Shivaji University, Kolhapur

Syllabus of Environmental Studies for 2020-21
as a Compulsory Paper for all Undergraduate Courses

6. Social Issues and the Environment : (8 lectures)

Disaster management: floods, earthquake, cyclone, tsunami and landslides
Urban problems related to energy.
Water conservation, rain water harvesting, watershed management.
Resettlement and rehabilitation of people; its problems and concerns.
Environmental ethics: Issue and possible solutions.
Global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.
Wasteland reclamation.
Consumerism and waste products.

7. Environmental Protection : (8 lectures)

From Unsustainable to Sustainable development
Environmental Protection Act.
Air (Prevention and Control of Pollution) Act.
Water (Prevention and control of Pollution) Act
Wildlife Protection Act
Forest Conservation Act
Population Growth and Human Health, Human Rights.

8. Field Work : (10 lectures))

Visit to a local area to document environmental assets-
River/forest/grassland/hill/mountain.

or

Visit to a local polluted site – Urban/Rural/Industrial/Agricultural

or

Study of common plants, insects, birds.

or

Study of simple ecosystems - ponds, river, hill slopes, etc.

(Field work is equal to 10 lecture hours)

SHIVAJI UNIVERSITY, KOLHAPUR - 416 004,
MAHARASHTRA
PHONE : EPABX – 2609000, www.unishivaji.ac.in, bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर - ४१६ ००४, महाराष्ट्र
दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग – ०२३१–२६०९०९४

Estd. 1962
"A++" Accredited by
NAAC (2021)
With CGPA 3.52

जा.क्र./शिवाजी वि./अ.मं./समाजशास्त्र/६२ दि.०५/११/२०२२

प्रति,

१. मा. प्राचार्य/संचालक,
सर्व संलग्नित महाविद्यालये/मान्यताप्राप्त संस्था,
शिवाजी विद्यापीठ, कोल्हापूर

२. मा. अधिविभाग प्रमुख,
समाजशास्त्र अधिविभाग,
शिवाजी विद्यापीठ, कोल्हापूर

विषय : एम. ए. भाग १ समाजशास्त्र कोर्सच्या अभ्यासक्रमाबाबत...
संदर्भ : या कार्यालयाचे पत्र क्र.३३३ दि.१९/०९/२०२२.

महोदय,

उपरोक्त संदर्भिय विषयास अनुसरुन आपणास आदेशान्वये कळविण्यात येते की, शैक्षणिक वर्ष २०२२–२३ पासून लागू करण्यात आलेल्या **एम. ए. भाग १ समाजशास्त्र कोर्सच्या** अभ्यासक्रमामध्ये किरकोळ दुरुस्ती करण्यात आलेली आहे. सोबत सदर अभ्यासक्रमाची प्रत जोडली आहे. तसेच विद्यापीठाच्या www.unishivaji.ac.in (Online Syllabus) या संकेतस्थळावर ठेवण्यात आला आहे.

सदर अभ्यासक्रम सर्व संबंधित विद्यार्थी व शिक्षकांच्या निदर्शनास आणून द्यावी ही विनंती.

कळावे,

आपला विश्वासू,

उपकुलसचिव

सोबत : अभ्यासक्रमाची प्रत.

प्रत : १. अधिष्ठाता, मानवविज्ञान विद्याशाखा.
२. समन्वयक, समाजशास्त्र अभ्यास मंडळ.
३. संचालक, परीक्षा व मुल्यमापन मंडळ कार्यालयास.
४. परिक्षक नियुक्ती ए व बी विभागास.
५. इतर परीक्षा २ परीक्षा विभागास.
६. संगणक केंद्र/आय. टी. सेल विभागास.
७. दूरस्थ व ऑनलाईन शिक्षण विभाग.
माहितीसाठी व पुढील कार्यवाहीसाठी.

SHIVAJI UNIVERSITY, KOLHAPUR.

Estd. 1962
"A++" Accredited by NAAC(2021)
With CGPA 3.52

New Syllabus for

Master of Arts [M. A. Sociology]

Faculty of Humanities

(M. A. Part - I, Semester I and II)

(Subject to the modifications to be made from time to time)Syllabus to be implemented from August 2022 Onwards

Shivaji University, Kolhapur
New Syllabus For
Master of Arts in Sociology
Semester with Credits and CIE System of Examination
[Faculty of Humanities]

1. TITLE: SOCIOLOGY
Under the Faculty of Humanities

2. YEAR OF IMPLEMENTATION: Under Academic Flexibility and New Education Policy 2020, the New Syllabus will be implemented from August 2022 onwards in the Shivaji University Department of Sociology.

3. PREAMBLE: The present restructuring and preparation of new M. A. Sociology syllabus, and introduction of Semester with Credits and Continuous Internal Evaluation [CIE] System of Examination, has been done keeping in view the continuous developments in sociology; in its growing knowledge resources and improvements in pedagogic methodologies, the NEP.

The present exercise of revision of sociology syllabus is guided by three broad teaching orientations: [1] job orientation (to prepare students to make use of employment opportunities), [2] knowledge orientation (development of personality and sharpening of intellectual skills among the students), and [3] social orientation (inculcation of social commitment among the students and making them responsible citizens).

Keeping these teaching orientations in mind, syllabus revision has been done with the following objectives: (i) to bring adequate correspondence between the changing social reality and the content of courses in sociology (ii) to equip the students to critically understand and interpret social reality, (iii) to develop among the students a distinctly sociological perspective on socio-economic and cultural reality,
(iv) to enhance the social sensitivity and sensibility of the students, and (v) to help students acquire skills that will be useful to them in their personal, social and professional life.

While revising the sociology curriculum, we have kept in mind the relevance of sociology for policy formulation and evaluation of policies at the regional and national level, updating the reading lists and introduction of practical/fieldwork component and innovations in the instructional methodologies [supplementing the lecture method with group discussions and seminar presentations, fieldwork, skills related with concerned subject, use of audio-visual aids, use of computers /internet in research].

The course structure consists of three broad components into which various courses have been classified. For every semester, there are *two* Discipline Specific core courses which are *compulsory* [four semesters will have 8 DSC/compulsory courses]. For every semester there are 6 Discipline Specific Elective Course. A student has to select one DSE course for each semester. For every semester student has to select one Inter Disciplinary Course. For every semester there are 5 Inter disciplinary courses. A student has to select one Inter Disciplinary Course. It is compulsory for student to complete one Skill Enhancement Course for each semester. Every student has to complete internship/Apprenticeship in first semester and one research project in second semester. Some of the papers (such as Environmental Sociology and Research Methodology] have practical/applied component. Some of the papers have applied value [e.g., Methodology of Social Research and Social Marketing, NGOs and Development, Rural Development in India].

4. GENERAL OBJECTIVES OF THE PROGRAMME:

1) To equip the students with latest sociological knowledge pertaining to various sub-fields within the discipline of sociology.
2) To orient the students for comprehending, analyzing and critically assessing the social reality from sociological perspective.
3) To inculcate the analytical ability, research aptitude and relevant skills in the students useful for their social and professional life.
4) To prepare the students for undertaking research, jobs in Colleges/Universities /Research Institutions, various Government Departments and Non-governmental organizations as well as for various competitive examinations.

5. GENERAL M.A. PROGRAMME OUTCOME

PO-1: Knowledge of Subject: Apply the Sociological knowledge to solution of complex social reality.

PO-2: Problem Analysis: Identify, formulate an analyse complex social problems by using available sociological literature.

PO-3: Knowledge about human values: Develop the ability among students about various societal and human values to build the better society.

PO-4: Skill Development and Employability: Improve and build the required skills which would enhance the students' employability.

PO-5: Team and Team Spirit: To develop the spirit of team work and team sprit to function effectively as an individual and as a member in different social settings.

6. GENERAL PROGRAMME SPECIFIC OUTCOMES

PSO:1: To understand the nature and basic concepts of sociology and its various branches

PSO:2: To analyse the interrelationships between sociology and other social science.

PSO:3: To evaluate changing social relationships and social institutions in the context of Indian society.

PSO:4: To understand the of individuals social behaviour, various organisational social behaviour in different social settings.

7. DURATION:

- The course shall be a full-time course.
- The duration of course shall be of Two years/Four Semesters.

8. EXAMINATION PATTERN: -

The pattern of examination will be Semester with Credit and Continuous Internal Evaluation [CIE].

9. IMPLEMENTATION OF FEE STRUCTURE:

In case of revision of fee structure, this revision will be implemented in phase wise manner as per the University decision in this regard.

10. ELIGIBILITY FOR ADMISSION:

As per the eligibility criteria prescribed by the University for each Course and the merit list will be prepared on the basis of graduate level performance along with reservation norms.

11. MEDIUM OF INSTRUCTION:

The medium of instruction shall be English. The students will have option to write answer-scripts in Marathi.

12. STRUCTURE OF PROGRAMME-.

Semester System with Credits and Continuous Internal Evaluation [CIE]
[To be introduced w.e.f. 2022-2023 for M. A. Part –I in the Department of Sociology, Shivaji University, Kolhapur-4, Under NEP]

PROGRAMME STRUCTURE WITH CREDIT POINTS AND MARKS

M. A. Sociology, Part – I: Semester – I [To be introduced from 2022-2023]			
SEMESTER - I: COMPULSORY/CORE COURSE			
Course Number	Course Title	Credits	Marks
	CORE COURSE		
DSC-01	Classical Sociological Traditions: Marx, Durkheim and Weber	04	100
DSC-02	Understanding Indian Society	04	100
	DISCIPLINE SPECIFIC ELECTIVE		
DSE 1	Social Movements in India	04	100
DSE 2	Social Ecology	04	100
DSE 3	Rural Society in India	04	100
DSE 4	Industry and Society in India	04	100
DSE 5	Social Problems in Contemporary India	04	100
DSE 6	Sociology of Marginalized Communities	04	100
	INTERDISCIPLINARY STUDIES		
IDS 7	Education and Society	04	100
IDS 8	Gender and Society	04	100
IDS 9	Society and Culture in Maharashtra	04	100
IDS 10	Comparative Sociology	04	100
IDS 11	Sociology of Sanitation Part-A	04	100
AECC	**Internship/ Apprenticeship**	04	100
	SKILL ENHANCEMENT COURSES (SEC)		
SEC-1	Gender Audit	02	50

Abbreviations:
DSC: Discipline Specific Core Course
DSE: Discipline Specific Elective
IDS: Interdisciplinary Studies
SEC: Skill Enhancement Course
AECC: Ability Enhancement Compulsory Course

Rules regarding selection of Core Course, Discipline Specific Elective and Interdisciplinary Course for Semester - I:

1) During the first Semester, every student must study four Courses [carrying 100 marks each].

2) The Discipline Specific Core Course Nos. D S C 01 and DSC 02 will be compulsory for all students.

3) A student should first select any one of the Discipline Specific elective Courses [DSE.01 to DSE.06]. During all the remaining Semesters, a student will have to select one course from the Discipline Specific elective Courses of that particular Semester.

4) A student can select any one out of five Interdisciplinary Courses [i.e., any one from IDS-07 to IDS- 11]

5) It is also compulsory for each student to complete Internship/Apprenticeship for 100 marks in first semester.

6) It is also compulsory for each student to study one skill enhancement course of 50 marks [i.e., SEC] in each semester. Skill enhancement compulsory courses SEC courses are value based/ skill based and are aimed at providing hands on training, competancies, skills etc. These courses may be chosen from a pool of courses designed to provide value based or skill based knowledge.

7) For introducing a Discipline Specific elective/ Interdisciplinary Course for teaching, a minimum enrolment of 05 students would be necessary and maximum 10 to 15 students will be permitted to offer any Discipline Specific elective/ Interdisciplinary Course.

8) The Departmental Committee reserves right to introduce the number of Discipline Specific elective/ Interdisciplinary Course to be taught during every Semester and the number of students to be restricted for any Discipline Specific elective/ Interdisciplinary Course. The decision will be declared at the beginning of first Semester.

M. A. Sociology, New Syllabus
Semester System with Credits and Continuous Internal Evaluation [CIE]
[To be introduced w.e.f. 2022-2023 for M. A. Part –I in the Department of Sociology, Shivaji University, Kolhapur-4, Under NEP]

M. A. Sociology, Part – I: Semester – II [To be introduced from 2022-2023]			
SEMESTER - II: COMPULSORY/CORE COURSE			
Course Number	Course Title	Credits	Marks
	CORE COURSE		
DSC- 03	Classical Sociological Traditions: Pareto, Cooley and Mead	04	100
DSC- 04	Perspectives on Indian Society	04	100
	DISCIPLINE SPECIFIC ELECTIVE		
DSE 11	Sociology of Change and Development	04	100
DSE 12	Resources, Development and Environment in India	04	100
DSE 13	Urban Society in India	04	100
DSE 14	Sociology of Tribal Society	04	100
DSE 15	Social Exclusion and Social Inclusion	04	100
DSE 16	Sociology of Religion	04	100
	INTER-DISCIPLINARY STUDIES		
IDS 17	Political Sociology	04	100
IDS 18	Sociology of Mass Communication	04	100
IDS 19	Criminology	04	100
IDS 20	Sociology of South Asia	04	100
IDS 21	Sociology of Sanitation Part- B	04	100
	SKILL ENHANCEMENT COURSES (SEC)		
SEC-1	Environment Impact Assessment	02	50
RP	RESEARCH PROJECT	04	100

Abbreviations:
DSC: Discipline Specific Core Course
DSE: Discipline Specific Elective
IDS: Interdisciplinary Studies
SEC: Skill Enhancement Course
RP: Research Project

Rules regarding selection of Core Course, Discipline Specific Elective, Interdisciplinary Course, Skill Enhancement Course and Research Project for Semester - II:

1) During the second Semester, every student must study four Courses [carrying 100 marks each].
2) The Discipline Specific Core Course Nos. DSC 03 and DSC 04 will be compulsory for all students.
3) A student should first select any one of the Discipline Specific elective Courses [DSE.11 to DSE.16]. During all the remaining Semesters, a student will have to select one course from the Discipline Specific elective Courses of that particular Semester.
4) A student can select any one out of five Interdisciplinary Courses [i.e., any one from IDS-17 to IDS- 21]

5) It is also compulsory for each student to study one skill enhancement course of 50 marks [i.e., SEC]in each semester.

6)

7) It is compulsory for each student to complete one research project carrying 100 marks in the second semester.

8) For introducing a Discipline Specific elective/ Interdisciplinary Course for teaching, a minimum enrolment of 05 students would be necessary and maximum 10 to 15 students will be permitted to offer any Discipline Specific elective/ Interdisciplinary Course.

9) The Departmental Committee reserves right to introduce the number of Discipline Specific elective/ Interdisciplinary Course to be taught during every Semester and the number of students to be restricted for any Discipline Specific elective/ Interdisciplinary Course. The decision will be declared at the beginning of first Semester.

SCHEME OF TEACHING AND EXAMINATION:

M. A. Part -I SEMESTER – I

Sr. No.	Subject /Course	Teaching Scheme (Hrs. /Week)				Examination Scheme (Marks)		
		L	T	P	Total	[Sem. Exam]	CIE	Total
DSC - 01	Classical Sociological Traditions: Marx, Durkheim and Weber	04	---	---	04	80	20	100
DSC- 02	Understanding Indian Society	04	---	---	04	80	20	100
DSE - 01	Social Movements in India	04	---	---	04	80	20	100
DSE – 02	Social Ecology	04	---	---	04	80	20	100
DSE – 03	Rural Society in India	04	---	---	04	80	20	100
DSE – 04	Industry and Society in India	04	---	---	04	80	20	100
DSE – 05	Social Problems in Contemporary India	04	---	---	04	80	20	100
DSE - 06	Sociology of Marginalized Communities	04	---	---	04	80	20	100
IDS- 07	Education and Society	04	---	---	04	80	20	100
IDS - 08	Gender and Society	04	---	---	04	80	20	100
IDS - 09	Society and Culture in Maharashtra	04	---	---	04	80	20	100
IDS - 10	Comparative Sociology	04	---	---	04	80	20	100
IDS- 11	Sociology of Sanitation Part- A	04	---	---	04	80	20	100
AECC	Internship/Apprenticeship	---	---	04	04	80	20	100
SEC-01	Gender Audit	02	---	---	02	40	10	50

M. A. Part -I SEMESTER – II

Sr. No.	Subject /Course	Teaching Scheme (Hrs./Week)				Examination Scheme(Marks)		
		L	T	P	Total	Sem. Exam	CIE	Total
DSC 03	Classical Sociological Traditions: Pareto, Cooley and Mead	04	---	---	04	80	20	100
DSC 04	Perspectives on Indian Society	04	---	---	04	80	20	100
DSE 12	Sociology of Change and Development	04	---	---	04	80	20	100
DSE 13	Resources, Development and Environment in India	04	---	---	04	80	20	100
DSE 14	Urban Society in India	04	---	---	04	80	20	100
DSE 15	Sociology of Tribal Society	04	---	---	04	80	20	100
DSE 16	Social Exclusion and Social Inclusion	04	---	---	04	80	20	100
DSE 17	Sociology of Religion	04	---	---	04	80	20	100
IDS 18	Political Sociology	04	---	---	04	80	20	100
IDS 19	Sociology of Mass Communication	04	---	---	04	80	20	100
IDS 20	Criminology	04	---	---	04	80	20	100
IDS 21	Sociology of South Asia	04	---	---	04	80	20	100
IDS 22	Sociology of Sanitation Part- B	04	---	---	04	80	20	100
SEC 02	Environment Impact Assessment	02	---	---	02	40	10	50
RP 01	RESEARCH PROJECT	04	---	---	04	80 Project	20 Viva-Voce	100

13. SCHEME OF EXAMINATION:

1. The Entire M. A. [Sociology] Course shall have 16 Courses each carrying 100 marks [Every semester shall have four papers], 1 Skill Enhancement Course for 50 marks for each semester and 1 Research Project for Second and Fourth Semester carrying 100 marks. Thus, entire M. A. examination shall be of 2000 total marks.

2. The system of examination would be Semester with credit system and Continuous Internal Evaluation (CIE). The examination shall be conducted at the end of each semester.

3. There shall be Continuous Internal Evaluation (CIE) System within the Semester System. In this System, for every paper, 20 marks are allotted for Internal Assessment and 80 Marks for the Semester Examination of three hours duration, which will be held by the end of each term.

4. Allocation and Division of CIE Marks: For every paper, CIE component shall carry 20 marks.

   (i) During every Semester, every student shall have to submit home assignments or present seminar papers or book review for each paper, on the topics given by the respective course teachers. This home assignment/ seminar presentation will carry 10 marks.
   (ii) For every paper during each semester there shall be a Written Internal Test for 10 marks.
   (iii) For papers having Practical component, students shall have to submit report carrying 20 marks. For these papers, students shall be exempted from home assignments/seminars and written internal test.
   (iv) For papers having project reports carrying 20 marks, students shall be exempted from home assignments/seminars and written test.
   (v) CIE will be conducted only once before the commencement of semester examination.

5) CIE - Re-examination: The CIE re-examination shall be conducted by the Head of the Department

6) Semester-Re-Examination: In case candidates who fail in any of the papers in any semester examination, they can appear for the re-examination as per the University rules.

7) For Internship/Apprenticeship 80 marks are allotted for attendance and report and 20 marks for viva-voce.

8) For Skill Enhancement Course 10 marks are allotted for Internal Assessment and 40 Marks for the Semester Examination of two hours duration,which will be held by the end of each term.

9) For Research Project which will be carried out in the second and fourth semester, 20 marks are allotted for viva-voce and 80 marks are allotted for Dissertation.

14. Standard of Passing:

1) To pass each paper, 40 marks out of 100 are required.

2) Semester Examination: In every paper a candidate should obtain a minimum of 40 % of total marks i.e., 32 marks out of 80 marks. For Skill Enhancement Course every student should obtain minimum of 40% of total marks i.e., 16 marks. For Research Project 40 marks are required for passing.

3) CIE – For every CIE component, a candidate should obtain a minimum of 40 % of the total marks, i.e., 4 out of 10 and/or 08 out of total 20 marks.

4) A candidate must obtain minimum marks as mentioned above in both the Heads of Passing. In other words, he/she must pass in both the Semester examination as well as CIE examination

5) Further details regarding Standard of Passing are given under credit system.

15. Credit System:

Introduction:

Students can earn credit towards their post-graduation by way of credit allotted to the papers or to the course. Credit system permits to follow horizontal mobility towards the post-graduation courses irrespective of the boundaries of the faculties or within the boundaries of the faculties. Besides, it provides a cafeteria approach towards the higher education. A scheme has been worked out to put the credit system within the framework of the present education system in the University.

What is Credit?

Credits are a value allocated to course units to describe the student's workload (i.e., Lectures, Practical work, Seminars, private work in the library or at home and examinations or other assessment activities) required to complete them. They reflect the quantity of work each course requires, in relation to the total quantity of work required to complete during a full year of academic study in the Department. Credit thus expresses a relative value.

Students will receive credit through a variety of testing programmes if they have studied a subject independently or have successfully completed department level regular course work. The objective of credit system is to guarantee the academic recognition of

studies throughout the world, enabling the students to have access to regular vertical and or horizontal course in any Institutions or the Universities in the world.

Types of Credits:

There shall be two types of credits viz. a) Credit by Examination and b) Credit by Non-Examination.

a) Credit by Examination: - Students can earn credit towards his/her Graduation and Post-graduation upon the successful completion of the tests in the credit by examination programme.

b) Credit by Non-examination: - Students can also earn credit by non-examination by proving his/her proficiency in State, National and International sports' achievements, Social Service (NSS), Military Services (NCC), Colloquium & debate, Cultural programme as shown below during the study period.

Sports Achievements /Participation (Any one event during the academic session)	Credits	NSS Recognition /Achievement (Any one event during the academic session)	Credits	NCC Achievements (Any one event during the academic session)	Credits
Olympics	15	International	10	R. D. Pared	6
International	10	National	8	Summer Camp (More than 10	6
National	8	Regional/Zonal	6	National level training (More than 10 days)	5
Regional/Zonal	6	State	4	State level training (More than 10 days)	4
State	4	University	3	University level training (More than 10 days)	3
Inter-University	4	Best University Volunteer	3	C certificate	2
University	3	2 Years NSS + 2 NSS Camps	2	Any special Camps of more than 2 weeks	2
Inter-collegiate/PE Exam.	2	2 Years NSS + 1 NSS Camp	2	Any special Camps of more than one week	2

Mechanism of Credit System: -

Credit is a kind of weightage given to the contact hours to teach the prescribed syllabus, which is in a modular form. Normally one credit is allotted to 15 contact hours. It is 30 contact hours in European system. The instructional days as worked out by the UGC are 180 days (30 Weeks). The paper wise instructional days with a norm of 4 contact hours per week per paper will be of 120 days. That is 60 days or 60 contact hours per paper shall be completed during each semester session. By converting these contact hours into credit at the rate of 15 contact hours for each subject, there will be 4 credits allotted to each paper.

Conversion of Marks into Grades:

The marks obtained by a candidate in each paper or practical/CIE (out of 100 or any fractions like 80: 20 shall be converted into grades on the basis of the following table.

Grades points	Range of marks obtained out of 100 or in any fractions	
0	from 00	to 39
1	40	44
2	45	49
3	50	54
4	55	59
5	60	64
6	65	69
7	70	74
8	75	79
9	80	84
10	85	89
11	90	94
12	95	100

The maximum credit point shall be 48 credits (i.e., 12 grade points * 4 minimum credits) for each paper.

