

University of Nigeria, Nsukka
DEPARTMENT OF PLANT SCIENCE & BIOTECHNOLOGY
POSTGRADUATE PROGRAMMES IN PLANT SCIENCE AND BIOTECHNOLOGY

1. PHILOSOPHY

The Department's programmes are designed to encourage and promote the training of students in all aspects of Plant Science and Biotechnology. The students are expected, at the end of their programme to become conscious of their environment and appreciate the delicate balance between plant life and the existence of the Earth. They are expected to become highly knowledgeable in the new frontiers of biotechnology as it relates to plants, the primary producers in the universe. Above all, it is the core goal of the department to produce graduates who can relate to the needs of the society through their knowledge and application of the amazing facts of plant life and products, and biotechnology.

2. OBJECTIVES

The Department offers Postgraduate Diploma (PGD), M.Sc. and Ph.D. Degree programmes designed to train botanists/plant scientists and biotechnologists for fundamental research and also for applied research in the areas of plant anatomy, taxonomy/biosystematics, embryology of angiosperms, ecology palynology/paleoecology, genetics/cytology, mycology/plant pathology, mushroom science, physiology/tissue culture, phycology/bryology, phytomedicine and plant biotechnology. This would ensure a fuller understanding of the amazing facets of plant life and plant products and emphasize the role of plants in the life of the individual and the nation's economy.

3. SCOPE

The Postgraduate Programme of the Department is designed to meet the needs of students interested in pursuing careers as research officers/teachers, and in forestry and forest products. Herbarium, natural museums, commerce and industry, environmental conservation, industrial palynology, phycology/limnology, tissue culture, conservation of germplasm, industrial and medical mycology, mushroom technology and other areas necessary for economic development.

4. ENTRY REQUIREMENTS

(a) Postgraduate Diploma in

The criteria for admission into the PGD programme in Plant Science & Biotechnology are as follows:

- i) Five credit passes including English, Mathematics, Biology and two other relevant science subjects at 'O' Level obtained at not more than two sittings and
- ii) Candidates with Bachelor's degree from an approved university must obtain a minimum of third class degree in the relevant science discipline
- iii) Holders of HND in relevant programmes from approved institutions with a minimum of Upper Credit may be considered for admission.

(b) Master of Science

The criteria for admission into the M. Sc. programme in Plant Science & Biotechnology are as follows:

- i) Five credit passes including English, Mathematics, Biology and two other relevant science subjects at 'O' Level **and**
- ii) Graduates of the University of Nigeria or of any other recognized University who obtained the approved degree of Bachelor of Sciences in Botany/Plant Science/Biotechnology or any other related discipline with at least a GPA of 2.5 on a 5-point scale or 2.0 on a 4-point scale or its equivalent (50% and above) are admitted into the Master's degree programme; **OR**
- (iii) Candidates with at least a third class degree and University PGD with a CGPA of 3.0/5.0 may be considered for admission into academic Master's programme; **OR**

- iv) A candidate with Master's Degree in Botany/Plant Science or any related discipline from University of Nigeria or any other recognized university, whose GPA is below 3.50 on a 5-point scale or below 3.0 on a 4-point scale shall not qualify for admission into the Masters/Ph.D. programme. Such a candidate may be admitted into the Masters programme.
- v) All candidates must demonstrate adequate intellectual capacity, maturity and effective decision making and problem solving potentials.

(c) Doctor of Philosophy

- i) Five credit passes including English, Mathematics, Biology and two other relevant science subjects at 'O' Level **and**
- (i) A candidate with first class honors Bachelor's Degree in Botany/Plant Science or any other related discipline from a recognized university may be admitted into the Masters/Ph.D. programme.
- (ii) A candidate with Master's Degree in Botany/Plant Science/Plant Biotechnology or any related discipline from University of Nigeria or any other recognized university with a minimum GPA of 3.50 on a 5-point scale or 3.0 on a 4-point scale wishes to do a Ph.D. in another related discipline other than the one which he obtained the Master's degree, may be admitted into the Masters/Ph.D. in the new area.
- (iii) Graduates of Botany/Plant Science/Plant Biotechnology or any other related discipline from University of Nigeria or any other recognized university with a minimum GPA of 3.50 on a 5-point scale or 3.0 on a 4-point scale and Thesis score not lower 60% may be admitted into the Ph.D. programme.
- (iv) All candidates must demonstrate adequate intellectual capacity, maturity and effective decision making and problem solving potentials.

5. MODE OF STUDY FOR POSTGRADUATE PROGRAMMES

All programmes shall include course work and research to be embodied in a project report or thesis as specified in the University PG regulations. Course work will include formal lectures and laboratory work. At the end of each course the candidate must sit and pass an examination on the course. At least one three hour written examination per course must be taken. A seminar course may be graded in cursu. The course to be taken by each student will be those considered by the Departmental post-graduate committee to be pre-requisites and relevant to the subject of his research. Other remedial courses may be recommended for students who are deficient in some courses at the under-graduate level.

Each student will in his research be under a supervisor or supervisors appointed by the Departmental Post-graduate Committee and approved by the Senate.

(a) Postgraduate Diploma

- (i) PGD in Plant Science and Biotechnology (Ethnomedicine & Phytomedicine)
- (ii) PGD in Plant Science and Biotechnology (Plant Micropropagation)

A student is required to take courses from his related area(s) of specialization not exceeding 30 units. Students who have previously taken a course in statistical methods in Biology at the undergraduate level will be required to take remedial course in this area. In some cases, remedial courses will be taken from undergraduate courses as the Departmental Postgraduate Committee may determine. Also, a Research Project of 6 credit units must be undertaken by the candidates under the guidance of a supervisor. The Project report must be sent to an external examiner nominated by the department and appointed by Senate for that purpose.

(b) Master of Science (M.Sc.)

A student is required to take courses from his related **area(s) of specialization/elective courses (12 Units), but not exceeding 18 units**, in addition to the **core courses totaling 27 units (Postgraduate (PGC) & Departmental)** applicable to all options. **Total credit units range = 39 – 45.** Students who

have not previously taken a course in statistical methods in Biology at the undergraduate level will be required to take remedial course in this area. In some cases, remedial courses will be taken from undergraduate courses or other departments as the Departmental Postgraduate Committee may determine.

(c) Ph.D.

- Doctorate (Ph.D.) programmes should primarily be by Research. In addition the Departmental Postgraduate Committee may prescribe some courses of not more than 12 credit units to be taken by the candidates. A Doctoral (Ph.D.) Thesis of 12 credit units **MUST** be defended before a Panel of Internal and External Examiners.

- A student shall present at least two seminars, submit and defend a thesis proposal.
- A student shall carry out research in a relevant area of specialization and submit an acceptable thesis.

Course work will include formal lectures and laboratory work. At the end of each course the candidate must sit and pass an examination on the course. At least one three hour written examination per course must be taken. A seminar course may be graded in cursu. The course to be taken by each student will be those considered by the Departmental post-graduate committee to be pre-requisites and relevant to the subject of his research. Other remedial courses may be recommended for students who are deficient in some courses at the under-graduate level. The student must present a seminar (3 units) on the findings of the research project before external examination. All laid down requirements in the University PG regulations apply.

(d) Final Examinations

Following successful completion of course work, examination for Postgraduate Diploma, Masters and Doctoral Degrees will be by submission of a project report or a thesis. Three examiners, one of whom shall be the external examiner, and two internal examiners; one of the internal examiners shall normally be the supervisor shall be appointed following the laid down regulations of the Postgraduate school.

(e) Grades

% Scores	Letter Grades	Grade Points (GP)
70 – 100	A	5
60 - 69	B	4
50 - 59	C	3
0 – 49	F	0

(i) Pass Mark

The minimum pass mark for any course/thesis shall be 50% for PGD and M.Sc.; and 60% for Ph.D

Postgraduate Diploma Classification

The determination of the Postgraduate Diploma shall be based on the Cumulative Grade Point Average (CGPA) earned at the end of the programme.

Cumulative Grade

4.50 – 5.00
3.50 – 4.49
3.00 – 3.49
Below 3.00

Class of Diploma

Distinction
Credit
Pass
Fail

6. DURATION OF PROGRAMMES

This shall be as outlined in the Postgraduate diploma, Master of Science and Doctor of Philosophy programmes of the School of Postgraduate Studies. For extension beyond the specified maximum period a special permission of Senate shall be required.

(i) Postgraduate Diploma

Full-time: A minimum of 2 semesters
A maximum of 4 semesters.

Part-time: A minimum of 4 semesters
A maximum of 6 semesters.

(ii) Duration of Masters

Full time: A minimum of 3 semesters
A maximum of 5 semesters

Part time: A minimum of 4 semesters
A maximum of 6 semesters

(iii) Duration of Ph.D.

