RANI CHANNAMMA UNIVERSITY, BELAGAVI

RANI CHANNAMMA UNIVERSITY, BELAGAVI

PROGRAM /COURSE STRUCTURE AND SYLLABUS
as per the Choice Based Credit System (CBCS) designed in accordance with
Learning Outcomes-Based Curriculum Framework (LOCF)
of National Education Policy (NEP) 2020
for

Bachelor of Science (Botany)

w.e.f.

Academic Year 2021-22 and onward

Board of Studies (UG) Committee

(NEP-Bachelor of Science)

Bachelor of science (Botany) Programme 2021-22

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3	Dr. N.A Jadhav,B.K.College, Belagavi.	Co-Opt Member	
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PREAMBLE

The objective of a B.Sc. (Honors) programme in Higher Education system is to prepare its students for the society. The current pattern is designed to provide a focused learning outcome-based syllabus at the Honors level providing structured teaching-learning experiences catering to the needs of the students. The honors courses will prepare the students both academically and in terms of employability. The programme also inculcates various attributes at the Honors level. These attributes encompass values related to emotional stability, social justice, creative and critical thinking, well-being and various skills required for employability, thus preparing students for

continuous learning and sustainability. The new curriculum based on learning outcomes of BSc (Honours) Botany offers knowledge of areas including Plant Systematics, Plant Biotechnology, Resource Botany, Genetics, Ecology, Conservation biology, Physiology and Bioinformatics, Medicinal plants, Plant diseases management etc. The courses define clearly the objectives and the learning outcomes, enabling students to choose the elective subjects broadening their skills in the field of Botany. The course also offers skills to pursue research and teaching in the field of Botany and thus would produce best minds to meet the demands of society This curriculum framework for the bachelor-level program in Botany is developed keeping in view of the student-centric learning pedagogy, which is entirely outcome-oriented and curiosity-driven. To avoid a rote-learning approach and foster imagination, the curriculum is more leaned towards self-discovery of concepts. The curriculum framework focuses on the pragmatist approach whereby practical application of theoretical concepts is taught with substantial coverage of practical and field works.

Aims of Bachelor's degree programme in Botany

The broad aims of the bachelor's degree programme in Botany are:

1. To provide an environment that ensures the cognitive development of students in a holistic manner. A dialogue about plants and their significance is fostered in this framework, rather than didactic monologues on mere theoreticalaspects
2. To provide the latest subject matter, both theoretical as well as practical, such a way to foster their core competency and discovery learning. A botany graduate as envisioned in this framework would be sufficiently competent in the field to undertake further discipline-specific studies, as well as to begin domain-relatedemployment.
3. To mould a responsible citizen who is aware of the most basic domain-independent knowledge, including critical thinking andcommunication.
4. To enable the graduate to prepare for national as well as international competitive examinations, especially UGC-CSIR NET, and UPSC Civil ServicesExamination.

Program Learning Outcomes

The students graduating with the Degree B.Sc. Three years and B. Sc. (Honors) Botany should be able toacquire.

Core competency: Students will acquire core competency in the subject Botany, and allied subject areas.

1. The student will be able to identify major groups of plants and compare the characteristics of lower (e.g. algae and fungi) and higher (angiosperms and gymnosperms)plants.
2. Students will be able to use the evidence-based comparative botany approach to explain the evolution of organisms and understand the genetic diversity on the earth. The students will be able to explain various plant processes and functions, metabolism, concepts of gene, genome, and how organism's function is influenced at the cell, tissue, and organ level.

3. Students will be able to understand the adaptation, development, and behavior of different forms oflife.
4. The understanding of networked life on earth and tracing the energy pyramids through nutrient flow is expected from thestudents.
5. Students will be able to demonstrate the experimental techniques and methods of their area of specialization inBotany.

Analytical ability:

The students will be able to demonstrate the knowledge in understanding research and addressing practicalproblems.

1. Application of various scientific methods to address different questions by formulating the hypothesis, data collection, and critically analyze the data to decipher the degree to which their scientific work supports theirhypothesis.

Critical Thinking and problem-solving ability:

An increased understanding of fundamental concepts and their applications of scientific principles is expected at the end of this course. Students will become critical thinkers and acquire problem-solving capabilities.

Digitally equipped:

Students will acquire digital skills and integrate the fundamental concepts with modern tools.

Ethical and Psychological strengthing: Students will also strengthen their ethical and moral values and shall be able to deal with psychological weaknesses.

Team Player: Students will learn team workmanship in order to serve efficiently institutions, industry, and society.

Independent Learner: Apart from the subject-specific skills, generic skills, especially in botany, the program outcome would lead to gain knowledge and skills for further higher studies, competitiveexaminations,andemployment.Learningoutcomes-basedcurriculumwouldensure

equal academic standards across the country and a broader picture of their competencies. The Bachelor's program in Botany and Botany honors may be mono-disciplinary or multidisciplinary with following broad objectives.