Grade & Grade Points:

The student's performance of course will be evaluated by assigning a letter grade on a few point scales as given below. The grade points are the numerical equivalent of letter grade assigned to a student in the 12 point's scale. The grade and grade points and credits shall be calculated as under: -

GRADES	FGPA CREDIT POINTS
O	10 to 12
A+	8 to 9.99
A	6 to 7.99
B+	4 to 5.99
B	2 to 3.99
C+	1 to 1.99
C	0 to 0.99

The grade and grade points and credits shall be calculated as under: -

1. Semester Grade Point Average (SGPA)- means a semester index grade of a student calculated in the

$$SGPA = \frac{(g1*c1) + (g2*c2) + \ldots..}{\text{Total number of credits offered by the student during the semester}}$$

2. Final Grade Point Average (FGPA) is the final index of a student in the courses. The final grade point average of student in the courses will be worked out on the basis of the formula indicated below:

$$\frac{N}{Ci} \div \frac{n}{c1 * g1}$$

Where,

c1= Credit of the Ci the course (Paper)

g1= Grade point secured in each paper

n = No. of Courses (No. of papers offered – 16 + 4 + 2)

ci = Total number of the credits for whole examination (80)

Standard of Passing/ Minimum Credits:

The minimum credits for M.A. Semester course (of four semesters) will be 22+22+18+18=80 credits. For continuation to the corresponding Semesters SGPA= 1-00 credit has to be obtained by a student. And to pass each paper 4

minimum credits are required, it means 40 marks or 1 grade point is required to pass the paper. The FGPA of the whole course shall be Minimum 3 Credits. The required Credits for passing FGPA can be compensated from the Credit by Non-examination. A student securing less than 3 FGPA Credits and passing in an individual paper with minimum 4 Credits can appear any paper of his/her choice from the course curriculum so far offered by him/her.

Evaluation: -

1. The BOS in Sociology shall lay down the evaluation system for each course.
2. There shall not be rounding off of SGPA/FGPA.
3. A student who fails in a course shall be required either to repeat that course or to clear another course in lieu thereof irrespective of his/her past performance in the semester if he/she has been awarded a final grade weighted grade of F in that course.
4. A student who secures a grade higher than C in a course may be permitted to improve grade by repeating the course provided that a student willing shall be allowed to do so only if he/she surrenders his/her earlier grade in the course. It will be his/her repeated performance in the course, which will be taken into account to compute the SGPA.

5. Non-examination credit shall be counted in the overall performance or for required minimum credits.
6. The students shall be further graded on a scale ranging from 0 to 12. The grades and grade points as shown below will express the level of good students.

Overall Final Credits	Degree of Good Students	
10 to 12	Higher Distinction Level	Extraordinary
8 to 9.99	Distinction Level	Excellent
6 to 7.99	First Class	Very Good
4 to 5.99	Higher Second Class	Good
2 to 3.99	Second Class	Satisfactory
1 to 1.99	Pass	Fair
0 to 0.99	Fail	Unsatisfactory

M.A. I (Semester I)		5 Courses with 4 minimum credit each and 1 course with 2 minimum credits i.e., a total of minimum 22 credits for First Semester.				
Course	Course DSC-01	Course DSC-02	Course DSE-01 To DSE-06 (any one)	Course IDS-07 To IDS-11 (any one)	Internship/ Apprenticeship	Course SEC-01
Minimum Credits	4	4	4	4	4	2
Grade Points Obtained	3	5	6	4	3	1
cl*gl	3 * 4	5 * 4	6 * 4	4 * 4	3*4	1 * 2
	= 12	= 20	= 24	= 16	= 12	= 2
		12 + 20 + 24 + 16 +12+ 2 = 86				
$\frac{cl*gl}{ci}$	$\frac{86}{22}$					
SGPA=	3.9					

M.A. I (Semester II)	4 Courses with 4 minimum credit each, 1 course with 2 minimum credit and 1 Research Project with 4 minimum credits i.e., a total of minimum 22 credits for Second Semester.					
Course	Course DSC-03	Course DSC-04	Course DSE-12 To DSE-17 (any one)	Course IDS-18 To IDS-22 (any one)	Course SEC-02	Course RP-01
Minimum Credits	4	4	4	4	2	4
Grade Points Obtained	3	5	6	4	1	3
cl*gl	3 * 4	5 * 4	6 * 4	4 * 4	1 * 2	3 * 4
	= 12	= 20	= 24	= 16	= 2	= 12
	12 + 20 + 24 + 16 + 2 + 12 = 86					
$\frac{cl*gl}{ci}$	$\frac{86}{22}$					
SGPA=	3.9					

Note: An aggregate of 3 credit points are required to pass the course curriculum.

16. NATURE OF QUESTION PAPER AND SCHEME OF MARKING:

A) There will be four questions in the question paper carrying 80 marks. All questions shall be compulsory,

NATURE OF QUESTION PAPER AND SCHEME OF MARKING
[UNDER ACADEMIC FLEXIBILITY]

SHIVAJI UNIVERSITY, KOLHAPUR
M.A. (SOCIOLOGY) SEMESTER-I/II/III/IV EXAMINATION, -----
Course No..... Course Title .....

Day and Date: Total Marks: 80
Duration : 03 Hours

Instructions: 1) All questions are compulsory.
2) Right side figure indicates marks.

Q. No. 1. Multiple Choice Questions	10
Q. No. 2. Descriptive Type Questions with internal choice	20
Q. No. 3: Descriptive Type Question with internal choice.	20
Q. No. 4. Short Notes (Any Three out of Five)	30

==========

B) There will be four questions in the question paper carrying 40 marks. All questions shall be compulsory,

SHIVAJI UNIVERSITY, KOLHAPUR
M.A. (SOCIOLOGY) SEMESTER-I/II/III/IV EXAMINATION, -----
Course No..... Course Title .....

Day and Date: Total Marks: 40
Duration : 02 Hours

Instructions: 1) All questions are compulsory.
2) Right side figure indicates marks.

Q. No. 1. Multiple Choice Questions	05
Q. No. 2. Descriptive Type Questions with internal choice	10
Q. No. 3: Descriptive Type Question with internal choice.	10
Q. No. 4. Short Notes (Any Three out of Five)	15

==========

C) There will be Dissertation for 80 marks and Viva-Voce for 20 marks.
(Rights of the evaluation of the Dissertation and Viva will be in the hands of department)

17. EQUIVALENCE IN ACCORDANCE WITH TITLES AND CONTENTS OF PAPERS- (FOR REVISED SYLLABUS):

Not Applicable for Semester and Credit with CIE System

18. SPECIAL INSTRUCTIONS, IF ANY : NIL

19. OTHER FEATURES:

1) INTAKE CAPACITY / NUMBER OF STUDENTS: 60

(i) M. A. Part-I : 60
(ii) M. A. Part-II: 60

2) TEACHERS' QUALIFICATIONS: -

(i) As prescribed by norms.
(ii) Work load of teachers in the department as per Apexbody/UGC/State Govt. /University norms.
(iii) List of books/journals are given for each paper
(iv) Teaching Aids like LCD, Smartboard, Projector Screen, Departmental Library, Computer Software,SPSS Version 27.O, Internet facilities etc. are available in the Department.

(A) LIBRARY:

A list of Text Books, Reference Books, Journals and Periodicals, required for the new course is being given to the University Librarian for procurement.

(B) SPECIFIC EQUIPMENTS: Necessary to run the Course.

The faculty teaching various courses will make use of L.C.D., and Computers/Internet wherever necessary. The equipment's are available in the Department.

Computer Lab with Internet connection to the one PC and SPSS software is already made available under SAP programme in the Department. For courses on Research Methodology and courses having Project Work /Practical component, the laboratory will be fully utilized.

14. A copy of New Syllabus for M. A. Sociology (Semester-I and II) is enclosed herewith.

M. A. [Sociology] New Syllabus M. A. Part – I; Semester -I

Course No. DSC- 01: CLASSICAL SOCIOLOGICAL TRADITIONS:MARX, DURKHEIM AND WEBER
Compulsory Paper

Specific Objectives:

1] To equip the students with an understanding of historical, socio-economic and intellectual forces in the rise of sociological theory.

2] To make the students understand the sociological theories of Karl Marx, Emile Durkheimand Max Weber.

Course Outcomes:

1) To apply the sociological theories to the existing sociological phenomena.
2) To understand the sociological theories of Karl Marx, Emile Durkheim and Weber.
3) To identify the relationships between socio-economic and intellectual factors and sociological theories.
4) To solve the social problems by using sociological theories.

		Lecture Hours Per Unit
Unit - I	Origins of Sociological Theory: A] Meaning of Social theory and Social Thought prior to the emergence of Sociology B] Socio-political and Economic Forces in the Development of Sociological Theory. C] Intellectual and Philosophical forces in the rise of Sociological Theory	15
Unit – II	Karl Marx (1818-1883): A] Intellectual background and Marx's Methodology B] Theory of Historical Materialism: Material conditions of life as the primary objective reality; Mode of Production - Basic Structure and Superstructure; Stages of Development of Human Society. C] Marx's Analysis of Capitalism: Classes and Class Struggle D] Marx's concept of Surplus Value and Alienation	15
Unit – III	Emile Durkheim (1858-1917): A] Durkheim's Conception of Sociology as a Science; Concept of Social Fact; Methodological Rules. B] Theory of Division of Labour C] Durkheim's theory of Suicide and Suicide Rate D] Theory of Religion and Religious rituals, their types and social functions.	15

Unit – IV Max Weber (1864-1920) 15

A. Intellectual background and Weber's Methodology – 'Verstehen' and 'Ideal Types'
B. Social Action: Concept and Types
C. Theory of the Protestant Ethic and the Spirit of Capitalism
D. Power and Authority- Types of Authority, Concepts of 'Status' and 'Class'

Readings:

Abraham Francis and John Harry Morgan	Modern Sociological Thought: From Comte to Sorokin, McMillan India Limited, Delhi, 1985.
Aron, Raymond:	Main Currents in Sociological Thought, Vol. I and Vol. II, Penguin, 1965-67
Fletcher Ronald:	The Making of Sociology, Vol. I & II, Michael Joseph Ltd./Thomas Nelson and Sons, London, 1971
Ritzer, George:	Sociological Theory, International Edition (5th Edition), Mc-Graw Hill Book Co., 1983.
David Ashley and David M. Orenstein:	Sociological Theory- Classical Statements (Third Edition), Allyn and Bacon, Paramount Publishing, Massachusetts, 1995.
Zeitlin Irving M:	Ideology and the Development of Sociological Theory, Prentice Hall, New Delhi, 1969.
Coser, Lewis A.:	Masters of Sociological Thought, Harcourt Base, New York, 1977.
Giddens, Anthony:	Capitalism and Modern Social Theory – An analysis of Writings of Marx, Durkheim and Weber, Cambridge University Press, 1997.
Hughes John A., Martin, P. J. and Sharrock W. W:	Understanding Classical Sociology – Marx, Weber and Durkheim, London, Sage Publications 1995.
Tucker, K.N.	Classical Social Theory, Blackwell Publication, Oxford, 2002.
Yakhot, O. Spirin A.	The Basic Principles of Dialectical and Historical Materialism, Progress Publishers, Moscow 1971.
Morrison, Ken	Marx, Durkheim and Weber-Formation of Modern Social Thought, Sage, New Delhi, 1995.
Marx, Karl	A Contribution to the Critique of Political Economy, Progress Publishers, Moscow, 1970/77.

Note: Any other text/Article suggested by the subject teacher.

M. A. [Sociology] New Syllabus M. A. Part – I; Semester –I

Course No. DSC 02 UNDERSTANDING INDIAN SOCIETY
Compulsory Paper

Specific Objectives:
1] To make the students understand the diversity and unity in Indian Society.
2] To familiarize the students about the major segments in society, the traditions, continuities and changes taking place in Indian society.

Course Outcomes
1) To understand the historical background of Indian Society.
2) To identify factors affecting the change taking place in Indian Society.
3) To understand the diversity and unity in Indian Society.
4) To familiarize the students about the major segments in Society.
5) To understand the major processes of change in Indian society.

		Lecture Hours Per Unit
Unit - I	Historical Moorings of Indian Society A] Traditional Social Organisation: Hindu, Buddhist, Jain and Sikh B] Impact of Islam and Colonial rule C] Origin and Features of Caste System in India	15
Unit - II	Diversity and Unity in India A] Diversity: Languages, Religions, Castes, Tribes and Races B] Unity in Diversity in India	15
Unit - III	Segments of Indian Society: Structure and Change A] Tribal Society: Structure and Change B] Rural Society: Structure and Change C] Urban Society: Structure and Change	15
Unit - IV	Indian Society: Major process of Change A] Modernization and its Impact B] Tradition and Modernity in India C] Globalization: Impact and Challenges	15

Readings:

Ahuja, Ram: Society in India: Concepts, Theories and Social Change, Rawat, Jaipur, 2005.

Ahuja, Ram: Indian Social System, Rawat, Jaipur, 2002.

Atal, Yogesh: Changing Indian Society, Rawat, Jaipur, 2006.

Atal, Yogesh (Ed): Understanding Indian Society, Her Anand Publication, Delhi, 1992.

Bose N. K. Culture and Society in India, Asia Publishing House Bombay, 1967.

Bose N. K. Structure of Indian Society, New Delhi, 1975

Singh, K. S. The People of India, Seagull, Calcutta, 1992

David, Mandelbaum: Society in India, Popular, Bombay,1972

Dube, S.C. Indian Society, Popular, Bombay, 2000

Karve Iravati Hindu Society: An Interpretation (Poona Deccon College,)1961

Sharma, K.L. Caste, Class and Tribe, Rawat, New Delhi

Sharma, K.L. Essays on Social Stratification, Rawat, New Delhi

Srinivas M.N. Social Change in Modern India, California University press, 1963

ICSSR A Survey in Sociology and Social Anthropology, 1999

Singh, Yogendra: Modernization of Indian Tradition, Thomson, 1973

Summant Yahswant and Punde Dattatray Maharashtratil Jati Santhavishayak Vichar, Pratima Prakashan, Pune, 2006

Note: Any other text/ article/reference book suggested by the teacher.

Course No. DSE 01 SOCIAL MOVEMENTS IN INDIA

Specific Objectives:

1] To sensitize the students to the variety and dynamics of Social Movements and their role in the social change and transformation in India.
2] To enable the students to look at the social movements from sociological perspective.

Course Outcomes:

1) To identify Social Movements and their role in the social change and transformation.
2) To summarise all the social movements and their role in the context of Indian society.
3) To evaluate the social movements from sociological perspectives.

		Lecture Hours Per Unit
Unit – I	Social Movements: A] Meaning and General Features of Social Movements B] Nature and Types of Social Movements: Reform, Revival, Revolutionary, Regional C] Bases of Social Movements: Class, Caste, Ethnicity and Gender D] Theories of emergence of social movement: Structural-Functional, Marxist and Weberian	15
Unit – II	Leadership, Social Movement and Social Change: A] The Role and Types of Leadership B] Relationship between Leaders and the Masses C] Forces and Process of social movement D] Social movement and social change	15
Unit – III	Traditional Social Movements in India: A] Social reform movement B] Labour and trade union movement C] Tribal movement	15
Unit – IV	New Social Movements in India A] Dalit movement B] Women'smovement C] Environmental movement D] Farmers movement	15

Readings:

Banks, J.A. The Sociology of Social Movements, London, Macmillan 1972
Desai, A.R. Ed. Peasant Struggles in India, Bombay, OUP, 1979.
Dhanagare, D.N Peasant Movements in Indian 1920-1950, Delhi, Oxford University Press, 1983.
Dhanagare D.N Populism and Power: Farmers' Movement in Western India: 1980-2014 , Routlege (Manohar), Delhi. 2016

Gore, M.S. The Social Context of an Ideology : Ambedkar's Political and Social Thoughts, New Delhi, Sage, 1993.

Omvedt, Gail Dalit visions: The Anti-caste Movement and the Construction of an Indian Identity, (New Delhi, Orient Longman) 1995

Oomen, T.K. Protest and Change : Studies in Social Movements, Delhi , Sage, 1990.

P. Radhakrishnan, Peasant Struggles : Land reforms and Social Change in Malabar 1836 – 1982. Sage Publications : New Delhi. 1989 :

Rao, M.S.A., Social Movements in India, New Delhi, Manohar, 1979.

Rao, M.S.A., Social Movements and Social Transformation, Delhi, Macmillan, 1979.

Singh, K.S Tribal Movements in India, New Delhi, Manohar, 1982.

Zelliot, Eleanor, From Untouchable to Dalit: Essays on the Ambedkar Movement, New Delhi, Manohar, 1995.

Gouldner, A.W.(Ed.) Studies in Leadership (New York : Harper and Brothers) 1950

Oommen, T.K., (Charisma, Stability and Change : An Analysis of Bhoodan Grandan Movement. (New Delhi : Thomas Press) 1972

Shah, Ghanshyam Protest Movements in two Indian States. New Delhi : Ajanta,1977

Shah, Ghanshyam Social Movements in India; a review of the literature (Delhi: Sage) 1990.

Shah, Nandita: The Issues at Stake : Theory and Practice in the Contemporary Women's movements in India (New Delhi: Kali for Women), 1992.

Jogdand, P. G. New Economic Policy and Dalits, (Jaipur, Rawat) 1991

Jogdand, P. G. Dalit Movement in Maharashtra, (New Delhi, Kanak) 1991

Shiva, Vandana Ecology and the Politics of Survival (New Delhi: Sage) 1991.

Note: Any other text/ article/reference book suggested by the teacher.

Course No. DSE- 02 SOCIAL ECOLOGY

Specific Objectives:

1] To make the students understand some fundamental concepts and principles of social ecology.

2] To sensitize the students regarding the dynamic relationship between human society and ecosystems.

Course Outcomes:

1) To know about relationship between human society and ecosystems.
2) To understand fundamental concepts and principles of social ecology.
3) To distinguish the ecosystem and environment
4) To explain the impact of growing population on ecosystem

		Lecture Hours Per Unit
Unit – I	Basic Concepts: A] Ecology and its Branches B] Ecosystem: Its components and Functioning C] Ecological Principles D) Social Ecology	15
Unit – II	Human Population and Ecosystem A] Growth and Distribution of World Population B] Ecological Degradation and Population C] Impact of Population Growth on Ecosystem in the context of India	15
Unit – III	Human Habitat and Settlement Patterns A] Distribution of Population- Tribal, Rural and Urban Communities B] Habitat and Settlement: Meaning and types C] Effects of Socio-economic Factors on Changing Habitats and Settlements D] Tempo of Work and Mobility among Tribal, Rural and Urban Communities	15
Unit – IV	Ecological Problems and Legislations A] Pollution-Water, Air and Noise B] Land Salinity: Causes, Impact and Measures C] Deforestation: Causes, Impact and Measures	15

Readings:

Miller, T. G.: Replenish the Earth: A Premier in Human Ecology, Belsmount, Wordswoth Publishing Co., 1972.

Odum, E. P.: Ecology: The Link between the Natural and Social Sciences, OUP, New Delhi, 1975.

Harvey, Brian and John D. Hailett: Environment and Society: An Introductory Analysis, McMillan, London, 1977.

Mukherji, Radhakamal: Man and His Habitat, A Study in Social Ecology, Popular, New Delhi, 1968.

Botkin, D. B. and Keller E. A.: Environmental Studies: The Earth as a Living Planet, Charles E. Merrill Publishing Co. Columbus, 1982.

Merchants, Carolyn (Ed): Key Concepts in Critical Theory: Ecology, Rawat, New Delhi, 1996.

Goudie, Andrew	The Human Impact: Man's Role in Environmental Changes, Basil Blackwell, Oxford, 1981.
Guha, Ramachandra (Ed):	Social Ecology, OUP, New Delhi, 1994.
Santra, S. C.	Environmental Science, New Central Book Agency, Kolkata, 2000.

Note: Any other text/ article/reference book suggested by the teacher.

Course No. DSE 03 RURAL SOCIETY IN INDIA

Specific Objectives:

1] To provide sociological understanding of rural social structure, change and development in India.

2] To develop skills among the students for contributing to the reconstruction of rural institutions / rural development programmes in terms of planning and critically evaluating the same.

Course Outcomes:

1) To know the approaches to the study of rural society.
2) To provide sociological understanding of rural social structure, change and development in India.
3) To understand the changing nature of rural social institutions
4) To understand agrarian social structure and social change.

		Lecture Hours Per Unit
Unit – I	Approaches to the Study of Rural Society: A] Ideal- Index-Typical Approach B] Rostov's five stages Approach C] Diffusionist Approach D] Marxist Approach	15
Unit – II	Changing Nature of Rural Social Institutions: A] Family B] Caste C] Religion	15
Unit – III	Agrarian Social Structure and Change: A] Agrarian Social structure: Evolution of land tenure system and land reforms. B] Agrarian Crisis: GM seeds and farmers suicide C] Farmers Movements in India: Critical Analysis	15
Unit – IV	Rural Society and Planned Change: A] Poverty Alleviation Programmes: An Outline B] Impact of green revolution C] Panchayati Raj D] Impact of Globalization	15

Readings:

Ahuja, Ram — Indian Social System, Rawat, Jaipur, 1993/2002.

Ahuja, Ram — Society in India: Concepts, Theories and Social Change, Rawat, New Delhi, 2005.

Beteille, Andre : Six Essays in Comparative Sociology, OUP, New Delhi, 1974.
Davey, Brian: The Economic Development of India, Spokesman Books, Bristol, 1975.
Desai A.R : Rural sociology in India, Popular Prakashan, Bombay, 1977.
Desai A.R (Ed): Peasant Struggles in India, Oxford University, Press, Bombay, 1979.
Dhanagare, D. N : Peasant Movement in India, OUP, New Delhi, 1988.
Doshi, S.L. and Jain P.C : Rural Sociology, Rawat Publications, Jaipur and New Delhi, 1999
Oommen, T.K : Social Transformation in Rural India, Vikas Publishing House, New Delhi, 1984.
Sen, Sunil : Agrarian Relations in India 1793 to 1947, People's Publications House, New Delhi, 1979.
Sen, Bhowani: Evolution of Agrarian Relations in India, People's Publishing house, New Delhi 1962.
Shanin, Teodor: Peasants and Peasants Societies, Modern sociology Readings, Penguin, 1971.
Sharma K. L : Rural Society in India, Rawat Publications, Jaipur and New-Delhi, 1997.
Singh, Raghavendra Pratap: Sociology of Rural Development in India, Discovery Publishing House Delhi, 1987.
Thorner, Daniel and Thorner Alice : Land and Labour in India, Asia Publications, Bombay, 1962
Tiwari, Jai Kant : Rural Transformation in India, Reliance Publishing House, New Delhi, 1994
Patil R.B. Rural Development in India, NavVishnu Publication, Ajmer,2015

Note: Any other text/ article/reference book suggested by the teacher.

Course No. DSE 04 INDUSTRY AND SOCIETY IN INDIA

Specific Objectives:
1] To provide the students sociological understanding of work and industry.
2] To acquaint the students with dynamics of industrial relations and consequences.

Course Outcomes:

1) To know sociological understanding of work, industry and social relationships.
2) To understand social problems in industrial society.
3) To acquaint the students with dynamics of industrial relationships and consequences.
4) To understand the Industrial Disputes and Role of Trade Unions to resolve the disputes.

		Lecture Hours Per Unit
Unit - I	Industrial Society in the classical Sociological Tradition: A] Emile Durkheim: Division of Labour, Anomie. B] Karl Marx: Surplus value, Alienation. C] Max Weber: Bureaucracy, Rationality.	15
Unit – II	Works and Economic Life: A] Social organization of work in different types of society- slave society, feudal society, industrial /capitalist society. B] Formal and informal organization of work C] Labour and society.	15
Unit - III	Industrial Relations: A] Industrial Disputes and Conflict Resolution: Negotiations, Conciliation, Arbitration and Adjudication B] Workers Participation in Management. C] Trade Unions: Growth, Functions and Problems	15
Unit - IV	Industrialization and Industrial Planning A] Industrial Policy B] Labour Legislation C]Human Relations in Industry.	15

Readings:

Watson Tony J: Sociology, Work and Industry, Routledge & Kegan Paul, London, 1995.

