

Programme Project Report (PPR)
for
Distance Learning Programme under School of Distance Education

Certificate in Biofertiliser Production Technology(CBPT)

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Academic support by
National Institute of Plant Science Technology (NIPST)
Mahatma Gandhi University
Kottayam, Kerala

Certificate in Biofertiliser Production Technology (CBPT)

(Distance Learning Programme – Certificate Programme)

Programme Project Report

Mahatma Gandhi University started the School of Distance Education in 1989 with the vision of providing the opportunity for quality education to all realms of society. Since the beginning, thousands of students have availed themselves of this opportunity for higher education to a great extent throughout Kerala. Many students outside the State have also benefited from this. But after the new directions of the UGC in 2014, the University had stopped all the Off-Campus Centres of the School of Distance Education both inside and outside the State.

Now it is the new endeavour to revamp the functioning of the school with different types of Diploma and Certificate programmes very relevant to the contemporary society, in addition to the conventional Graduate and Post Graduate programmes with the academic and infrastructural support of the eminent Schools and interdisciplinary interuniversity Centres of the University. All these Schools/ Centres have already conducted similar Programmes or Post Graduate Programmes in the same area. This Post Graduate Diploma Programme has been designed by the National Institute of Plant Science Technology and to be conducted by the School of Distance Education with the academic support of the School.

National Institute of Plant Science Technology (NIPST), an Inter-School centre of Mahatma Gandhi University. The course established on 20th August 2014. The Institute enrolling students through competitive examinations at the National level in the campus of Mahatma Gandhi University for advanced education in plant science, promoting research in Interdisciplinary areas of 'Plants and their Environment Relations' towards developing 'Plant-based Eco-technologies'.

The Institute will inspire students to apply their creative talents to research potentials of the rich botanical wealth of Kerala in the development of globally significant technologies useful in sustainable agricultural, phyto-medicinal, bio-fuel, bio-based industrial and eco-remediation purposes. Instead of keeping science and technology as watertight compartments in conventional programmes, this institute will enable science students to end up their post graduation to a productive research on plant-based eco-technology and entrepreneurship based on the technology that they develop. Overall, the Institute aims at boosting entrepreneurship in the country through productive research in plant science.

The institute will have advanced instrumental as well as experimental facilities for plant scientists to pursue excellence in all branches of plant science and is expected to contribute to the talent pool of researchers and specialized technicians in plant-based technologies. Technologies to be focused in the programme include those for plant medicines, nutraceuticals, sustainable agriculture, Phytoremediation and all kinds of bio-fuels. In addition to advanced research laboratories for the above mentioned technologies, the institute will have a medicinal garden, field experimental station, regional herbarium and museum of plant resources of the Western Ghats.

a. Programme's mission & Objectives

Biofertilizers are defined as preparations containing living cells or latent cells of efficient strains of microorganisms that help crop plants' uptake of nutrients by their interactions in the rhizosphere when applied through seed or soil. They accelerate certain microbial processes in the soil which augment the extent of availability of nutrients in a form easily assimilated by plants.

Very often microorganisms are not as efficient in natural surroundings as one would expect them to be and therefore artificially multiplied cultures of efficient selected microorganisms play a vital role in accelerating the microbial processes in soil.

Use of biofertilizers is one of the important components of integrated nutrient management, as they are cost effective and renewable source of plant nutrients to supplement the chemical fertilizers for sustainable agriculture. Several microorganisms and their association with crop plants are being exploited in the production of biofertilizers. They can be grouped in different ways based on their nature and function.

Large Population of viable cells of effective strains of specific nitrogen fixing bacteria can be supplied through carrier based powder form of biofertilizer for cultivator use. Biofertilizers production technology includes isolation of bacteria, selection of suitable effective strain, preparation of mother or seed culture, inoculants isolation of bacteria, selection of suitable effective strain, preparation of mother or seed culture, inoculant production, carrier preparation and their mixing, followed by curing, packaging, storage and despatch.

b. Nature of prospective target group of learners:

Students from various streams can join for the programme. Thus the prospective target group of learners include undergraduates, postgraduates, researchers and the general public who are desirous of studying such a programme.

c. Instructional design:

The programme is of six month duration comprising four courses with a total of 16 credits. There are adequate contact classes and the assessment involves both internal as well as external components. Each student has to submit a report based case studies or project.