1. Critically evaluation of ideas and arguments by collecting relevant information about the plants, to recognize the position of the plant in the broad classification and phylogenetic level.
2. Identify problems and independently propose solutions using creative approaches, acquired through interdisciplinary experiences, and a depth and breadth of knowledge/expertise in the field of Plant Identification.
3. Accurately interpretation of collected information and use taxonomical information to evaluate and formulate a position of the plant in taxonomy.
4. Students will be able to apply the scientific method to questions in botany by formulating testable hypotheses, collecting data that address these hypotheses, and analyzing those data to assess the degree to which their scientific work supports theirhypotheses.
5. Students will be able to present scientific hypotheses and data both orally and in writing in the formats that are used by practicingscientists.
6. Students will be able to access the primary literature, identify relevant works for a particular topic, and evaluate the scientific content of theseworks.
7. Students will be able to apply fundamental mathematical tools (statistics, calculus) and physical principles (physics, chemistry) to the analysis of relevant biologicalsituations.
8. Students will be able to identify the major groups of organisms with an emphasis on plants and be able to classify them within a phylogenetic framework. Students will be able to compare and contrast the characteristics of plants, algae, and fungi that differentiate them from each other and other forms oflife.

9. Students will be able to use the evidence of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth. They will be able to use specific examples to explicate how descent with modification has shaped plant morphology, physiology, and lifehistory.
10. Students will be able to explain the ecological interconnectedness of life on earth by tracing energy and nutrient flow through the environment. They will be able to relate the physical features of the environment to the structure of populations, communities, andecosystems
11. Students will be able to demonstrate proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization withinbiology.

B. Sc. Botany Course outcomes under NEP program

The framework of curriculum for the Bachelor's program in Botany aims to transform the course content and pedagogy to provide a multidisciplinary, student-centric, and outcome-based, holistic education to the next generation ofstudents.

Aside from structuring the curriculum to be more in-depth, focused, and comprehensive with significant skill-set for all exit levels; keeping in mind the job prospects; the emphasis has been to maintain academic coherence and continuum throughout the program of study and help build a strong footing in the subject, thereby ensuring a seamless transition into theircareers.

Special attention is given to eliminate redundancy, discourage rote learning, and espouse a problem-solving, critical thinking, and inquisitive mindset among learners.

The curriculum embraces the philosophy that science is best learned through experiential learning, not limited to the confines of a classroom but rather through hands-on training, projects, field studies, industrial visits, andinternships.

This updated syllabus, with modern technology, helps students stay informed on the leading- edge developments in plant sciences and promotes curiosity, innovation, and a passion for research, that will serve them well in their journey into scientific adventure and discovery beyondgraduation.

The goal is to equip students with holistic knowledge, competencies, professional skills, and a strong positive mindset that they can leverage while navigating the current stiff challenges of the job market.

Program Outcomes:

By the end of the program the students will be able to:

(Refer to literature on outcome based education (OBE) for details on Program Outcomes)

PO1: Skill development for the proper description using botanical terms, identification, naming and classification of life forms especially plants and microbes.

PO2: Acquisition of knowledge on structure, life cycle and life processes that exist among plant and microbial diversity through certain model organism studies.

PO3: Understanding of various interactions that exist among plants and microbes; to develop the curiosity on the dynamicity of nature.

PO4: Understanding of the major elements of variation that exist in the living world through comparative morphological and anatomical study.

PO5: Ability to explain the diversity and evolution based on the empirical evidences in morphology, anatomy, embryology, physiology, biochemistry, molecular biology and life history.

PO6: Skill development for the collection, preservation and recording of information after observation and analysis- from simple illustration to molecular database development.

PO7: Making aware of the scientific and technological advancements- Information and Communication, Biotechnology and Molecular Biology for further learning and research in all branches of Botany..

PO8: Internalization of the concept of conservation and evolution through the channel of spirit of inquiry.

PO 9: To enable the graduates to prepare for national as well as international level competitive examinations like UGC-CSIR, UPSC, KPSC etc.

PO10: To enable the students for practicing the best teaching pedagogy as a biology teacher including the latest digital modules.

PO 11: The graduates should be knowledgeable and competent enough to appropriately deliver on aspects of global importance like climate change, SDGs, green technologies etc at the right opportunity.

PO 12: The graduate should be able to demonstrate sufficient proficiency in the hands-on experimental techniques for their area of specialization within biology during research and in the professional career.

RANI CHANNAMMA UNIVERSITY
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Curricular and Credits Structure under Choice Based Credit System [CBCS] of Botany Major& One Minor Discipline Scheme for the Four Years Computer Science B.Sc. Undergraduate Honors Programmewith effect from 2021-22

SEMESTER-I										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
L1	21BSC1L1LK1	Kannada	40	60	100	4	-	-	3	2
	21BSC1L1LFK1	Functional Kannada								
L2	21BSC1L2LEN2	English	40	60	100	4	-	-	3	2
	21BSC1L2LHI2	Hindi								
	21BSC1L2LSN2	Sanskrit								
	21BSC1L2LTE2	Telugu								
	21BSC1L2LUR2	Urdu								
DSC1	21BSC1BOT1L	Microbial Diversity and technology	40	60	100	4	-	-	4	2
	21BSC1BOT1P	Microbial Diversity and technology	25	25	50	-	-	4	2	3
DSC1	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	3
SEC1	21BSC1SE1CS1	Digital Fluency	25	25	50	1	-	2	2	2
VBC1	21BSC1V1PE1	Physical Education- Yoga	25	-	25	-	-	2	1	-
VBC2	21BSC1V2HW1	Health & Wellness	25	-	25	-	-	2	1	-
OEC1	21BSC1BOT1	Plants and Humanwelfare	40	60	100	3	-	-	3	2
Total Marks					**700**	**Semester Credits**			**25**	
SEMESTER-II										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	