Full time: A minimum of 6 semesters
A maximum of 8 semesters

Part time: A minimum of 8 semesters
A maximum of 10 semesters

7. EMPLOYMENT OPPORTUNITIES

(a) Students graduating from the Department of Plant Science and Biotechnology may choose careers in research and/or pedagogy in Colleges, Universities and Research Institutions, Government, Agriculture, Forestry, Criminal Investigation Institutions, Biotechnology Research Centres, Conservation and Wild-life Management; Wood Technology and Industries, such as Sugar, Rubber, Paper Pulp, Fertilizer and Oil (Vegetable and Mineral), Petroleum Refinery; Mushroom Production; Floriculture, hedging and landscaping using indigenous and exotic hedge plants; Establishment of orchards and plantations for food and raw material production; macro-propagation of many economic tree crops; off season vegetable and fruit production and preservation; production of seedless fruits; establishment of germplasm companies; beekeeping for honey and synergy in crop productivity.

(b) Areas of self-employment include formulation and marketing of Herbal soaps, identification, naming, preservation and use of medicinal plants for health care delivery through refining of unacceptable crude practices by indigenous people; organic horticulture through composting; production of phytoplankton for biofuels and feeding of animals especially fishes; recycling of waste products; construction of bioreactors for energy production for households; production of fruit juices from assorted fruits and their combinations.

8. AREAS OF SPECIALIZATION

Taxonomy/Biosystematics

Palynology/Palaeoecology

Plant Anatomy

Plant Physiology

Ecophysiology

Plant Pathology/Mycology

Genetics and Plant Breeding

Plant Ecology

Environmental Botany/Economic Botany
 Plant Biotechnology
 Algal Biotechnology
 Fungal Biotechnology
 Aquatic Botany
 Phycology/Limnology
 Ethnomedicine/Phytomedicine

9. STRESS AREAS

General/Foundamental Courses /Seminar/Project	0
Biosystematics/Taxonomy/ /Palynology/Palaeoecology	1
Plant Anatomy	2
Plant Physiology/Ecophysiology	3
Plant Pathology/Mycology	4
Genetics and Plant Breeding	5
Plant Ecology/ /Environmental Botany/Economic Botany	6
Plant Biotechnology	7
Phycology/Limnology/Aquatic Botany	8
Ethnomedicine/Phytomedicine	9

10. LIST OF APPROVED POSTGRADUATE SUPERVISORS

1	Prof. C. E. A. Okezie B.Sc., Ph.D, M.I.Biol., FLS	Plant Physiology, Plant Biotechnology
2	Prof. Dr. Maria O. Nwosu B.Sc. (<i>Vordiplom</i>) M.Sc. (<i>Diplom</i>) Ph.D FLS	Plant Taxonomy & Biosystematics
3	Prof. Nneka V. Chiejina B.Sc., M.Sc., Ph.D	Plant Pathology & Plant Virology
4	Prof. (Mrs.) Florence I. Akaneme B.Sc., M.Sc., Ph.D	Genetics & Plant Breeding, Plant Biotechnology
5.	Dr. Nkechinyere O. Nweze (Reader) B.Sc., M.Sc., Ph.D	Phycology, Limnology & Algal Biotechnology
6	Dr. (Mrs.) Alfreda. O. Nwadinigwe (Reader) B.Sc., M.Sc., Ph.D & PGDE	Plant Ecology
7	Dr. O. S. Udengwu B.Sc. Ph.D	Genetics & Plant Breeding, Plant Biotechnology
8	Dr. (Mrs.) Ngozi E. Abu B.Sc., M.Sc., Ph.D	Genetics & Plant Breeding, Plant Biotechnology
9.	Dr. (Mrs.) Christiana N. Ogbonna. B.Sc., M.Sc., Ph.D	Mycology and Fungal Biotechnology
*10.	Dr. R. C. Njokuocha B.Sc., M.Sc., Ph.D.	Palynology/Palaeoecology
11.	Dr. C. C. Onyeke B.Sc., M.Sc., Ph.D.	Plant Pathology, Nematology & Mycology
12.	Dr. G. C. Ajuziogu B.Sc., M.Sc., Ph.D.	Plant Anatomy and Wood Technology

11. COURSES FOR ONE YEAR PGD IN PLANT SCIENCE AND BIOTECHNOLOGY

(a) PGD Ethnomedicine/Phytomedicine

First Year

Course Code	Title	Units
<i>1st Semester</i>		
PSB 0514	Plant Systematics	3
PSB 0591	Management & Utilization of Medicinal Plants	3
PSB 0597	Introductory Pharmacognosy	3
PSB 0593	Philosophy, Policy and Ethics of Herbal Medicine	3
PSB 0501	*Seminar	3
<i>2nd Semester</i>		
PSB 0592	Introductory Herbal <i>Materia Medica</i>	3
PSB 0594	Ethnobotany, Nutrition, Health & Poisonous Plants	3
PSB 0596	Introduction to IPR and Patent Law	3
PSB 0502	*Project	6
	TOTAL	30

(b) PGD in Plant Micropropagation

First Year

Course Code	Title	Units
<i>1st Semester</i>		
PSB 0537	Plant Micropropagation and its Applications	3
PSB 0575	Techniques in Plant Tissue Culture	3
PSB 0535	Culture Conditions and Environment in Plant Micropropagation	3
PSB 0533	Morphogenic Pathways in Plant Tissue Culture	3
PSB 0501	*Seminar	3
<i>2nd Semester</i>		
PSB 0536	Plant Hormonal Control	3
PSB 0572	Plant Tissue Culture for Crop Improvement	3
PSB 0576	Production of Plant Secondary Metabolites	3
PSB 0502	*Project	6
	TOTAL	30

(c) PGD in Genetics and Plant Breeding

Genetics

Course Code	Title	Units
<i>1st Semester</i>		
PSB 0551	Plant Cytogenetics	3
PSB 0553	Introductory Radiation Plant Genetics	3
PSB 0555	Plant Molecular Genetics	3
PSB 0557	Plant Evolution	3
PSB 0559	Advanced Genetics	3
PSB 0501	*Seminar	3
<i>2nd Semester</i>		
PSB 0552	Genetics of Quantitative traits	3
PSB 0556	Dynamics of Population Genetics	3
PSB 0558	Principles of Plant Breeding	3
PSB 0554	Management and Exploitation of Genetic Resources	3
PSB 0502	*Project	6
	TOTAL	30

* Compulsory

(d) Remedial undergraduate courses for PGD students in Genetics and Plant Breeding Course

Course Code	Title	Units
PSB 451	Cytology	2
PSB 453	Plant Breeding	2
PSB 457	Phytobioinformatics	1
PSB 391	Research methods and Plant Breeding	2

12. COURSES FOR M. SC. IN PLANT SCIENCE AND BIOTECHNOLOGY**Year One****(a) Core Courses Applicable to all Options for M.Sc****(i) PG School/Faculty**

Course Code	Title	Units
PGC 601	Research Methodology and Application of ICT in Research	3
PGC 603	Management and Entrepreneurship	3

(ii) Departmental**1st Semester**

PSB 601	Seminar	3
PSB 605	Advanced & Current Techniques in Plant breeding	3
PSB 607	Science, Environment and Innovation	3

2nd Semester

PSB 606	Field Studies of Nigeria flora	3
PSB 608	Evolution and diversity of Major Plant Groups	3
Sub total		21

Year Two

Course Code	Title	Units
3rd Semester		
PSB 602	Project Report	6
TOTAL CORE COURSES		27

b. Elective Courses for M.Sc.**Genetics**

Course Code	Title	Units
1st Semester		
PSB 651	Advanced Cytogenetics	3
PSB 653	Radiation Genetics in Plants	3
PSB 655	Advanced Molecular Genetics	3
PSB 657	Evolutionary Mechanisms	3
PSB 659	Advanced Genetics	3
2nd Semester		
PSB 652	Quantitative Genetics	3
PSB 656	Population Genetics	3
PSB 658	Cytogenetics, Evolution and Phylogeny	3
PSB 654	Plant Genetic Resource Management and Utilization	3
TOTAL		12 – 18

Plant Physiology

Course Code	Title	Units
1st Semester		
PSB 631	Nutrient Metabolism in Plants	3
PSB 633	Growth and Developmental Physiology in Plants	3
PSB 635	Biological Techniques	3

PSB 637	Applications of Plant Tissue Culture & Micropropagation	3
PSB 639	Plant Adaptation and Acclimation Mechanisms	3
2nd Semester		
PSB 632	Advanced Physiology and Metabolism	3
PSB 636	Plant Growth Regulatory Substances	3
	TOTAL	12 – 18

Plant Ecology

Course Code	Title	Units
1st Semester		
PSB 663	Concept of Community	3
PSB 661	Weed Biology	3
PSB 683	Ecology of Aquatic Macrophytes	3
PSB 665	Environmental Audit and Impact Assessment	3
PSB 667	Biogeography	3
PSB 669	Production Ecology	3
PSB 673	Techniques in Plant Ecology	3
2nd Semester		
PSB 634	Physiological Plant Ecology	3
PSB 662	Air Pollution and Plant Degradation	3
PSB 664	Forest and Savanna Ecology	3
PSB 666	Ecosystems Pollution Ecology	3
PSB 668	Landscape Restoration Ecology	3
	TOTAL	12 – 18