Course Code	Course Type	Course Name	Contact Sessions (hours)	Credits	*Internal Marks	External Marks	Total Marks
CBPT101	Core course	Soil Fertility and Nutrient Management	12	4	20	80	100
CBPT 102	Core course	Soil microbiology	12	4	20	80	100

CBPT103	Core course	Biofertiliser production technology	12	4	20	80	100
CBPT 104	Core course	Practical and project	60	2+2	20	80	100
Total			96	16	80	320	400

d. Procedure for admission, curriculum transaction and evaluation:

Admission to the programme will be done by the University through a common procedure for all the programmes under the School of Distance Education. A pass at the Plus Two level is the minimum eligibility criterion for admission. Candidates (undergraduates, graduates, and postgraduates) are eligible for admission irrespective of age. The fee structure will be decided by the University. The study materials will be delivered through online and print formats. The School will prepare an academic calendar/activity planner that will be circulated among all the learners at the time of admission itself. The academic calendar will include all the significant activities, important dates, schedule of submission of assignments, schedule of contact classes, schedule of examinations, etc.

Evaluation of the courses shall be done by the faculty themselves on the basis of internal assessment and end semester examinations. 20% of the marks will be decided by the internal evaluations and the remaining 80% by the end semester examinations which will be conducted by the University. The performance of a student in each course will be evaluated in terms of percentage of marks obtained with a provision for its conversion to grade points.

Each student shall be required to do one Assignment/Book Review/Debate/Seminar/ Presentation of the case study for each course. Assignments/Book Review after valuation shall be returned to the students. The teacher shall define the expected quality of the above in terms of structure, content, presentation and the like, and inform the students of the same.

Grading System will be followed for the evaluation on a ten point scale. The details of the grading system are given in the following Table.

Percentage Equivalence of Grade:

Range of % of Marks	Grade Letter	Performance	Grade Point
95 - ≤ 100	O	Outstanding	10
85 - < 95	A plus	Excellent	9
75 - < 85	A only	Very Good	8
65 - < 75	B plus	Good	7
55 - < 65	B only	Above Average	6
45 - < 55	C	Average	5
40 - < 45	P	Pass	4

< 40	F	Fail	0
Absent	Ab	Absent	0

'P' grade is required for a minimum pass in a course. The minimum GPA required for a pass in the Certificate programme is 4.

Calculation of Grade Point Average (GPA) :

Credit Points for the Course = (No. of Credits assigned for the course x Grade Point secured for that course).

GPA indicates the performance of a student in the programme. GPA is based on the total **credit points** earned by a student in all the courses divided by the total number of credits assigned to the courses required in the programme.

Note: GPA is computed only if the candidate passes in all the required courses (gets a minimum required grade for a pass in all the required courses as per the curriculum).

$$\text{GPA} = \frac{\text{Total credit points earned by the student from all the required courses of the programme}}{\text{Total credits of all courses required in the programme}}$$

This formula shall be printed on the Grade Card issued to the student with a note that it could be used to convert the grades into mark-percentages. (The details of the grading system as indicated above shall also be printed on the Grade Card).

Conversion of GPA to Grade

GPA	Grade
10	O
9.0 - < 10	A plus
8.0 - < 9	A only
7.0 - < 8	B plus
6.0 - < 7	B only
5.0 - < 6	C
4.0 - < 5	P
< 4	F
Absent	Ab

Conversion of GPA to percentage

$$\text{Equivalent Percentage} = (\text{GPA obtained}) \times 10$$

e. Requirement of the laboratory support and library resources:

The library and infrastructure support of the Centre and the University will be extended to the learners as per the requirement.