Ramswamy, E.A.: Industry and Labour, Oxford University Press, New Delhi, 1998.

Mamoria, C.B. and Mamoria C.: Dynamics of Industrial Relations in India, Himalaya Publishing House, Mumbai, 1992

Gisbert, Pascual:	Fundamentals of Industrial Sociology, Tata McGraw Hill Publishing Co.Ltd. New Delhi, 1985.
Schneider E.V	Industrial Sociology, Tata McGraw Hill Publishing Co.Ltd. New Delhi, 1979.
Sheth, N.R	The Social Framework of an Indian Factory, Hindustan Publishers, Delhi, 1984.
Sheth, N.R. and Patel P.J	Industrial Sociology In India: A Book of Readings, Allied Publishers Pvt.Ltd. New Delhi, 1982.
Sharma, Krishna Lal:	Research in Industrial Sociology: Trends and Issues, in Nayar, P.K.B. (Ed.), Sociology in India: Retrospect and Prospect, B.R. Publishing Corporation, Delhi, 1982.
Breaman, Jan:	The Making and Unmaking of an Industrial Working Class, Oxford University Press, Oxford 2004.
Haralambos and Holborn,	Sociology:Themes and Perspectives, Collins Publication, 2008.
Bhowmik S.K.	Industry, Labour and Society, Orient Blackswan, New Delhi, 2012

Note: Any other text/ article/reference book suggested by the teacher.

M. A. [Sociology] New Syllabus M. A. Part – I; Semester -I

Course No. 05 DSE - SOCIAL PROBLEMS IN CONTEMPORARY INDIA

Specific Objectives:

1] To familiarize the students with the concept of social problems and theoretical approaches to understand them.

2] To acquaint the students with various structural, familial, developmental and dis-organizational social problems in contemporary India.

Course Outcomes:

1) To familiarize the students with concept of social problems and theoretical approaches.
2) To understand the various structural and familial problems.
3) To understand the developmental problems.
4) To understand the disorganizational problems.

		Lecture Hours Per Unit
Unit - I	Social Problems: Meaning, Nature and Theoretical approaches A] Social Problems: definition and nature B] Theoretical approaches to study the social problems: Social disorganizational, value Conflict, Deviant Behaviour and Labeling	15
Unit - II	Structural and Familial Problems: A] Structural: Poverty, inequality of caste and gender B] Familial: Domestic violence, intra and intergenerational conflict and the problem of the aged	15
Unit - III	Developmental Problems: A] Development induced Displacement B] Ecological Degradation and Environmental Pollution	15
Unit – IV	Disorganizational Problems: A] White-Collar crime and Corruption B] Drug addiction and Suicide	15

Readings:

Jogan Sankar (ed)	Social Problems and Welfare in India, Ashish, New Delhi, 1992
Madan, G.R.:	Indian Social Problems : volume I and II, Allied, Bombay,1973
Ahuja, Ram:	Social Problems in India, Rawat, Jaipur, 2002
Jain, Prabha Shasi and Singh Mamta :	Violence against Women, Radha, New Delhi, 2001
Mishra, Girish and Pandey Brajkumar :	White –collar crimes, Gyan, New Delhi, 1998
Ahmad, Siddique :	Criminology (5th ed.), Eastern Book Company, New Delhi, 2005
Paranjape, N.P. :	Criminology (12th ed.), Central, Allahabad, 2005
Attar, chand :	Poverty and Underdevelopment : New Challenges, Gain, New Delhi

Horton, Paul B and Leslie Gerald R:	The Sociology of Social Problems (fifth edition), Prentice-Hall, New Jersey, 1974
Weinberg, M.S. Rubington Earl and Sue Kiefer Hammersmith :	The Solution of Social Problems-Five Perspectives, (Second Edition) Oxford University Press, New York, 1981.

Note: Any other text/ article/reference book suggested by the teacher.

M. A. [Sociology] New Syllabus M. A. Part – I; Semester -I

Course No. DSE - 06 SOCIOLOGY OF MARGINALISED COMMUNITIES

Specific Objectives:

1] To sensitize the students about the importance and significance of sociological study of marginalized communities in India

2] To understand the problems of marginalized communities in India.

Course Outcomes:

1) To understand the problems of marginalised communities in India.
2) To familiarize the students about the importance and significance of sociological study of marginalised communities in India.
3) To understand the relationship between caste and untouchability.
4) To understand the perspectives and issues of marginalised communities in India

Lecture Hours Per Unit

Unit – I Concept of Marginalized Communities and Indices of Measuring the Marginalization: 15

A] The concept of marginalized communities
B] Marginalization, Socio-economic and political indices: discrimination, deprivation, exploitation, segregation, poverty
C] Educational Backwardness and inequality; a critical view of the caste system;

Unit - II Caste and Untouchability: 15

A] Caste system and untouchability and marginalization mechanism
B] Theoretical explanation of marginalization: Racial, Occupational, Brahminical and Dr. B. R. Ambedkar's Broken-men Theory
C] Current practices of casteism and untouchability

Unit - III Marginalized Communities in India: 15

A] Meaning of the SCs, STs, NTs, DNTs, OBCs and Minorities
B] Status and problems of marginalized communities
C] Social mobility among the marginalized communities

Unit - IV Abolition of Marginality: Perspectives and Issues 15

A] Views of Mahatma Jyotiba Phule, Rajarshi Shahu Maharaj, Dr. B. R. Ambedkar, Vitthal Ramji Shinde, Periyar E. V. Ramaswami, Basvanna, M.K. Gandhi and Birasa Munda
B] Marginalization and affirmative action: Constitutional provisions and implementation
C] New Economic Policy and marginalized communities- Issues of access to education, employment means of livelihood and health

Readings:

Ahuja, Ram	Indian Social System, Rawat, Jaipur, 1993/2002.
Beteille, Andre	Backward classes and the new social order, Oxford, Delhi, 1981.
Beteille, Andre	The Backward Classes in Contemporary India, Oxford, Delhi, 1992
Charsley, S.R. and G.K. Karanth (Eds.)	Challenging Untouchability, Sage, Delhi, 1998 Chaudhuri,
S.N.	Changing Status of depressed castes in contemporary India Daya Publishing House, Delhi, 1988.
Gore, M.S.	The Social Context of an Ideology: The Social and Political Thoughts of Babasaheb Ambedkar, Sage, New Delhi, 1993.
Gupta, Dipankar,	Social Stratification, Oxford University Press, New Delhi, 1991.
Jogdand, P.G.,	New Economic Policy and Dalits (Jaipur: Rawat) 2000
Jogdand P.G.,	Dalit Movement in Maharashtra, Kanak Publications, New Delhi, 1991.
Karade Jagan (Ed)	Caste Discrimination, Rawat Publication, Jaipur 2015
Karade Jagan (Ed)	Caste based Exclusion, Rawat Publication, Jaipur 2015
Karade Jagan	Occupational Mobility among Scheduled Castes, Cambridge U.K. , 2010.
Karade Jagan	'Caste & Marginal Community' Rawat Publication, Jaipur 2022
Karade Jagan	'Marginal Community: Issues & Challenges, Rawat Publication, Jaipur 2022
Mane Suresh	Glimpses of Socio-Cultural Revolts in India, Samrudh Bharat Mumbai, 2006.
Mahajan, Gurpreet,	Democracy, Difference and Social Justice, Oxford University Press, New Delhi, 1998.
Omvedt, Gail,	Dalit Visions: The anti-caste movement and the construction of An Indian Identity, Orient Longman New Delhi, 1995.
Omvedt, Gail,	Dalits and the Democratic Revolution, Sage, New Delhi, 1999.
Oommen, T.K.,	Protest and Change: Studies in Social Movements, Sage, Delhi, 1990.
Robb, Peter (Ed),	Dalit Movements and the Meeting of Labour in India, Sage, Delhi, 1993.
Shah, Ghansham:	Social Movements in India: A Review of Literature, Sage, Delhi 1990.
Singh, K.S.,	The Scheduled Castes, Anthropological survey of India, Delhi, 1998.
Singh, K.S.,	The Scheduled Tribes, Oxford University Press, Delhi, 1995.
Thorat, Sukhadeo	New Economic Policy and its Impact on Employment and Poverty of the Scheduled Castes, 1997, (Pune University)
Zelliot, Eleanor,	From Untouchable to Dalit: Essays on the Ambedkar Movement, Manohar, New Delhi, 1995.

Venugopal, C. N. Ideology and Society in India: Sociological Essays, CriterionPublications, New Delhi, 1988.

Salve R. N. Impact of Government Welfare Measures on Scheduled Castes of India, Shruti, Jaipur, 1998

Note: Any other text/ article/reference book suggested by the teacher.

Corse No. IDS - 07 EDUCATION AND SOCIETY

Specific Objectives:
1] To orient the students to the sociological perspective to education.
2] To introduce students to inter-relationships between educational system and other aspects of society.

Course Outcomes:

1) To understand the interrelationship between educational system and other aspects of society.
2) To know the various theoretical perspectives to understand education.
3) To know the recent development and challenges of education

		Lecture Hours Per Unit
Unit - I	Sociology of Education: A] Nature and Scope of Sociology of Education; B] Development of Sociology of Education; C] Significance of Sociology of Education.	15
Unit - II	Theoretical Perspectives to understand Education: A] Functionalist Perspective; B] Radical Perspective; C] Cultural Reproduction; D] Feminist Perspective.	15
Unit - III	Education and Society: A] Education and Socialization; B] Education and Social Stratification; C] Education and Modernization; D] Education, Social mobility and Social Change.	15
Unit - IV	Recent Development and Challenges of Education A] Basic education and social development B] Higher Education: system, governance C] Higher Education Problems and challenges D] Education and Privatisation	15

Readings:

Acker, S.: Gendered Education: Sociological Reflections on Women, Open University Press, Birmingham, 1994.

Banks, James A. and Lynch, James (eds.), Multicultural Education in Western Societies, Holt Saunder, London, 1986.

Bhatia and Bhatia. : The Philosophical and Sociological Foundations of Education, Doaba House, Delhi, 1974.

Blackledge, D. and Hunt, B.: Sociological Interpretations of Education, Crom Helm, London, 1985.

Chanana, Karuna: :	Socialization, Education and Women: Exploration in Gender Identity, Orient Longman, New Delhi, 1988.
Chitins, Suma and P.G. Altbach:	Higher Education Reform in India, Experience and Perspectives, Sage, New Delhi, 1993.
Durkheim, Emile. :	Education and Sociology, Free Press, New York, 1956.
Jayaram, N. :	Sociology of Education in India, Rawat Publication, Jaipur, 1990.pp. 144-67.
Mathur, S.S. :	A Sociological Approach to Indian Education, Vinod Publication, Agra, 1966.
Michael, Haralambos, (with Robin Heald) :	Sociology: Themes and Perspectives, 13th Edn., Oxford University Press, Delhi, 1994, pp. 521-58.
Ottaway, A.K.C.:	Education and Society, Routledge Kegan Paul, London, 1962.
Robinson, P.:	Perspectives in the Sociology of Education: An Introduction, Rutledge and Kegan Paul, London, 1987. 1992.
Shatrugan, M.:	Privatizing Higher Education, Economic and Political Weekly, 1988.
Saha, V. B. and Saha B.V:	Sociology of Education, 2000.
Note:	Any other text/Article/reference book suggested by the subject teacher

Course No. IDS-08 GENDER AND SOCIETY

Specific Objectives:

1] To introduce the students to the debate regarding role of biology and culture in the determination of gender roles.

2] To orient the students regarding theories of gender relations, position of women in Indian Society and women's movement in India.

Course Outcomes:

1) To understand the theories of gender relations.
2) To know the debate regarding role of biology and culture in the determination of gender roles.
3) To understand the gender issues in Indian society.
4) To evaluate the historical development of women's organisation and women movements.

		Lecture Hours Per Unit
Unit - I	Social Construction of Gender A] Conceptual issues: Patriarchy, Gender, Gender Roles and Sex-gender distinction B] Biology, Culture and Division of labour C] Women in Family D] Understanding gender inequalities: Caste and Class	15
Unit - II	Theories of Gender Relations A] Liberal B] Radical C] Socialist D] Post- modernist	15
Unit - III	Gender and Society in India A] Women and work B] Political participation and political empowerment C] Religion and Culture: Marriage, dowry and property D] Violence against women and Laws.	15
Unit - IV	Women's Organizations and Movements in India: A] Women's Organizations in Pre-Independent India B] Development of Women's organizations after Independence and their types. C] Women's Movement in India: A Historical Sketch. D] Women's Movement in contemporary India: Issues Problems and Prospects	15

Readings:

Altekar, A.S.	The Position of Women in Hindu Civilization, Motilal, Delhi, 1983.
Bhasin Kamal:	Understanding Gender, New Dehli:Kalifor Women,2002
Desai, Neera and M. Krishnaraj:	
Geeta V:	Gender ,Calcutta:Stree, 2002
Geeta V:	Patriarchy,Calcutta:Stree,2007
Forbes, G.,	Women in Modern India, Cambridge University Press, New Delhi, 1998.
Ookley, Ann:	Sex, Gender and Society, Harper and Row, New York, 1972.
Dube, Leela :	Women and Kinship: Comparative Perspective on Gender in South and South-East Asia, Tokyo United Nations University Press, 1997.
Ghadially, Rehana	Women in Indian Society, Sage, New Delhi.
Mies, Maria:	Indian Women and Patriarchy: Conflicts and Dilemmas of Students and Working Women, New Delhi.
Vaid, S. and K. Sangani:	Recasting Women: Essays in Colonial History, Kali for Women, New Delhi.
Gandhi, N. and N. Shah	The Issue at State: Theory and Practice in the Contemporary Women's Movement in India, Kali for Women, New Delhi.
Omvedt, Gail	Caste, Class and Women's Liberation in India, Bulletin of concerned Asian Scholars.
Shah, Nandita:	The Issues at Stake : Theory and Practice in the Contemporary Women's movements in India (New Delhi: Kali for Women), 1992.
Neera Desai and Usha Thakkar	Women and Society in India, NBT, 2004.

Note: Any other text/Article suggested by the subject teacher.

Course No. IDS- 09 SOCIETY AND CULTURE IN MAHARASHTRA

Specific Objectives:
1] To enhance sociological understanding about the society and culture in Maharashtra.
2] To develop insights for sociological analysis of contemporary issues in Maharashtra.

Course Outcomes:

1) To understand socio-political history and economic profile of Maharashtra.
2) To know Polity, Education and Cultural life in Maharashtra
3) To understand the features, changing nature and problems of rural, urban and tribes of Maharashtra
4) To understand the major social movements in Maharashtra.

		Lecture Hours Per Unit
Unit - I	Maharashtra: Socio-political history and Economic profile: A] A Brief Socio-political History of the Region [1818-1960] B] Maharashtra after 1960s: Population Growth and Demographic Features C] Maharashtra State: Socio-economic Profile after 1960s	15
Unit - II	Society in Maharashtra: Rural, Urban and Tribal A] Rural Social Life: Features and Changes B] Urban Areas in Maharashtra: Urbanization, Features and Problems C] Tribes in Maharashtra: Classification, Features, Changing nature and Problems	15
Unit - III	Polity, Education and Aspects of Cultural Life in Maharashtra A] Bases of Political Power in Maharashtra and Coalition politics in Maharashtra B] Progress and Problems of Education in Maharashtra, C] Salient Features of Culture in Maharashtra	15
Unit - IV	Major Social Movements in Maharashtra: A] Farmers Movement in Maharashtra B] Women's Movement in Maharashtra C] Co-operative Movement in Maharashtra D] Dalit Movement in Maharashtra	15

Readings:

Karve, I. : 'Maharashtra, Land and Its People', Directorate of Publications, Government of Maharashtra, Bombay, 1968.

Karve, I. Marathi Lokanchi Sanskriti, Deshmukh Pub, Mumbai.

Khekale, N	'Pressure Politics in Maharashtra', Himalaya Publishing House, Bombay. 1999.
Lele, J:	'Caste, Class and Mobilization in Maharashtra' in Frankel Pub. 1990.
Lele, Jayant:	Elite Pluralism and Class Rule- Political Development in Maharashtra, Popular Prakashan, Bombay, 1982.
Gare, Govind:	Maharashtratil Adivasi,
Government of Maharashtra	Human Development Report, Maharashtra, Government of Maharashtra Pub. Mumbai, 2002.
Jogdand, P. G:	Dalit Movement in Maharashtra, Kanak Publications, New Delhi, 1991.
Jain, Ashok:	"Government and Politics of Maharashtra", Sheth Publishers, Bombay, 1995.
Sirsikar, V. M.:	"Government and Politics of Maharashtra", Continental, Pune, 1985.
Phadke Y. D.:	"Visavya Shatakatil Maharashtra, Vol. 1 to-8 , Srividya Prakashan , Pune.
Munagekar, S. G. (Ed):	Parivartanache Pravah: Maharashtra 1932 to 1981, For Sakal Papers Continental Prakashan, Pune, 1982.
Bhole, B. L. and Kishor Bedkihal (Eds)	Badalata Maharashtra (Change After 1060s) , Dr. Babasaheb Ambedkar Academy, Satara
Kosambi, Meera (Ed):	Intersections: Socio-cultural Trends in Maharashtra, Orient Longman, New Delhi, 2000.
Omvedt, Gail:	Dalit and the Democratic Revolution, New Delhi, Sage. 1999
Palshikar, Suhas and Nintin Birmal (Eds):	"Maharashtrache Rajkaran," Pratima Prakashan, Pune, 2007.
Palshikar, Suhas and Kulkarni Suhas (Eds):	"Maharashtrache Rajkaran,", Unique Features, Pune, 2007.
Naniwadekar Medha (Ed)	Maharashtratil Stree Chalavalicha Magova (in Marathi), Pratima Prakashan and Stree Abhyas Kendra, S.U. K, 2006.
Phadake, Y. D.	Language and Politics in Maharashtra, Himalaya, Mumbai
Pansare Govind	Maharashtrachi Arthik Pahani… Paryaye drushtikon, Shramik Pratishtan,Kolhapur, 2012
Note:	Any other text/ article/reference book suggested by the teacher.

Course No. IDS-10 COMPARATIVE SOCIOLOGY

Specific Objectives:

1] To sensitize the students to the salience of the comparative perspective in sociology by highlighting the historical and social context of its development, key issues, and themes as well as theoretical concerns.

2] To contextualize the above issues to the Indian situation.

Course Outcomes:

1) To understand the comparative study of development of sociology in the world.

2) To know the emergence and growth of sociology in Asia and Africa.

3) To understand the central themes in comparative sociology.

4) To know the issues of Indian Sociology

		Lecture Hours Per Unit
Unit - I	Emergence of Sociology and Comparative Perspective: A] Historical and social context of the emergence and growth of sociology in the West; B] Eurocentric moorings of Western sociological tradition - Americanization of sociology; C] Comparative Perspective in sociology	15
Unit - II	Sociology in Asia and Africa: A] The emergence and growth of sociology in Asia and Africa; B] The impact of Western sociology on the development of sociology in the Third World; C] Sociology in a post-colonial mould; the issue of reorientation of research and teaching in sociology in accordance with national concerns and priorities.	15
Unit - III	Central themes in Comparative Sociology: A] Modernity and Development B] Diversity, Pluralism C] Multiculturalism and Nation-state;	15
Unit - IV	The Indian Context: A] The bearing of the colonial context on the development of sociology in India; B] Sociology for India: An Issue for Indian sociology; C] The debate on contextualization and indigenization; the focus on national and regional concerns.	15

Readings:

Andreski, S.:	Elements of Comparative Sociology, Widenfeld and Nicolson, London, 1964.
Beteille, Andre:	Essays in Comparative Sociology, Oxford University Press, New Delhi, 1987.
Dube, S.C.:	Modernization and Development: The Search for alternative Paradigm Vistar, New Delhi, 1988.
Dube, S.C.:	Social Sciences in a Changing Society, Lucknow, 1973.
Kiely, R. and Phil Marfleet (Eds.):	: Globalization and the Third World, Routledge, London,1998.
Kothari, Rajni:	Rethinking Development: In Search of Humane Alternatives, : Ajanta, Delhi, 1988.
Oommen, T. K. and P. N. Mukherjee, (Eds.):	Indian Sociology: Reflections and Introspections, Popular Prakashan, Bombay, 1986.
Parekh, Bhikhu:	Rethinking Multiculturalism: Cultural Diversity and Political Theory, Macmillan London, 2000.
Saraswati, B.N.:	Interface of Cultural Identity and Development, Indira Gandhi National Centre of the Arts, New Delhi, 1994.
Yogesh Atal	Indian Sociology from where to where, Rawat Publications, Jaipur, 2003
Nagla B.K.	Indian Sociological Tradition, Rawat Publications, Jaipur, 2013
Note:	Any other text/ article/reference book suggested by the teacher.

Course No. IDS - 11 SOCIOLOGY OF SANITATION – PART-A

Specific Objectives:

1] To enhance sociological understanding about the Sanitation, society and culture.

2] To develop insights for sociological analysis of Sanitation issues in India.

Course Outcomes

1) : To understand sanitation, society and culture in sociological perspective.
2) To understand historical development of sanitation.
3) To know relationship between sanitation health and society
4) To understand sanitation in various cultural settings.

Lecture Hours Per Unit

Unit - I Sanitation: Concept and Dimensions 15

A] Concept and Genesis
B] Sanitation and its dimensions: environment, public health, women and sustainable development,
C] Sanitation and its relationship with social institutions

Unit - II Historical development of Sanitation 15

A] Social Perspectives and Orientation
B] Approaches to Public health
C] Sanitation challenges

Unit - III Sanitation, Health and Society 15

A] Hygiene
B] Scavenging and Poverty
D] Environment and Population
E] Wastage: Public and Private space.

Unit - IV Culture and Sanitation 15

A] India's lack of toilet is a cultural problem
B] Social construction of Hygiene and sanitation,
C] Sanitation of Public health,
D] New Culture of Sanitation: Cultural belief and practices, Forces and responses of change, Empowering people.

Readings:

Bindeshwar Pathak: Sociology of Sanitation, Kalpaz Publications, New Delhi, 2015

Nagla B. K: Sociology of Sanitation, Kalpaz Publications, New Delhi, 2015

Richard Pais: Sociology of sanitation, Kalpaz Publications, New Delhi, 2015

Ashis Saxena: Sociology of Sanitation: Themes and Perspectives, Kalpaz Publications, New Delhi, 2015

Mohmmad Akram: Sociology of Sanitation, Kalpaz Publications, New Delhi, 2015

A. S. Bagela: Swachhata Ka Samajshasta, Kalpaz Publications, New Delhi, 2015

P.S. Vivek: World of Garbage and Waste: Undercurrents of Swatchh Bharat and Sabka Vikas in India, Himalaya Publishing House, Mumbai, 2015.

Leela Visaria: Sanitation in India with focus on Toilets and Disposal of Human Excreta, Gyan Publishing House, New Delhi, 2015.

Hetukar Jha: Sanitation in India: A Historico-Sociological Survey, Kalpaz Publications, New Delhi, 2016

Bhartiya Samajshasta Sameeksha, Sociology of Sanitation, July- December 2016, vol.3, No.2

AECC-01 **INTERNSHIP/APPRENTICESHIP**

60 Hours

Specific Objectives:

1) To enhance the ability of the students through practical training.
2) To understand the working of government and non government agencies.