Plant Anatomy

Course Code	Title	Units
1st Semester		
PSB 621	Advanced Plant Anatomy	3
PSB 623	Developmental Plant Anatomy	3
PSB 625	Secondary Growth in Plants	3
2nd Semester		
PSB 618	Taxonomic Data Processing and Presentation	3
PSB 624	Anatomy of Phloem Cells	3
	TOTAL	12 – 18

Biosystematics/Taxonomy

Course Code	Title	Units
1st Semester		
PSB 621	Advanced Plant Anatomy	3
PSB 613	Principles and Procedures of Plant Taxonomy	3
PSB 615	Palynology	3
PSB 617	Quaternary Palaeoecology	3
PSB 667	Biogeography	3
2nd Semester		
PSB 618	Taxonomic Data Processing and Presentation	3
PSB 612	Advanced Herbarium Studies	3
PSB 614	Advanced Plant Systematics	3
PSB 616	Ecology of Cryptogams and Epiphytes	3
PSB 658	Cytogenetics, Evolution and Phylogeny	3
	TOTAL	12 – 18

Mycology/Plant Pathology

Course Code	Title	Units
<i>1st Semester</i>		
PSB 641	Physiology of Plant Diseases	3
PSB 643	Physiology of Parasitism	3
PSB 645	Viral and Mycoplasma Diseases	3
PSB 647	Advanced Phytopathology	3
PSB 649	Advanced Mycology	3
<i>2nd Semester</i>		
PSB 678	Advanced Techniques in Biology	3
PSB 646	Control of Plant Diseases	3
PSB 648	Mushroom Science	3
PSB 670	Fungal Biotechnology	3
	TOTAL	12 – 18

Phycology/Limnology/Aquatic Botany

Course Code	Title	Units
<i>1st Semester</i>		
PSB 665	Environmental Audit & Impact Assessment	3
PSB 681	Limnology	3
PSB 683	Ecology of Aquatic Macrophytes	3
PSB 689	Phycology (Advanced Algology)	3
<i>2nd Semester</i>		
PSB 666	Ecosystems Pollution Ecology	3
PSB 674	Bioinformatics	3
PSB 677	Phytoremediation	3
PSB 676	Industrial Application of Algae	3
PSB 684	Advanced Primary Productivity	3
	TOTAL	12 – 18

Plant Ecophysiology

Course Code	Title	Units
<i>1st Semester</i>		
PSB 633	Growth and Developmental Physiology in Plants	3
PSB 639	Plant Adaptation and Acclimation Mechanisms	3
PSB 665	Environmental Audit and Impact Assessment	3
PSB 666	Ecosystems Pollution Ecology	3
<i>2nd Semester</i>		
PSB 634	Physiological Plant Ecology	3
PSB 636	Plant Growth Regulatory Substances	3
PSB 662	Air Pollution and Plant Degradation	3
PSB 673	Techniques in Plant Ecology	3
	TOTAL	12 – 18

Environmental Botany

Course Code	Title	Units
<i>1st Semester</i>		
PSB 665	Environmental Audit and Impact Assessment	3
PSB 677	Phytoremediation	3
PSB 673	Techniques in Plant Ecology	3
<i>2nd Semester</i>		

PSB 634	Physiological Plant Ecology	3
PSB 662	Air Pollution and Plant Degradation	3
PSB 664	Forest and Savanna Ecology	3
PSB 666	Ecosystems Pollution Ecology	3
PSB 668	Landscape Restoration Ecology	3
	TOTAL	12 – 18

Phytomedicine/Ethnomedicine

Course Code	Title	Units
<i>1st Semester</i>		
PSB 679	Plant Genetic Resources Management & Utilization	3
PSB 691	Introductory Pharmacology	3
PSB 693	Herbal Medicine: Philosophy, Policy and Ethics	3
PSB 695	Medicinal Mycology	3
<i>2nd Semester</i>		
PSB 614	Advanced Plant Systematics	3
PSB 674	Bioinformatics	3
PSB 692	Herbal <i>Materia Medica</i>	3
PSB 694	Herbal Clinical Internship	3
PSB 696	Ethnobotany, Nutrition and Health	3
PSB 698	IPR and Patent Law	3
	TOTAL	12 – 18

Plant Biotechnology

Course Code	Title	Units
<i>1st Semester</i>		
PSB 637	Applications of Plant Tissue Culture & Micropropagation	3
PSB 671	Algal Biotechnology	3
PSB 675	Advances in Plant Tissue Culture Techniques	3
PSB 677	Phytoremediation	3
PSB 673	Techniques in Plant Ecology	3
PSB 679	Plant Genetic Resources Management & Utilization	3
<i>2nd Semester</i>		
PSB 636	Plant Growth Regulatory Substances	3
PSB 670	Fungal Biotechnology	3
PSB 652	Genomics, Transcriptomics and Proteomics of Plants	3
PSB 654	Plant Genetic Resource Management and Utilization	3
PSB 672	Biotechnology in Crop Improvement	3
PSB 676	Plant Secondary Metabolite Production	3
PSB 674	Bioinformatics	3
PSB 678	Advanced Techniques in Biology	3
PSB 686	Industrial Application of Algae	3
	TOTAL	12 – 18

13. COURSE WORK FOR PH.D. IN PLANT SCIENCE AND BIOTECHNOLOGY**Ph.D. (Plant Taxonomy/Biosystematics/Palynology/Palaeocology)**

Course Code	Title	Units
<i>First Semester</i>		
PGC 701	Synopsis and research grant writing	3
PGC 703	Advanced Research methodology and application of ICT	

	in research	3
PSB 711	Special Topics in Plant Taxonomy/Biosystematics/ Palynology/Palaeocology	3
PSB 701	Special Seminar I	3
Second Semester		
PSB 712	Special Topics in Taxonomic/Palynology Data Processing and Presentation	3
PSB 702	Special Seminar II	3
PSB 703	Thesis	12
	TOTAL	30

Ph.D. (Plant Anatomy)

Course Code	Title	Units
First Semester		
PGC 701	Synopsis and research grant writing	3
PGC 703	Advanced Research methodology and application of ICT in research	3
PSB 721	Special Topics in Plant Anatomy	3
PSB 701	Special Seminar I	3
Second Semester		
PSB 722	Special Topics in Developmental Plant Anatomy	3
PSB 702	Special Seminar II	3
Third Semester		
PSB 703	Thesis	12
	Total	30

Ph.D. (Plant Physiology/Ecophysiology)

Course Code	Title	Units
First Semester		
PGC 701	Synopsis and research grant writing	3
PGC 703	Advanced Research methodology and application of ICT in research	3
PSB 731	Special Topics in Plant Physiology/Ecophysiology	3
PSB 701	Special Seminar I	3
Second Semester		
PSB 732	Special Topics in Applications of Plant Tissue Culture & Micropropagation	3
PSB 702	Special Seminar II	3
Third Semester		
PSB 703	Thesis	12
	TOTAL	30

Ph.D. Plant Pathology

Course Code	Title	Units
First Semester		
PGC 701	Synopsis and research grant writing	3
PGC 703	Advanced Research methodology and application of ICT in research	3
PSB 741	Special Topics in Plant Pathology	3
PSB 701	Special Seminar I	3
Second Semester		
PSB 742	Special Topics in Control of Plant Diseases	3
PSB 702	Special Seminar II	3

Third Semester

PSB 703	Thesis	12
	TOTAL	30

Ph.D. Genetics and Plant Breeding

Course Code	Title	Units
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First Semester

PGC 701	Synopsis and research grant writing	3
PGC 703	Advanced Research methodology and application of ICT in research	3
PSB 751	Special Topics in Genetics and Plant Breeding	3
PSB 701	Special Seminar I	3

Second Semester

PSB 752	Genomics, Transcriptomics and Proteomics of Plants	3
PSB 702	Special Seminar II	3

Third Semester

PSB 703	Thesis	12
	TOTAL	30

Ph.D Plant Ecology/Environmental Botany/Economic and Industrial Botany

Course Code	Title	Units
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First Semester

PGC 701	Synopsis and research grant writing	3
PGC 703	Advanced Research methodology and application of ICT in research	3
PSB 761	Special Topics in Plant Ecology/Environmental Botany/ Economic and Industrial Botany	3
PSB 701	Special Seminar I	3

Second Semester

PSB 762	Advanced Techniques in Plant Ecology	3
PSB 702	Special Seminar II	3

Third Semester

PSB 703	Thesis	12
	TOTAL	30

Ph.D Plant Biotechnology/Algal Biotechnology/Fungal Biotechnology

Course Code	Title	Units
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First Semester

PGC 701	Synopsis and research grant writing	3
PGC 703	Advanced Research methodology and application of ICT in research	3
PSB 771	Special Topics in Biotechnology/Algal Biotechnology/ Fungal Biotechnology	3
PSB 701	Special Seminar I	3

Second Semester

PSB 772	Advances in Plant Biotechnology/Algal Biotechnology /Fungal Biotechnology	3
PSB 702	Special Seminar II	3