			IA	SEE	Total	L	T	P		Duration of exams (Hrs)
L3	21BSC2L3LK2	Kannada	40	60	100	4	-	-	3	2
	21BSC2L3FKL2	Functional Kannada								
L4	21BSC2L4EN2	English	40	60	100	4	-	-	3	2
	21BSC2L4HI2	Hindi								
	21BSC2L4SN2	Sanskrit								
	21BSC2L4TE2	Telugu								
	21BSC2L4UR2	Urdu								
DSC2	21BSC2BOT2L	Diversity of Non flowering plants	40	60	100	4	-	-	4	2
	21BSC2BOT2P	Diversity of Non flowering plants	25	25	50	-	-	4	2	3
DSC2	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	3
AECC1	21BSC2AE1ES2	Environmental Studies	20	30	50	3	-	-	2	2
VBC3	21BSC2V3PE2	Physical Education- Sports	25	-	25	-	-	2	1	-
VBC4	21BSC2V4NC1	NCC/NSS/R&R(S&G) / Cultural	25	-	25	-	-	2	1	-
OEC2	21BSC2BOT2	Bio-fuels	40	60	100	3	-	-	3	2
Total Marks					**700**	**Semester Credits**			**25**	
Exit option with Certificate (with the completion of courses equal to a minimum of 48 credits)					**1400**				**50**	

SEMESTER-III

Category	Course code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
			IA	SEE	Total	L	T	P		
L5	21BSC3L5LK3	Kannada	40	60	100	4	-	-	3	2
	21BSC3L5LFK3	Functional Kannada								
L6	21BSC3L6EN3	English	40	60	100	4	-	-	3	2
	21BSC3L6HI3	Hindi								
	21BSC3L6SN3	Sanskrit								
	21BSC3L6TE3	Telugu								
	21BSC3L6UR3	Urdu								
DSC3	21BSC2BOT3L	Plant Anatomy and Developmental Biology	40	60	100	4	-	-	4	2
	21BSC2BOT3P	Plant Anatomy and Developmental Biology	25	25	50	-	-	4	2	3
DSC3	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	3
SEC2	21BSC3SE2ES2	Artificial Intelligence	25	25	50	1	-	2	2	2
VBC5	21BSC3V5PE3	Physical Education- Sports	25	-	25	-	-	2	1	-
VBC6	21BSC3V6NC2	NCC/NSS/R&R(S&G) / Cultural	25	-	25	-	-	2	1	-
OEC3			40	60	100	3	-	-	3	2
Total Marks					**700**	**Semester Credits**			**25**	

SEMESTER-IV

Category	Course code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
			IA	SEE	Total	L	T	P		
L7	21BSC4L7LK4	Kannada	40	60	100	4	-	-	3	2

	21BSC4L7LFK4	Functional Kannada								
L8	21BSC4L8EN4	English	40	60	100	4	-	-	3	2
	21BSC4L8HI4	Hindi								
	21BSC4L8SN4	Sanskrit								
	21BSC4L8TE4	Telugu								
	21BSC4L8UR4	Urdu								
DSC4	21BSC2BOT4L	Ecology and Conservation Biology	40	60	100	4	-	-	4	2
	21BSC2BOT4P	Ecology and Conservation Biology	25	25	50	-	-	4	2	3
DSC4	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	3
AECC2	21BSC4AE1CI2	Constitution of India	20	30	50	3	-	-	2	2
VBC7	21BSC4V5PE4	Physical Education- Sports	25	-	25	-	-	2	1	-
VBC8	21BSC4V6NC3	NCC/NSS/R&R(S&G) / Cultural	25	-	25	-	-	2	1	-
OEC4			40	60	100	3	-	-	3	2
Total Marks					**700**	**Semester Credits**			**25**	
Exit option with Diploma in Science (with the completion of courses equal to a minimum of 96 credits)OR continue studies with Major and Minor					**2800**				**100**	

SEMESTER-V										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
Botany as Major Discipline										

DSC5	21BSC2BOT5L	Plant Taxonomy & Resource Botany	40	60	100	3	-	-	3	2
	21BSC2BOT5P	Plant Taxonomy & Resource Botany	25	25	50	-	-	4	2	3
DSC6	21BSC2BOT6L	Cell Biology and Genetics	40	60	100	3	-	-	3	2
	21BSC2BOT6P	Cell Biology and Genetics	25	25	50	-	-	4	2	3
DSC5	Another Department Code as a Minor Subject	Another Department Course Title	40	60	100	3	-	-	3	2
			25	25	50	-	-	4	2	3
VC1	21BSC5VC1US	Unix & Shell Programming	40	60	100	3	-	-	3	2
	21BSC5VC1FD	Fundamentals of Data Science								
VBC9	21BSC5V5PE5	Physical Education- Sports	25	-	25	-	-	2	1	-
VBC10	21BSC5V6NC4	NCC/NSS/R&R(S&G) / Cultural	25	-	25	-	-	2	1	-
SEC3	21BSC5SE3CS3	Cyber Security	25	25	50	1	-	2	2	2
Total Marks					**650**	**Semester Credits**			**22**	

SEMESTER-VI										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
Botany as Major Discipline										
DSC7	21BSC2BOT7L	Plant Physiology and Biochemistry	40	60	100	3	-	-	3	2