1) Visit to Local Self Government
   (Gram Panchayat, Panchayat Samiti, Zhilla Parishad)
2) Visit to Urban Self Government
   (Nagarpalika, Mahanagarpalika)
3) Visit to NGOs
4) Health Care Centres
   (Primary Health Centre, Community Health Centre, District Health Centre, Urban Health Centre, Private Multispecialty Hospitals)
5) Government and Co-operative offices.

(Kamgar Kalyan, Samaj Kalyan, Mahila and Bal Vikas, MAVIM, Milk Cooperative offices, Sugar Cooperative offices, Cooperative Credit Society)

Sr. No.	**RULES REGARDING SUBMISSION OF INTERNSHIP/APPRENTICESHIP**
1	Internship is compulsory for each student of M.A. First Semester
2	Admitted students of the department equally divided among the existing faculty members to complete their Internship.
3	In the Internship programme each student has to select one of the government or non-government agencies to complete his/her Internship.
4	As per the rules defined by the department of Sociology each student has to submit the required attendance and report to respective faculty.
5	In Internship 80 marks will be given to practical work and 20 marks will be given for internal viva-voce.

M. A. [Sociology] New Syllabus M. A. Part – I; Semester -I

Course No. SEC - 01 GENDER AUDIT

Specific Objectives:

1] To familiarise the students with concepts and theories of sex and gender as used in feminist perspective.

2] To familiarise the students how to conduct gender audit and to enhance the skill among the students.

Course Outcomes:

1) To bring the gender sensitization among the students.
2) To enhance the skill among the students to conduct the gender audit of various sectors.

Lecture Hours Per Unit

Unit-I Basic Concepts and theories of Gender Relations 15

A] Basic Concepts: Sex, Gender, Patriarchy, Gender Role and Gender Audit

B] Theories of Gender Relations: Liberal, Radical and Socialist.

C] Pattern of Gender inequality in terms of Caste, Class and Religion.

Unit-II How to conduct the Gender Audit 15

A] History, Objective and need of Gender Audit

B] Steps for preparing Gender Audit: Planning, Carrying Out, Draft Report and Final Report.

C] Role and Checklist of Gender Auditors

D] Gender Audit: Private and Public Sectors in India.

Reading :

Bhasin Kamal: Understanding Gender, New Dehli: Kali for Women, 2002

Geeta V: Gender ,Calcutta: Stree, 2002

Geeta V: Patriarchy, Calcutta: Stree,2007

Ghadially, Rehana	Women in Indian Society, Sage, New Delhi.
Omvedt, Gail :	Caste, Class and Women's Liberation in India, Bulletin of Concerned Asian Scholars.
Neera Desai and	Women and Society in India, NBT, 2004.
Usha Thakkar: Rege, Sharmila:	Writing Caste/ Writing Gender: Narrating Dalit Women's Testimonies, New Delhi: Zubaan, an imprint of Kali for Women. (2006)
B. Ratna Kumari and K. Mary Sujatha:	Gender Awareness and Gender Audit, Uday Publishing House, 2014
Rajesh Gill:	Gender, Culture and Honour: Gender Audit of Punjab and Haryana, Rawat Publication- 2019
Inter Action	"The Gender Audit Handbook: A tool for organisational self-assessment and transformation" , 2010.
International Labour Organisation	A Manual for Gender Audit Facilitators. The ILO Participatory Gender Audit Methodology, 2012.
UNICEF	Gender Audit Manual, A social audit tool to monitor the progress of Viet Nam‟s Socio-Economic Development Plan, 2012 The Gender Audit Handbook (2003,2010)

Note: Any other text/Article suggested by the subject teacher.

M. A. Part -I SEMESTER – II

Sr. No.	Subject /Course	Teaching Scheme (Hrs./Week)				Examination Scheme(Marks)		
		L	T	P	Total	Sem. Exam	CIE	Total
CC 03	Classical Sociological Traditions: Pareto, Cooley and Mead	04	---	---	04	80	20	100
CC 04	Perspectives on Indian Society	04	---	---	04	80	20	100
DSE 12	Sociology of Change and Development	04	---	---	04	80	20	100
DSE 13	Resources, Development and Environment in India	04	---	---	04	80	20	100
DSE 14	Urban Society in India	04	---	---	04	80	20	100
DSE 15	Sociology of Tribal Society	04	---	---	04	80	20	100
DSE 16	Social Exclusion and Social Inclusion	04	---	---	04	80	20	100
DSE 17	Sociology of Religion	04	---	---	04	80	20	100
IDS 18	Political Sociology	04	---	---	04	80	20	100
IDS 19	Sociology of Mass Communication	04	---	---	04	80	20	100
IDS 20	Criminology	04	---	---	04	80	20	100
IDS 21	Sociology of South Asia	04	---	---	04	80	20	100
IDS 22	Sociology of Sanitation Part- B	04	---	---	04	80	20	100
SEC 02	Environment Impact Assessment	02	---	---	02	40	10	50
RP 01	RESEARCH PROJECT	---	---	04	04	80 Project	20 Viva-Voce	100

Course No. DSC-03Compulsory Paper — CLASSICAL SOCIOLOGICAL TRADITIONS: PARETO, COOLEY AND MEAD

Specific Objectives:

1] To introduce the students to major ideas of Vilfredo Pareto, C. H. Cooley, and G. H. Mead.

2] To develop insights for understanding the later developments in sociological Theory.

Course Outcomes:

1) To understand Classical Sociological theories of Pareto, Cooley and Mead
2) To understand the later developments in sociological theory.
3) To understand the Sociological perspectives in sociology.

		Lecture Hours Per Unit
Unit –I	Vilfredo Pareto (1848-1920): A] Intellectual Background and conception of Society and Sociology B] Logical and Non-Logical Action C) Residues and Derivations D] Theory of Circulation of Elites	15
Unit - II	Charles Horton Cooley (1864-1929): A] Intellectual Background B) Views on 'Relation between Individual and Society' C] Self and Society: Theory of Looking –Glass-Self D] The Primary Groups	15
Unit - III	George Herbert Mead (1863-1931): A] Intellectual Background B) Social Behaviourism C] The Act, Gestures and Significant Symbols D] Analysis of Mind, Self and Society	15
Unit - IV	Classical Traditions: A summary A] Objective Study of Social Facts B] Dialectical and Materialistic Interpretation of Society C] Interpretative Understanding of Social Action D] Social Psychological Aspects of Society	15

Readings:

Aron, Reymond: Main Currents in Sociological Thought, Vol. I and Vol. II, Penguin, 1965-67

Fletcher Ronald: The Making of Sociology, Vol. I & II, Michael Joseph Ltd./Thomas Nelson and Sons, London, 1971

Ritzer, George:	Sociological Theory, International Edition (5th Edition), Mc-Graw Hill Book Co., 1983.
David Ashley and David M. Orenstein:	Sociological Theory- Classical Statements (Third Edition), Allyn and Bacon, Paramount Publishing, Massachusetts, 1995.
Zeitlin, Irving M:	Ideology and the Development of Sociological Theory, Prentice Hall, New Delhi, 1969.
Coser, Lewis A.:	Masters of Sociological Thought, Harcourt Base, New York, 1977.
Giddens, Anthony:	Capitalism and Modern Social Theory – An analysis of Writings of Marx, Durkheim and Weber, Cambridge University Press, 1997.
John A., Martin, Peter, J. and Sharrock, W. W:	Understanding Classical Sociology – Marx, Weber and Durkheim, London: Sage Publications 1995.
Tucker, K.N.	Classical Social Theory. Blackwell Publication, Oxford, 2002.
Haralambos and Holborn,	Sociology: Themes and Perspectives, Collins Publication, 2008.
Note:	Any other text/Article suggested by the subject teacher

Course No. DSC-04 PERSPECTIVES ON INDIAN SOCIETY
Compulsory Paper

Specific Objectives:
1] To sensitize the students to diverse as well as the interconnections of theoretical perspectives on Indian Society
2] To introduce the contributions of select Indian Sociologists to the students.

Course Outcomes:

1) To understand interconnections of theoretical perspectives on Indian Society.
2) To study the development of Sociology and Social anthropology in India.
3) To understand the theoretical approaches to the study of Indian society.

		Lecture Hours Per Unit
Unit - I	Development of Sociology and Social Anthropology in India A] Phases of Development of Sociology: Exploratory, Development and Analytical B] Phases of Development of Social Anthropology: Exploratory, Development and Analytical	15
Unit - II	Perspectives on Indian Society A] Indological / Textual Perspective: G. S. Ghurye and Louis Dumount B] Structural Perspective: M. N. Srinivas and S. C. Dube.	15
Unit - III	Marxist Perspective A] D. P. Mukherjee B] A.R. Desai	15
Unit - IV	Civilizational and Sub-altern Perspective A] N.K.Bose and Surajit Sinha B] David Hardiman and Dr. B.R.Ambedkar	15

Readings:

Dhanagare, D.N.: Themes and Perspectives in Indian Sociology, Rawat, Jaipur, 1993.

Oommen, T.K. and Partha Mukherjee : Indian sociology: Reflections and introspections, Popular, Bombay, 1986

Guha, Ranjit (ed) : Subaltern Studies: Writings on South Asian Histroy and Society, Oxford ,1982

Desai, A.R : Social Background of Indian Nationalism, Popular, Bombay,1948

Ambedkar, B.R.: Speeches and Letters, Bombay.

Sinha, Surajit : Tribes and Indian Civilization in Man in India, 1980
Bose Normal Kumar : Problems of Indian Nationalism, Calcutta

Singh, Yogendra : Modernization of Indian Tradition, Thomson, 1973

Singhi, N. K.:	Theory and Ideology in Indian Sociology, Rawat, Jaipur, 1996
Relevant articles from	Man in India, Social Change and Eastern Anthropologist
Nagla B.K.	Indian Sociological Thought, Rawat Publication, Jaipur
Doshi S.L.	Bhartiy Samajik Vichar(Indian Social Thinkers), Rawat Publication, Jaipur, 2010
Note:	Any other text/ article/reference book suggested by the teacher.

M. A. [Sociology] New Syllabus M. A. Part – I; Semester -II

Course No. DSE - 12-SOCIOLOGY OF CHANGE AND DEVELOPMENT

Specific Objectives:

1] To provide conceptual and theoretical understanding of social change and development as it has emerged in sociological literature;

2] To prepare the students for professional careers in the field of development planning, including governmental, non-governmental and international agencies engaged in development.

Course Outcomes:

1) To know the various theories of social change.
2) To understand the concept of social change and various processes of social change in Indian society.
3) To understand the theories of development and underdevelopment.
4) To understand the various paths of development.

		Lecture Hours Per Unit
Unit - I	Meaning, theories and factors of social Change: A] Evolution, progress and development B] Theories: Linear and Cyclical; C] Factors: Demographic, Economic, Religious, Bio-tech, Info-tech and Media.	15
Unit - II	Social Change in Contemporary India: A] Processes of change: Westernization and Modernization; B] Processes of change: Sanskritization and Secularization; C] Religious conversions	15
Unit - III	Concepts and Theories of Development and Underdevelopment A] Concepts: Human Development, Social development and Sustainable development; B] Centre-periphery Theory; C] World systems Theory.	15
Unit - IV	Paths of Development: A] Capitalist Path of Development; B] Socialist Path of Development; C] Mixed economy as a path of Development; D] Gandhian Path of Development	15

Readings:

Abraham, M.F. : Modern Sociological Theory: An Introduction. New Delhi: Oxford University Press, 1990.

Appadural, Arjun: Modernity At Large: Cultural Dimensions of Globalization. New Delhi: OUP. 1997.

Dereze, Jean and Amartya Sen :	India: Economic Development and Social Opportunity. New Delhi: OUP. 1996.
Desai, A.R.:	India's Path of Development: A Marxist Approach. Bombay: Popular Prakashan, (Chapter 2). 1985.
Giddens, Anthony :	Global Problems and Ecological Crisis, in Introduction to Sociology. IInd Edition: New York: W. W. Norton & Co. 1996.
Harrison, D. :	The Sociology of Modernization and Development. New Delhi: Sage. 1989.
Haq, Mahbub UI:	Reflections on Human Development. OUP New Delhi, 1967.
Sharma, S.L.:	Criteria of Social Development, Journal of Social Action. Jan-Mar, 1980.
Hoselitz, B. F.:	Sociological Aspects of Economic Growth Amend Publishing Co. Pvt. Ltd., New Delhi, 1960.
Moore, Wilbert and Robert Cook.:	Social Change. New Delhi: Pretice-Hall, (India) 1991.
Sharma, S.L.:	Development: Socio-Cultural Dimension. Jaipur: Rawat, 1986.
Sharma, S.L.:	Salience of Ethnicity in Modernization: Evidence from India, Sociological Bulletin. Vol.39, Nos. 1&2. Pp.33-51, 1994.
Srinivas, M.N.:	Social Change in Modern India. Berkley: University of Berkley. Symposium on Implications of Globalization. 1995. Sociological Bulletin. Vol.44. (Articles by Mathew, Panini & Pathy). 1966.
Amin, Samir.:	Unequal Development. New Delhi: OUP, 1979.
Giddens, Anthony.:	The Consequences of Modernity. Cambridge: Polity Press, 1990.
Sharma, S.L.:	Social Action Groups as Harbingers of Silent Revolution, Economic and Political Weekly. Vol.27, No.47. 1992.
Sharma, S.L.:	Perspectives on Sustainable Development in South Asia. The Case of India, In Samad (Ed.) Perspectives on Sustainable Development in Asia. Kuala Lumpur: ADIPA, 1994.
Wallerstein, Imnanual.:	The Modern World System. New York: OUP, 1974.
Waters, Malcoln.:	Globalization. New York: 1995.
Rutledge and Kegan Paul.:	World Commission on Environment and Development. Our Common Future. (Brundtland Report). New Delhi. OUP, 1987.
Haralambos and Holborn,	Sociology:Themes and Perspectives, Collins Publication, 2008.
Report	World Development Report, 1995. New York, UNDP, Sustainable development, New York

Note: Any other text/ article/reference book suggested by the teacher.

M. A. [Sociology] New Syllabus M. A. Part – I; Semester -II

Course No. DSE – 13 RESOURCES, DEVELOPMENT AND ENVIRONMENTIN INDIA

Specific Objectives:

1] To sensitize the students about the availability and depletion of natural resources as well as the processes of development and environmental degradation.

2] To create awareness among the students regarding the importance of judicious use and conservation of natural resources.

Course Outcomes:

1) To understand the current status of various natural resources and its distribution in India.

2) To know the concepts of development and environment.

3) To understand the developmental processes and its impact on environment in India.

Lecture Hours Per Unit

Unit - I Natural Resources and Distribution in India 15

A] Natural Resources: Concept and Types

B] Current Natural Resources: (i) Water, (ii) Land (iii) Forest (iv) Minerals (v) Energy (vi) Wild-life (vii) Ocean

C] Distribution of current natural resources in India

Unit - II Development and Environment 15

A] Concepts: Development, Environment; Development and Environment Debate

B] Paths of Development: Capitalist, Socialist, Mixed economy

C] Impact of Paths of Development on the Environment

D] Concept of Sustainable Development

Unit - III Specific Developmental Processes and Environment in India 15

A] Industrialization and its impact on Environment

B] Urbanization and its impact on Environment

C] Social Forestry and Environment

D] Organic Farming and Environment

Unit - IV Disasters in India: 15

A] Disasters: Meaning and nature

B] Natural Disasters and their Impact

C] Man-made Disasters and their Impact

Readings:

Santra, S. C.: Environmental Science, New Central Book Agency, Kolkata, 2000

Sexena, H. M.: Environmental Studies, Rawat, Jaipur-2006.

Sexena, H. M.: Environmental Geography, Rawat, Jaipur, 2004.

Sundar, I and Muthukumar, P. K.: Environmental Sociology, Sarup and Sons, New Delhi, 2006.

Martel, Luke	Ecology and Society: An Introduction, Polity Press, UK, 1995.
Satapathy, N.	Sustainable Development, An Alternative Paradigm, Karnavati Publications, Ahmedabad, 1998.
Salunkhe, Sarjerao	The Concept of Sustainable Development: Roots, Connotations and Critical Evaluation, in Social Change, Vol. 33, No.1, pp.67-80, 2003.
Haralambos and Holborn,	Sociology:Themes and Perspectives, Collins Publication, 2008.
Report	UNDP, Sustainable development, New York

Note: Any other text/ article/reference book suggested by the teacher.

Course No. DSE - 14 URBAN SOCIETY IN INDIA

Specific Objectives:

1] To acquaint the students with basic concepts in urban sociology and urban ecological theories.

2] To make students understand the process of urbanization, its social consequences and different urban problems in India.

Course Outcomes:

1) To understand the basic concepts in Urban Sociology.
2) To know the theories of urban development.
3) To understand the different urban processes and social consequences of urbanization.
4) To know the various urban problems occurred due to urbanization.

		Lecture Hours Per Unit
Unit - I	Basic Concepts in Urban Sociology: A] Ecology and Community B] Characteristics of Urban Society C] Pre-industrial city and Industrial city	15
Unit - II	Theories of Urban Development: A] Concentric zone theory B] Sector theory C] Multiple Nuclei Theory	15
Unit - III	Classification of Cities & Towns and Urban Processes: A] Classification of Cities and Towns: Physical, Historical, Demographic; B] Process of Industrialization and Urbanization; C] Migration and Urbanization; D] Social consequence of urbanization: Family, Class, Caste and Status of women.	15
Unit - IV	Urban Problems, Planning and Development: A] Housing, Sanitation and Drug addiction B] Slums and environmental pollution. C] Urban planning: Early planning ideas, Garden city Model, Metropolitan planning and Smart Cities	15

Readings:

Bergel, E. E.: 'Urban Sociology', Mc-Graw Hill Book Company, New York, 1955.

Nayar, P.K.B.: 'Sociology in India: Retrospect and Prospect', B. R. Publishing Corporation, Delhi, 1982.

Kopardekar, H.D.: 'Social Aspects of Urban Development', Popular Prakashan, Mumbai, 1986.

Abrahmson, Mare	'Urban Sociology', Englewood Cliff, Prentice Hall, 1976.
Gill, Rajesh	'Slum as urban villages', Rawat Publications, Jaipur,1994
Ahuja, Ram:	'Social Problems in India, 'Rawat Publications, Jaipur, 1997.
Quinn, J.A.	'Urban Sociology', S.Chand & Co., New Delhi.
Bose, Ashis:	'Studies in India's Urbanization', Tata McGraw-Hill Publishing Co. Ltd., New Delhi., 1973.
Colllngworkth, J. B.	'Problems of and Urban Society,' Vol II, George Allen & Unwin Ltd, 1972.
Bhattacharya, B.:	'Urban Development in India', Shree Publishing House, Delhi, 1979.
Elsentadt, S.N. and Shachar, A	"Society, Culture and Urbanization", Sage Publications, New Delhi, 1987.
Desai, A.R. and Pillai, S.D (Eds.)	'Slums and Urbanization', Popular Prakashan, Mumbai. 1970.
Ramchandran, R.	Urbanization and Urban system in India,O.U.P. Delhi 1991.
Edward, W. Soja:	Post Metropolis, critical studies of cities and regions, Oxford Blackwell, 2000.
Fawa, F.Sylvia:	New urbanism in world perspectives – A Reader, T.Y.Cowell, New York, 1968.
Nels, Anderson:	Urban sociology, Asia publishing house New Delhi, 1965.
De' Souza, Alfred (Ed):	Urban growth & Urban planning – Indian social institute, New Delhi 1983.
M.S.A. Rao and Bhat,	A reader in Urban sociology, Orient Longman, 1991.
Nagla B. K:	Sociology of Sanitation, Kalpaz Publications, New Delhi, 2015
P.S. Vivek	World of Garbage and Waste: Undercurrents of Swatchh Bharat and Sabka Vikas in India, Himalaya Publishing House, Mumbai, 2015.

Note: Any other text/ article/reference book suggested by the teacher.

M. A. [Sociology] New Syllabus M. A. Part – I; Semester -II

Course No. DSE - 15 SOCIOLGY OF TRIBAL SOCIETY

Specific Objectives:

1] To make students understand the concepts and approaches to the study of tribes.

2] To acquaint the students with the problems of tribes and the factors responsible for change in tribal socio-cultural life.

Course Outcomes:

1) To understand the concept and approaches to the study of tribes.
2) To understand the problems of tribes such as land alienation, poverty, indebtedness and factors responsible for change in tribal socio-cultural life.
3) To identify Changes in Social, Economic and Political life of tribals.
4) To understand the Constitutional Safeguards, Policies and Programmes for the welfare of scheduled Tribes.

		Lecture Hours Per Unit
Unit - I	Tribal Society: A] The concept of tribe: Tribe and Caste B] Characteristics of Tribes C] Demographic profile of IndianTribes D] Tribal studies in India	15
Unit - II	Problems of Tribes: A] Land alienation, poverty and indebtedness B] Health and Mal-nutrition C] Displacement and rehabilitation	15
Unit – III	Tribes in Transition: A] Impact of industrialization and urbanization B] Impact of Globalisation and Privatisation C] Changes in tribal society. D] Tribal Identity and Tribal Movements	15
Unit – IV	Tribal Development: A] Approaches to tribal development: Assimilationist and Isolationist B] Constitutional safeguards for the Scheduled Tribes C] Policies and Programmes for the welfare of Tribal people D] NGOs and Tribal Development	15

Readings:

Ember.C.K. and Melvin Ember :	Introduction to Cultural Anthropology, Prentice Hall, New Jersey, 1977
Vidyarthi, L.P. and Roy B.K :	Tribal Culture in India. Concept, New Delhi
Ghurye, G.S :	Scheduled Tribes, Popular, Bombay.
Sharma Suresh	Tribal Identity and modern world, Sage Publication, New Delhi, 1994
Singh, K.S :	Tribal Situation in India, Indian Institute of Advanced, Simla, 1972.
Singh K.S.	Tribal movements in India, Vol-I and II,
Doshi, S.L. and Jain, P. C.	Introduction to Anthropology, Rawat, New Delhi, 1997.

Raha, Manish Kumar:	Tribal India: Problem of Development, New Delhi, 1997
Harasukar, Laxmi	The tribes and their development, Current, Agra, 2005
Devi, Upadhyay, V.S. and Pandey Gaya,:	History of Anthropological Thought, Concept, New Delhi, 2002
Relevant Articles in Journals:	(1) Hakara, (2) Social Change, (3) Man in India and (4) Tribal Research Bulletin

Note: Any other text/ article/reference book suggested by the teacher.

M. A. [Sociology] New Syllabus M. A. Part – I; Semester -II
Course No. DSE –16 SOCIAL EXCLUSION AND SOCIAL INCLUSION

1] To introduce to the students the concepts of social exclusion and social inclusion.
2] To understand the Indian society from the vantage point of social exclusion and social inclusion.

Course Outcomes:

1) To understand the significance of Social Exclusion and Social Inclusion. Classify theories of Social Exclusion of Dr. B. R. Ambedkar and David Hardiman.
2) To understand the history of Social Exclusion and Inclusion in India.
3) To understand the Caste, Gender and Minorities as a mechanism of Social Exclusion.
4) To study the Social Exclusion and Inclusion Policies in India.