Third Semester

PSB 703	Thesis	12
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TOTAL		30
Ph.D Phycology/Limnology/Aquatic Botany		
Course Code	Title	Units
First Semester		
PGC 701	Synopsis and research grant writing	3
PGC 703	Advanced Research methodology and application of ICT in research	3
PSB 781	Special Topics in Phycology/Limnology/Aquatic Botany	3
PSB 701	Special Seminar I	3
Second Semester		
PSB 782	Advances in Aquatic Botany	3
OR		
PSB 784	Nigerian Algal Biodiversity Bank Development and Utilization	3
PSB 702	Special Seminar II	3
Third Semester		
PSB 703	Thesis	12
TOTAL		30

Ph.D Ethnomedicine/Phytomedicine		
Course Code	Title	Units
First Semester		
PGC 701	Synopsis and research grant writing	3
PGC 703	Advanced Research methodology and application of ICT in research	3
PSB 791	Special Topics in Ethnomedicine/Ethnobotany	3
PSB 701	Special Seminar I	3
Second Semester		
PSB 792	Ethnobotany, Nutrition and Health	3
PSB 702	Special Seminar II	3
Third Semester		
PSB 703	Thesis	12
Total		30

14. REMEDIAL COURSES AT UNDERGRADUATE LEVEL AVAILABLE TO POSTGRADUATE STUDENTS

PSB 411	Dendrology	2
PSB 413	Herbarium and Phytosystematics	2
PSB 415	Introductory Palynology	2
PSB 417	Freshwater Phycology	2
PSB 433	Plant Embryology & Morphogenesis	2
PSB 443	Fungus Physiology	2
PSB 445	Plant Virology and Diagnostics	2
PSB 451	Cytology	2
PSB 453	Plant Breeding	2
PSB 457	Phytobioinformatics	1
PSB 461	Aquatic and Pollution Biology	2
PSB 465	Phyto – Environmental Impact Assessment	1
PSB 469	Plants Productivity and Apiculture	1
PSB 473	Phyto-biofuels	1
PSB 475	Plant Biophysics	2

PSB 477	Applications of Plant Biotechnology	2
PSB 391	Research methods and Plant Breeding	2

15. SYNOPSIS OF COURSES FOR PGD IN PLANT SCIENCE AND BIOTECHNOLOGY

PSB 0501: Seminar (3 Units)

A candidate for the PGD will be required to present a seminar on a topic selected from within the study area before the Departmental Postgraduate Committee. The performance of a candidate shall be evaluated by a panel selected by the Departmental Postgraduate Committee. Apart from the oral presentation, the seminar shall be typewritten, soft-bound and submitted to earn credit.

PSB 0502: Project (6 Units)

A candidate for the PGD shall undertake an independent research in the particular field of specialization under the guidance of a supervisor appointed by the Department Postgraduate Committee and approved by the Postgraduate School and the University Senate. A report on the Research Project shall be examined marks by three internal examiners from the Departmental Postgraduate Committee.

PSB 0533: Morphogenetic Pathways in Plant Tissue Culture (3 Units)

Two major pathways of explant development in culture, namely; organogenesis and somatic embryogenesis should be distinguished. The morphological similarities between somatic embryo development and zygotic embryo development should be highlighted. Embryogenic competence as it relates to the parent source of the explant should be discussed. Direct organogenesis leading to shoot or root production as opposed to indirect organogenesis involving a callus phase should be clearly distinguished.

PSB 0535: Culture Conditions and Environment in Plant Micropropagation (3 Units)

This course should distinguish between semisolid and liquid shake-up cultures in plant micropropagation. The effects of temperature, light, pH and osmoregulators and frequencies of subculture as they affect morphogenetic pathways should be highlighted.

PSB 0536: Plant Hormonal Control (3 Units)

Classes of plant hormones: growth promoters such as auxins (IAA, NAA, IBA, etc), gibberellins, cytokinins. Plant growth retardants. Synthetic plant growth regulators. Synthetic plant growth regulators and their bioassays. Ecological significance of plant hormones

PSB 0537: Plant Micropropagation and its Applications (3 Units)

This course will consider applications such as mass production of elite plants; stress tolerance (as in salt, drought, etc); disease resistance; production of high yielding crops; *in vitro* conservation; production of secondary metabolites

PSB 0551: Plant Cytogenetics 3 Units

Understanding chromosome structure and function. Evolution of karyotype in plant families. Changes in chromosomes number and structures- aneuploidy, duplication, deletions, deficiency, inversion etc. Lethality and epistasis. Types of polyploidy, characteristics and evolutionary significance. Induction of haploidy, autopolyploidy and allopolyploid. Basic chromosome number and evolution of species. Recent advances in Plant cytogenetics.

PSB 0552: Genetics of Quantitative traits 3 Units

Fundamentals of Quantitative Genetics. Differences between quantitative and qualitative traits. The nature of quantitative traits, Basic inheritance of quantitative traits, Basic statistical tools

used in quantitative genetics, Introduction to Quantitative genetic analysis, Fundamentals of heritability-components of phenotypic variance. Introduction to broad and narrow sense heritability.

PSB 0553: Introductory Radiation Plant Genetics 3 Units

History of experimental mutagenesis. Introduction to spontaneous and induced mutations. Physical and Chemical mutagens. Ionizing and non-ionizing radiations. Introduction to mutation, selection and population fitness. Cytogenetic effects of ionizing and non-ionizing radiations. Repair of mutagenic damage. Screening techniques and selection procedures of induced mutations; test systems. Induction of mutations in sexually and asexually propagated species. Utilization of induced mutations in crop improvement and propagation. Application methodology of mutagens and modification of their effect. Transposons as mutagens.

PSB 0554: Management and Exploitation of Plant Genetic Resources 3 Units

Historical perspective; Taxonomical classification of cultivated plants. Gene pool: primary, secondary and tertiary. Centres of origin and diversity. Introduction to data management of genetic resources. Plant genetic resources characterization and evaluation. Sampling and conservation strategies. *In situ* and *ex situ* conservation. Principles of *in vitro* cryopreservation; Germplasm conservation- *in situ*, *ex-situ* and on-farm; short, medium, long term conservation strategies for conserving of orthodox and non-orthodox seeds, vegetatively propagated crops; registration of plant genetic resources. Germplasm introduction and exchange. Principles, strategies and practices of exploitation, collection, characterization, evaluation and cataloging of PGR. Gene banks, reserves, protected areas and botanic gardens. Introduction to Plant genetic resources in plant productivity.

PSB 0555: Plant Molecular Genetics 3 Units

Genomes in prokaryotes and eukaryotes. Genome organization- euchromatin and heterochromatin. Definition of the gene. Introns and exons. Study of the fine structure of the gene. Introduction to DNA and the genetic code. Types of DNA and RNA. Differences between DNA and RNA. Types of DNA sequences-unique and repetitive sequences, VNTRs, mini satellites and microsatellites. The Central Dogma of molecular biology. DNA splicing, split genes, alternative splicing, trans-splicing, pseudogenes, overlapping genes, nested genes, jumping genes. Regulation of protein synthesis in prokaryotes and eukaryotes. Structural and functional genomics; proteomics and protein-protein interaction. Basic study of the role of genes in regulation and development. Current trends in Plant Molecular Genetics.

PSB 0556: Fundamentals of Population Genetics 3 Units

Foundation of theoretical population genetics. Hardy-Weinberg Law. Dynamics of gene frequency under selection, migration, mutation and genetic drift. Linkage-equilibrium, two and multi-gene systems. Polymorphisms and evolution, inbreeding. Mixed mating systems. Genetic load and fitness. Co-adapted gene complexes. Homeostasis. Adaptive organization of gene pools.

PSB 0557: Evolutionary Mechanisms 3 Credit Units

The synthetic theory of evolution and its development. The sources of variability. The nature of mutation, its causes and adaptiveness. The organization of genetic variability. The differentiation of population. Reproductive isolation and the origin of species. The role of hybridization and polyploidy in evolution. Major trends of evolution. Current issues in evolution.

PSB 0558: Principles of Plant Breeding**3 Credit Units**

Introduction to Plant Breeding-historical perspectives, objectives, achievements in the pre-Mendelian era, post-Mendelian plant breeding, potentials and opportunities. Introduction, domestication and acclimatization. Patterns of evolution in crops plants. Centres of origin, gene pool concept- primary, secondary and tertiary gene pool, and gene introgression. Modes of reproduction in plants-asexual and sexual reproduction, self and cross pollinated mechanisms, male sterility and self-incompatibility. Methods of breeding self-pollinated, cross pollinated and asexually propagated crops; Land races, pure line selection and mass selection. Pedigree selection, bulk method and its modification; Hybrid breeding; clonal selection. Mechanisms and genetic bases of resistance/tolerance to biotic and abiotic stress in plants, breeding for resistance/tolerance.

