THE OPEN UNIVERSITY OF SRI LANKA
B. Sc / B. Ed DEGREE PROGRAMME
BOTANY – LEVEL 4
BOU2200 / BOE4200: PLANT PHYSIOLOGY
FINAL EXAMINATION 2016/2017

DURATION: THREE (03) HOURS

Date: 9th January 2018 **Time: 9.30 am -12.30 pm**

There are two (2) parts in this paper with total of eight (8) questions in five (5) pages. Each part comprises of four (4) questions. You have to answer FIVE (5) questions selecting at least TWO (2) questions from each part. PLEASE START EACH QUESTION IN NEW PAGE OF THE ANSWER BOOK.

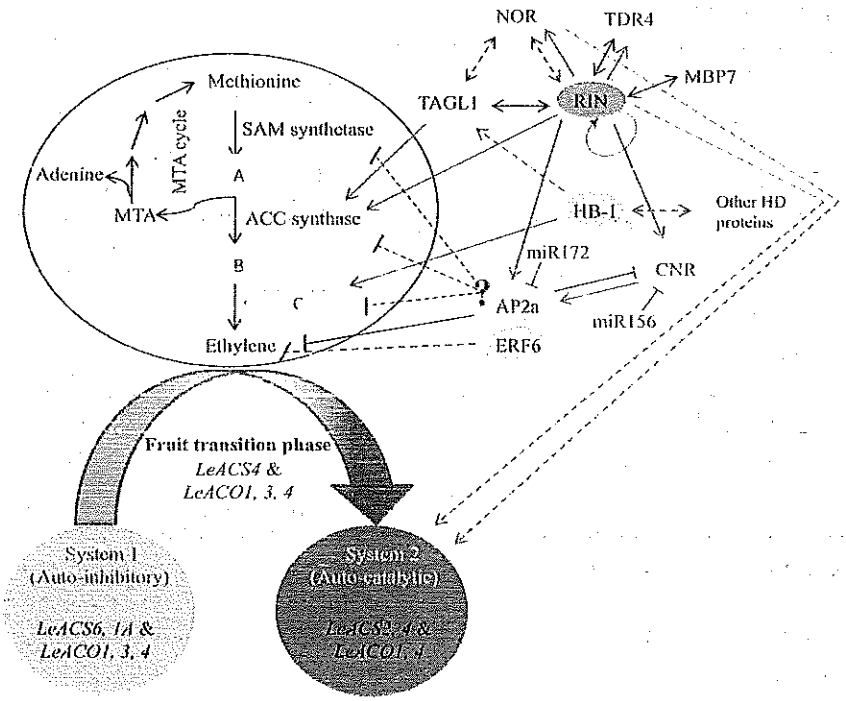
Part 1

1. Questions in this section are based on the following abstract extracted from a research publication.

Abstract: Stomata usually open when leaves are transferred from darkness to light. However, reverse-phase stomatal opening in succulent plants has been known. CAM plants such as cacti and *Opuntia ficus–indica* achieve their high-water use efficiency by opening their stomata during the cool, desert nights and closing them during the hot, dry days. Signal transduction pathway for stomatal opening by blue light photoreceptors including phototropins and the carotenoid pigment zeaxanthin has been suggested. Blue light regulated signal transduction pathway on stomatal opening could not be applied to CAM plants, but the most possible theory for a nocturnal response of stomata in CAM plants is photoperiodic circadian rhythm. *(Joon SL, (2010) J. Plant Biol. 53:19–23)*

a) Briefly explain the underlined sentence in the above abstract.
b) What do you understand by photoperiodic circadian rhythm?
c) Briefly describe how the higher water use efficiency is achieved by CAM plants?
d) What do you think about the efficiency of photosynthesis in CAM in comparison to C3 plants? Explain briefly.
e) Discuss theories that explain the opening and closing of stomata.

2. **Questions in this section are based on the following diagram extracted from a research publication** (Kumar R *et al., (2014) Journal of Experimental Botany*, 65:16)



This is diagrammatic representation of regulation of ethylene biosynthesis during fruit development and ripening. Upper part of the figure shows the regulation of various ethylene biosynthesis steps by different developmental regulators during ripening in tomato. The lower part of the figure shows the transition phase from green to red tomato fruits. Solid lines/arrows show the interactions supported by some experimental findings. Dotted arrows indicate that RIN and NOR regulate fruit ripening primarily via controlling the ethylene biosynthesis aspect during system 2. Blunt arrow (|---) indicates the negative impact on the pathway. (system 1 = green tomato and system 2 = red (rippened) tomato).

a) What are the compounds denoted by A, B and C in above diagramme?
b) What are the changes that take place when system 1 converted to system 2?
c) Comment on the methods of inducing ethylene synthesis in plants and associated health risks.
d) List the situations which require delaying fruit ripening and identify the key components that can be manipulated to delay the ripening?
e) Discuss the prospects of using plant hormones for inducing fruit setting and yield increment.