		Lecture Hours Per Unit
Unit - I	Social Exclusion and Social Inclusion: A] Meaning and Nature B] Scope and Significance C] Theories of Social Exclusion (Dr. B. R. Ambedkar and David Hardiman)	15
Unit - II	History of Social Exclusion and Inclusion in India: A] Social Reform Movements: Periyar Ramaswami, V. R. Shinde B] Social Revolutionary Movements: Mahatma Phule, Chh. Sahau Maharaj, Dr. B. R. Ambedkar.	15
Unit - III	Caste, Gender, Minorities and Social Exclusion A] Caste as a mechanism of Social Exclusion B] Gender and Social Exclusion. C] Positions of SCs/STs/ OBCs/ DTs/NTs/ Women and Minorities.	15
Unit - IV	Social Exclusion and Inclusive Policies in India A] Natural /Ecological Resources and Weaker Sections B] Politics of Inclusive Policies C] Globalization and Social Exclusion and Social Inclusion.	15

Readings:

Ram, Ahuja: Society in India, Rawat, 2004.

Rao, Shankar: Sociology of Indian Society, S. Chand & Company, New Delhi, 2004.

Ghurye, G.S: Caste and Race in India, Popular, Bombay, 1969.

Guha, Ranjit (ed.) Subaltern Studies: Writings on South Asian History and Society, Oxford, Delhi, 1982.

Michael, Haralambos (with Robin Heald): Sociology: Themes and Perspectives, 13th Ed., Oxford University Press, Delhi, 1994

Forbes, G. Women in Modern India. New Delhi, Cambridge University Press, 1998.

Oakley, Ann.: Sex, Gender and Society. New York: Harper and Row Waters, 1972.

Malcolm: Globalization. London: Rutledge, 1996.

Beteille, Andre:	The Backward Classes in contemporary India, Delhi. Oxford University Press, 1992.
Jogdand, P.G.,	New Economic Policy and Dalits (Jaipur: Rawat) 2000
Jogdand P.G.,	Dalit Movement in Maharashtra, Kanak Publications, New Delhi, 1991.
Karade Jagan(Ed)	Caste Discrimination, Rawat Publication, Jaipur 2015
Karade Jagan(Ed)	Caste based Exclusion, Rawat Publication, Jaipur 2015
Zelliot, Eleanor	From Untouchable to Dalit: Essays on the Ambedkar, Movement, New Delhi, Manohar, 1995.
Ambedkar, B. R	The untouchables: Who were they and why they become untouchables, New Delhi, 1948
Amrit	Collected Works of PERIYAR E.V.R. Vol. I. Madras, The Periyar Institution, 1991.

Note: Any other text/Article suggested by the subject teacher.

M. A. [Sociology] New Syllabus M. A. Part – I; Semester -II

Course No. DSE-17 SOCIOLOGY OF RELIGION

Specific Objectives:

1] To introduce the students to the subfield of Sociology of Religion.

2] To acquaint with the interface between religion and society, contestation over religion and social change in relation to religion in India.

Course Outcomes:

1) To understand the Sociological Theories and Religious Practices of Religion.
2) To understand the Socio-Historical Perspective of different Religions in India.
3) To understand Communal Harmony and Problems of Religious Minorities in India.
4) To study the Social Change taken place due to Socio-Religious Movements.

		Lecture Hours Per Unit
Unit - I	Religion and Society A] Sociological theories of religion. B] Types of religious practices: animism, monism, pluralism, sects, cults. C] Religion in modern society: religion and science, secularization, religious revivalism, fundamentalism	15
Unit - II	Religions in India: Socio-historical Perspective, Demographic profile and Contemporary Trends: A] Hinduism; B] Jainism, Buddhism and Sikhism; C] Christianity and Islam.	15
Unit - III	Communal Harmony and Religious minorities A] Role of Religion in communal harmony B] Problems of Religious minorities	15
Unit - IV	Religion and Social Change: A] Socio-religious movements. B] Impact of popular religiosity and emerging cults.	15

Readings:

Baird Robert D. (Ed.)	Religion in Modern India" Manohar, Delhi, 1995.
Madan, T.N.(Ed.)	"Religion in India", Oxford University Press, New Delhi, 1992.
Muzumdar, H.T.	"India's Religious Heritage" Allied New Delhi, 1986.
Roberts Keith A	"Religion in Sociological Perspective", Dorsey Press, New York, 1984.
Schermerhorn, R.A.	"Ethnic Plurality in India" University of Arizona Press, Arizona, 1978.
Prabhu, Pandharinath H.	"Hindu Social Organization: A Study in Socio-Psychological and Ideological Foundations", Popular Prakashan, Bombay, 1963.
Sangave, Vilas A.	"Jain Community: A Social Survey" Popular Prakashan, Bombay, 1980.
Desouza, Leela:	Sociology of Religion",
"Pias, Richard	"Sociology of Religion"
Salve R.N.	"Buddhism and Education" Shruti, Jaipur, 2008
Haralambos and Holborn,	Sociology:Themes and Perspectives, Collins Publication, 2008.

Nadeem Husnain Indian Society & Culture: Continuity and Change, Palaka Prakashan, Delhi.

Note: Any other text/ article/reference book suggested by the teacher.

M. A. [Sociology] New Syllabus M. A. Part – I; Semester -II

Course No. IDS-18 POLITICAL SOCIOLOGY

Specific Objectives:

1] To introduce the students to the basic concepts in and field of political sociology.
2] To orient the students to the various theoretical approaches in Political Sociology and political processes in India.

Course Outcomes:

1) To understand various theoretical approaches in political sociology.
2) To understand political participation and political bureaucracy in India.
3) To know the contemporary political issues and challenges of different political parties in India.

		Lecture Hours Per Unit
Unit - I	Political Sociology: A] Meaning, Nature and Scope of Political Sociology B] Development of political sociology C] Political Sociology and Social Sciences D] Concept of Nation –State and Nationalism	15
Unit - II	Theoretical Approaches A] Ideology and Politics in India B] System Analysis Approach C] Elite theories of power (Vilfredo Pareto, C. W. Mills, and Mosca); D] Input-output Approach.	15
Unit - III	Political Participation and Political Socialization A] Political socialization: - Meaning, Significance and Agencies; B] Pressure group and Interest groups; C] Political Bureaucracy: Characteristics D] Political Recruitment and Political Culture.	15
Unit - IV	Contemporary Issues and Challenges A] Politics in Plural Societies B] Political Parties- composition & functions C] Political Participation in India D] Welfare state and Democracy in India	15

Readings:

Harold D. Lasswell: On Political Sociology, The University of Chicago Press, Chicago, 1997

Bottomore: Elites and Society, Harmondsworth, Penguin, 1966/ Thomas Nelson and Sons Ltd. London, 1971

Bhambri C.P.:	Bureaucracy and Politics in India, Vikas Publications, Bombay, 1971.
Jangam, R.T.:	Text Book of Political Sociology, Oxford and IBH Publishing co. 1980.
S.N.Elsentadt (Ed.)	Political Sociology Vol I & II, Rawat Publications, 1989.
Kothari, Rajni:	Politics in India, Orient Longman, New Delhi, 1970.
Nehru Jawaharial:	The Discovery of India, Meridian Books, London, 1951.
Dowse R.E. and Huges:	Political Sociology, New York, Basic Books, 1971.
Horowitz, Irving L.:	Foundation of political sociology, New York, Harper & Row 1972.
Runciman, W.G.:	Social sciences & political theory, Cambridge University Press, London, 1965.
Samuel P. Huntington:	Political order in changing societies, Yale university press, New haven, 1969.
Almond A. Gabriel et. Al:	Crises choice & change, Historical studies Of Political development, Boston, 1973.
Rajani Kothari (ed):	Caste in Indian Politics, Orient Longmans Ltd, 1973.
Barrington Moore Jr.P:	Political power and social theory, Cambridge, Harward University Press, 1958.
R. Bhaskaran:	Sociology of politics tradition & politics in India, Asia publishing house Bombay, 1967.
V.B. Damle:	Caste, Religion & Politics in India, Oxford & IBM publishing company New Delhi, 1982.

Note: Any other text/ article/reference book suggested by the teacher.

M. A. [Sociology] New Syllabus M. A. Part – I; Semester –II

Course No. IDS-19 SOCIOLOGY OF MASS COMMUNICATION

Specific Objectives:

1] To sensitize the students about the importance of social dimensions of communication and interrelationships between society and communication process.

2] To bring awareness among the students about the rapid and profound social, economic, cultural and political changes due to Information and Communication Technologies (ICT's).

Course Outcomes:

1) To understand the various concepts of Communication.
2) To understand the Theoretical approaches of Mass Communication.
3) To understand the Rise and Growth of Mass Media in India.
4) To understand the different emerging issues related with Mass Media.

		Lecture Hours Per Unit
Unit - I	Concepts of Communication	15
	A] Communication, Elements of Communication	
	B] Folk Media and Mass Media: Nature and Characteristics	
	C] Transition from pre industrial to Information Society	
	D] Folk Culture and Popular Culture	
Unit - II	Theoretical approaches	15
	A] Functionalist perspective	
	B] Marxist Critical Perspective	
	C] Liberal perspective	
	D] Second Age Media Thesis	
Unit - III	Rise and Growth of Mass Media	15
	A] Print Media – Past and present	
	B] Changing Nature of Electronic Media	
	C] Internet and Concept of New Social Media	
	D] Impact of media on Society	
Unit - IV	Emerging Issues	15
	A] Digitization and Digital divide	
	B] Social Responsibility and Cyber Security	
	C] Media and Social Change	
	D] Media and Socialization	

Readings:

McQuail, Denis:	Mass Communication theory: Sage, New York, 2000.
Arvind Singhal and Rogers Everett:	India's Communication Revolution from Bullock Carts to Cyber Mart, Sage Publications, New Delhi, 2000.
Ambekar J. B:	Communication and Rural Development, Mittal Publication, New Delhi, 1992.
Melkote Shrinivas:	The Information Society, Sage, New Delhi.
Ault Emery, Agee, Dodd:	Introduction to Mass Communications, Mead and Company, 1963.
Curran, J. and M. Gurevith (eds.):	. Mass Media and Society, Edward Arnold, Sage, London
French, D. and Michal Richard (eds.):	Television in Contemporary Asia, Sage, London, 2000.
Preston, P:	Reshaping Communications. Sage London, 2000.
Zachariah Aruna:	Communication Media and Electronic Revolution, Kanishka, New Delhi, 1986
Relevant Articles from the Journals	Media Asia, Communicator, Social Change, University News,

Note: Any other text/ article/reference book suggested by the teacher.

Course No. IDS -20 CRIMINOLOGY

Specific Objectives:

1] To equip the students with recent conceptual and theoretical perceptions
2] To impart the students with correctional measures and programmes/agents in sphere of criminal justice administration, particularly in the prisons and correctional institutions.

Course Outcomes:

1) To understand the concept and theoretical approaches to crime.
2) To know the various perspectives on crime causation.
3) To understand the theories of punishment such as Retributive, deterrent and reformative.
4) To know the various Correctional Programmes / Correctional Institutions in India.

		Lecture Hours Per unit
Unit - I	Conceptual Approaches to Crime A] Legal, Behavioural and Sociological B] Crime and Delinquency C] Types of crime- Economic, Violent, White-collar crime	15
Unit - II	Perspectives on Crime Causation A] Classical, Positivist and Psychological B] Sociological, Marxian and Geographical C] Criminal Personality and Labeling	15
Unit - III	Theories of Punishment A] Retributive and deterrent B] Reformative C] Kinds of Punishment	15
Unit - IV	Correctional Programmes A] Meaning and significance and forms of correction programmes/correctional institutions B] Prison Structure and Prison Management C] Role of Victim in Crime, Types of Victims	15

Readings:

Bedi, Kiran. It Is Always Possible. New Delhi: Sterling Publications Pvt. Ltd. 1998.

Gill, S.S. The Pathology of Corruption. New Delhi: Harper Collins Publishers, India, 1998.

Goel, Rakesh M. and Manohar S. Powar. Computer Crime: Concept, Control and Prevention. Bombay: Sysman Computers Pvt. Ltd., 1994.

Lilly, J. Robert, Francis T. Wallen and Richard Ball A. Criminological Theory, Context and Consequences. New Delhi: Sage Publications, 1995.

Makkar, S.P. Singh and Paul C. Friday. Global perspectives in Criminology. Jalandhar: ABC Publications. 1993

Ministry of HomeAffairs.	Crime in India. New Delhi: Government of India, 1998.
Reid, Suetitus.	Crime and Criminology. Illinayse: Deydan Press, 1976.
Shankardas, Rani Dhavan,	Punishment and the Prison: India and International Perspective. New Delhi: Sage Publications, 2000.
Sutherland, Edwin H. and Donald R. Cressey.	Principles of Criminology. Bombay: The Times of India Press, 1968.
Walklete, Sandra.	Understanding Criminology. Philadelphia: Open University Press, 1998.
Williams, Frank P. and Marilym D. Meshare.	Criminological Theory. New Jersey: Prentice-Hall, 1998.
Williamsan, Harald E.	The Correction Profession. New Delhi: Sage Publications, 1990.
Bequai, August.	Computer Crime. Toronto: Lesington Books, 1978.
Buckland, John.	Combating Computer Crime: Prevention, Detection and Investigation. New Delhi: McGraw Hill, 1992.
Drapkin, Ismail and Viano, Emilio.	Victimology: A New Focus. London, Lesington Press, 1975.
Hallman, Taryl A.	The Economics of Crime. New York: St. Martin's Press, 1950
Inciarti James A. and Pottieger Anne E.	Violent Crime: Historical and Contemporary Issues. London: Sage Publications, 1978.
Ministry of Home Affairs.	Report of the All India Committee on Jail Reforms. 1980-83. New Delhi: Government of India.
Pace, Denay F.	Concept of Vice, Narcotics and Organized Crime. London, Prentice – Hall, 1991.
Revid, Jorathan.	Economic Crime. London, Kejan Paul, 1995.
Ryan, Patrick J. and George Rush.	Understanding Organized Crime in Global Perspective. London: Sage Publications, 1997.
Weisburd, Dand and Kip Schlegal	White Collar Crime Reconsidered. Boston: Northeastern University Press, 1990.
Ahuja Ram	Criminology, Rawat Publication, Jaipur, 2000.

Note: Any other text/ article/reference book suggested by the teacher.

M. A. [Sociology] New Syllabus M. A. Part – I; Semester –II

Course No. IDS - 21 SOCIOLOGY OF SOUTH ASIA

Specific Objectives:

1) To expose the student to the strategic importance of South Asia as a civilizational centre as well as a player in international affairs and to acquaint her/him with the social cultural, economic, religious and political similarities and differences between the countries of the region.
2) The student should be acquainted with the processes which have shaped the emergence of nation states in the region, the play of ethnic, regional and religious identities and conflicts in this process.

Course Outcomes:

1) To understand the Culture and Society of South Asia.
2) To understand the socio-economic features and importance of social and economic institutions in the region.
3) To know the political systems, democracy and ethnic conflicts in the region.
4) To understand Demographic Change and Socio-economic Development in the South Asian Countries.

	Lecture Hours Per unit
Unit – I South Asia region A] South Asia culture B] South Asia society	15
Unit – II Socio-economic features and importance A] Social and economic institutions B] Demographic features C] Geographical D] Political importance.	15
Unit – III Political Systems and Democracy A] Political regimes, religion, B] Politics and the state ethnicity, C] Ethnic conflicts D] Sub-national movements	15
Unit – IV Change and Development A] Migration and Population movements. B] Socio-economic development and demographic change. C] Conflict and cooperation between South Asian states. D] Gender and society.	15

Readings:

Bjorkman, J.W. 1987. The Changing Division of Labour in South Asia. New Delhi: Manohar.

Frnacis Robinson, 1989 : Cambridge Encyclopedia of India, Pakistan, Sri Lanka,

Bepal, Bhutan and Maldives : Cambridge : Cambridge University Press.

Chaudhary, Jamil 2000 Cultural Cooperation in South Asia : The Search for Community. NewDelhi : Manohar.

Dube, Leela, 1997. Women And Kinship : Comparative Perspectives on Gender in South and South East Asia. New Delhi : Sage Publications.

Farmer, B.H., 1983 : An Introduction to South Asia : London : Methuen

Gamage, Siri and I.B. Watson (Eds.) 1999. Conflict and Community in Contemporary Sri Lanka. New Delhi : Sage Publications.

Ganguli, R. 1998. Kin State Intervention in Ethnic Conflicts : Lessons from South Asia. New Delhi : Sage Publications.

Gough, K. and Hari P. Sharma (eds.) 1973. Imperialis and Revolution in South Asia, New York : Monthly Renew Press, (article by Hamza Alvi)

Kudasiya, G. 1995. The Demographic Upheaval of Partition Refugees and AgriculturalResettlement in India 1947-87, South Asia, Special Member, pp. 73-95.

Kumar, Dharma (ed.) 1982. The Cambridge Economic History of India. Vol. II, Cambridge : Cambridge University Press.

Mallick, Ross. 1998. Development, Ethnicity and Human Rights in South Asia. New Delhi : Sage Publications.

Pfaff – Czarnecka, Joanna, Darini Rajasingham – Senanayaka, et.al. 1999. Ethnic Futures : TheState and Identity Politics in Asia. New Delhi : Sage Publications.

Phadnis Urmila. 1990. Ethnicity and Nation Building in South Asia. New Delhi : Sage Publications.

Samaddar, R. 1999. The Marginal Nation : Transborder Migration from Bangladesh to WestBengal, New Delhi : Sage Publications.

Shand, Ric. (ed.) 1999. Economic Liberalization in South Asia. New Delhi Macmillan India Ltd.

Smith Donald E. (ed.) 1966. South Asian Politics and Religion. Princeton, New Jerssey : Princeton University Press.

Stein, Burton and Sanjay Subramanian (eds.) 1997. Institutions and Economic Change in SouthAsia. New Delhi : Oxford University Press 1997.

References

Diamond, L., J.Linz and S.M.Lipset (eds.) 1989. Democracy in Aisa. New Delhi : Sage Publications.

Maloney, C. (ed.) 1974. South Asia : Seven Community Profiled. New York : Holt, Rinehartand Winston.

Robb, Peter. 1995. Concept of Race in South Asia : Understanding and Perspectives. London :Oxford University Press.

Rothermund, Dietmar. 2000. The Role of the State in South Asia and Other Eassays. New Delhi, Manohar.

Sengupta, Bhabani, 1988. South Asian Perspectives : Seven Nations in Conflict and Co-operation. Delhi : B.R. Publishing Corporation.

Tambiah, S. 1997. Levelling Crowds : Ethnonationalist Conflicts and Collective Violence in

South Asia. New Delhi : Sage Publications.

Wilson, A.J. and Dennis Dalton (eds.) 1982. The State of South Asia : Problems of National Integration. London.

Note: Any other text/ article/reference book suggested by the teach

M. A. [Sociology] New Syllabus M. A. Part – I; Semester –II

Course No. IDS – 22 SOCIOLOGY OF SANITATION PART – B

Specific Objectives

1] To enhance sociological understanding about the Sanitation, society and culture.
2] To develop insights for sociological analysis of Sanitation issues in India.

Course Outcomes:

1) To understand the Social Structure and Sanitation issues in India.
2) To know the importance of toilet as tool of social change.
3) To understand various sanitation programmes in India.
4) To understand the problems of environmental sanitation in India.

Lecture Hours Per unit

Unit – I Social Structure and sanitation: 15
A] Practice of Scavenging
B] Caste and class of scavenging
C] Gender and sanitation
D] Children and sanitation

Unit – II Toilet as a tool of social change: 15
A] Origin of Toilets and its benefits
B] Toilet and social change
C] Sanitation programmes in India
D] Sulabh sanitation Movement in India

Unit- III Environmental Sanitation: 15
A] Concept of Environmental sanitation
B] Water and Sanitation
C] Environment and social sanitation
D] Problems of Environmental sanitation in India

Unit -IV State and sanitation in India: 15
A] Policies and programmes of sanitation
B] Liberation and Rehabilitation of scavengersC] Globalization and sanitation

Readings:

Bindeshwar Pathak: Sociology of Sanitation, Kalpaz Publications, New Delhi, 2015

B. K. Nagla: Sociology of Sanitation, Kalpaz Publications, New Delhi,

2015Richard Pais: Sociology of sanitation, Kalpaz Publications, New

Delhi, 2015

Ashis Saxena: Sociology of Sanitation: Themes and Perspectives, Kalpaz Publications, NewDelhi, 2015

Mohmmad Akram: Sociology of Sanitation, Kalpaz Publications, New Delhi, 2015

A. S. Bagela: Swachhata Ka Samajshasta, Kalpaz Publications, New Delhi, 2015

P.S. Vivek: World of Garbage and Waste: Undercurrents of Swatchh Bharat and Sabka Vikas in India, Himalaya Publishing House, Mumbai, 2015.

Leela Visaria: Sanitation in India with focus on Toilets and Disposal of Human Excreta, GyanPublishing House, New Delhi, 2015.

Hetukar Jha: Sanitation in India: A Historico-Sociological Survey, Kalpaz Publications, New Delhi, 2016

Bhartiya Samajshasta Sameeksha, Sociology of Sanitation, July- December 2016, vol.3, No.2

Note: Any other text/ article/reference book suggested by the teacher.

M. A. [Sociology] New Syllabus M. A. Part – I; Semester –II

Course No. SEC – 02 ENVIRONMENTAL IMPACT ASSESSMENT

Specific Objectives:

1) This course aims to introduce the concepts, procedures and methods of Environmental Impact Assessment (EIA).

2) The purpose of EIA is to promote environmental considerations in planning and decision-making processes in order to arrive at measures that avoid or minimize adverse environmental impacts.

Course Outcomes:

1) To understand the concept of environmental impact assessment and sustainable development.
2) To understand the methodology and processes of environmental impact assessment.

Lecture Hours Per unit

Unit-I Introduction to Environmental Impact Assessment 15

A] Concept and aspects of Environment- Definition, Background, Sustainable Development

B] Environmental Sustainability

C] Environmental Impact Assessment- History, Definition, Benefits

D] Legal, Policy and Regulatory Framework in Indian Context

Unit-II Introduction to Environmental Impact Assessment 15

A] Environmental Impact Assessment Methodologies

B] Environmental Impact Assessment Process- Alternative, Screening, Scoping, Impact Analysis and Mitigation

C] Public involvement in Environmental Impact Assessment

D] Environmental Impact Assessment case examples

Books and references

1) Wathern P., *"Environmental Impact Assessment: Theory and Practice"*,Routledge Publishers,1990

2) Marriott B., *"Environmental Impact Assessment: A Practical Guide"*,McGraw-Hill Publication,1997

3) Shrivastava A.K., Baxter Nicola, Grimm Jacob, *"Environmental Impact Assessment"*, APH Publishers, 2003

4) Anjaneyulu Y., Manickam Valli, *"Environmental Impact Assessment Methodologies",* CRC Press 2011

5) Glasson J., Therivel Riki, Chadwick Andrew, *"Introduction to Environmental Impact Assessment"*, Oxford Brookes University 2012/ 4th edition

Note: Any other text/Article suggested by the subject teacher.

M. A. [Sociology] Syllabus: M. A. Part – I; Semester – II [To be introduced w.e.f. August 2022 Under Academic Flexibility]

Course No. RP - 01	**RESEARCH PROJECT**

Specific Objectives:

1] To provide practical training to the students in order to develop research skills required for various phases in the process of research.

2] To develop the students' report writing skill and to encourage them to pursue career in the field of social research (particularly survey research).

			Hours
	Students will be individually guided and trained for the following major phases in survey research:		
	1.	Selection of Topic, Formulation of Research Topic and Review of relevant Literature	05
	2.	Defining the Scope of the proposed study.	02
	3.	Formulation of Research Design for the proposed study	02
	4.	Preparation for Sampling Design for the proposed study	02
	5.	Designing Instrument of Data Collection	05
	6.	Fieldwork/ Collection of Data by using designed tools.	20
	7.	Editing and Coding of the Data	05
	8.	Using SPSS for Computer feeding of data	05
	9.	Using SPSS for generating statistical output; Tables and Graphs	02
	10.	Interpreting Data and Writing a Project Report.	12
			60 hrs.