PSB 0559: Principles of Genetics**3 Credit Units**

Historical perspectives on Genetics, Mendelian principles, Gene interactions; Linkage, detection and estimation in bacteria, fungi and other eukaryotes; Multiple allelism: Mechanism of sex determination; Sex-linked, sex influenced and sex limited traits; Intergenic and intragenic complementation and recombination, complex loci, Gene-protein-polypeptide relationships; Genetic material; nature, organization, structure and replication; Genetic code, transcription and translation; Gene regulation in prokaryotes and eukaryotes, split genes, alternative splicing, transcriptional and post-transcriptional regulation; mobile genetic elements and dynamic nature of genome; Developmental genetics, Epigenetics and epigenomics; environmental influence of gene expression; Extra nuclear inheritance; Introduction to recombinant DNA technology- restriction enzymes, vectors, genetic transformation and genomics.

PSB 0572: Plant Tissue Culture for Crop Improvement (3 Units)

Scope of plant tissue culture. Somaclonal variations and their potential uses in crop improvement. Protoplast culture for production of cybrids. Oval and anther culture and their potential applications

PSB 0575: Techniques in Plant Tissue Culture (3 Units)

Concept of totipotency as the bases for plant micropropagation. Explants employed in plant tissue culture and micropropagation. Asepsis in plant micropropagation Viz: steam /dry heat/filter sterilization of instruments and surface sterilization as in seeds.

PSB 0576: Production of Plant Secondary Metabolites (3 Units)

This course should distinguish between primary and secondary metabolites in plants. Specific examples should be given such as oils, resins, gums, latex and examples of plants that produce them (for example the rubber plant *Hevea brassiliensis* produces latex). Economic importance of plant secondary metabolites as in pharmaceutical, cosmetics and food industries should be stressed.

16. SYNOPSIS OF M.SC. CORE COURSES IN PLANT SCIENCE AND BIOTECHNOLOGY**PGC 601: Research methodology and application of ICT in research [3 Units]**

In-depth research work aimed at acquiring full knowledge and presentations in scholarly writing of the concepts, issues, trends in the definition and development of the study area from African and Western perspectives. Major steps in research: selection of problem, literature review, design, data collection, analysis and interpretation, conclusions. Study of various research designs, historical, case studies, survey, descriptive, cross sectional, experimental, etc. Analysis, surveys and synthesis of conceptual and

philosophical foundations of different disciplines. Identification of research problems and development of research questions and or hypotheses. Detailed treatment of methods of collecting relevant research data and the format for presenting research results (from designing the table of contents to referencing, bibliography and appendix). Data analysis and result presentation in different disciplines using appropriate analytical tools. Methods of project/ dissertation writing. Application of appropriate advanced ICT tools relevant in every discipline for data gathering, analysis, and result presentation. Essentials of spreadsheets, internet technology, internet search engines, statistical packages, precision and accuracy of estimates, principles of scientific research, concepts of hypothesis formulation and testing, organization of research and report writing. All registered Master's Degree students must attend a solution-based interactive workshop to be organized by the School of Postgraduate Studies for a practical demonstration and application of the knowledge acquired from the course, conducted by selected experts.

PGC 603: Management and Entrepreneurship [3 Units]

The course will cover business environment, general management, financial management, entrepreneurship development, feasibility studies, marketing and managerial problem solving.

PSB 601: Seminar [3 Units]

A candidate for the M.Sc. degree will be required to present two seminars on a topic selected from within the study area (Project proposal and the Project Report Findings) before the Departmental Postgraduate Committee. The performance of a candidate shall be evaluated for the award of marks by a panel composed of the Departmental Postgraduate Committee.

PSB 602: Research Project [6 Units]

A candidate for the M.Sc. degree shall undertake an independent research in the particular field of specialization under the guidance of a supervisor appointed by the Department Postgraduate Committee and approved by the Postgraduate School and the University Senate. A Seminar on the research findings shall be presented by the candidate before external examination. A report on the Research Project Report shall be submitted to the Department and the candidate shall be examined orally by a panel of external and internal examiners.

PSB 605: Advanced and Current Techniques in Plant Breeding [3 Units]

Goals of plant breeding. Plant introduction and germplasm collections. Centers of genetic diversity and origin of cultivated plants. Genetic basis of selection: pure line theory, quantitative inheritance and heritability. Apomixes, incompatibility and sterility. Haploidy and polyploidy and their significance in plant breeding. Uses of aneuploids in plant breeding. Breeding methods for self and cross-fertilized crop species. Backcross breeding, mutation breeding, resistance breeding for diseases, pests and drought. Quality breeding, seed testing and certification. Cell fusion and another culture in plant breeding. Crop domestication and utilization in medicine.

PSB 606: Field Studies of Nigerian Flora [3 Units]

An intensive field investigation into the taxonomy and ecology of critical groups of vascular and non-vascular plants. Indicator species for major biomes in Nigeria. Threatened and Endangered plant species in Nigeria. Invasive plants; Exotic invasives (management, law and legislation).

PSB 607: Science, Environment and Innovation [3 Units]

Element of global warming, environmental protection issues, biodiversity, pollution, species at risk, social and ethical implications of science, enterprise and productivity, intellectual property rights, private public partnership and investment will be covered in this course.

PSB 609: Evolution and Diversity of Major Plant Groups [3 Units]

Origin of plants: Green algae multicellular and mosses as aquatic ancestors. Movement of land: mosses and liverworts. Characteristics of first terrestrial plants. Origin of seeds. Evolution of higher plants and their diversity. Importance of plant diversity. Relationship between families of flowering plants. Diversity and evolution of gymnosperms. Reticulate evolution of higher plants. Evolution of flower. Ecological importance of species diversity.

17. SYNOPSIS OF THE ELECTIVE COURSES FOR M. SC. IN PLANT SCIENCE AND BIOTCHNOLOGY**PSB 612: Advanced Herbarium Studies [3 Units]**

The herbarium, and economic botany, conservation and taxonomy, types of herbaria, the herbarium building, purpose of a herbarium and the herbarium labels, herbarium materials, preservation techniques. Introduction to herbarium techniques and management. Storage methods. Seed banks and their management. Photography in herbarium practice. Herbarium legislation.

PSB 613: Principles and Procedures of Plant Taxonomy [3 Units]

Historical background; the natural system and the value of character, phenetic and phylogenetic concept in taxonomy including rules and nomenclature, the categories in taxonomy. Evolution, identification of flowering plants. Recent trends in plant taxonomy.

PSB 614: Advanced Plant Systematics [3 Units]

A survey of floral morphology in relation to classification and evolution, chromosome numbers, polyploidy and their role in taxonomy. Flow cytometry as a taxonomic tool. Chemotaxonomy.

PSB 615: Palynology [3 Units]

Pollen diagrams and their interpretation. Fossil vegetation maps. Palynology and mineral oil exploitation. Pollen load of the atmosphere. Pollen grains and allergy.

PSB 616: Ecology of Cryptogams and Epiphytes [3 Units]

Affinities and evolution of higher algae, bryophytes, pteridophytes, a systematic survey of major vascular and non-vascular epiphytes. Ecology of epiphytes. Functions of epiphytes environmental monitoring and ecosystem stabilization.

PSB 617: Quaternary Palaeoecology [3 Units]

Comparative Ecology and Palaeoecology, principles of palaeoecology, sampling and description of sediments, reconstruction of past flora and past communities, the reconstruction of past environment, floral biology, morphology of pollen and spores, pollen production, dispersal, deposition and preservation.

PSB 618: Taxonomic Data Processing and Presentation [3 Units]

Collection of plants; preparation of herbarium specimens; preparation of microscope slides. Geographical and morphological methods in presentation of data, literature mapping, tabulation, symbolic and graphical methods. Identification: keys, comparison with named materials, nomenclature. Use of methods of numerical taxonomy in construction of taxonomic groups. Relevance of taxonomy in plant identification and usage.

PSB 621: Advanced Plant Anatomy [3 Units]

The structure of the cell wall. Cambium and its activities. Types, characteristics and structure of wood fibre, Wood pulping, Buttressing and its use in the industry.

PSB 623: Developmental Plant Anatomy [3 Units]

Review of root, stem and leaf initiations in plants. Studies on the epidermal tissue system, their functions and distribution stomata, cuticle, trichomes, epiblems, piliferous layer. The ground or fundamental tissue systems, their function and distribution cortex, endodermis, pericycle, pith and pith rays (parenchyma, collenchyma and sclerenchyma). The vascular tissue system: elements of vascular bundles xylem: protoxylem and metaxylem; phloem protophloem and metaphloem. Cambium: types of vascular bundles. A comprehensive knowledge of leaves, leaf epidermis, mesophyll palisade parenchyma, spongy parenchyma and vascular bundles of gymnosperms and angiosperms.

PSB 624: Anatomy of Phloem Cells [3 Units]

Studies on the origin and distribution of phloem should be reviewed. Primary phloem, sieve elements secondary phloem, structure and components of secondary phloem, companion cells, phloem fibres and sieve, parenchyma cells. Periderm meaning and occurrence. Phellogen and phelloderm, initiation of periderm. Activity of phellogen, distribution of lenticels, ultra-structure of plant cell wall, the pit fields chemical aspect of cell wall lignin, cellulose, hemicellulose etc. principal uses of phloem cells.

