Monotonically decreasing with no limit
d) Monotonically decreasing with specific limit

(xxvi) What will be the next number: 8, 12, 18, 27, …. ?

a) 36
b) 38.5
c) 40.5
d) 42

(xxvii) In a close system bioreactor. There is ……

a) No exchange of energy
b) No exchange of mass
c) Both
d) none of these

(xxviii) If mean infection period of a certain disease is 14 days, what will be the removal rate?

a) 0.7 days-1
b) 0.07 days-1
c) 0.5 week-1
d) Both (0.07 days-1) and (0.5 week-1)

(xxix) Seasonal influenza can be modeled using ….

a) SIR model
b) SIS model
c) SI model
d) SIRS model

(xxx) Which of the following equation represent the Spruce-Budworm Outbreak. [Consider: w(t) is the budworm population, h(w) is the mortality of budworm due to predatory birds, 'a' is the carrying capacity and 'r' is the low-density growth rate]

a) dw/dt = rw(1?w/a) ? h(w)
b) dh/dt = rw(1?w/a) ? h(w)
c) dw/dt = rw(1+w/a) ? h(w)
d) dw/dt = rw(1?w/a)

(xxxi) Spruce-Budworm model is a modification of ……..

a) Continuous logistic growth model
b) Exponential growth model
c) Arithmetic growth model
d) None of these

(xxxii) If budworm population is small, the rate of predation will be ..

a) high
b) low
c) zero
d) average

(xxxiii) Spruce Budworm outbreak is a general phenomenon of ……..

a) African countries
b) Asian countries
c) American countries
d) European countries

(xxxiv) The spruce budworm outbreak stops because of

a) Predatory birds
b) Budworms itself
c) Both
d) None of these

(xxxv) In a spruce budworm outbreak model, predators have …..

a) Limitless appetite
b) Limited appetite
c) Very low appetite to contain the outbreak
d) None of these

(xxxvi) If $x` = ax$ is a differential equation where x^* is a stable steady state, then ….

a) $(dx`/dx)x=x^* > 0$
b) $(dx'/dx)x=x^* = 0$
c) $(dx'/dx)x=x^* < 0$
d) $(dx'/dx)x=x^* = 1$

(xxxvii) If $x` = ax$ is a differential equation where x^* is a unstable steady state, then ….

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d) $(dx'/dx)x=x^* = 1$

(xxxviii) Singular points in a phase plane are just ….

a) Neutral steady states
b) Stable steady states

c) Unstable steady states
d) Steady states

(xxxix) Bi-stability of visual perception is an example of ……

a) saddle-node bifurcation
b) Super-critical pitchfork bifurcation
c) Limit cycle
d) None of these

(xl) If this is a bifurcation plane, the blue marked state at (?, x*) = (0, 0) is called …

a) Limit point
b) knee
c) turning point
d) all of these

(xli) Annihilation of SA node pulse occurs on the application of …….

a) Sub-threshold pulse
b) Super-threshold pulse
c) Normal frequency pulse
d) none of these

(xlii) The coexistence of single-pulse triggering and annihilation indicates the presence of …

a) limit cycle
b) stable steady state
c) both
d) none of these

(xliii) Solution of a limit cycle is …..

a) $x(t+ T) = x(t)$ for all t
b) $x(t - T) = x(t)$ for all t
c) $x(t+ T) = 2x(t)$ for all t
d) both ($x(t+ T) = x(t)$ for all t) and ($x(t - T) = x(t)$ for all t)

(xliv) For a 1D transcritical bifurcation, bifurcation occurs for the value of ……. bifurcation parameter.

a) zero
b) positive
c) negative
d) both (zero) and (positive)

(xlv) Diffusion is a movement towards …..

a) high concentration
b) low concentration
c) both high and low concentration
d) none of these

(xlvi) Which of the following is a unit of diffusion constant?

a) cm2 sec-1
b) lb2 min-1
c) m2 min-1
d) both (cm2 sec-1) and (lb2 min-1)

(xlvii) In Fick's law, diffusion is related to ……..

a) Friction of the surface
b) Mass of the substance
c) Flux of the substance
d) none of these

(xlviii) The negative sign in Fick's equation indicates ….

a) Diffusion
b) Chemotaxis
c) Random walk
d) Movement against gravity

(xlix) Bacterial infection in a body is an example of …….

a) Diffusion
b) Chemotaxis
c) Random walk
d) Movement against gravity

(l) The presence of a gradient in an attractant concentration represented by a(x, t), gives rise to a movement of the cells. The flux of cells will increase with the number of cells, n(x, t), present. What will be the representation of the chemotactic flux?