	21BSC2BOT7P	Plant Physiology and Biochemistry	25	25	50	-	-	3	2	3
DSC8	21BSC2BOT8L	Plant Biotechnology	40	60	100	3	-	-	3	2
	21BSC2BOT8P	Plant Biotechnology	25	25	50	-	-	3	2	3
DSC6	Another Department Code as a Minor Subject	Another Department Course Title	40	60	100	3	-	-	3	2
			25	25	50	-	-	3	2	3
VC2	21BSC6VC2HT	Health Care Technologies	40	60	100	3	-	-	3	2
	21BSC6VC2DM	Digital Marketing								
INT1	21BSC6 INT1L	Internship*	25	50	75	-	-	-	2	2
VBC1	21BSC6V5PE5	Physical Education- Sports	25	-	25	-	-	2	1	-
VBC2	21BSC6V6NC4	NCC/NSS/R&R(S&G) / Cultural	25	-	25	-	-	2	1	-
SEC4	21BSC6SE4CS4	Professional Communication	25	25	50	1	-	2	2	2
Total Marks					**700**	**Semester Credits**			**24**	
Exit with Bachelor of Science Degree, B. Sc. (with the completion of courses equal to a minimum of 140 credits)or continue studies with the Major					**4175**	**Total Credits for BSC Program**			**146**	

*Internship between 5 th& 6th Semester with 3 to 4 weeks

Botany Subject as a Minor Discipline

SEMESTER-V										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
DSC5 As a Minor Subject	21BSC2BOT5L	Plant Taxonomy & Resource Botany	40	60	100	3	-	-	3	2

	21BSC2BOT5P	Plant Taxonomy & Resource Botany	25	25	50	-	-	3	2	3

SEMESTER-VI										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
DSC6 As a Minor Subject	21BSC2BOT7L	Plant Physiology and Biochemistry	40	60	100	3	-	-	3	2
	21BSC2BOT7P	Plant Physiology and Biochemistry	25	25	50	-	-	3	2	3

Concept Note, Abbreviation Explanation and Coding:

Concept Note:

1. **CBCS** is a mode of learning in higher education which facilitates a student to have some freedom in selecting his/her own choices, across various disciplines for completing a UG/PG program.
2. A credit is a unit of study of a fixed duration. For the purpose of computation of workload as per UGC norms the following is mechanism be adopted in the University:
   One credit (01) = One Theory Lecture (L) period of one (1) hour.
   One credit (01) = One Tutorial (T) period of one (1) hour.
   One credit (01) = One practical (P) period of two (2) hours.
3. Course: paper/subject associated with AECC, DSC, DSEC, SEC, VBC, OEC, VC, IC and MIL
4. In case of **B.Sc**. **Once a candidate chose two courses/subjects of a particular two department in the beginning, he/she shall continue the same till the end of the degree, then there is no provision to change the course(s) and Department(s).**
5. A candidate shall choose **one of the Department's courses as major and other Department course as minor in fifth and sixth semester and major course will get continued in higher semester.**
6. Wherever there is a practical there will be no tutorial and vice-versa
7. A major subject is the subject that's the main focus of Core degree/concerned.
8. A minor is a secondary choice of subject that complements core major/ concerned.
9. Vocational course is a course that enables individual to acquire skills set that are required for a particular job.
10. Internship is a designated activity that carries some credits involving more than **25 days** of working in an organization (either in same organization or outside) under the guidance of an identified mentor. Internship shall be an integral part of the curriculum.
11. **OEC: For non- Botany science students. Botany Science students have to opt for OEC from departments other than major and minor disciplines.**

Abbreviation Explanations:

1. AECC: Ability Enhancement Compulsory Course.
2. DSC: Discipline Specific Core Course.
3. DSEC: Discipline Specific Elective Course.
4. SEC: Skill Enhancement Course.
5. VBC: Value Based Course.
6. OEC: Open/Generic Elective Course
7. VC: Vocational Course.
8. IC: Internship Course
9. L1: Language One
10. L2: MIL
11. L= Lecture; T= Tutorial; P=Practical.
12. MIL= Modern Indian Language; English or Hindi or Telugu or Sanskrit or Urdu

Program Coding:

1. Code 21: Year of Implementation
2. Code BSC: BSC Program under the faculty of Applied Science of the University
3. Code 1: First Semester of the Program, (2 to 6 represent higher semesters)
4. Code AE: AECC, (C for DSC, S for SEC, V for VBC and O for OEC)
5. Code 1: First "AECC" Course in semester, similarly in remaining semester for such other courses
6. Code LK: Language Kannada, similarly Language English, Language Hindi, Language Telugu, Language Sanskrit, &Language Urdu
7. Code 1: Course in that semester.
8. Bot: Botany

ASSESSMENT METHODS

Evaluation Scheme for Internal Assessment:

Theory:

Assessment Criteria	40 marks
1st Internal Assessment Test for30 marks 1 hr after 8 weeks and 2nd Internal Assessment Test for 30 marks 1 hr after 15 weeks . Average of two tests should be considered.	30
Assignment	10
Total	**40**

Assessment Criteria	25 marks
1st Internal Assessment Test for20 marks 1 hr after 8 weeks and 2nd Internal Assessment Test for 20 marks 1 hr after 15 weeks. Average of two tests should be considered.	20
Assignment	05
Total	**25**

Practical:

Assessment Criteria	25 marks
Semester End Internal Assessment Test for 20 marks 2 hrs	20
Journal (Practical Record)	05
Total	**25**

Question Paper Pattern:

RANI CHANNAMMA UNIVERSITY

Department of Botany

BSc(botany)

Sub: Code: Maximum Marks: 60

a. Answer any Six Questions from Question 1 b. Answer any Three each Questions from Question 2,3,4 and 5