PSB 625: Secondary Growth in Plants [3 Units]

Origin and distribution of xylem. Components of xylem vessels secondary growth in dicotyledonous plants should be treated. The activities of cambium, origin and activity, cork cambium, secondary cortex should be emphasized in respect of wood formation and annual rings in plants. Emphasis should be laid on the origin of cambium, structure and cell types. Ray initials: size, variation, cell arrangement (stored and non-stored). The uniseriate and multiseriate concepts of cambium structure. Importance of cambium. The dimensions of wood, groups of wood (soft and hard wood). Apotracheal and paratracheal wood nature. Rays in hard and soft woods. General studies on the nature and structure of pits as found in hard and soft woods, fibre and vessels. Significance of pit and pit membranes. Cambia and cambial activity in both angiosperm and gymnosperms. Physiology of cambial activity, metabolism of cambium (enzymes activity, temperature, soil nutrient, light intensity and photoperiodism effect on cambial activity). Uses in wood structure and utilization.

PSB 631: Nutrient Metabolism in Plant [3 Units]

Plant, soil and water relationships. Nutrient uptake; Mechanisms and theories of nutrient uptake; Roles of major and minor plant nutrients in plant metabolism. Nutrient interactions and deficiency symptoms. Bio-fortification and Genetic improvement of plants for enhanced micronutrient content. Analytical techniques in plant nutrition studies Hydroponics. Techniques in radio labeling/tracer studies.

PSB 632: Advanced Physiology and Metabolism [3 Units]

Energy metabolism; electron donors and acceptors and their electron potentials. Enzymes, coenzymes and mechanisms of action. Catabolism and anabolism pathways for proteins, lipids and carbohydrate. Nitrogen fixation and its function in plant development. Types and distribution of proteins, lipids and carbohydrate.

PSB 633: Growth and Developmental Physiology in Plants [3 Units]

Plant growth: Effects of irradiance, light quality, temperature, duration of light on reproductive growth. Seasonal and geographic aspects of photoperiodism. Long-day, and short-day plants as the basic categories. Photoperiodic induction, mechanism of photoperiodism. Rhythmic behaviour of plant processes. Growth and vernalization and apical dominance Cyclical periodicity abscission and mechanism of abscission. Dynamics of primary vegetative growth. Totipotency. Measures of indices of growth and rates of growth. Alternative ways of plant growth for their products for world market. Hormones in horticulture and agriculture.

PSB 634: Physiological Plant Ecology [3 Units]

In-depth consideration of the physiological aspects of plant physical/chemical environmental relationships. Emphasis is placed on field problems relating to productivity limitations and environmental stress. Ecosystem functioning.

PSB 635: Biological Techniques [3 Units]

Phytochemical Methods: Electrophoresis, chromatography, anatomical and histological techniques. To demonstrate chemical processes involved in variety of biologically important processes e.g, photosynthesis, mitochondrial respiration, nitrogen fixation, and carbon transfer etc.

PSB 636: Plant Growth Regulatory Substances [3 Units]

The auxins, chemical nature and roles of auxin translocation. Gibberellins: chemical nature and roles of Gibberellins, translocation of Gibberellins. The cytokinins: roles of the cytokinins, synthesis of cytokinins. Abscisic acid: roles of abscisic acid. Vitamins. Ethylene: effects of ethylene. Other hormone like substances in plants. Mechanism of hormone action. Interactions among hormones. Ecological importance of hormonal actions.

PSB 637: Applications of Plant Tissue Culture & Micropropagation [3 Units]

This course involves detailed review of the concept of totipotency as it applies to production of elite crops and useful biochemicals (as in production of secondary metabolites) should be discussed.

PSB 639: Plant Adaptation and Acclimation Mechanisms [3 Units]

Phenotypic plasticity and acclimation mechanisms. Physiological responses to drought, heat, salinity and acidity. Heat shock proteins (HSPs). Secondary metabolites and plant defense responses to abiotic stress, herbivory and pathogens. Plant hormonal response mechanisms. Free radicals in plant stress phenomena. Anti-oxidants in plant stress responses. Metal tolerance, accumulation and the phytochelatin response.

PSB 641: Physiology of Plant Diseases [3 Units]

Degradation of host plant tissue by pathogens, breakdown of cellulose; unienzyme theory, two enzyme theory and multi-enzyme theory. Pectic substances, mechanisms of wilting physiological wilting and pathological wilting; production of toxins blocking of vascular elements by substances tyloses. Production of enzymes by parasites. Production of substances with growth regulating activity. Respiration of diseased plant. Plant vigor and protection.

PSB 643: Physiology of Parasitism [3 Units]

The study of parasitism and pathogenicity. Entry of pathogens into plants and mechanism of attack. Mechanical forces exerted by pathogens of host tissue. The study of chemical weapons of pathogens enzymes, toxins and growth regulating enzymes. Ethylene and its role. Mechanisms of defense. Applications in wood preservation.

PSB 645: Viral and Mycoplasma Diseases [3 Units]

A review of plant diseases including distinction between bacterial diseases, fungal disease and viral diseases should be highlighted. Transmission of plant viruses: through insects, animals, mechanical transmission, vegetative propagation, seeds, dodder, fungi, etc. Physical and chemical properties of viruses, virus structure and chemistry; diseases swollen shoot, cassava mosaic, pepper mosaic. Applications in plant breeding.

PSB 646: Control of Plant Diseases [3 Units]

The chemical structure and mode of action of fungicides. Factors influencing fungicides. The evaluation of fungicides in the laboratory. Methods of application of fungicides. Different treatments of lumber with fungicides. Application of Nematicides. Current trends in the control of plant diseases.

PSB 647: Advanced Phytopathology [3 Units]

Advances in mechanisms of disease development and control. Methods and materials used in plant disease control and the problems involved in their application. Survey of principles of hand and mechanically operated machinery for applying pesticides. Biological control. The physiology and biochemistry of plant parasitic diseases. Pre and post penetration, interactions of the host and pathogen. Assaying of phytotoxins, phytoalexins, cell wall-degrading enzymes and growth substances produced during pathogenesis.

PSB 648: Mushroom Science [3 Units]

The history, basic principles and cultural practices of Mushroom production, including a survey of locally occurring edible species. Various methods of growing mushrooms. Factors affecting growth and basidiocarp formation *in vivo* and *in vitro*. Mushroom abnormalities; their pests and control. Mushroom chemistry, including nutritive value, poisons and treatment. Growth habits of selected local species of edible mushrooms.

PSB 649: Advanced Mycology [3 Units]

Evolutionary patterns of fungi and the criteria used in fungal taxonomy. Fungal ecology in relation to both man and plants. Aeromycology with emphasis on spore liberation and dispersal. Fungal differentiation and biotechnology.

PSB 651: Advanced Cytogenetics [3 Units]

In depth study of evolution of genophores chromosome structure and function. Karyotype evolution. Structural changes in chromosomes duplication and deficiency, inversion etc. The study of lethal system. Polyploidy types, characteristics and evolutionary significance. Induction of autopolyploidy and allopolyploidy current issues in advanced cytogenetics.

PSB 652: Quantitative Genetics [3 Units]

Introduction to Quantitative Genetics, The nature of quantitative traits, Inheritance of quantitative traits, Review of basic statistical tools in quantitative genetics, Quantitative genetic analysis, Heritability-components of phenotypic variance, broad and narrow sense heritability, Response to selection, Quantitative trait loci(QTL) etc.

PSB 653: Radiation Genetics in Plants [3 Units]

Comparison of spontaneous and induced mutations. Mutation, selection and population fitness. Types of ionizing radiation and their cytogenetic effects. Comparison of radiation and chemical mutagenic effects. Effects of pre-irradiation and post irradiation. Factors modifying irradiation of successive generations. Spontaneous and induced mutations in vegetatively propagated species. Methods of utilizing induced mutations in crop improvement and propagation.

PSB 654: Plant Genetic Resource Management and Utilization [3 Units]

Management of genetic resources data. Indigenous management of plant genetic resources. Plant genetic resources characterization and evaluation. Sampling and conservation strategies. *In situ* and *ex situ* conservation. *In vitro* storage of genetic materials. Reserves, protected areas and botanic gardens. Plant genetic resources in Agriculture and Biotechnology.

PSB 655: Advanced Molecular Genetics [3 Units]

The fine structure of the gene. DNA and the genetic code. Mutation and the code. In-born errors of metabolism. Genetic engineering, Genetic mapping, Genetic regulation of development. Selected papers in biochemical genetics.

PSB 656: Population Genetics [3 Units]

Forces in population dynamics. Estimation of population parameters. Models. Selected papers in population genetics.

PSB 657: Evolutionary Mechanisms [3 Units]

The synthetic theory of evolution and its development. The sources of variability. The nature of mutation, its causes and adaptiveness. The organization of genetic variability. The differentiation of population. Reproductive isolation and the origin of species. The role of hybridization and polyploidy in evolution. Major trends of evolution. Current issues in evolution.