a) Jchemo = n?(a)?a
b) Jchemo = -n?(a)?a
c) Jchemo = 1 - n?(a)?a
d) Jchemo = 1 + n?(a)?a

(li) For a chemotactic movement of a cell, the total flux of the cell does include ……

a) Chemotactic flux only
b) diffusive flux only
c) both (Chemotactic flux only) and (diffusive flux only)
d) none of these

(lii) The growth pattern of E.coli obtained in the semi-solid medium is due to ….

a) Osmosis
b) Diffusion
c) Chemotaxis
d) Both (Osmosis) and (Chemotaxis)

(liii) The cell proliferation term in the bacterial growth model includes …

a) Cell growth
b) Cell death
c) Flux
d) Both (Cell growth) and (Cell death)

(liv) The growth model of E.coli in the semi-solid medium has the production term of ….

a) Chemoattractant
b) Nutrient
c) Both
d) None of these

(lv) When births of organisms occur in regular, well-defined 'breeding seasons', we use ..

a) Continuous growth model
b) Discreet growth model
c) Semi-discreet growth model
d) None of these

(lvi) The freshwater European eel migrates out to the Sargasso Sea near Bermuda to …….

a) Just die
b) Spawn and die
c) Mating and die
d) Eat and die

(lvii) The general form of density-independent discreet growth is …… [R0 = net reproduction rate]

a) $N_{t+1} = (R0)^t N0$
b) $N_{t+1} = (R0) N0$
c) $N_{t+1} = (N0)^t R0$
d) None of these

(lviii) Which of the following statement is true for density-dependent growth?

a) the number of offspring per adult varies with population density
b) number of offspring per adult always stay constant

c) death rate doesn't vary with population density

d) none of these

(lix) Beverton-Holt curve is …….

a) compensatory

b) Over-compensatory

c) Under- compensatory

d) Doesn't have any relation with population compensation

(lx) In host-parasitoid interaction, female parasitoid searches for a host to ….

a) Hunt

b) Lay eggs

c) Take shelter

d) None of these

(lxi) The Age-structure model is proposed by

a) Nicholshol

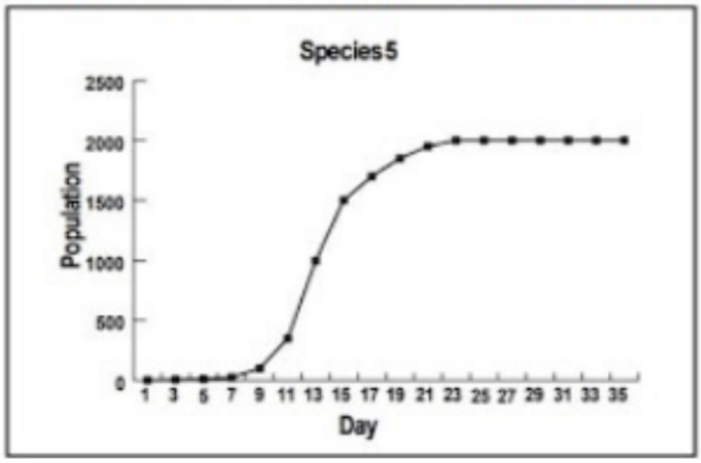
b) Bailey

c) W. W. Murdoch

d) Thomas Malthuis

(lxii)

Which of the following number is closest to the carrying capacity?



a) 500

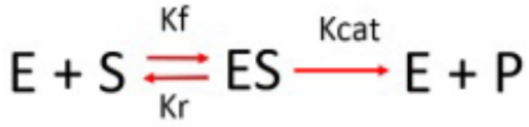
b) 1500

c) 2500

d) 2000

(lxiii)

What is the correct mass balance equation for the substrate?



E : Enzyme
S: Substrate
ES: Enzyme-Substrate complex
P: Product

Kf : Forward rate constant
Kr : Backward rate constant
Kcat : Catalytic rate constant

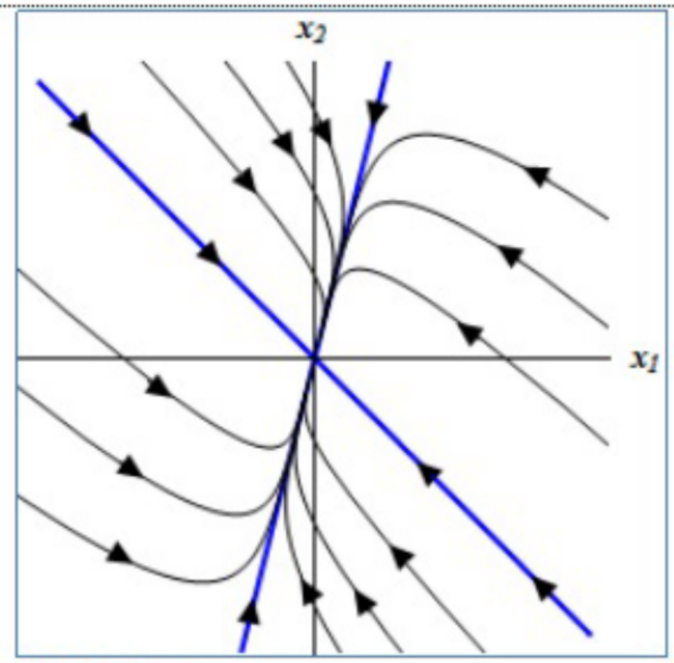
a) d[S]/dt = - (Kf * [E] * [S]) + (Kr * [ES]]?