Q.No.1.	Answer any Six Questions (Atlest Two question from Each Unit) a. b. c. d, e. f. g. h.	2X6=12
Q.No.2.	(Should cover Entire Unit-I) a. b. c. d.	4X3=12
Q.No.3.	(Should cover Entire Unit-II) a. b. c. d.	4X3=12
Q.No.4.	(Should cover Entire Unit-III) a. b. c. d.	4X3=12
Q.No.5.	(Should cover Entire Unit-IV) a. b. c. d.	4X3=12

COURSE-WISE SYLLABUS

Semester I

Year	I	**Course Code:** 21BSC1BOT1L **Course Title:** Microbial diversity and Technology	**Credits**	04
Sem.	1		**Hours**	52
Course Pre-requisites, if any		NA		
Formative Assessment Marks: 40		Summative Assessment Marks: 60	Duration of ESA:.02 hrs.	
Course Outcomes		1. Understand the fascinating diversity, evolution, and significance ofmicroorganisms. 2. Comprehend the systematic position, structure, physiology and life cycles of		

	microbes and their impact on humans andenvironment. 3. Gain laboratory skills such as microscopy, microbial cultures, staining, identification, preservation of microbes for their applications in research andindustry.	
Unit No.	**Course Content**	**Hours**
Unit I	**Chapter No. 1:** Microbial diversity-Introduction to microbial diversity; Hierarchical organization and positions of microbes in the living world. Whittaker's five-kingdom system . Distribution of microbes in soil, air, food and water. Significance of microbial diversity in nature. **5 Hours** **Chapter No. 2** History and developments of microbiology-Microbiologists and their contributions (Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Dmitri Iwanowski, SergiusWinogradsky and M W Beijerinck and Paul Ehrlich).**3 Hours** **Chapter No. 3** Microscopy-Working principle and applications of light, dark field, phase contrast and electron microscopes (SEM and TEM). Microbiological stains (acidic, basic and special) and Principles of staining. Simple, Gram's and differential staining. **5 Hours**	13
Unit II	**Chapter No. 4.** Culture media for Microbes-Natural and synthetic media, Routine media -basal media, enriched media, selective media, indicator media, transport media, and storage media. **3 Hours** **Chapter No. 5**. Sterilization methods -Principle of disinfection, antiseptic, tyndallisation and Pasteurization, Sterilization-Sterilization by dry heat, moist heat, UV light, ionization radiation, filtration. Chemical methods of sterilization-phenolic compounds, anionic and cationic detergents. **5 Hours** **Chapter No. 6**. Microbial Growth-Microbial growth and measurement. Nutritional types of Microbes- autotrophs and heterotrophs, phototrophs and chemotrophs; lithotrophs and organotrophs. **5 Hours**	13
Unit III	**Chapter No. 7** Microbial cultures and preservation-Microbial cultures. Pure culture and axenic cultures, subculturing, Preservation methods-overlaying cultures with mineral oils, lyophilisation. Microbial culture	13

	collections and their importance. A brief account on ITCC, MTCC and ATCC. **5 Hours** **Chapter No. 8. Viruses-** General structure and classification of Viruses; ICTV system of classification. Structure and multiplication of TMV, SARS-COV-2, and Bacteriophage (T2). Cultivation of viruses. Vaccines and types. **5 Hours** **Chapter No. 9. Viroids**- general characteristics and structure of Potato Spindle Tuber Viroid (PSTVd); Prions - general characters and Prion diseases**.** Economic importance of viruses. **3 Hours**	
Unit IV	**Chapter No. 10. Bacteria-** General characteristics and classification. Archaebacteria and Eubacteria. Ultrastructure of Bacteria; Bacterial growth and nutrition. Reproduction in bacteria- asexual and sexual methods. Study of *Rhizobium* and its applications. A brief account of Actinomycetes and Cyanobacteria. Mycoplasmas and Phytoplasmas- Generalcharacteristics and diseases. Economic importance of Bacteria. **5 Hours** **Chapter No. 11. Fungi-**General characteristics and classification. Thallus organization and nutrition in fungi. Reproduction in fungi (asexual and sexual). Heterothallism and parasexuality. Type study of *Phytophthora, Rhizopus,,Puccinia, Penicillium***.** **5 Hours** **Chapter No. 12. Lichens –** Structure and reproduction. **VAM Fungi** and their significance. **Fungal diseases**-. Black stem rust of wheat; Downy Mildew of Bajra, Grain smut of Sorghum, Citrus Canker, Economic importance of Fungi. **3 Hours**	13
Recommended Leaning Resources		

Print Resources	**Text Books** 1. Ananthnarayan R and Panikar JCK. 1986. Text book of Microbiology. Orient Longman ltd. New Delhi. 2. Arora DR. 2004. Textbook of Microbiology, CBS, NewDelhi. 3. William CG. 1989. Understanding microbes. A laboratory text book for Microbiology. W.H. Freeman and Company. New York. 4. Dubey RC and Maheshwari DK. 2007. A textbook of Microbiology, S. Chand and Company, NewDelhi. 5. Dubey RC and Maheshwari DK. 2002. A Text book of Microbiology, S.C.Chand and Company, Ltd. Ramnagar, New Delhi. 6. Sharma R. 2006. Text book of Microbiology. Mittal Publications. New Delhi. 305pp. 7. Sharma PD. 1999. Microbiology and Plant Pathology. Rastogi publications. Meerut, India. 8. Vasanthkumari R. 2007. A textbook of Microbiology, BI Publications Pvt. Ltd., New Delhi. **References** 1. Alexepoulos CJ and Mims CW. 1989. Introductory Mycology, Wiley Eastern Ltd., NewDelhi. 2. Allas RM. 1988. Microbiology: Fundamentals and Applications, Macmillan publishing co. NewYork. 3. Brook TD, Smith DW and Madigan MT. 1984. Biology of Microorganisms, 4th ed. Eaglewood Cliffts. N.J.Prentice- Hall. NewDelhi. 4. Burnell JH and Trinci APJ. 1979. Fungal walls and hyphal growth, Cambridge UniversityPress.Cambridge. 5. Michel J, Pelczar Jr.EC and Krieg CR. 2005. Microbiology, Mc.Graw-Hill, New Delhi. 6. Powar CB and Daginawala. 1991. General Microbiology, Vol – I and Vol – II Himalaya publishinghouse,Bombay. 7. Reddy S and Ram. 2007. Microbial Physiology. Scientific Publishers, Jodhpur, 385pp. 8. Sullia SB and Shantharam S. 1998. General Microbiology. Oxford and IBH publishing Co.Pvt.Ltd. NewDelhi