PSB 658: Cytogenetics, Evolution and Phylogeny [3 Units]

Chromosomal organization in relation to gene environment, genetic recombination in population the use of genetic system in evolution, the origin of species hybridization its origin and its significance polyploidy occurrence, distribution and its importance.

PSB 659: Advanced Genetics [3 Units]

Genetics and biochemistry of cell cycle (role of reversible phosphorylation), Mechanism of gene mutation, Molecular mechanism of homologous recombination, Molecular mechanism of site specific recombination, Organellar genetics, Gene mapping in bacteria, viruses, algae and fungi (including parasexual cycles), Plasmids, transposons and retroelements, Molecular mechanism of antibody diversity, Developmental genetics, Epigenetics and epigenomics.

PSB 661: Weed Biology [3 Units]

Weeds in relation to man. Origin and life cycles of weeds. Propagation and weed dissemination. Weed growth, development and establishment. Competitive ability of weeds. Weed-crop association in the tropics. Weed control (chemical, biological etc). selectivity of herbicides.

PSB 662: Air Pollution and Plant Degradation [3 Units]

Air pollution: Types of pollutants. Tissue degradation. Effects of pollution impacts of air pollutants on crops, semi and natural vegetation. Impacts of ozone pollution on vegetation and atmospheric deposition of heavy metals to vegetation. Impact of pollutant mixtures (e.g., ozone and nitrogen). Acid rain. Consequences of air pollution for biodiversity, modifying influence of climate change and impact of air pollutants on vegetation.

PSB 663: Concepts of Plant Community [3 Units]

Individualistic, organismic concepts, etc. Association between species. Types of ordination. Subjective and quantitative assessment of vegetation abundance.

PSB 664: Forest and Savanna Ecology [3 Units]

Community structure of tropical rainforests and Savanna ecosystems. Natural and man-made forests. Habitat characteristics and Biodiversity. Global warming. Roles of forest in carbon sequestration and modification of microclimate. Ecological factors that affect the productivity of forests and savanna ecosystems. Nutrient cycling and ecosystem dynamics. Deforestation and forest regrowth. Land use practices and Nigerian vegetation profile. Fire as a management tool in forests. Savanna forest fires.

Timber and non-timber forest products (NTFPs). Forestry administration and management programmes in Nigeria. Community forests. Forestry policies and legislation. Forest conservation and the Nigerian protected area system.

PSB 665: Environmental Audit and Impact Assessment [3 Units]

Objectives of EIA. Resources required for EIA. Basic principles of EIA. Site selection, environmental screening and preliminary assessment. Scoping of significance issues; Impact identification, prediction, measurement and evaluation. Identification of monitoring and mitigating measures. Documentation of EIA. Environmental impact statement. A selected survey with case studies.

PSB 666: Ecosystems Pollution Ecology [3 Units]

The study of major pollutants: oil and petrochemical, heavy metals, solid wastes of aerial, terrestrial and aquatic environment and their effects on other components of ecosystems. The study of radiation and plant life. Survey of environmental pollution control and measures.

PSB 667: Biogeography [3 Units]

Importance of biogeography; distribution of species, genera and families: Endemic species and genera. Pan tropical species and genera. Discontinuous species and genera; factors of distribution (climatic, edaphic, geographic and dispersal effects). Theory of tolerance. Floristic regions of the world. Vegetation mapping.

PSB 668: Landscape Restoration Ecology [3 Units]

Causes and effects of land degradation; deforestation, overgrazing, over cultivation, fire/bush burning, soil erosion, contamination by oil, pesticides and other polyaromatic, hydrocarbons (PAHs). Forest decline and soil acidification. Land restoration and reclamation. Plant species selection and planting materials. Nursery and field practices for reforestation/ re-vegetation. Watershed management. Ecological succession. Energy and nutrient dynamics of climax communities. Landscape horticulture.

PSB 669: Production Ecology [3 Units]

The characteristics of fresh water brackish, marine, wetland and habitats and their effects on ecosystem production processes including ecosystem structure and architecture laws governing energy transformation in nature. Food chains and Food webs etc. wetland conservation (Government policies governing wetland conservation)

PSB 670: Fungal Biotechnology [3 Units]

Screening of fungi for production of useful metabolites, Genetic modification of fungi for increased metabolite production; Classes of useful metabolites produced by fungi; Cultivation of fungi: Culture media, nutritional requirements of fungi, media preparation, culture inoculum batch versus continuous culture, free cell versus immobilized cell culture, liquid submerged (suspended); liquid surface culture, solid state culture. Factors that affect fungi growth and metabolite production; downstream processing of fungal metabolites; Application of fungi in bioremediation.

PSB 671: Algal Biotechnology [3 Units]

Media for algal culture: Chu, Bold, Allen etc, Algal biomass production using bioreactors, Algal biomass production for biofuels, phytochemicals, feed, hydrogen gas etc, Algae as sources of pharmaceuticals and nutraceuticals, Use of algal extracts in tissue culture etc, Nanoparticle biosynthesis by algal systems, Bioremediation methods, Algae in phycoremediation: Pollution mitigation in various environments – Uptake of excess nutrients, industrial effluents; pH correction of acidic effluent from industries; CO₂ mitigation – Phycoremediation of radioactive materials, sewage (waste Stabilization ponds) – Case Studies, Use of aquatic macrophytes in bioremediation.

PSB 672: Biotechnology in Crop Improvement [3 Units]

Crop biotechnology and its scope, Plant organ, tissue and cell culture, Elementary idea of theory and application of molecular techniques, Post-transcriptional gene silencing (PTGS), Bio-fertilizers and bio-

insecticides, Restriction enzymes, Vectors and gene cloning, Libraries and molecular probes, Polymerase chain reaction (PCR), Methods of gene transfer in plants, Transgenic plants in dicots and monocots, A brief idea of DNA-based molecular markers

PSB 673: Techniques in Plant Ecology [3 Units]

Plant sampling techniques in aquatic, forest and savanna ecosystems; Elements of forest mensuration. Data collation, cleaning, coding, information retrieval, significance testing, multiple and partial correlation and regression. Classification, clustering, ordination and principle component analysis. Ecosystem modeling and systems approach to ecological problem.

PSB 674: Bioinformatics [3 Units]

Sequence retrieval and analysis, bioalgorithms, biological databases and their search, sequence alignment and construction of phylogenetic trees, Gene predictions, RNA and protein structure prediction, Use of bioinformatics tools in biotechnology biopharma.

PSB 675: Advances in Plant Tissue Culture Techniques [3 Units]

Development of protocols for *in vitro* culture of plant parts (embryo, organ, tissue, cell and protoplast). Micropropagation, germplasm conservation, virus elimination, screening and selection, and improved production efficiencies, and hence use less space to produce the same amount of yields.

PSB 676: Plant Secondary Metabolite Production [3 Units]

Focuses on production (biosynthesis and engineering) in plants of secondary metabolites; such as pharmaceuticals, cosmetics, food flavours, biofuels and oils to substitute non-renewable ones

PSB 677: Phytoremediation [3 Units]

Overview of Phytoremediation – metal bioavailability and hyperaccumulation, phytoextraction and phytovolatilization. Rhizofiltration, phytodegradation and phytostabilization. Soil improvement with organic/plant residues. Phytodegradation of oil, herbicides, pesticides and other organic compounds by plants, bacterial and fungi. Genetic improvement of plants for phytoremediation. Techniques (e.g. EDXRF, TXRF, micro-PIXE, INAA and AAS) in phytoremediation studies; Phytoremediation System Selection and Design Considerations; Remedial Objectives, Treatability and Evaluation; Case Studies.

PSB 678: Advanced Techniques in Biology [3 Units]

Collection methods, temporary preservation of fresh materials. Preparation of herbarium packets and labeling. Permanent preservation of materials using specific mountants. Microclimatology, types of instruments and their uses

PSB 679: Techniques in Phycology [3 Units]

Sampling for Physical and chemical (edaphic) environmental factors; standard methods for the estimation of edaphic factors; Sampling for phycological studies – sampling techniques/methods of algal collection; Herbarium techniques: Preservation of algae; Preparation of slides liquid preps/wet mounts, permanent mounts; Algal herbarium development; Use of Light microscope (LM), Inverted microscopy, Photomicrography; calibration of light microscope for measurement of algae; Ultra Structure Studies – Use of Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM) in identification

PSB 681: Limnology [3 Units]

A limnological treatment of tropical freshwater and brackish water bodies including the physiology and growth of algal species. An advanced discussion of selected topics in the ecology, productivity and systematics of freshwater and marine algae, physical and chemical limnology.

PSB 683: Ecology of Aquatic Macrophytes [3 Units]

Diversity of aquatic habitats and their vegetation; Growth forms and life form classifications; Distribution and growth of aquatic macrophytes; reproductive strategies of aquatic macrophytes, structural and

dynamic characteristics of aquatic plant communities: Primary production and energetics; Nutrient uptake and release. Problems and control of noxious weeds: conservation of aquatic macrophytes.