Mahatma Gandhi University Library and Information System consists of University Library, libraries of the Schools and 4 study centre Libraries. The University Library was established in 1989. The University Library which is situated in the main

campus occupies purpose-built accommodation, and provides a variety of facilities and has a user-friendly environment. These include individual work spaces, room for group study and teaching, audio-visual access and online information retrieval system. The building of the University Library is 2000 sq.m in area consisting of the cellar, the ground floor and the first floor.

Academic as well as public users are given the facility to use the library. Special category membership is provided to journalists. The library is providing service from 8 am to 8 pm in three shift timings for its staff. The library functions on an average of 345 days in a year. The libraries of teaching departments are open during working hours of the Schools. Reading space is provided in all the three floors housing the various sections of the library. The library provides reading facility to the visually impaired users too. For this, an electronic lab custom made for visually and physically challenged users has been set up during 2016.

The University Library has a Library Advisory Committee. It is an 18 member committee with Vice-Chancellor as Chairman and University Librarian as Convener.

The library has a collection of 59,000 books, 232 journals, 2,135 Ph.D. theses and has access to 15000+ e-journals under E-ShodhSindhu. The activities of the Library are comprehensively automated using open source library management software KOHA. OPAC, Journal Article Index, By monthly Bibliography compilation and Literature Search Service are also available

The library is a member of the INFLIBNET Centre, Ahmedabad as well as DELNET (Developing Library Network). As a member of these networks, the library provides access to the resources of other major libraries in the country. In addition to the access to UGC INFONET consortium, it has access to major online databases, such as EBSCO, ProQuest dissertations and theses, Oxford Scholarship Online, IEEE All Society Periodicals Package etc. Mahatma Gandhi University had won the State IT Award during the year 2009 in the e-learning category for its university online theses digital library. The various department libraries have a good collection of subject specific books and journals.

A. MAHATMA GANDHI UNIVERSITY LIBRARY	
Category	No.
Books	59000
Journals	232
Bound Journals	7500
Ph.D Theses	2135
E-Journals (in UGC-Infonet, renamed as E-ShodhSindhu)	15000
Online databases (in UGC Infonet)	11
Online Archives subscribed	185 Titles
Online databases subscribed	4
E-books	7338
DVDs: Educational Videos	293

B	Name of School/Centre	Total No. of books
	National Institute of Plant Science Technology (NIPST)	420

f. Cost estimate of the programme and the provisions:

Sl.No.	Item	Amount (Rs. in Lakhs)
1.	Manpower	2
2.	Study material	1.5
3.	Laboratory	3
4.	Internal assessment	0.5
	Total	7.00

Total Programme fee: Rs.7000/-

a) Quality assurance mechanism and expected programme outcomes:

The quality of the programme will be ensured through strict monitoring by an executive committee that includes the Co-ordinator of the programme, subject experts, Director, School of Distance Education and Head of the National Institute of Plant Science Technology. The Co-ordinator of the programme shall ensure regular student feedback of courses, teachers and the programme in the prescribed format towards the end of the semester and the same shall be analysed to draw conclusions for effecting improvement. Periodical review meetings on the programme's efficacy will be held, in which the remarks of teachers on curriculum, syllabi and methods of teaching and evaluation will be given due importance. Moreover, the progress and the quality of the programme will be monitored by the Internal Quality Assurance Cell of the University from the outcome and feedback of the learners as well as the proper documentation maintained in the Centre.

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SYLLABUS

Certificate in Biofertiliser Production Technology (CBPT)

CBPT101 Soil Fertility and Nutrient Management

(4+ 0: Theory course)

Unit 1

Soil profile, soil physical properties, soil texture, textural classes, particle size analysis, soil structure, classification, soil aggregates, significance, soil consistency, soil crusting, Bulk density and particle density of soils & porosity, their significance and manipulation. Soil organic matter, composition, decomposability, Humus, Fractionation of organic matter, carbon cycle, C:N ratio, Soil biology, Biomass, Soil Organisms & their beneficial & harmful roles.