Sr. No.	**RULES REGARDING SUBMISSION OF M. A. RESEARCH PROJECT:**
1	Admitted students of the department equally divided among the existing faculty members to complete their Research Project.
2	The language for Research Project will be English/Marathi.
3	A candidate should submit two copies of the Research Project before appearing at the Semester II Theory Examination [CD containing soft copy in PDF format should be submitted along with Dissertation.]
4	Size of the Paper: A4 size paper should be used for the Research Project. A margin of 1 ½" to be on the lefthand side and bound in standardized form.
5	Degree, Year and Name of the student and Guide and Title should be printed neatly and legibly on the front cover. Rule for Font Size, Headings, Cover Page will be applicable as per suggestions of the department.
6	Research Project should be typed with one and half line space between two lines on both sides of the paper. The length of Research Project has to be above 100 pages. Good quality paper should be used for the Research Project.
7	Outline of Chapterization will be as under: First chapter: Introduction Second chapter: Review of literature.
	Third chapter: Methodology of the Study. Fourth chapter: Data analysis and Interpretation. Fifth chapter: Summary, Conclusion and Suggestions. Bibliography
8	Research Project will be evaluated by one external referee for 80 marks and viva-voce examination will carry 20 marks. The viva will be conducted by the research guide as an internal examiner and the external referee.
9	For evaluation of Research Project submitted by the candidates an external examiner will be invited at the end of M.A. II Semester.

Estd. 1962
"A"" Accredited by NAAC(2021) With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR - 416004, MAHARASHTRA
PHONE : EPABX – 2609000,
www.unishivaji.ac.in, bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर - ४१६००४,महाराष्ट्र
दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दुरध्वनी विभाग २३१–२६०९०९३/९४

SU/BOS/Science/ 18 **Date:** 01-10-2022

To,
The Principal,
All Affiliated Concerned Science Colleges/Institutions
Shivaji University, Kolhapur.

Subject :- Regarding syllabi of M.Sc. & B.Sc. (NEP-2020) degree programme under the Faculty of Science and Technology as per National Education Policy 2020 .

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the syllabi and Nature of question paper of **M.Sc., & B. Sc.** under the Faculty of Science and Technology **as per National Education Policy 2020 .**

Sr. No.	Faculty of Science and Technology	Programme/ Course
1	Environmental Science, Engineering and Technology	M. Sc. Part- I Environmental Science, B. Sc. Part- I Environmental Science, (Entire)

This syllabi and nature of question paper shall be implemented from the Academic Year 2022-2023 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in (students Online Syllabus)

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

By Registrar

Copy to:

1	The Dean, Faculty of Science & Technology	7	Appointment Section
2	Director, Board of Examinations and Evaluation	8	P.G.Seminar Section
3	The Chairman, Respective Board of Studies	9	Computer Centre (I.T.)
4	B.Sc. Exam	10	Affiliation Section (U.G.)
5	Eligibility Section	11	Affiliation Section (P.G.)
6	O.E. I Section	12	P.G.Admission Section

M.Sc. Environmental Science

Programme Structure and Syllabus
(Level 8)

Choice Based Credit System (CBCS) with Multiple Exit option (NEP 2020)

ACADEMIC SESSION
(w.e.f. 2022-2023)

DEPARTMENT OF ENVIRONMENTAL SCIENCE,

SHIVAJI UNIVERSITY, KOLHAPUR

Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)
M.Sc. Environmental Science Programme Structure
M.Sc. Part – I (Level-8)

SEMESTER-I (Duration- Six Month)												
	Sr. No.	Course Code	Teaching Scheme			Examination Scheme						
			Theory and Practical			University Assessment (UA)			Internal Assessment (IA)			
			Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours	
CGPA	1	CC-101 Global Environmental Issues	4	4	4	80	32	3	20	8	1	
	2	CC-102 Environmental Chemistry and Instrumentation Techniques	4	4	4	80	32	3	20	8	1	
	3	CC-103 Environmental Ecology and Biodiversity	4	4	4	80	32	3	20	8	1	
	4	CC-104 Environmental Geosciences, GIS and Remote Sensing	4	4	4	80	32	3	20	8	1	
	5	CCPR-105 Environmental Chemistry, Ecology and Biodiversity	16	16	8	200	80	--	--	--	*	
Total (A)			--	--	**24**	**520**	--	--	**80**	--	--	
Non-CGPA	1	AEC-106	2	2	2	--	--	--	50	20	2	

SEMESTER-II (Duration- Six Month)

CGPA	1	CC-201 Air and Noise Pollution with its control	4	4	4	80	32	3	20	8	1
	2	CC-202 Water pollution and its control	4	4	4	80	32	3	20	8	1
	3	CC-203 Solid and Hazardous Waste Management	4	4	4	80	32	3	20	8	1
	4	CC-204 Energy studies	4	4	4	80	32	3	20	8	1
	5	CCPR-205 Environmental Sampling of Air, Water, Soil and Analysis	16	16	8	200	80	--	200	80	*
Total (B)			--	--	**24**	**520**	--	--	**80**	--	--
Non-CGPA	1	SEC-206	2	2	2	--	--	--	50	20	2
Total (A+B)					**48**	**1040**	--	--	**160**	--	--

- Student contact hours per week : **32** Hours (Min.)
- Theory and Practical Lectures : **60** Minutes Each
- CC-Core Course
- CCPR-Core Course Practical
- AEC-Mandatory Non-CGPA compulsory Ability Enhancement Course
- SEC- Mandatory Non-CGPA compulsory Skill Enhancement Course

- Total Marks for M.Sc.-I : **1200**
- Total Credits for M.Sc.-I (Semester I & II) : **48**
- Practical Examination is annual.
- Examination for CCPR-105 shall be based on Semester I Practicals.
- Examination for CCPR-205 shall be based on Semester II Practicals.
- *Duration of Practical Examination as per respective BOS guidelines

	• *Separate passing is mandatory for Theory, Internal and Practical Examination*
• **Requirement for Entry at Level 8:** **Completed all requirements of the relevant Bachelor's degree (Level 7) with principal / major subjects B. Sc. Degree in any subject, including B.Sc. in Agriculture, Horticulture, Forestry**	
• **Exit Option at Level 8:** Students can exit after Level 8 with **Post Graduate Diploma in Environmental Science if** he/she completes the courses equivalent to minimum of 48 credits.	

Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)
M.Sc. Environmental Science Programme Syllabus
M.Sc. Part – I (Level-8)

- **PROGRAMME OUTCOMES (PO'S)**

The post graduates are able to

PO-1) Acquire in–depth knowledge and integrate with existing knowledge to sensitize the people about global and local environmental issues.

PO-2) Develop an ability to identify, critically analyze, formulate and solve environmental problems using basic principles of nature conservation.

PO-3) Get acquainted with environmental and social impacts of any developmental activity.

PO-4) An ability to design a system and process to meet desired needs of society within realistic limitations such as health, safety, security and environmental considerations.

PO-5) An ability to design and conduct experiments, interpret data, and provide well informed conclusions.

PO-6) Communicate effectively socio-economic problems related to environment by appropriate documentations and presentations.

PO-7) Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-8) Apply ethical principles and commit to professional ethics and responsibilities and follow the norms of the any surrounding practice.

- **PROGRAM SPECIFIC OUTCOMES (PSO's):**

PSO-I: Professional skills

Ability to monitor the present status of environmental parameters through monitoring for design and development of new concept or technology.

PSO-II: Industrial Skills

Successfully tackle with the industrial pollution problems through appropriate technology and tools.

PSO-III: Environmental and Social values within individual

Inclusion of environmental and social values within the individual's life.

PSO-IV: Problem Solving approach:

Identify, formulate, review literature and analyze complex environmental problems and suggest suitable solutions reaching substantiated conclusions using first principles of natural science.

PSO-V: Successful development of Career and Entrepreneurship

To prepare the students with broad environmental perspective and become a successful in career and entrepreneurship.

PSO –VI: Modern tool usage:

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with understanding of the limitations.

M.Sc. Part I
Sem. I (Duration Six Months)

Sr. No.	Course Code	Title of the course
1.	CC-101	Global Environmental Issues
2.	CC-102	Environmental Chemistry and Instrumentation Techniques
3.	CC-103	Environmental Ecology and Biodiversity
4.	CC-104	Environmental Geosciences, GIS and Remote Sensing
5.	CCPR-105	Environmental Chemistry, Ecology and Biodiversity
6.	AEC- 106	

M.Sc. Part I
Sem. II (Duration Six Months)

Sr. No.	Course Code	Title of the course
1.	CC-201	Air and Noise Pollution with its control
2.	CC-202	Water pollution and its control
3.	CC-203	Solid and Hazardous Waste Management
4.	CC-204	Energy studies
5.	CCPR-205	Environmental Sampling of Air, Water, Soil and Analysis
6.	SEC -206	

CC-101: Global Environmental Issues

After completion of the course, the students are able to

CO1: Get acquainted with the scope and multidisciplinary nature of environmental science.

CO2: Familiarise with the global environmental issues and Climate change.

CO3: Get acquainted with National & Global Environmental Initiatives.

CO4: Understand the basics of environmental education.

Syllabus

Unit -1

a) Introduction to Environmental Science: **(15)**

Meaning, scope and interdisciplinary nature of Environmental Science, Principles, Background and scope of Environmental Science, Applications of Environmental Science, environmental ethics, Environmental consciousness, Western and Eastern views

b) Environmental Education

Environmental Education: history, concept, goals, objectives and guiding principles, Strategies for EE development, Models for future EE System, Awareness and action through environmental education.

Unit- 2 Global Warming and Climate Change: **(15)**

a) **Global warming** : introduction, greenhouse gases, greenhouse effect, Global warming, possible impacts of global warming,
b) **Climate Change:** Climate change and Clean Development Mechanism, Carbon Sequestration, Concept of Carbon trading and Carbon credits.

Unit -3 Ozone problem and other environmental problems: **(15)**

a) Ozone in the atmosphere, Ozone depletion process, Ozone hole, Consequences of Ozone depletion.
b) Acid rain, Biodiversity loss, Desertification: causes, effects and remedies, El-Nino, La-Nina, Impacts of El-Nino.

Unit- 4 National & Global Environmental Initiatives **(15)**

International Initiatives towards Environmental Protection: Stockholm Conference, Earth Summit, World Summit on Sustainable Development, Rio+20, Ramsar Convention, Vienna Convention, Montreal Protocol, Kyoto Protocol; Sustainable Development Goals; Ecomark Scheme

References:

1. Environmental Science - Arms Karen, Holt McDougal , 1996.
2. Principles of Environmental Science-Watt, K. E. F. (1973) McGraw-Hill Book Company.
3. Environmental Science –Noble, B .J. Kormandy, E.J.(1981),The way world works, Prentice-Hall Inc., N .J.
4. Environmental Science-Turk A., Turk J. Wittes J.T. and Wittes, R.E.
5. Environmental Issues: Measuring, Analyzing, Evaluating, Abel, Daniel C. McConnell, Robert L. Abel, Daniel C. Edi. 2 Prentice Hall Publication.
6. Environmental Science, S.C. Santra, New Central agency Pvt. Ltd.

CC-102: Environmental Chemistry and Instrumentation Techniques

After completion of the course, the students are able to

CO1: Understand the basic concepts in environmental chemistry.

CO2: Identify the chemical nature of air pollutants.

CO3: Analyse the chemistry of water and soil pollutants.

CO4: Study the working of different equipment's used for environmental analysis.

Syllabus

Unit – 1 Concepts in Environmental Chemistry **(15)**

a) Environmental Chemistry

Concept and scope of environmental chemistry, Chemistry of environmental segments - lithosphere, hydrosphere, atmosphere, Stoichiometry, Gibb's energy; chemical potential; chemical equilibrium; acid - base reaction; solubility product; unsaturated and saturated hydrocarbons, radionuclide's. Organic chemicals in the environment, Inorganic chemicals in the environment, pesticides residues

b) Chemistry of soil:

Soil profile, Inorganic and organic components of soil, Classification of soil, Chemical factors affecting the soil quality, adsorption of contaminants in soil, Effect of modern agro-technology on quality of soil

Unit -2 Air & Water Chemistry **(15)**

a) Chemistry of Air:

Composition of air; particles ions and radicals in the atmosphere; chemical processes for formation of inorganic and organic particulate matter; thermo-chemical and photochemical reactions in the atmosphere, Oxygen and Ozone chemistry; photochemical smog.

b) Chemistry of water:

Structure and properties of water, Water quality parameters, Physicochemical concepts of colour, odour, turbidity, pH, conductivity, DO, COD, BOD, alkalinity, detection of Coliforms, Solubility of gases, carbonate system, redox potential

Unit – 3 **(15)**

a) Spectrometric Analytical Techniques

UV- Visible spectrophotometer, Flame photometry, atomic absorption spectrophotometry; Plasma Emission Spectroscopy; X-Ray Spectroscopy (X-Ray Fluorescence, X-Ray Diffraction); Fourier-transform Infrared Spectroscopy (FTIR); Nephelometry and Turbidimetry

b) Chromatographic Techniques

Chromatographic Techniques (Paper Chromatography, Thin Layer Chromatography, Gas Liquid Chromatography, High Performance Liquid Chromatography, Ion-exchange Chromatography); Electrophoresis

Unit -4 **(15)**

a) Microscopy Techniques and other useful instruments

Optical Microscopy (Brightfield and Darkfield, Phase Contrast, Fluorescence, Confocal); Electron Microscopy,(Scanning (SEM) and Transmission Electron Microscopy(TEM)

b) Instruments used in environmental monitoring:

Global Positioning System (GPS), Total Organic Carbon Analyzer (TOC), Total Kjeldas Nitrogen Analyzer (TKN), Electrophoresis, , Transmission Electronic Microscopy (TEM), GCMS, LCMS.

References:

1. Environmental Chemistry by B. K. Sharma S. H. Kaur Goel Publishing House, Meerut
2. Environmental Chemistry - A.K. De, New Age Int. Pub. Co., New Delhi, 1990
3. Toxic Chemicals, health and the Environment, Lave, L.B and Upton, A.C. 1987. The Hopkins Press Ltd., London.
4. Vogel's Textbook of quantitative Chemical analysis, 5th Edition-J. H. Basett, J. Nendham and Denny, R.C.
5. Instrumental Methods of analysis – Chatwal and Anand, Himalaya Publishing House, New Delhi.
6. Chemistry for Environmental Engineering, C. N. Sawyer and P L Mc Carty, McGraw Hill Kogakusha ltd., 1990
7. Fundamentals of Analytical Chemistry, 1982.Hobert H. Willard D.L. Merrit and J. R. J. A. Dean
8. Fundamental Concepts of Environmental Chemistry, G. S. Sodhi, Narosa Publishing House, New Delhi.

CC-103: Environmental Ecology and Biodiversity

After completion of the course, the students are able to

CO1: Demonstrate the structure and functions of Ecosystem.

CO2: Illustrate the different characteristics of population.

CO3: Enlist the characteristics of community and understand its dynamics.

CO4: Aware about the aquatic and terrestrial biomes with its importance.

CO5: Identify the role of microbes in soil, water and air environment.

Syllabus

Unit – 1 **(15)**

a) Ecosystem Dynamics:

Introduction, kinds of ecosystem, structure and function of ecosystem, food chain, food web, trophic level, ecological pyramids, energy flow models, ecosystem productivity, methods of measuring primary productivity, Ecosystem stability and regulation, biogeochemical cycles-cycling of water and nutrients.

b) Biomes: Structure of some typical ecosystems:

Bio-geographical realms, Classification of terrestrial biomes – Tundra, Taiga, Grassland, Desert, Evergreen and deciduous forests, Tropical rain forests

Classification of Aquatic Habitats: Fresh water pond, Wetlands, Rivers – their characteristics, flora and fauna;

Bio-geo-chemical Cycles: Gaseous and sedimentary cycles: Carbon cycle, Nitrogen cycle, Phosphorous cycle, Oxygen cycle.

Unit – 2 Population and Community ecology **(15)**

a) Population ecology:

Basic concepts of population ecology, population dynamics, characteristics of population: natality, mortality, fecundity, density, age distribution, relationships among organisms, population explosion, Community types and community composition.

b) Community ecology:

Characteristics of community, Composition, structure, origin and development of community, Characters used in community structure, Community dynamics, Succession: causes, types and general process of succession, Development of Hydrosere or hydrarch and Lithosere or xerosere,

Unit – 3 Biodiversity conservation

a) Biodiversity conservation **(15)**

Biodiversity as life support system for man, types of biodiversity, ecosystem, species and genetic, Values of biodiversity, Indian ethos of wildlife conservation, Hotspots of Biodiversity, Causes for loss of biodiversity, measurement of biodiversity; listing of threatened biodiversity.

b) Methods of biodiversity conservation – in situ conservation (sanctuaries, national parks and biosphere reserve); ex situ conservation (zoo, botanical gardens; gene/germ plasma banks).Convention on Biological Diversity (CBD), Biodiversity conservation efforts in the country.

Unit – 4 Environmental Microbiology **(15)**

a)Microbes in Environment:

Prokaryotes, classification of microbes, isolation of microbes, dispersal of microorganisms in extreme environments, Role of microorganisms in elemental cycles, Microbes as bio indicators in the environment.

Water microbiology:

Waterborne diseases, role of microorganism in treatment of wastewater.

b)) Air microbiology:

Aerobiology, allergies; role of microorganism in airborne diseases, Classification and enumeration of microbes in air, dust droplet and droplet nuclei.

Soil microbiology:

Important microbes for soil fertility, biodegradation of waste; soil borne diseases, Role of microbes in soil reclamation.

References :

1. Ecology - E.P. Odum, 1983, Holt-Saunders International Edition
2. Concepts of Ecology. E. J. Kormondy, 1984. Indian reprint 1991 Prentice-Hall of India.
3. Ecology and Environment, P. D. Sharma, Ashish publications, 1994.
4. Microbiology – Pelzar, Reid and Chan. Tata Mc Graw Hill Publishing Company Limited, 1996.
5. Environmental Science, S.C. Santra, New Central agency Pvt. Ltd.
6. Fundamentals of Ecology, M.C. Dash, Tata McGrow Hill Publishing Pvt. Ltd., New Delhi.
7. General Microbilogy, Stainer R.Y. , Mc Millan Press, New Delhi.
8. Microbial methods for Environmental Biotechnology, Grenar J.M., Academic Press, New Delhi.

CC-104: Environmental Geosciences, GIS and Remote Sensing

After completion of the course, the students are able to

CO1: Understand the universe, solar system Origin and evolution of biosphere

CO2: Know the basics of Atmosphere, structure, composition and dynamics

CO3: Understand the concepts in Meteorology and Climatology.

CO4: Relate the knowledge of remote sensing in understanding the basics of geography.

CO5: Apply the principles of GIS in solving various environmental problems and disaster Management.

Syllabus

Unit – 1 **(15)**

a) The universe and solar system

Brief introduction to universe, Sun - its structure and atmosphere, physical Characteristics of planets, brief description of – comets, asteroid, meteors, origin of earth.

b) Origin and evolution of biosphere

Origin and evolution of life, spontaneous generation of the life, abiogenic synthesis of low molecular weight organic compounds. Chemical evolution, prokaryotic and eukaryotic cellular evolution, Evolution of organelles and genetic basis for evolution

Unit -2 **(15)**

a) Atmosphere, structure, composition and dynamics

The vertical structure of atmosphere, composition of earth's atmosphere, thermal stratification, the ionosphere, D.E.F. and G regions, energy transfer near earth's surface, isolation, terrestrial radiation and heat balance of the earth.

b) Meteorology and Climatology

Concept of Weather, Climate, Meteorology and Climatology, Elements of Weather, Measurement of premise – Temperature, Air pressure, Turbulence, Wind, Rain, Humidity and Radiation. Wind systems of the world, El Nino, Monsoon phenomenon and its role in Indian subcontinent.

Unit -3 **(15)**

Principles of Remote Sensing, its Applications in Environmental Monitoring

Principles of remote sensing, EMR and its interaction with matter, types of sensors and platforms, IRS satellites and their sensors, aerial photography, satellite imagery, elements of aerial/satellite image interpretation, application of remote sensing in environmental studies.

Unit -4

Geographical Information System (GIS) **(15)**

Concept of GIS, Maps and GIS, cartography, digital representation of geographic data, types of geographical data, raster and vector based GIS data processing

Use of software's in Remote sensing and GIS to solve Environmental problems including Groundwater Exploration, Rainwater Harvesting, Biomass analysis and its relationship with Georesource evaluation, Sustainable Agriculture, Applications of Remote sensing and GIS in early warning of Tsunami, Earthquake, Snowfall, Global warming, Forest fire, Landslide, Land subsidence.

References:

1. Physical Geography - S. Strahler ,John Wiley and Sons,
2. Earth Science - Turbuck E. J.
3. Earths Dynamic Systems _ Hamblin W. K. and E. H. Christian
4. Planet Earth - Cesare Emiliani.
5.B.L.Wadehra; Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications; Universal law Publishing Pvt. Ltd., India 2000

CC-201: Air and Noise Pollution

After completion of the course, the students are able to

CO1: Explain the classification of air pollutants with its effects on biota

CO2: Explain the sampling and monitoring of air pollutants.

CO3: Explain the working principle of air pollution controlling equipment.

CO4: Understand the control measures of noise pollution

Unit -1 Basic concepts of Air pollution **(15)**

Air pollution

a) Natural and anthropogenic sources of air pollution, Classification of air pollutants, Indoor air pollution, air pollution episodes and disasters.

b) Effects of air pollution on human health, animals, plants, material and climate, Formation of fog and smog, acid rain, National Air Quality standards, laws governing behaviour of air pollutants, Air quality index.

Unit -2 Monitoring of Air Pollution: **(15)**

a) **Air pollutants sampling:** Sedimentation, High-volume Filtration, Tape sampler, Impingement and Electrostatic precipitator; Collection of gaseous air pollutants: Grab sampling, Absorption in liquid, Adsorption on solids, Freeze out sampling; Indoor Air Monitoring.

b) **Source Sampling:** Representative sampling, isokinetic sampling, Flue gas analyser, principles for monitoring COx, NOx, SOx, Hydrocarbon.
Air Pollutants Dispersion and Modelling: Meteorological aspects of air pollutants dispersion, Plume behavior; Gaussian Plume Model, Line source model and Area source model

Unit -3 Air pollution control technologies: **(15)**

a) **Particulate pollutants Control:** Gravitational Settling Chambers, Cyclonic separator, Fabric filter System, Electrostatic precipitators, Wet scrubbers
Gaseous Pollutants Control: Absorption; spray chambers (and towers or columns), plate or tray towers, packed towers, and venturi scrubbers; Adsorption, Pressure-Swing Adsorption (PSA), Condensation: Surface and contact condensers; Combustion: Direct-flame, thermal and catalytic combustion

b) **Vehicular Pollution Control**: Air-Fuel ratio, Catalytic convertor: Selective catalytic reduction (SCR), Selective non-catalytic reduction (SCNR), Bharat Stage Emission Standards (BSES).

Unit -4 Noise Pollution and its control: **(15)**

Noise Pollution

Definition; Sources; Decibel Scale, Sound Pressure Level, Combining Decibel, Frequency Weighting Networks, Noise Indices (L10, L50, L90, Leq, LDN, TNI). Noise & vibration measurement and noise standards, Sound level meter, Noise control and abatement measures: Active and Passive methods, Impact of noise and vibrations on human health.