PSB 684: Advanced Primary Productivity [3 Units]

Concepts and scope of primary productivity. Comparative account of primary productivity in (1) different habitats (fresh water, estuarine and marine); (2) different geographical zones (polar, tropical and temperate waters, etc); (3) different seasons (dry, wet, summer, winter, autumn and spring). Contributions to primary productivity and global energy computation. Measurement of primary productivity. Factors affecting primary productivity.

PSB 686: Industrial Application of Algae [3 Units]

Algae and Food security/Agriculture: Fisheries, food, feed biofertilizers etc; petrochemical, Hydroelectric generation; Public health – pest control, medicinal and toxic algae; Forensic botany; Water purification; Cosmetics, sunscreen production from algae etc. Space research; Algae as weapons of mass destruction (WMD); biotechnology- nutraceuticals, biofuel, bioethanol etc.

PSB 689: Advanced Phycology (Algology) [3 Units]

Place of algae in Plant Kingdom. Ecology of algae. Algae in the phytoplankton Cyanophyceae, Rhodophyceae, Phaeophyceae, Euglenophyceae. Phytoplankton crop. Nature of culture media. The characteristics of algae growth in cultures of limited volume. The growth of algae in continuous and synchronous culture. Single cell culture. Metabolic patterns and growth.

PSB 691: Introductory Pharmacology [3 Units]

Pharmacokinetics: absorption, distribution, metabolism and excretion of remedies, Basic components: acids, alcohols, carbohydrates, gums and mucilages, phenols, tannins, coumarins, anthraquinones, flavones and derivative, volatile oils, saponins, cardioactive and cyanogenic glycosides and alkaloids. Remedies and their pharmacology for the urinary system, cardiovascular system, digestive system, respiratory system, nervous system, endocrine system, reproductive system, the skin, infectious conditions and tumours. Allopathic remedies.

PSB 692: Herbal Materia Medica [3 Units]

Remedies grouped according to primary therapeutic action: stimulants, relaxants, astringents, depuratives, demulcent, antiseptics, diuretics, cardiovascular agents, diaphoretics, pulmonary agents, hepatic, cholagogues, gastro-intestinal agents and nerviness.

PSB 693: Herbal Medicinal Practice: Philosophy Policy and Ethics [3 Units]

History of Herbal Medicine, the whole person and homeostasis, vitalism, health and disease, essentials of health, rational therapy, herbal approach to treatment, pain and its rational treatment, micro-organisms and disease, the germ theory, poisonous and safe medicines. The Herbal Practitioner and the Law, Supply of Remedies. Code of Ethics and Rules of Practice in relation to biodiversity prospecting and conservation on medicinal plants.

PSB 694: Herbal Clinical Internship [3 Units]

The purpose of the clinical training is to enable the students to combine and take thorough case histories, follow up consultations, learn examination techniques, formulate and dispense herbal remedies. Eight (8) weeks of clinicals supervised by Clinic Practitioners.

PSB 695: Medicinal Mycology [3 Units]

Basic structure and biology of fungi. Systematic survey of fungi with medicinal properties. Fungi as sources of antibiotics. Medicinal and food value of mushrooms. Historical, folklore of fungi. Hallucinogen mushroom in primitive culture. Ergots of rye and ergotism in humans and animals. Biopharmaceutins of fungal origin. Industrial uses of fungi.

PSB 696: Ethnobotany, Nutrition and Health [3 Units]

The nature and ecological significance of food and medicinal plant biodiversity in traditional subsistence systems; scientific, institutional and ethical issues in ethnobotany; evaluation, application and management of plants and indigenous knowledge of plants to address contemporary health and nutrition problems.

PSB 697: Conservation and Sustainable Use of Plant Genetic Resources [3 Units]

Centres of diversity and centres of origin, A brief idea of modern system of classification, Biodiversity vs. genetic resources, Direct and indirect uses of plant genetic resources for human welfare, Plant genetic resources, Techniques for conservation of plant germplasm, Biodiversity International (IPGRI) and NBPGR, Future harvest centers, CBD and sustainable use of biodiversity, Role of FAO/CGIAR system for access to genetic resources, Biodiversity prospecting for agriculture and pharmaceuticals, IPRs in plant breeding.

PSB 698: IPR and Patent Law [3 Units]

Intellectual property, Patent law fundamentals, International IP treaties relevant to biotechnology, International agreements relevant to biotechnology-associated IP, Drafting Patent Application, Documentation, Patent Search databases, Revocation of Patent, Litigation and Infringement, Licensing and IP Management, Plant Breeders rights, protection of new plant varieties. Traditional knowledge vis-à-vis industry.

18. SYNOPSIS FOR PH.D. COURSES

PGC 701: Synopsis and research grant writing [3 units]

Identification of types and nature of grant and grant writing; mining of grant application calls on the internet. Determining appropriate strategy for each grant application. Study of various grant applications structures and contents and writing of concept notes, detailed project description, budgeting and budget defense. Project justification, review of critical problems, principles of scientific research, concepts of hypothesis formulation and testing, aims and objectives, essentials of literature review, methodology, experimental design, SWOT analysis, work plan, budgeting, expected outcome, beneficiary, cost benefit analysis, overall contributions to society. Study of sample grants writings in various forms and writing of mock research and other grants. Identification of University of Nigeria synopsis structure and requirements (Introduction, methodology and results). Determining the content of each subunit of the synopsis. Steps in the writing of the synopsis from project report/dissertation/thesis. Structural and language issues. Common errors in synopsis writing and how to avoid them. The role of the student and the supervisor in the production of the synopsis. Writing of mock synopsis. All registered Ph.D students must attend a solution-based interactive workshop to be organized by the School of Postgraduate Studies for a practical demonstration and application of the knowledge acquired from the course, conducted by selected experts.

PGC 703: Synopsis and scientific paper writing techniques [3 Units]

Writing of synopsis, preparation of data (tables, graphs and other illustrations); arrangement of the illustrations, Organization of scientific paper for publication; Abstract/Summary (types and scopes), Introduction, Literature review, Results, Discussion, Conclusions, Acknowledgement, Reference citation and listing.

PSB 701: Special Seminar I [3 Units]

Each student is expected to give a Proposal Seminar on his research

PSB 702: Special Seminar II [3 Units]

Each student is expected to give a Final Seminar on his research findings before external examination

PSB 703: Ph.D. Thesis [12 Units]

This shall be approved for the award of the degree of Doctor of Philosophy if it embodies original research carried out by the candidate, displays critical judgment and has at least one publication from it in an Impact Factor Journal approved by the School of Postgraduate Studies. The candidate shall be examined orally by a panel of external and internal examiners.

PSB 711: Special Topics in Plant Taxonomy/Biosystematics [3 Units]

Review of some topical issues, emerging technologies and recent developments in Plant Taxonomy.

PSB 721: Special Topics in Plant Anatomy [3 Units]

Review of some topical issues, emerging technologies and recent developments in Plant Anatomy

PSB 731: Special Topics in Plant Physiology/Ecophysiology [3 Units]

Review of some topical issues, emerging technologies and recent developments in Plant Physiology/ecophysiology

PSB 741: Special Topics in Plant Pathology [3 Units]

Review of some topical issues, emerging technologies and recent developments in Plant Pathology/Myiology/Virology

PSB 751: Special Topics in Genetics and Plant Breeding [3 Units]

Review of some topical issues, emerging technologies and recent developments in Genetics and Plant Breeding

PSB 752: Genomics, Transcriptomics and Proteomics of Plants [3 Units]

Molecular maps of genomes and comparative genomics, Isolation, sequencing and synthesis of genes and genomes, Whole genome sequencing, Annotation of whole genome sequence and functional genomics, Comparative genomics, Chemical genetics and chemogenomics, Significance of transcriptomics, Methods of transcriptome analysis, Transcriptome of some model plant species, Significance of proteomics, Post-translational modification of proteins, Protein interactions and protein complexes, Analysis of nucleic acid /protein sequence and structure data, Analysis of nucleic acid / protein sequence and structure data, Proteome of model plant species, Methods for proteomics analysis.

PSB 761: Special Topics in Plant Ecology/Environmental Botany/ Economic and Industrial Botany [3 Units]

Review of some topical issues, emerging technologies and recent developments in Ecology

PSB 771: Special Topics in Plant Biotechnology [3 Units]

Review of some topical issues, emerging technologies and recent developments in Plant Biotechnology

PSB 781: Special Topics in Phycology/Limnology/Aquatic Botany [3 Units]

Review of some topical issues, emerging technologies and recent developments in Phycology Limnology and Aquatic Botany

PSB 784: Nigerian Algal Biodiversity/ Bank Development and Utilization [3 Units]

Techniques for algal culture, isolation and cultivation of algae from different Nigerian environments; maintenance of algal culture and biomass production. Bio-fuel production from algal biomass. Every student is expected to maintain a culture bank of various species of local algae in the Phycology Laboratory throughout their study.

PSB 791: Special Topics in Ethnomedicine/Phytomedicine [3 Units]

Review of some topical issues, emerging technologies and recent developments in Plant Ethnomedicine/Phytomedicine