Year	I	**Course Code:** 21BSC1BOT1P **Course Title:**Microbial diversity and Technology	**Credits**	02
Sem.	I		**Hours**	45

Course Pre-requisites, if any:	NA	
Formative Assessment Marks: 25	Summative Assessment Marks: 25	Duration of ESA: 03 hrs.

Practical 1: Safety measures in microbiology laboratory and study of equipment/appliances used for microbiological studies (Microscopes, Hot air oven, Autoclave/Pressure Cooker, Inoculation needles/loop, Petri plates, Incubator, Laminar flow hood, Colony counter, Haemocytomer, Micrometer etc.).

Practical 2: Enumeration of soil/food /seed microorganisms by serial dilution technique.

Practical 3: Preparation of culture media (NA/PDA) sterilization, inoculation, incubation of E coli / B. subtilis/ Fungi and study of cultural characteristics.

Practical 4: Determination of cell count by using Hemocytometer and determination of microbial cell dimension by using Micrometer.

Practical 6: Simple staining of bacteria (Crystal violet /Nigrosine blue) / Gram's staining of bacteria.

Practical 7: Isolation and study of morphology of Rhizobium from root nodules of legumes

Practical 8: Preparation of spawn and cultivation of paddy straw (Oyster) mushroom.

Practical 9: Study of vegetative structures and reproductive structures - Albugo,Phytophthora/Pythium, Rhizopus/Mucor, Saccharomyces, , Puccinia, Agaricus, Lycoperdon, Aspergillus/Penicillium.

Practical 10: Preparation of agar slants, inoculation, incubation, pure culturing and preservation of microbes by oil overlaying.

Practical 11: Downy mildew of Bajra/Maize/Sorghum, Citrus canker, Tobacco mosaic disease.

Practical 12: Study of well-known microbiologists and their contributions through charts and photographs.

Practical-13: Visit to water purification units/Composting/ microbiology labs/dairy and farms to understand role of microbes in day today life.

	(Note: Visit to Composting/ microbiology labs/dairy and farms to understand role of microbes in day today life and submission of study report is compulsory)

Note: Student has to execute a minimum of 10 programs in each part to complete the Lab course

Evaluation Scheme for Lab Examination

Assessment Criteria		Marks
Preparation	Gram staining	05
Enumeration		05
Identification		05
Comment		05
Viva Voice /Tour report		05
Total		**25**

OPEN-ELECTIVE SYLLABUS :

Year	I	**Course Code:** 21BSC1BOT1 **Course Title: PLANTS AND HUMANWELFARE**	**Credits**	03
Sem.	II		**Hours**	40

Course Pre-requisites, if any	NA	
Formative Assessment Marks: 40	Summative Assessment Marks: 60	Duration of ESA:.02 hrs.

Course Outcomes	At the end of the course the student should be able to: 1. To make the students familiar with economic importance of diverse plants that offer resourcesto human life. 2. To make the students known about the plants used as-food, medicinal value and also plantsource of different economic value. 3. To generate interest amongst the students on plants importance in day today life, conservation,ecosystem and sustainability.

Unit No.	**Course Content**	**Hours**
Unit I	Origin of Cultivated Plants. Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions. Crop domestication and loss of genetic diversity (Only conventional plant breeding methods). Importance of plant bio- diversity and conservation. **Cereals**: Wheat and Rice (origin, evolution, morphology, post-harvest	10

	processing & uses).Green revolution. Brief account of millets and their nutritional importance.	
Unit II	**Legumes:** General account (including chief pulses grown in Karnataka- red gram, green gram, chick pea, soybean). Importance to man and ecosystem. **Cash crops:** Morphology, new varieties and processing of sugarcane, products and by- products of sugarcane industry. Natural Rubber – cultivation, tapping and processing.	10
Unit III	**Spices:** Listing of important spices, their family and parts used, economic importance with special reference to Karnataka. Study of fennel, clove, black pepper and cardamom. **Fruits:** Mango, grapes and Citrus (Origin, morphology, cultivation ,processing and uses)	10
Unit IV	**Oils and fats:** General description, classification, extraction, their uses and health implications; groundnut, coconut, sunflower and mustered (Botanical name, family & uses). Non edible oil yielding trees and importance as biofuel. Neem oil and applications. **Beverages:** Tea, Coffee (morphology, processing&uses)	10
Recommended Leaning Resources		
Print Resources	**Text Books:** 1. Kochhar, S.L. (2012). Economic Botany in Tropics. MacMillan & Co. New Delhi. 2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. The Netherlands:Kluwer Academic Publishers. Netherland. 3. Chrispeels, M.J. and Sadava, D.E. (1994) Plants, Genes and Agriculture. Jones & Bartlett- Publishers. Lincoln, United Kingdom	