3. Questions in this section are based on the abstract given below.

Abstract: Drought is a major constraint for rice production in the rainfed lowlands in China. Silicon (Si) has been verified to play an important role in enhancing plant resistance to environmental stress. Two near-isogenic lines of rice (*Oryza sativa* L.), w-14 (drought susceptible) and w-20 (drought resistant), were selected to study the effects of exogenous Si application on the physiological traits and nutritional status of rice under drought stress. In wet conditions, Si supply had no effects on growth and physiological parameters of rice plants. Drought stress was found to reduce dry weight, root traits, water potential, photosynthetic parameters, basal quantum yield (F_v/F_0), and maximum quantum efficiency of PSII photochemistry (F_v/F_m) in rice plants, while Si application significantly increased photosynthetic rate (Pr), transpiration rate (Tr), F_v/F_0, and F_v/F_m of rice plants under drought stress. In addition, water stress increased K, Na, Ca, Mg, Fe content of rice plants, but Si treatment significantly reduced these nutrient levels. These results suggested that silicon application was useful to increase drought resistance of rice through the enhancement of photochemical efficiency and adjustment of the mineral nutrient absorption in rice plants. (Chen, W. et al. (2011) Biol Trace Elem Res 142: 67)

a. Flowchart the experimental method followed in this research project indicating the treatments and controls.
b. List the physiological and nutritional traits studied in this experiment and indicate the effect of exogenous application of Si on them.
c. What are the main factors in the soil that affect the nutrient availability to plants?
d. Discuss the underlined statement in the abstract in the perspective of uptake and transport of mineral nutrients with water.
e. Briefly outline the background theory of detection method of K and Na ions in plants.

4. Following graphs are extracted from the recent research publication on the response of rice (16) varieties for 30-day stagnant flooding. Changes in plant height (B) and dry weight (D) under stagnant flooding *compared to control* are shown in the graphs.

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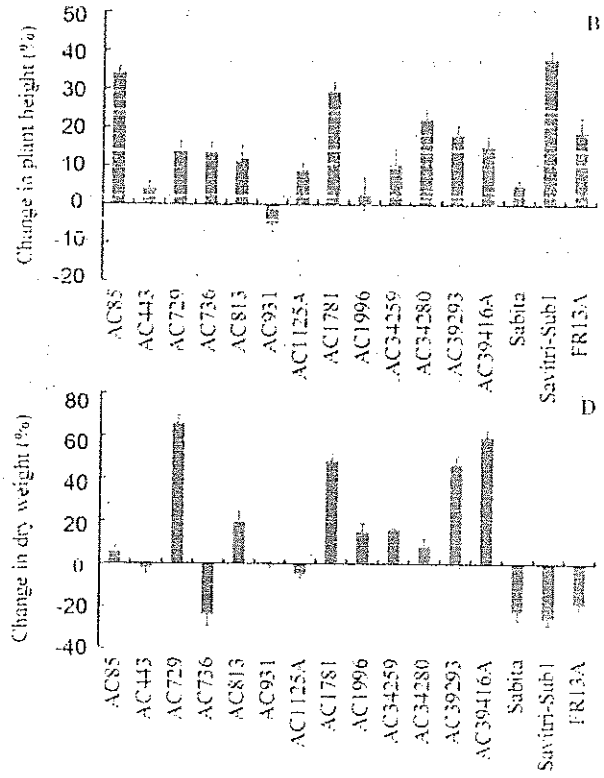


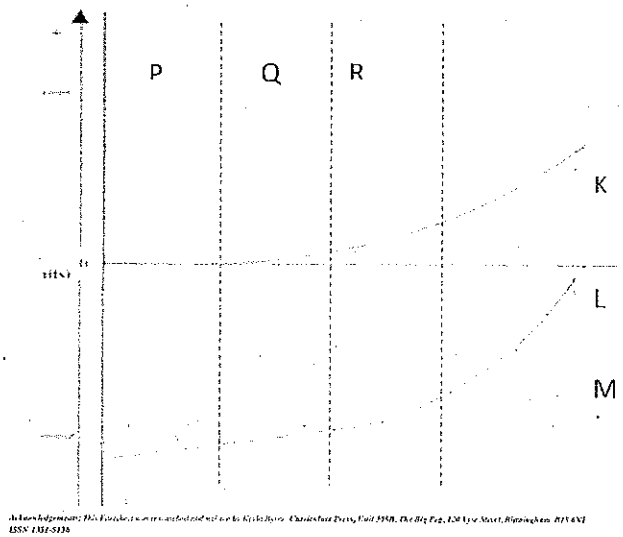
a. What are the varieties that are highly and least affected by the stagnant flood?
b. What is the criteria used to determine the degree of sensitivity of the above varieties?
c. List the stresses impose by the stagnant flood on plants.
d. What is the type of respiration favoured under this condition?
e. Discuss briefly the "ASPECT Physiology of water stress".