References:

1. Waste water engineering, Met Calf and Eddy, INC, Tata Mc Graw Hill
2. Indian Standard for Drinking Water, BSI, New Delhi.
3. Environmental Pollution Control, C.S.Rao, Wiley Eastern Ltd.,1993
4. Air Pollution Control and Engineering, De Nevers, Mc Graw Hills, 1993.
5. Fundamentals of Air Pollution, Samuel, J.W., 1971, Addison Wesley Publishing
6. Fundamentals of Environmental Pollution, Krishnan Khannan, S. Chand and Company Ltd.,1994.
7. Noise Pollution, Vandana Pandey, Meerut Publishers,1995.

CC-202: Water Pollution and its Control

After completion of the course, the students are able to

CO1: Acquire the knowledge of basic rationale of water quality management.
CO2: Characterize the typical inorganic and organic pollutants from a variety of sources entering into water bodies.
CO3: Design and develop water purification techniques for safe drinking water and wastewater treatment technologies for abatement of water pollution.
CO4: Apply the knowledge of various methods for water resource management

Syllabus

Unit – 1

a) **Water Pollution** **(15)**

Principle forms of water pollution, sources of water pollution, Sampling of water, physicochemical and bacteriological analysis of water, water quality parameters, Eutrophication and recovery,

b) **Ocean pollution**-sources of pollution, Ballast water, Oil pollution effects, control.

Thermal pollution, **Ground water pollution** - sources of pollution, effects, control, Water quality standards, consequences of water pollution and control. Water quality index.

Unit – 2 Drinking Water Characteristics and Purification Techniques **(15)**

a) **Water Sources** – Availability and quality of Surface water and Groundwater, Water Requirements for Domestic Consumption (Population forecasting), Drinking water standards (physical, chemical & bacteriological),

b) Water Treatment process – Principal, process design and applications (Aeration, flocculation, Sedimentation, Filtration, Disinfections (Chlorination, UV, Ozonation), water softening

Unit -3 Wastewater Treatments **(15)**

a) **Primary treatments**-principle, flow measurement, screening, grit removal, skimming tank, equalization; sedimentation **Secondary treatments**- principle, coagulation, flocculation, filtration, chemical precipitation, membrane filtration, Activated Sludge Treatment Process, Trickling filter, rotating biological contactors (RBC), Up flow anaerobic sludge blanket (UASB),

b) **Wastewater treatment for small communities**: aerobic lagoons, oxidation ponds, septic tank, SBR **Sludge treatment** – Preliminary operation, Thickening, Conditioning, Dewatering, Filtration, Digestion and Drying of sludge, Sludge disposal,

Tertiary treatment - Activated carbon filtration unit, disinfection of water -UV radiation, Ozonation, Chlorination, Reverse osmosis (RO).

Unit–4 Concept, Design and functioning of treatment plants **(15)**

Concept, Design and functioning of treatment plants, Design and functioning of sand filter, Sewage treatment plant (STP), Effluent treatment plant (ETP), Common Effluent treatment plant (CETP).

References:

1. Environmental Pollution Control, C.S. Rao, Wiley Eastern Ltd.,1993
2. Air Pollution Control and Engineering, De Nevers, Mc Graw Hills, 1993
3. Fundamentals of Environmental Pollution, Krishnan Khannan, S.Chand and Company Ltd., 1994.
4. Environmental Chemistry, A. K .De.,New Age Intl. pub Co, New Delhi, 1990.
5. Environmental Pollution Anlysis- Khopkar

CC-203: Solid and Hazardous Waste Management

After completion of the course, the students are able to

CO1: Understand various concepts related to solid waste management.

CO2: Apply steps in solid waste management - waste reduction at source, collection techniques, materials and resource recovery/recycling, transport, optimization of solid waste transport, treatment and disposal techniques.

CO3: Acquire the knowledge related to hazardous waste management.

CO4: Evaluate the solid waste management according to the legal framework

Syllabus

Unit –1 Municipal Solid Waste **(15)**

Solid wastes: Sources, classification, characteristics of solid waste, Waste generation rates, Collection and storage of municipal solid wastes, transfer stations, waste processing - volume and size reduction, source reduction, recycling, waste minimization.

Unit -2: Waste Treatment and Disposal **(15)**

a) Waste processing technologies, Incineration, Combustion, Stabilization, Solidification, chemical fixation, encapsulation, Composting, Vermicomposting, Energy from waste – Bio- gasification - Anaerobic digestion, pyrolysis, refuse derived fuels;
b) Landfill bioreactors, Burning, open dumping - problems, Landfill – site selection, Sanitary and secured – structure, design, construction, operation and closure. Landfill leachate and gas management, Landfill bioreactors

Unit -3 Hazardous Waste Management **(15)**

a) **Hazardous waste**: Definition, sources, classification, collection, segregation, characterization, Treatment and disposal.
Radioactive wastes: Definition, sources, classification, collection, segregation, Treatment and disposal.
b) **E waste**: Definition, sources, classification, collection, segregation, Treatment and disposal. **Biomedical wastes:** Definition, sources, classification, collection, segregation, Treatment and disposal. **Plastic Waste:** types as per chemistry, Problems in environment, Disposal mechanisms

Unit – 4 Waste Management Legislation **(15)**

Solid Waste (Management and Handling) Rules, 2000, 2016 and amendments, Biomedical Waste (Management and Handling) Rules, 2016; Plastic Waste Management Rules, 2016; E-Waste Management Rules, 2016; Bio-Medical Waste Management Rules, 2016; Hazardous and Other Wastes (Management and Trans boundary Movement) Rules, 2016; Construction and Demolition Waste Management Rules, 2016.

References:

1. Ecology and Environment, P. D. Sharma, Ashish publications, 1994.
2. .Ground water Hydrology by D..K..Todd John Wiley and Sons.
3. Ground water contamination (Transport and remediation) by Philp Bedient, Hanadi.
4. S. Rifai and Charles. Publishers: Prentice Hall.
5. Environmental Hydrology by Andy. D. Ward and William J..Elliot, Lewis
6. Environmental Geography, Valdia ,K..S(1987)
7. Environmental Geography, Savindra Singh
8. Environmental Geology,Keller E.A. and Turk and Turk
9. Introduction to weather and climate-Trewartha
10. Physical Geography - S. Strahler, John Wiley and Sons,

CC-204: Energy studies

After completion of the course, the students are able to

CO1: Classify the energy resources into renewable and non-renewable resources.

CO2: Recognise the power and applications of solar energy

CO3: Get acquainted with the knowledge of biomass energy.

CO4: Make aware about the energy generation from ocean, tides and hydel power plant.

CO5: Illustrate the mechanism and types of methods for watershed management

Syllabus

Unit- 1 **(15)**

a) Introduction to energy resources

Energy use pattern in developed and developing Energy crises; Energy use pattern in India; Sources of energy and their classification; Energy forms and transformation, role of IREDA and MEDA in energy generation.

b) Fossil Fuels:

Fossil fuels – classification, composition, physiochemical characteristics; Energy content of coal, petroleum and natural gas; Formation, reserves, exploration/ mining and uses of Coal, Oil and Natural gas; Environmental problems associated with exploration/mining, processing, transportation and uses

Unit- 2 **(15)**

a) Solar Energy

Sun as source of energy: Nuclear fusion on sun, Solar spectrum, solar radiation – absorption, reflection, scattering and diffusion in the atmosphere, Albedo, Measurement of solar radiation, Harnessing of solar energy, Solar collectors and concentrators, Solar thermal energy, Solar electricity generation, Solar heaters, dryers and cookers; Photovoltaic

b) Biomass Energy

Biomass composition and types; Conversion processes – pyrolysis, charcoal production, compression, gasification and liquefaction; Energy plantation;
Biogas – production and uses, anaerobic digestion; Types of digesters, Environmental constrains; Energy from solid wastes - Sources, types, energy production

Unit- 3 **(15)**

a) Energy from water:

Principles of generation of hydroelectric power, hazard related to hydropower generation and distribution, environmental impacts, Energy from oceans- OTEC, Tidal energy, wave energy.

b) **Wind Energy:**

Wind power, Harnessing of wind energy, Power generation – wind mills, concentrators, wind characteristics and siting, environmental considerations; Wind energy potential in India.

Unit- 4 **(15)**

a) Geothermal energy:

Sources – crust, high temperature aquifers, low temperature aquifers, reserves; Harnessing of geothermal energy – problems and prospect; Geothermal energy prospect in India.

b) Nuclear energy:

Fission and fusion, Nuclear fuels, – Mining and processing of Uranium –concentration, refining, enrichment, fuel fabrication and fuel cycle; Nuclear reactors and radioactive waste; Magneto Hydro Dynamic (MHD) power generation, Fuel cells.

References :

1. Remote Sensing and GIS - M. Anji Reddy.
2. Environmental Remote Sensing - F. Mark Danson.
3. Principles of GIS for Land - Burrough P.A. Resources Assessment.
4. Renewable Energy Environment and Development, Maheswar Dayal Konark Publishers pvt. Ltd.
5. Renewable Energy Programmes in India : some recent developments , Sinha P.C., Natural Resource Forum, 18 (3), 1994.
6. Renewable Energy Resources: Basic Principles And Applications Tiwari, G.N., Narosa Publishing House.
7. Conventional and Non conventional Energy sources G. D Rai.

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. (Environmental Science and Technology)

Course Structure

Semester I

Applicable For
Academic Year 2016-17

Sr. No.	Subject Code	Subject Title	Contact hours			Credits
			L	T	P	
1	ESTC10	Research Methodology (Audit)	2	-	-	-
2	ESTC 11	Physico-Chemical and Biological Treatment Processes	4	-		4
3	ESTC 12	Remote Sensing and GIS Applications in Environmental Engineering	4	-		4
4	ESTC13	Solid and Hazardous Waste Management	3	1		4
5	ESTE 1	Elective-I	3	-		3
6	ESTE 2	Elective-II - **Open Elective ***	3	-		3
7	ESTS1	Seminar -I	-	-	2	2
8	ESTC14	Laboratory- I Water Quality Analysis	-	-	2	1
9	ESTC15	Laboratory-II Remote Sensing and GIS Applications in Environmental Engineering	-	-	2	1
10	ESTC16	Laboratory-III Solid and Hazardous Waste Management	-	-	2	1
		Total	1	1	8	23
Total Contact hours per week = 28						

Elective I

ESTE-11 Energy and Environment

ESTE - 12 Environmental Toxicology

ESTE - 13 Environmental Chemistry and Microbiology

* **Students from M.Tech any branch of Department of Technology Can opt for this Elective.**

Elective II: choose from list on next page

Semester –I Open Elective*)

Sr.No.	Elective-II (Open Elective*)	Branch
1	E15(V) Digital System And Testing	Electronics Technology
2	E 15 (V)Mixed Signal ASIC Design	
3	E 15 (E) Automotive Embedded Systems	
4	FTE-21: Advances in processing of dairy Technology	Food Technology
5	FTE-22: Food rheology and texture	
6	FTE-23: Advances in cereals and pulses processing technology	
7	ETE 2 Fuel and Combustion Technology	Energy Technology
8	ETE 2Solar Passive Architecture	
9	ETE 2Energy storage systems	
10	ESTE-21 Optimization Techniques	Environmental Science and Technology
11	ESTE-22 Design of Energy Efficient Building	
12	ESTE-23 Operational Health and Safety Management	
13	CS515 Advanced Operating Systems	Computer Sci. & Technology
14	CS515 Real Time Systems	
15	CS515 Web Engineering	

Minimum Number of students for selection of Elective -8
Minimum Number of students for selection of Elective -36*
Preference will be given to core branch

Semester II

Sr. No.	Subject Code	Subject Title	Contact hours			Credits
			L	T	P	
1	ESTC20	Air Pollution and Control	4	-	-	4
2	ESTC21	Environment Management Systems	3	1	-	4
3	ESTC22	Advanced Water and Wastewater Treatment	3	1	-	4
4	ESTE3	Elective-III	3	-	-	3
5	ESTE4	Elective-IV - **Open Elective ***	3	-	-	3
6	ESTS2	Seminar -II	-	-	2	2
7	ESTC23	Laboratory- I Air Pollution and Control	-	-	2	1
8	ESTC24	Laboratory-II Wastewater Characterization	-	-	2	1
9	ESTC25	Laboratory-III Specific Treatment Lab	-	-	2	1
		Total	16	2	8	23
Total Contact hours per week = 26						

Elective III

ESTE - 31 Industrial Waste Treatment

ESTE - 32 Environmental Policies and Legislation

ESTE - 33 Environmental Sanitation

Elective IV: Choose from list on next page

* **Students from M.Tech any branch of Department of Technology Can opt for this Elective.**

Semester –II (Open Elective*)

Sr.No.	Elective-IV (Open Elective*)	Branch
1	E 25 (V) VLSI in Signal Processing	Electronics Technology
2	E25(E) High Performance Networks	
3	E 25 (E) High Speed Digital Design	
4	FTE-41: Recent developments in processing of plantation crops	Food Technology
5	FTE-42: Simulation and modeling in food processing	
6	FTE-43: Project management for food processing industries	
7	ETE 4-1 Power Co-generation	Energy Technology
8	ETE 4-2 Energy modeling and project Management	
9	ETE 4-3 The New Energy Technologies	
10	ESTE-41 Operation and Maintenance of Environmental Facilities	Environmental Science and Technology
11	ESTE-42 Rural Water Supply and Sanitation	
12	ESTE-43 Environmental Biotechnology	
13	CS525 Geographical Information Systems	Computer Sci. & Technology
14	CS525 Artificial Intelligence and Natural Language Processing	
15	CS525 System modeling and simulation	

Minimum Number of students for selection of Elective -8
Minimum Number of students for selection of Elective -36*
Preference will be given to core branch

(Semester III)

Sr. No.	Subject Code	Subject Title	Contact hours			Credits
			L	T	P	
1	T31	*Industrial Training	-	-	**2	4
2	S32	Dissertation Phase-I	-	-	**5	10
		Total	-	-	7	14
**Total Contact hours per week/ students = 2 &5 respectively for for T31 & S32						

* 8 Weeks at the end of First Year (Summer)

* OR

* Industrial Training will be split in two slots of four weeks during semester III.

** Average contact hours/ week/ student

(Semester IV)

Sr. No.	Subject Code	Subject Title	Contact hours			Credits
			L	T	P	
1	D 42	Dissertation Phase- II	-	-	5	20
		Total	-	-	**5**	**20**
Total Contact hours per week = 5						

Shivaji University, Kolhapur First Year M. Tech Environmental Science and Technology(Semester I)	
1.ESTC 10Research Methodology (Audit)Research Methodology (Audit)	
Old Syllabus	**New Syllabus**
Teaching Scheme: L: 2 hrs/ weekT: -- Credits: --	Teaching Scheme : L : 2 hrs/ weekT: -- Credits: --
	Course Objective: 1. To provide knowledge of basic concepts of research and its methodologies 2. To prepare project proposal
	Course Outcome: 1. Able to know the basic concepts of research. 2. Able for select and define appropriate research problem and parameters for writing a research report and thesis. 3. Understand measurement and Scaling Techniques 4. Able to analysis of Variance and Co-variance.
Unit 1 **4 HRS** **Research Methodology: An Introduction** Objectives of Research, Types of Research, Research Methods and Methodology, Defining a Research Problem, Techniques involved in Defining a Problem	**Unit 1** **4 HRS** **Research Methodology: An Introduction** Objectives of Research, Types of Research, Research Methods and Methodology, Defining a Research Problem, Techniques involved in Defining a Problem
Unit 2 **6 HRS** **Research Design** Need for Research Design, Features of Good Design, Different Research Designs, Basic Principles of Experimental Designs, Sampling Design, Steps In Sampling Design, Types of Sampling Design, Sampling Fundamentals, Estimation, Sample size Determination, Random sampling	**Unit 2** **6 HRS** **Research Design** Need for Research Design, Features of Good Design, Different Research Designs, Basic Principles of Experimental Designs, Sampling Design, Steps In Sampling Design, Types of Sampling Design, Sampling Fundamentals, Estimation, Sample size Determination, Random sampling
Unit 3 **4 HRS** **Measurement and Scaling Techniques** Measurement inResearch,MeasurementScales,Scales,SourcesinError, Techniques ofDevelopingMeasurementTools,Scaling,Meaning ofScale, ScaleConstructionTechniques.	**Unit 3** **4 HRS** **Measurement and Scaling Techniques** Measurement inResearch,MeasurementScales,Scales,SourcesinError, Techniques ofDevelopingMeasurementTools,Scaling,Meaning ofScale, ScaleConstructionTechniques.
Unit 4 **4 HRS** **Methods of Data Collection and Analysis** Collection of Primary and Secondary Data, Selection of appropriate method, Data Processing Operations, Elements of Analysis, Statistics in Research, Measures of Dispersion, Measures of Skewness, Regression Analysis, Correlation	**Unit 4** **4 HRS** **Methods of Data Collection and Analysis** Collection of Primary and Secondary Data, Selection of appropriate method, Data Processing Operations, Elements of Analysis, Statistics in Research, Measures of Dispersion, Measures of Skewness, Regression Analysis, Correlation

Unit 5 **4 HRS** **Techniques of Hypotheses, Parametric or Standard Tests** Basic concepts, Tests for Hypotheses I and II, Important parameters, Limitations of the tests of Hypotheses, Chi-square Test, Comparing Variance, as a non-parametric Test, Conversion of Chi to Phi, Caution in Using Chi- square test	**Unit 5** **4 HRS** **Techniques of Hypotheses, Parametric or Standard Tests** Basic concepts, Tests for Hypotheses I and II, Important parameters, Limitations of the tests of Hypotheses, Chi-square Test, Comparing Variance, as a non-parametric Test, Conversion of Chi to Phi, Caution in Using Chi- square test
Unit 6 **4 HRS** **Analysis of Variance and Co-variance** ANOVA, One way ANOVA, Two Way ANOVA, ANOCOVA, Assumptions in ANOCOVA, Multivariate Analysis Technique, Classification of Multivariate Analysis, factor Analysis, R-type Q Type Factor Analysis, Path Analysis	**Unit 6** **4 HRS** **Analysis of Variance and Co-variance** ANOVA, One way ANOVA, Two Way ANOVA, ANOCOVA, Assumptions in ANOCOVA, Multivariate Analysis Technique, Classification of Multivariate Analysis, factor Analysis, R-type Q Type Factor Analysis, Path Analysis
InterpretationandReport **1**	**InterpretationandReport** **1**
	References: 1. Research Methodology: R. Panneerselvam, Prentice Hall Publication ,2004 2. Research Methodology: Methods and Techniques by C. R. Kothari New Age International Publishing,second edition 3. Statistical Methods for Research Workers , Fisher R. A. Macmillan Pub Co, 1970

2.ESTC-11Physico-Chemical and Biological Treatment ProcessesPhysico-Chemical and Biological Treatment Processes	
Old Syllabus	**New Syllabus**
Teaching Scheme : L : 4 hrs/ weekCredits: 4 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40	Teaching Scheme : L : 4 hrs/ week Credits: 4 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40
	Course Objective: 1. To provide knowledge and concepts of physical, and chemicalprocesses used for water and wastewater treatment. 2. To provide knowledge for design water and wastewater treatment plant.
	Course Outcome: 1. Able to know various processes used in water and wastewater treatment. 2. Able for various design crireria with design procedure forwater and wastewater treatment plant.

	3. Understanding of basic principle of mass transfer. 4. Able to learnmechanisms and modes of disinfection.
Unit 1 **6 HRS** Mass transport processes, Mass balance analysis, types of reactions, reaction kinetics, Configurations of ideal and non-ideal reactors, principles of ideal reactor design. Basic principle of mass transfer, Gas-liquid mass transfer, Two film theory Introduction to process selection.	**Unit 1** **6 HRS** Mass transport processes, Mass balance analysis, types of reactions, reaction kinetics, Configurations of ideal and non-ideal reactors, principles of ideal reactor design. Basic principle of mass transfer, Gas-liquid mass transfer, Two film theory Introduction to process selection.
Unit 2 **8 HRS** Coagulation processes, stability of colloids and destabilization, coagulants, Flocculation theory, orthokinetic and perikinetic Design of slow and rapid mixers. Sedimentation, particle settling theory, types of settling and related theory, types of clarifier, high rate clarification, design of clarifiers.	**Unit 2** **8 HRS** Coagulation processes, stability of colloids and destabilization, coagulants, Flocculation theory, orthokinetic and perikinetic Design of slow and rapid mixers. Sedimentation, particle settling theory, types of settling and related theory, types of clarifier, high rate clarification, design of clarifiers.
Unit 3 **5 HRS** Introduction to depth filtration, filtration processes, principal mechanisms of filtration, filter hydraulics, backwash hydraulics, Rate control patterns and methods, design and operation of slow sand, rapid sand and dual media filters.	**Unit 3** **5 HRS** Introduction to depth filtration, filtration processes, principal mechanisms of filtration, filter hydraulics, backwash hydraulics, Rate control patterns and methods, design and operation of slow sand, rapid sand and dual media filters.
Unit 4 **8 HRS** Adsorption processes, causes and types of adsorption, influencing factors, adsorption equilibria and development of adsorption isotherms, activated carbon adsorption kinetics, analysis and design of GAC and PAC contactors. Ion exchange, exchange materials, exchange capacity, ion exchange chemistry and reactions, applications for hardness and TDS removal, design of ion exchange softener, Introduction to membrane processes.	**Unit 4** **8 HRS** Adsorption processes, causes and types of adsorption, influencing factors, adsorption equilibria and development of adsorption isotherms, activated carbon adsorption kinetics, analysis and design of GAC and PAC contactors. Ion exchange, exchange materials, exchange capacity, ion exchange chemistry and reactions, applications for hardness and TDS removal, design of ion exchange softener, Introduction to membrane processes.
Unit 5 **6 HRS** Disinfection, modes of disinfection, mechanisms, factor influencing, ideal disinfectant, chemistry of chlorination, ozone chemistry, estimation of ozone dosage, UV disinfection, Estimation of UV dose. Corrosion processes, electrochemical nature of corrosion, types of corrosion, methods of corrosion control.	**Unit 5** **6 HRS** Disinfection, modes of disinfection, mechanisms, factor influencing, ideal disinfectant, chemistry of chlorination, ozone chemistry, estimation of ozone dosage, UV disinfection, Estimation of UV dose. Corrosion processes, electrochemical nature of corrosion, types of corrosion, methods of corrosion control.
Unit 6 **7 HRS** Objectives and fundamentals of biological treatment, types of biological treatment processes. Conventional activated sludge process, process kinetics and design considerations, process control measures,	**Unit 6** **7 HRS** Objectives and fundamentals of biological treatment, types of biological treatment processes. Conventional activated sludge process, process kinetics and design considerations, process control measures,

operational problems, Introduction to modifications. Trickling filter, classification, process design considerations. Fundamentals of anaerobic treatment, general design considerations, types of anaerobic reactors.	operational problems, Introduction to modifications. Trickling filter, classification, process design considerations. Fundamentals of anaerobic treatment, general design considerations, types of anaerobic reactors.
References: 1. Theory and Practice of water and Wastewater treatment – Ronald Droste. 2. Environmental engineering – Peavy, Rowe and Tchnologous. 3. Physico-chemical processes of water purification – Weber 4. Wastewater Engineering treatment and reuse– Metcalf Eddy	**References:** 1. Theory and Practice of water and Wastewater treatment – Ronald Droste. 2. Environmental engineering – Peavy, Rowe and Tchnologous. 3. Physico-chemical processes of water purification – Weber 4. Wastewater Engineering treatment and reuse– Metcalf Eddy