Semester: II

	I	**Course Code: 21BSC2BOT2L**	**Credits**
	2	**Course Title:Diversity of non flowering plants**	**Hours**

rse Pre-requisites, if any	**NA**	
native Assessment Marks: 40	**Summative Assessment Marks: 60**	**Duration of ESA: 03**

rse omes

After completing this course satisfactorily, a student will be able to:

1. Understand the diversity and affinities among Algae, Bryophytes, Pteridophytes and Gymnosperms.
2. Understand the morphology, anatomy, reproduction and life cycle across Algae, Bryophytes, Pteridophytes and Gymnosperms, and their ecological and evolutionary significance.
3. Obtain laboratory skills/explore non-flowering plants for their commercial applications.

No.	**Course Content**	**Hou**
I	**Chapter No. 1** Algae –Introduction and historical development in algology. General characteristics and classification of algae, Diversity- habitat, thallus organization, pigments, reserve food, flagella types, life-cycle and alternation of generation in Algae. Distribution of Algae. **5Hours** **Chapter No. 2** Morphology and reproduction and life-cycles of Nostoc, *Oedogonium*, *Spirogyra*, *Ectocarpus and Batrachospermum*. Diatoms and their importance. Blue-green algae-A general account. Algal blooms and toxins. **5Hours** **Chapter No. 3** Algal cultivation- Cultivation of microalgae-*Spirulina*;Algal cultivation methods in India. Algal products- Food and Nutraceuticals, Feed stocks, food colorants; fertilizers, aquaculture feed; therapeutics and cosmetics; medicines; dietary fibres from algae and uses. **3 Hours**	1
II	**Chapter No. 4.** Bryophytes – General characteristics and classification of Bryophytes, Diversity-habitat, thallus structure, Gametophytes and sporophytes. **5 Hours** **Chapter No. 5** Distribution, morphology, anatomy, reproduction and life-cycles of *Riccia*, *Anthoceros*, and *Funaria.* Ecological and economic importance of Bryophytes. Fossil Bryophytes. **3 Hours** **Chapter No. 6. . Pteridophytes**- General characteristics and classification; Structure of sporophytes and life-cycles. Distribution, morphology, anatomy, reproduction and life-cycles in Psilotum, *Selaginella*, *Equisetum*, *Pteris*. **5Hours**	1
III	**Chapter No. 7** A brief account of heterospory and seed habit. Stelar evolution in Pteridophytes. Affinities and evolutionary significance of Pteridophytes. Ecological and economic importance. **5Hours** **Chapter No. 8. Gymnosperms-** General characteristics. Distribution and classification of	1

	Gymnosperms. Study of the habitat, distribution, habit, anatomy, reproduction and life-cycles in Cycas, Pinus andGnetum. **5 Hours** **Chapter No. 9.** Affinities and evolutionary significance of Gymnosperms. Economic importance of Gymnosperms - food, timber, industrial uses and medicines. **3 Hours**	
it IV	**Chapter No. 10. Origin and evolution of Plants:** Origin and evolution of plants through Geological Time scale. **2 Hours** **Chapter No. 11. Paleobotany-** Paleobotanical records, plant fossils, Preservation of plant fossils - impressions, compressions, petrification's, moulds and casts, pith casts. Radiocarbon dating. **6 Hours** **Chapter No. 12.** Fossil taxa- *Rhynia, Lepidodendron,Lyginopteri* Exploration of fossil fuels. BirbalSahni Institute of Paleosciences. 5 Hours	1

Recommended Leaning Resources

urces	**Text Books:** **Text Books** 1) Chopra,G.L.AtextbookofAlgae.Rastogi&Co.,Meerut,Co.,NewDelhi,Depot. Allahabad. 2) Johri, LataanfTyagi, 2012, A Text Book of, Vedam e Books, NewDelhi. 3) Sharma, O.P. 1990. Text Book of Pteridophyta. McMillan India Ltd. NewDelhi. 4) Sharma, O.P. 1992. Text Book of Thallophytes. McGraw Hill Publishing Co. New Delhi. 5) Sharma, O.P., 2017, AlgaeSingh-Pande-Jain2004-05. A Text Book ofBotany. Rastogi Publication, Meerut. **References** 1. Sambamurty, A.V.S.S.. A Text Book of Algae. I.K. International Private Ltd., New Delhi. 2. Agashe, S.N. 1995. Paleobotany. Plants of the past, their evolution, paleoenvironment and Allie plants. Hutchinson & Co., Ltd., London. 3. Anderson R.A. 2005, Algal cultural Techniques, Elsievier, London. 4. Publication, Application in exploration of fossil fuels. Oxford & IBH., New Delhi. 5. Eams, A.J., (1974) Morphology of vascular plants - Lower groups. Tata Mc Grew- Hill Publishing Co Delhi, Freeman & Co., New York. 6. Fritze, R.E. 1977. Structure and reproduction of Algae. Cambridge University Press. 7. Goffinet B and Shaw A.J. 2009, Bryophyte Biology, 2nd ed. Cambridge Unversity Press,