b) d[S]/dt = - (Kf * [E]*[S]) - (Kr * [ES]]

c) d[S]/dt = - Kcat * [ES]

d) None of these

(lxiv)



This is a ….

a)

b) Phase plane

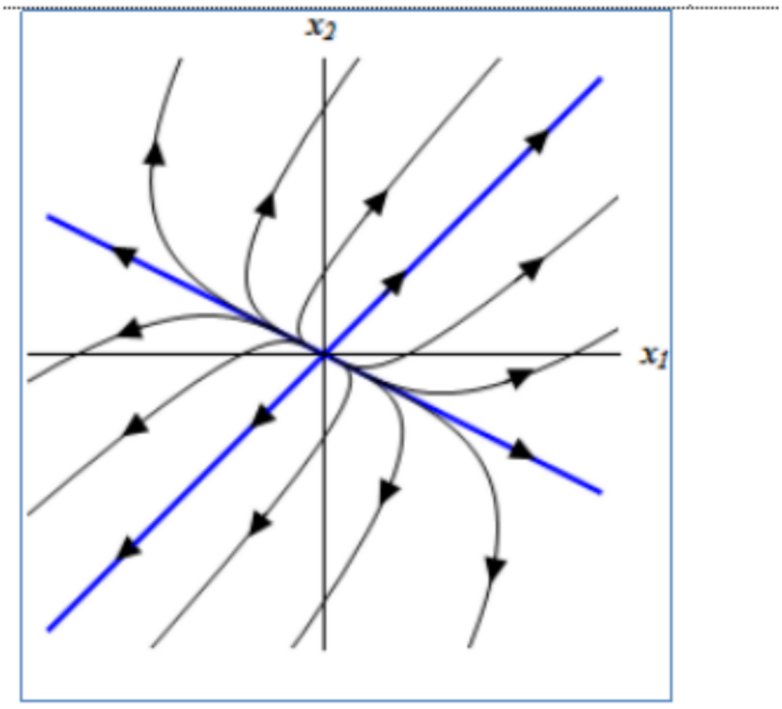
Bifurcation plane

c)

d) Both (Bifurcation plane) and (Phase plane)

Configuration plane

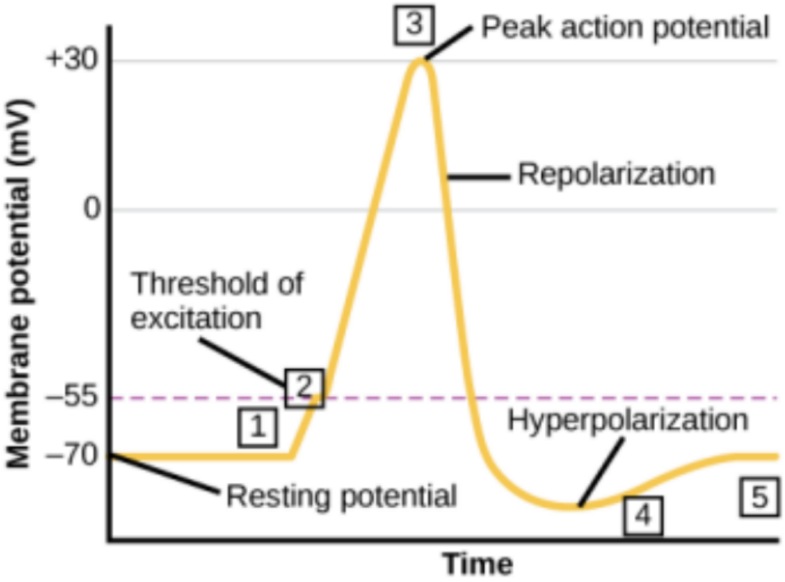
(lxv)



Here the steady state is .....

a) Centrally stable
b) stable
c) unstable
d) neutral

(lxvi)