Unit 2

Soil as a source of plant nutrients, Essential and beneficial elements, criteria of essentiality, forms of nutrients in soil, mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants.

Unit 3

Measures to overcome deficiencies and toxicities, problem soils-acid,salt affected and calcareous soils, characteristics, nutrient availabilities, Reclamation-mechanical, chemical and biological methods, Fertilizer and insecticides and their effect on soil water and air, irrigation water-Quality of irrigation water and its appraisal. Indian standards for water quality. Use of saline water for agriculture.

Unit 4

Soil fertility-Different approaches for soil fertility evaluation. Methods, soil testing-Chemical methods, critical levels of different nutrients in soil. Plant analysis-DRIS methods, critical levels in plants, Rapid tissue tests, Indicator plants, Biological method of soil fertility evaluation.

Unit 5

Soil test based fertilizer recommendation to crops. Factors influencing nutrient use efficiency (NUE) in respect of N,P,K,S, Fe and Zn fertilizer. Source, method and scheduling of nutrients for different soils and crops grown under rainfed and irrigated conditions.

References

- S.L. Tisdale, W.L. Nelson, J.D. Beaton and J.L. Havlin. 1997. Soil Fertility and Fertilizers. Prentice, Hall of India, Pvt. Ltd., New Delhi
- T.R. Reddy and G.H.S. Reddi 1992. Principles of Agronomy, Kalyani Publishers, New Delhi
- G.Singh, J.S. Kolar and H.S. Sekhon, 2002. Recent Advances in Agronomy, Indian Society of Agornomy, IARI, New Delhi
- J.S. Kanwar, 1978. Soil Fertility: Theory and Practices, ICAR Publication, New Delhi
- J.L. Havlin, J.D. Beaton, S.L. Tisdale and WL. Nelson, 2006. Soil Fertility and Fertilizers- An Introduction to Nutrient Management, Prentice Hall of India, Pvt. Ltd., New Delhi
- N.C. Brady and R.R. Weil, 2003. Elements of the Nature and Properties of Soils. Prentice Hall, New Jersey.
- R.S. Yawalkar, J.P. Agarwal and J. Bokde 1992. Manures and Fertilizers. Agri-Horticultural House, Nagpur

CBPT102 Soil microbiology

(4+ 0: Theory course)

Unit 1

Overview of soil microbiology, definitions- Concepts and scope, discovery, distribution and importance of soil microorganisms in soil fertility - factors affecting the activities of soil microorganisms; Rhizosphere microorganisms and importance; Phyllosphere microorganisms

Unit 2

Brief account of microbial interactions –symbiosis-mutualism-commensalism-Amensalism-synergism-parasitism-predation.Plant –microbe interactions- Mycorrhiza– VAM, Ecto, Endo and Ectendomyccorhiza. Actinomycets. - plant-microbe and microbe-microbe interactions in soil.

Unit 3

Beneficial microorganisms in Agriculture; Biofertilizer (Bacterial, Cyanobacterial and fungal), microbial insecticides, Bioremediation of problem soils, plant growth promoting rhizobacteria and their mode of action. Formation and composition of soil organic matter: fulvic acid and humic acid. Biodegradation, biogas production.

Unit 4

Microbial transformation of nutrients in soil Microbial transformation of nutrients in soil - carbon, phosphorous and sulphur cycle; nitrogen cycle, biological nitrogen fixation - symbiotic and non-symbiotic microorganisms, Process of nodulation and nitrogen fixation; Silicate and zinc solubilising bacteria, Types and importance of biofertilizers in agriculture

Unit 5

Natural defense mechanisms of plants. Microbial agents for control of plant diseases, Biopesticides-Bacterial-viral-fungal pesticides.Biological control of plant diseases. Integrated pest management