Cambridge.Gymnosperms.
8. Srivastava, H N, 2003. Algae Pradeep Publication, Jalandhar, India.
9. Kakkar, R.K. and B.R.Kakkar(1995) The Gymnosperms (Fossils and Living) Central Publishing Hou Allahabad.
10. Kumar H. D., 1999, Introductory Phycology, Affiliated East-West Press, Delhi.
11. Lee, R.E., 2008, Phycology, Cambridge Unversity Press, Cambridge. 4th edition.McGraw Hill Publish Co., New Delhi.
12. Parihar, N.S. 1970. An Introduction to Embryophyta. Vol. I. Bryophyta. Central Book, Allhabad.
13. Parihar, N.S. (1976) An Introduction to Pteridophytes, Central Book Depot, Allhabad.
14. Parihar, N.S. 1977. The Morphology of Pteridophytes. Central Book Depot.,Allahabad.Press, Cambridge.
15. Rashid, A. 1998. An Introduction to Pteridophyta. II ed., Vikas Publishing House, New D
16. Smith, G.M. 1971. Cryptogamic Botany. Vol. II. Bryophytes &Pteridophytes. Tata Tata McGraw Hill Publishing, New Delhi.
17. Smith, G.M. 1971. CryptogamicBotny. Vol.I Algae & Fungi. Tata McGraw Hill Publishing. New Dell
18. Sporne, K.R. 1965. The Morphology of Gymnosperms. Hutchinson & Co., Ltd., London.
19. Stewart, W.M. 1983. Paleobotany and the Evolution of Plants, Cambridge UniversityCambridge.

	I	**Course Code: 21BSC2BOT2P** **Course Title:Diversity of Non flowering plants**	**Credits**	**02**
	2		**Hours**	**45**

rse Pre-requisites, if any:	**NA**	
native Assessment Marks: 25	**Summative Assessment Marks: 25**	**Duration of ESA: 03 hrs.**

Practical-1: Study of morphology, classification, reproduction and lifecycle of Nostoc, Oscillatoria.

Practical-2: Study of morphology, classification, reproduction and life-cycle of Oedogonium& Spirogyra, Ectocarpus and Batrachospermum.

Practical-3: Study of morphology, classification, reproduction and life-cycle of Riccia&Anthoceros/ Funaria.

Practical-4: Study of morphology, classification, anatomy, reproduction and life-cycle of Selaginella and Equisetum.

Practical -5: Study of morphology, classification, anatomy, reproduction and life-cycle of Pteris, Azolla/.Psilotum

	Practical -6: Study of morphology, classification, anatomy and reproduction in Cycas. Practical -7: Study of morphology, classification & anatomy, reproduction in Pinus. Practical -8: Study of morphology, classification & anatomy, reproduction in Gnetum. **Practical -9**: Study of important blue green algae causing water blooms in the lakes. **Practical -10**: Preparation of natural media and cultivation of Azolla in artificial ponds. **Practical -11:** Study different algal products and fossils impressions and slides. **Practical-12:** Visit to algal cultivation units/lakes with algal blooms/Fern house/ Nurseries/Geology museum/lab to study plant fossils. (Note: Botanical study tour to a floristic rich area for 1-2 days and submission of study report is compulsory)

Evaluation Scheme for Lab Examination

Assessment Criteria		Marks
Classification and description		10
T.S. of given material		05
Identification		05
Viva Voice /Tour report		05
Total		**25**

OPEN-ELECTIVE SYLLABUS:

Year	I	**Course Code:** 21BSC1BOT2	**Credits**	03
Sem.	II	**Course Title:** Bio-fuels	**Hours**	40
Course Pre-requisites, if any		NA		
Formative Assessment Marks: 40		Summative Assessment Marks: 60	Duration of ESA:.02 hrs.	
Course Outcomes		At the end of the course the student should be able to: 1. To make the students familiar with Bio-fuel plant species cultivation for commercialexploitation. 2. To make the students known about the Bio-fuel used in automobile industries and solvingfuel problems in feature. 3. To generate interest amongst the students to know the importance of Bio-fuel in day todaylife and economic wellbeing. 1.		

Unit No.	Course Content	Hours
Unit I	Introduction, definition, scope and Importance of Bio-fuel with respect to climate change and environmental issues. Public awareness. Biofuels scenario in India and world. History of Biofuels. Advantages and disadvantages of biofuels. Developmental generation of biofuels: first, second, third and fourth generation of biofuels andpresent status.	10
Unit II	Biofuel feed stocks: Agricultural waste, farm waste, forestry waste, organic wastes from the residential, institutional and industrial waste and its importance.(Biomass- plant, animal and microbial based waste). Algal biofuel.	10
Unit III	Biodiesel species: *Pongamia pinnata, Simarouba gluca, Jatropha curcas, Azardirachta india, Madhuca indica* and *Callophyllum innophyllum* . Seed harvesting, processing, oil extraction, and characterization.	10
Unit IV	Introduction to biodiesel, bioethanol, biogas and bio hydrogen. Production technology of biofuels (Biodiesel, ehanol and biogas). Quality analysis of biodiesel, bioethanol and biogas and its comparison with national and international standards. Biofuel sustainability; Biofuel Policy in Karnataka and India. Biofuel production statistics. Fuel against food security concepts.	10
Recommended Leaning Resources		
Print Resources	**Text Books and References** 1) The Biodiesel Handbook (2005). Jurgen Krahl, Jon Harlan Van Gerpen.AOCS Press. 2) Bioenergy and Biofuels (2017).Ozcan Konur. CRC Press, Taylor & Franci's group. 3) https://mnre.gov.in/biofuels 1.	