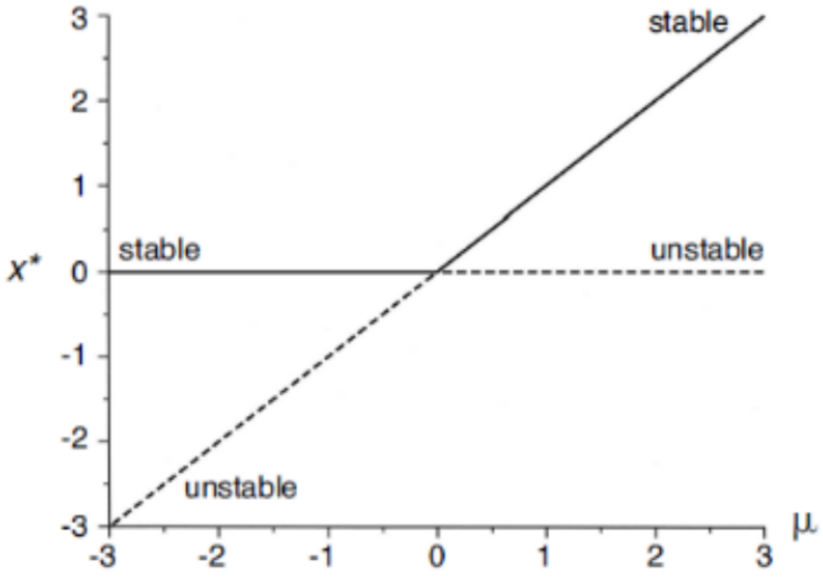


This implies the presence of …… steady states.

a) 1 b) 2

c) 3 d) 4

(lxvii)



This is the bifurcation diagram of ……

a) Pitchfork bifurcation b) <a

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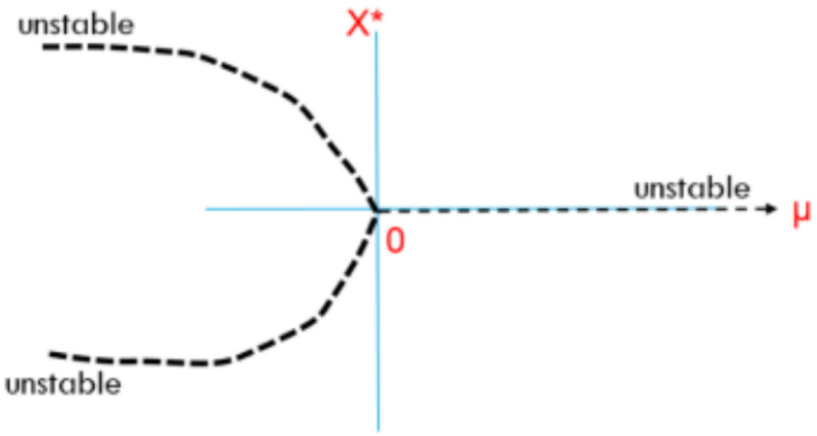
c) Limit cycle

d) Saddle-node bifurcation

(lxviii)



This is …….

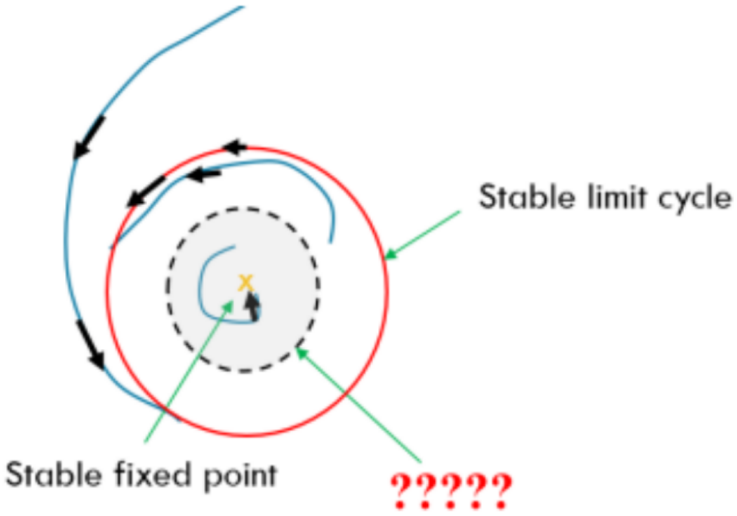
a) Super-critical saddle-node bifurcation

b) Super-critical pitchfork bifurcation

c) Sub-critical saddle-node bifurcation

d) None of these

(lxix)



a) limit cycle

b) separatrix

c) basin of attraction

d) none of these

(lxx)

Find the steady state for the equation: x' = 4 + 3x [where x' = dx/dt].

a)

b) 0

4/3

c) 3/4

d) -4/3