References

- Martin Alexander 1976. Introduction to soil microbiology Willy Eastern Ltd. New Delhi.
- Robert LTate III. 1995. Soil Microbiology. John Wiley & Sons, New York, pp 398.
- Subbarao, N.S. 1977. Soil microorganisms and plant growth, Oxford & IBH Publishing Co., New Delhi.
- Walker, N. 1975. Soil Microbiology. Butterworths, London

CBPT103 Biofertiliser production technology

(4+ 0: Theory course)

Unit-1

Biofertilizers - Introduction, scope. A general account of Biofertilizers organisms - Cyanobacteria (BGA), Bacteria and Mycorrhizae - Cyanobacteria (BGA) as biofertilizers - Anabaena, Cylandrospermum, Gloeocapsa, Lyngbya, Nostoc, Plectonema and Tolypothrix. Algalization, Azolla - Anabaena as biofertilizers. Isolation of cyanobacteria. Formation of Fogg's medium.

Unit-2

A general account of bacterial biofertilizers organisms. Azospirillum, Azotobacter, Frankia, Phosphobacteria and Rhizobium. Isolation - Azotobacter - Ashby's mannitol agar, Azospirillum - Semisolid medium (Bulow and Dobereiner, 1975). Rhizolium - Yeast Extract Mannitol Agar medium - Culture characteristics. Mechanism of nitrogen fixation (free-living and symbiotic) - Biochemistry and molecular basis of nitrogen fixation - Phosphate solubilization and mobilization.

Unit-3

Mycorrhizal fungi as biofertilizers - Introduction, scope. A general account of Ecto, Endo and Arbuscularmycorrhizae (AM). Methods of collection, wet sieving and decanting method and inoculum production. Culture of mycorrhizae in Modified Melin - Norkrans (MMN) agar medium - Cultural characteristics of Ectomycorrhizal fungi. Techniques of

Ectomycorrhizalinoculum, Endo mycorrhizae of orchids. Isolation and method of inoculation of Arbuscularmycorrhizae (AM), Legume - AM interactions

Unit-4.

Production technology: Strain selection, sterilization, growth and fermentation, mass production of various biofertilizers. Mass production of Azospirillum, Azotobacter and Phosphobacteria. Mass cultivation of Azolla - Cyanobacterial biofertilizers - Field application of Cyanobacterial inoculants.

Unit -5.

Application technology: Standards and quality control, application for field and tree crops, nursery plants and seedlings. Extension, promotion and marketing: Extension strategies, diagnosis for the effectiveness of inoculation, improvement in distribution system. National and Regional Biofertilizers Production and Development Centres.

References

- Dilworth, M.J. and A.R. Glenn, 1991. Biology and Biochemistry of Nitro-gen Fixation. Elsevier, Amsterdam P. 438.
- Motsara, I. M.R., P. Bhattacharyya and Beena Srivastava, 1995. Biofertilizer Technology, Marketing and usage - A source Book -cum- glossary - FDCO, New Delhi.
- Somasegaran, P and H.J.Hoben, 1994. Hand book for Rhizobia; Methods in legume Rhizobium Technology. Springer-Verlag, New York.
- Subba Rao, N.S. 1982. Advances in Agricultural Microbiology, Oxford and IBHPubl. Co., New Delhi.P. 704.
- Subba Rao, N.S. 1993. Biofertilizers in Agriculture and Forestry Oxford and IBHPubl. Co., New Delhi P.242.

CBPT104 Practical and project work

(0+4: Practical and project work)

A. Biofertiliser production technology practicals

1. Enumeration of soil microbes by Plate culture method
2. Isolation of Microorganisms from soil sample – Bacteria, Fungi, Actinomycetes and Azotobacteria.
3. Isolation and cultivation of Azotobacter, Rhizobium, Azospirillum, Cyanobacteria, Actinomycetes, Mycorrhiza.
4. Biofertilizer production using Rhizobium
5. Biofertilizer production using Mycorrhiza
6. Mass production technology for biofertilisers
7. Quality control

B. Project work and Report Submission