Part 2

5. Photosynthesis in higher plants are occurred in three different pathways and are affected by various internal and external factors.
    a. What are the main steps of CO_2 fixation in plants?
    b. How does the CO_2 compensation point vary in C3 and C4 plants?
    c. Compare C4 and CAM photosynthesis and identify the most advantageous type in drought stress. Use illustrations whenever appropriate.
    d. Briefly discuss "the quality of light and physiology of plants".

6. "Flowering in plants is regulated by three key factors." Discuss with examples and illustrations.

7. Water potential is defined as "the tendency of water to enter or leave a cell". It is dependent on three factors and is used as the theory explaining the movement of water in plant.
    a. Following graph shows the degree of variation (y - axis) of the components of water potential in different water status in cell (x - axis). Identify K, L and M giving reasons.



    b. Illustrate the cells depicting its water status at the stages of P, Q and R.
    c. Describe how the components of water potential varies in radial movement of water in plants under drought conditions.
    d. Explain briefly with examples how cell water potential is regulated by ABA.
    e. Discuss the statement that 'phloem translocation is affected under water stress condition'.

8. Discuss the statement that dormancy and senescence are unique phenomena in plants and dependent on both genetic and environmental factors.

Please attach this page with the answer book. You will be given 5 min of additional time to answer this questionnaire.

SURVEY ON ACCEPTANCE OF SMS LEARNING

You will be greatly appreciated if you kindly respond to the questions sincerely and honestly. Your responses will be considered only as a feedback and kept strictly confidential. Thank you very much, in advance, for your cooperation.

	Question	Your response (mark 'X' from questions 4 onward)									
1	I subscribed to short message service (SMS) of Plant Physiology and was receiving messages until last week	Yes				No					
2	My registration number is										
3	My mobile phone number is										
4	Short messages received for BOU2200 were easily understood	100 % agree		75% agree		Neutral		75% disagree		100% disagree	
5	Number of messages received per week is adequate	100 % agree		75% agree		Neutral		75% disagree		100% disagree	
6	Short messages prompted me to recall the relevant parts in lessons	100 % agree		75% agree		Neutral		75% disagree		100% disagree	
7	Short messages strengthened my learning on BOU2200 significantly.	100 % agree		75% agree		Neutral		75% disagree		100% disagree	
8	Short message helped me to keep engaged in the subject continuously	100 % agree		75% agree		Neutral		75% disagree		100% disagree	
9	I read short messages on the particular day it received to my phone	100 % agree		75% agree		Neutral		75% disagree		100% disagree	
10	I usually read short messages once in a week	100 % agree		75% agree		Neutral		75% disagree		100% disagree	
11	Once read short messages, I usually go through the relevant section in the course material	100 % agree		75% agree		Neutral		75% disagree		100% disagree	
12	I can easily remember the terms in SMS that I received on my mobile phone	100 % agree		75% agree		Neutral		75% disagree		100% disagree	
13	Short messages often motivated me to study the course material regularly	100 % agree		75% agree		Neutral		75% disagree		100% disagree	
14	Reading short messages on BOU2200 built my confidence on achieving learning outcomes	100 % agree		75% agree		Neutral		75% disagree		100% disagree	

15	On whole, Mobile learning increases the quality of my learning in BOU2200	100 % agree	75% agree	Neutral	75% disagree	100% disagree
16	I strongly recommend that other courses adopt similar short message service	100 % agree	75% agree	Neutral	75% disagree	100% disagree
17	Receiving SMS on BOU2200 did not cause any inconvenience for my other work	100 % agree	75% agree	Neutral	75% disagree	100% disagree
18	SMS of BOU2200, in many a time, prompted discussions with peers on subject matter.	100 % agree	75% agree	Neutral	75% disagree	100% disagree
19	SMS of BOU2200 reminded me to focus attention into studies despite my other engagements	100 % agree	75% agree	Neutral	75% disagree	100% disagree
20	I found the SMS learning enjoyable	100 % agree	75% agree	Neutral	75% disagree	100% disagree
21	Write two suggestions to improve mobile learning in BOU2200					

Thank you very much for the kind cooperation extended,

Prasad Seandheera PhD
Senior course coordinator