3.ESTC-12 Environmental Chemistry and Microbiology Remote Sensing and GIS Applications in Environmental Engineering	
Old Syllabus	**New Syllabus**
Teaching Scheme : L : 4 hrs/ week Credits: 4 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40	Teaching Scheme : L : 4 hrs/ week Credits: 4 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40
	Course Objective: 1. To provide necessary knowledge of the principles, applications, trends, and pertinent issues ofgeographical information systems and sciences, including remote sensing (RS). 2. To provide knowledge of various Application of remote sensing and GIS
	Course Outcome: 1. Ability to know the basicremote sensing and GIS 2. Knowledge of Application of remote sensing and GISin various fields. 3. Develop a critical awareness of the strengths and limitations of monitoring using Remote Sensing 4. Widerrole of Remote Sensing and GISin environmental modeling and monitoring.
Unit 1 6 HRS Chemistry of pollutants in the Atmosphere: Solid, liquid, gaseous and radioactive pollutants in the atmosphere, formation of physical processes of pollutants in the atmosphere, Effects of temperature, solar radiation and wind currant on the various pollutants, Effect of gravitational force and rain scrubbing on air pollutants, Chemical	**Unit 1 7 HRS** Concepts of remote sensing; Energy sources and Radiation principles, spectral characteristics of earth's surface and of atmosphere. Sensors and their characteristics; Radiometers, cameras, multi-spectral scanners and microwave systems. Aerial and satellite platforms.

properties of air pollutants chemisorptions, effect of solar radiation on acidic basic characteristics, reducing, oxidizing properties of air pollutants.	
Unit 2 **8 HRS** Chemistry of pollutants in the water (Hydrosphere), Characteristics of water as a solvent. Interaction of water with organic, Inorganic species(Natural & Anthropogenic),Determination of water quality parameters, physical, chemical, biological and physiological parameters. Water Treatment Technology: water and process waste water & its composition Detection, estimation and removal of heavy toxic metals pesticides, organic residues, oxidizing, and reducing agents in Waste Water. Reduce Recycle and Reuse of heavy toxic metals Ion exchange, catalytic conversion, stream gas stripping cooling & chilling, Organic pollutants in waste water & treatment technology Determination of BOD, DO, COD, TOC, & Organic loading, Aerobic & Anaerobic treatments Activated sludge process.	**Unit 2** **6 HRS** Optical, infrared and microwave imagery, Analysis of imagery, Visual and machine interpretation of imagery, Ground truth data, Digital image processing.
Unit 3 **6 HRS** Air pollution control Engineering, Control of particulate matter Gravity setting, fabric filters, centrifugal imp actors, Electrostatic precipitators, scrubbers limitations of these techniques with reference to chemistry of pollutants. Control of gaseous pollutants. Absorption, Adsorption, Condensation (cold trapping) Chemical conversions of gaseous pollutants. Control of specific gaseous pollutants, SO_2, H_2S, CO, CO_2, NO, NO_2.	**Unit 3** **8 HRS** Application of remote sensing – Land use and Land cover mapping, biodiversity, forestry and agriculture, soil erosion, water resources, wetland mapping, Wild life ecology, Environmental assessment, Environmental management, Urban and regional planning, Monitoring natural disasters.
Unit 4 **5 HRS** Instrumental methods of pollutant analysis, Spectroscopic techniques, AAS, NAA, GCMS, HPLC,Electro analytical techniques, EEM-608, Industrial waste management and environmental audit, environmental sensing techniques.	**Unit 4** **6 HRS** Fundamentals of GIS: Definition, Components, spatial data, thematic characteristics, rasters and vectors, databases and database management.
Unit 5 **8 HRS** Bacteria : classification and characteristics of bacteria, cell morphology, growth rate curve, culture techniques, Gram staining, microscopic methods, MPN, Plate count and membrane filter techniques, Algae: classification, symbiosis, factors affecting algal growth, control of algae, Fungi, moulds, protozoa , population dynamics, role of microbes, in biological waste treatment, significance	**Unit 5 6 HRS** Data input and Editing: Data stream, data encoding, map digitization and conversion, data analysis, network and surface analysis in GIS, analytical modelling, forms of GIS output, decision support systems, GIS project design and management.

of F/ M ratio, acclimatization of bacteria, bioassay tests, aerobic and aerobic metabolism.	
Unit 6 **7 HRS** Structure of prokryotic and eukryotic cells, Types and metabolic classification of micro organisms, Microbial metabolism, respiration and energy generation, ; enzyme kinetics and regulation; Bacterial genetics; structure of DNA nad RNA ; transcription and translation; Gene expression and regulation; Gene transfer and recombinant DNA technology.	**Unit 6** **7 HRS** GIS applications: Forestry, Bio-diversity, Environment, Soil resource management, Hydrological modelling, Public utilities (water distribution, sewerage, solid waste management).
References- 1. Chemistry for Environmental Engineers - Swayer and McCarty 2. Outlines of Biochemistry - Conn and Stump 3. Microbiology - Pelzar and Reid 4. Microbiology for Sanitary Engineers - Ray MaKinney	**References-** 1. Remote Sensing and Image Interpretation – Lillesand and Kiefer. 2. Introduction to the physics and techniques of Remote Sensing – Elachi. 3. Geographical Information System Vol. I and II– Longley. 4. An Introduction to GIS– Ian Haywood.

4.ESTC-13 Solid Waste Management	**Solid and Hazardous Waste Management**
Old Syllabus	**New Syllabus**
Teaching Scheme : L : 3 hrs/ week T : 1 hrs/ week Credits: 4 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40	Teaching Scheme : L : 3 hrs/ week T : 1 hrs/ week Credits: 4 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40
	Course Objective: 1. To provide knowledge of Solid wastemanagement. 2. To provide knowledge biomedical and Hazardous Wastes generation and management.
	Course Outcome: 1. Ability to know the functional elements of solid waste with management. 2. Able to knowbiomedical and HazardousWastes management. 3. Knowledge for solving and communication skills to specific problems in order to practice the role of health and safety professionals in managing hazardous materials and wastes. 4. Understand fundamental principles of existing and emerging technologies for the treatment of waste and

	recovery of value from waste.
Unit 1 **6 HRS** Solid waste management: Objectives, Functional elements, Environmental impact of mismanagement. Solid waste: Sources, Types, Composition, Quantities, Physical, Chemical and Biological properties.	**Unit 1** **6 HRS** Solid waste management: Objectives, Functional elements, Environmental impact of mismanagement. Solid waste: Sources, Types, Composition, Quantities, Physical, Chemical and Biological properties. Indian scenario.
Unit 2 **7 HRS** Solid waste generation rate: Definition, Typical values for Indian cities, Factors affecting. Storage and collection: General considerations for waste storage at source, Types of collection systems. Transfer station: Meaning, Necessity, Location, Economic analysis. Transportation of solid waste: Means and methods, Routing of vehicles.	**Unit 2** **7 HRS** Solid waste generation rate: Definition, Typical values for Indian cities, Factors affecting. Storage and collection: General considerations for waste storage at source, Types of collection systems. Transfer station: Meaning, Necessity, Location, Economic analysis. Transportation of solid waste: Means and methods, Routing of vehicles.
Unit 3 **6 HRS** Sorting and material recovery: Objectives, Stages of sorting, Sorting operations, Guidelines for sorting for material recovery, Typical material recovery facility for a commingled solid waste.	**Unit 3** **4 HRS** Sorting and material recovery: Objectives, Stages of sorting, Sorting operations, Guidelines for sorting for material recovery, Typical material recovery facility for a commingled solid waste..
Unit 4 **8 HRS** Composting of solid waste: Principles, Methods, Factors affecting, Properties of compost, Vermicomposting.Energy recovery from solid waste: Parameters affecting, Biomethanation, Fundamentals of thermal processing, Pyrolysis, Incineration, Advantages and disadvantages of various technological options. Landfills: Definition, Essential components, Site selection, Land filling methods, Leachate and landfill gas management.	**Unit 4** **8 HRS** Composting of solid waste: Principles, Methods, Factors affecting, Properties of compost, Vermicomposting.Energy recovery from solid waste: Parameters affecting, Biomethanation, Fundamentals of thermal processing, Pyrolysis, Incineration, Advantages and disadvantages of various technological options. Landfills: Definition, Essential components, Site selection, Land filling methods, Leachate and landfill gas management.
Unit 5 **6 HRS** Biomedical Waste: Generation, identification, storage, collection, transport, treatment, common treatment and disposal, occupational hazards and safety measures. Biomedical waste legislation in India	**Unit 5** **7 HRS** Biomedical Waste: Generation, identification, storage, collection, transport, treatment, common treatment and disposal, occupational hazards and safety measures. Biomedical waste legislation in India. E-waste management.
Unit 6 **7 HRS** Indian scenario: Present scenario and measures to improve system for different functional elements of solid waste management system. Elements of financial management plan for solid waste system.	**Unit 6** **8 HRS** Definition and identification of Hazardous Wastes, Sources and Characteristics of hazardous wastes, Hazardous waste in municipal waste, Hazardous waste regulations and legislations, Minimization of Hazardous wastes, Handling and storage of Hazardous wastes, Hazardous Waste Treatment technologies, Physical, chemical & thermal methods of stabilizations, Solidification, Chemical Fixation & encapsulation, Incineration of Hazardous waste landfills, Reclamation of Hazardous waste landfill sites.Radioactive waste management
References:	**References:**

1.Manual on municipal solid waste management – Government of India publication. 2.Integrated solid waste management – George Tchobanoglous. 3. Solid waste management – A. D. Bhide. 4.Solid waste management handbook– Pavoni.	1.Manual on municipal solid waste management – Government of India publication. 2.Integrated solid waste management – George Tchobanoglous. 3. Solid waste management – A. D. Bhide. 4. Solid waste management handbook– Pavoni.

5.ESTE-1Elective – I -ESTE-11 Energy and Environment	**Energy and Environment**
Old Syllabus	**New Syllabus**
Teaching Scheme : L : 3hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40	Teaching Scheme : L : 3hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40
	Course Objective: 1. To teach renewable and non renewable energy resources with energy crisis. 2. To teach Energy Storage and Heat Energy recovery systems
	Course Outcome: **1.** Get knowledge ofenergy crisis with renewable and non renewable energy resources. **2.** Get idea about variousEnergy Storage system with Energy recovery systems. **3.** Learn variousnon-conventional energy sources. **4.** Understanding concept biomass energy utilization.
Unit 1 **5 HRS** Energy Crisis: Historical events, energy requirement of society in past and present situation, availability and need of conventional energy resources, major environmental problems related to the conventional energy resources, future possibilities of energy need and availability.	**Unit 1** **5 HRS** Energy Crisis: Historical events, energy requirement of society in past and present situation, availability and need of conventional energy resources, major environmental problems related to the conventional energy resources, future possibilities of energy need and availability
Unit 2 **6 HRS** Non-conventional energy sources: Hydel power plant, tidal energy, biomass energy, wind energy, Hydrogen as a source of energy, energy conversion technologies, their principles, equipment and suitability in context of India. Environmental impacts of these technologies.	**Unit 2** **6 HRS** Non-conventional energy sources: Hydel power plant, tidal energy, biomass energy, wind energy, Hydrogen as a source of energy, energy conversion technologies, their principles, equipment and suitability in context of India. Environmental impacts of these technologies.
Unit 3 **6 HRS** Solar Energy option: Sun as source of energy, direct methods of solar energy collection, process of photovoltaic energy conversion, solar energy conversion technologies and devices, their principles, working and application, environmental impacts of solar energy.	**Unit 3** **6 HRS** Solar Energy option: Sun as source of energy, direct methods of solar energy collection, process of photovoltaic energy conversion, solar energy conversion technologies and devices, their principles, working and application, environmental impacts of solar energy.

Unit 4 **8 HRS** Biomass option: Concept of biomass energy utilization, types of biomass energy, conversion processes, biogas production, biomass gasification process and technologies, environmental impacts of biomass energy.	**Unit 4** **8 HRS** Biomass option: Concept of biomass energy utilization, types of biomass energy, conversion processes, biogas production, biomass gasification process and technologies, environmental impacts of biomass energy.
Unit 5 **7 HRS** Energy Storage: Types of energy storage, devices for sensible and latent heat storage, energy storage in dry batteries, nickel-cadmium batteries, secondary heat storage, chemical storage, environmental consequences of energy storage systems.	**Unit 5** **7 HRS** Energy Storage: Types of energy storage, devices for sensible and latent heat storage, energy storage in dry batteries, nickel-cadmium batteries, secondary heat storage, chemical storage, environmental consequences of energy storage systems.
Unit 6 **8 HRS** Heat Energy recovery systems: Approaches to waste Energy Utilization, Equipment, Utilization System, objective , principles of heat transfer, Gas to Gas heat transfer, Gas to Liquid heat transfer, Recovery of waste heat in coil coating, Non-conventional liquid fuels, Heat recovery by Cogeneration.	**Unit 6** **8 HRS** Heat Energy recovery systems: Approaches to waste Energy Utilization, Equipment, Utilization System, objective , principles of heat transfer, Gas to Gas heat transfer, Gas to Liquid heat transfer, Recovery of waste heat in coil coating, Non-conventional liquid fuels, Heat recovery by Cogeneration.
References- 1. Bewik M.W.M. - Handbook of organic waste conversion. 2. Bokris J.O. - Energy, the solar hydrogen alternative. 3. Rai G.D - Non-conventional Energy Sources. 4. Sukhatme S.P.- Solar Energy. 5. Kiang Y. H.- Waste Energy Utilization Technology.	**References-** 1. Bewik M.W.M. - Handbook of organic waste conversion. 2. Bokris J.O. - Energy, the solar hydrogen alternative. 3. Rai G.D - Non-conventional Energy Sources. 4. Sukhatme S.P.- Solar Energy. 5. Kiang Y. H.- Waste Energy Utilization Technology.
ESTE-1Elective – I –ESTE-12 Environmental ToxicologyEnvironmental Toxicology	
Old Syllabus	**New Syllabus**
Teaching Scheme : L : 3hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40	Teaching Scheme : L : 3hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40
	Course Objective: 1. To provide knowledge of experimental methods for measuring toxicity. 2. To provide knowledge of Environment and health and environmental stress.
	Course Outcome: 1. Able to understand Environmental Toxicology and experimental methods for measuring toxicity.

	2. Good knowledge of Ecological risk assessment process and Environment and health and environmental stress. 3. Identify the significance and applications of toxicology. 4. Understand Occupational health hazards.
Unit 1 **7 HRS** Introduction to Environmental Toxicology : Definition, classification, origin and general nature of toxicants in environment, factors affecting toxicity, nutritional and non nutritional food supplements and their effects, mutagenesis, teratogenesis, carcinogens, hellucinogens, phytotoxins and animal toxins.	**Unit 1** **7 HRS** Introduction to Environmental Toxicology : Definition, classification, origin and general nature of toxicants in environment, factors affecting toxicity, nutritional and non nutritional food supplements and their effects, mutagenesis, teratogenesis, carcinogens, hellucinogens, phytotoxins and animal toxins.
Unit 2 **8 HRS** Systematic and Eco-toxicology : Toxic response of different body systems likes respiratory, gastro-intestinal tract, Liver, kidney, immune system, reproductive system. Problems and approach, Environmental distribution of chemicals in air, water, sediments, soil and biota; Effects of toxicants on ecosystem, Detoxification of toxicants in resistant biota.	**Unit 2** **8 HRS** Systematic and Eco-Toxicology : Toxic response of different body systems likes respiratory, gastro-intestinal tract, Liver, kidney, immune system, reproductive system. Problems and approach, Environmental distribution of chemicals in air, water, sediments, soil and biota; Effects of toxicants on ecosystem, Detoxification of toxicants in resistant biota.
Unit 3 **6 HRS** Experimental methods for measuring toxicity; Types of bioassays (Ames test, bioluminescence, algal toxicity, gene induction etc.), the interaction of chemicals with ecosystems; Methods for assessing the impacts of chemicals on ecosystems (toxicity tests, field assessment, special analyses such as biomarkers, bioaccumulation, mesocosm and microcosm studies).	**Unit 3** **6 HRS** Experimental methods for measuring toxicity; Types of bioassays (Ames test, bioluminescence, algal toxicity, gene induction etc.), the interaction of chemicals with ecosystems; Methods for assessing the impacts of chemicals on ecosystems (toxicity tests, field assessment, special analyses such as biomarkers, bioaccumulation, mesocosm and microcosm studies).
Unit 4 **8 HRS** Biotransformation, bioaccumulation and bio-magnification of toxicants ,Toxicants absorption and distribution of toxicants in animal body, Bio-transformation of toxicants, antidotes treatment and their detoxification of toxicants, Bio-accumulation, Bio- magnification.	**Unit 4** **8 HRS** Biotransformation, bioaccumulation and bio-magnification of toxicants ,Toxicants absorption and distribution of toxicants in animal body, Bio-transformation of toxicants, antidotes treatment and their detoxification of toxicants, Bio-accumulation, Bio- magnification.
Unit 5 **8 HRS** Environment and health and environmental stress : Basic principles of environmental health, community health, impact of changing environment on biota, effect of stress on environment, adaptations and tolerance level of various organisms and stress factors, micro-organisms of extreme environment. Occupational health hazards : Stress, man, machine and environment, ergonomics and occupational physiology and Hazards of working environment safety management of occupational hazards.	**Unit 5** **8 HRS** Environment and health and environmental stress : Basic principles of environmental health, community health, impact of changing environment on biota, effect of stress on environment, adaptations and tolerance level of various organisms and stress factors, micro-organisms of extreme environment. Occupational health hazards : Stress, man, machine and environment, ergonomics and occupational physiology and Hazards of working environment safety management of occupational hazards.

Unit 6 **5 HRS** Ecological risk assessment process and evaluation of human exposure, Case studies related to accidental discharge of pollutants and their impacts on the ecology and inhabitants of the surrounding areas.	**Unit 6** **5 HRS** Ecological risk assessment process and evaluation of human exposure, Case studies related to accidental discharge of pollutants and their impacts on the ecology and inhabitants of the surrounding areas.
References- 1. Principles of Ecotoxicology, Edited by : G. C. Butler 2. Basic Environmental Toxicology, Edited by: Cockerham, shane, CRC Press. 3. Environmental Toxicology by Wright. 4. A. P. H. A. Ed. 1992. 5. Modern Toxicology by Gupta and Salunkhe.	**Refrences-** 1. Principles of Ecotoxicology, Edited by : G. C. Butler 2. Basic Environmental Toxicology, Edited by: Cockerham, shane, CRC Press. 3. Environmental Toxicology by Wright. 4. A. P. H. A. Ed. 1992. 5. Modern Toxicology by Gupta and Salunkhe.

ESTE-1 Elective – I –ESTE-13 Disaster Management and Risk Analysis	**Environmental Chemistry and Microbiology**
Old Syllabus	**New Syllabus**
Teaching Scheme : L : 3hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40	Teaching Scheme : L : 3hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40
	Course Objective: 1. To provide necessary knowledge of chemistry of pollutants in the atmosphere and water with water treatment technology. 2. To provide knowledge about bacterial structure.
	Course Outcome: 1. Able to know chemistry of pollutants in the atmosphere and water with water treatment. 2. Able to get knowledge about bacterial structure. 3. Understanding of chemistry of pollutants in the water. 4. Able to use instrumental methods of pollutant analysis.
Unit 1 **6 HRS** Disaster: Definition, Classification, Natural and Anthropogenic, Accidents, Disaster Profile of India. Geo-climatic and Social conditions, past records, Vulnerable areas of the country, national Response approach.	**Unit 1** **6 HRS** Chemistry of pollutants in the Atmosphere: Solid, liquid, gaseous and radioactive pollutants in the atmosphere, formation of physical processes of pollutants in the atmosphere, Effects of temperature, solar radiation and wind currant on the various pollutants, Effect of gravitational force and rain scrubbing on air pollutants, Chemical properties of air pollutants chemisorptions, effect of solar radiation on acidic basic characteristics, reducing, oxidizing properties of air pollutants.

Unit 2 **7 HRS** Risk assessment, Contingency Planning, Major Natural disasters, Each Quake Cyclone, Flood Epidemics, Check list-Agencies, Personnel Equipment, Materials, Services and Time management	**Unit 2** **8 HRS** Chemistry of pollutants in the water (Hydrosphere), Characteristics of water as a solvent. Interaction of water with organic, Inorganic species(Natural & Anthropogenic),Determination of water quality parameters, physical, chemical, biological and physiological parameters. Water Treatment Technology: water and process waste water & its composition Detection, estimation and removal of heavy toxic metals pesticides, organic residues, oxidizing, and reducing agents in Waste Water. Reduce Recycle and Reuse of heavy toxic metals Ion exchange, catalytic conversion, stream gas stripping cooling & chilling, Organic pollutants in waste water & treatment technology Determination of BOD, DO, COD, TOC, & Organic loading, Aerobic & Anaerobic treatments Activated sludge process.
Unit 3 **7 HRS** Prediction and forecasting, disaster preparedness, data base assessment of Disaster relief and Rehabilitation measures, Mobilization of men and Material	**Unit 3** **6 HRS** Air pollution control Engineering, Control of particulate matter Gravity setting, fabric filters, centrifugal imp actors, Electrostatic precipitators, scrubbers limitations of these techniques with reference to chemistry of pollutants. Control of gaseous pollutants. Absorption, Adsorption, Condensation (cold trapping) Chemical conversions of gaseous pollutants. Control of specific gaseous pollutants, SO_2, H_2S, CO, CO_2, NO, NO_2.
Unit 4 **6 HRS** Legal frame work, Trigger mechanism – Water. Climate and Geologically Related Chemical, Industrial, Nuclear, GIS enabled Disk net	**Unit 4** **5 HRS** Instrumental methods of pollutant analysis, Spectroscopic techniques, AAS, NAA, GCMS, HPLC,Electro analytical techniques, EEM-608, Industrial waste management and environmental audit, environmental sensing techniques.
Unit 5 **7 HRS** Maps Special and non special data. Activities, Agencies, Resources and Funds, Implementation and Monitoring Flood Hazard Map	**Unit 5** **8 HRS** Bacteria : classification and characteristics of bacteria, cell morphology, growth rate curve, culture techniques, Gram staining, microscopic methods, MPN, Plate count and membrane filter techniques, Algae: classification, symbiosis, factors affecting algal growth, control of algae, Fungi, moulds, protozoa , population dynamics, role of microbes, in biological waste treatment, significance of F/ M ratio, acclimatization of bacteria, bioassay tests, aerobic and aerobic metabolism.
Unit 6 **7 HRS** Quick response flow chart, Emergency operation center, Emergency support Functions, Disaster specific modules.	**Unit 6** **7 HRS** Structure of prokryotic and eukryotic cells, Types and metabolic classification of micro organisms, Microbial metabolism, respiration and energy generation, ; enzyme kinetics and regulation; Bacterial

	genetics; structure of DNA nad RNA ; transcription and translation; Gene expression and regulation; Gene transfer and recombinant DNA technology.
References- 1. "National Disaster Response Plan", A Document prepared by Department of Agriculture and Cooperation. 2. "Concept of Trigger Mechanism",Gpvt. Of India, Ministry of Home Affairs, February 2001, Publication. "Water and Climate related Disasters", Govt. of India, Ministry of Home affairs, Publication.	**References-** 1.Chemistry for Environmental Engineers - Swayer and McCarty 2.Outlines of Biochemistry - Conn and Stump 3.Microbiology - Pelzar and Reid 4.Microbiology for Sanitary Engineers - Ray MaKinney

6.ESTE-2Elective – II -ESTE – 21Optimization TechniquesOptimization Techniques	
Old Syllabus	**New Syllabus**
Teaching Scheme : L : 3hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40	Teaching Scheme : L : 3hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40
	Course Objective: 1. To study of optimization problems, Linear programming, Non-Linear programming, dynamic programming. 2. To study of genetic algorithm and scope of optimization techniques to environmental systems.
	Course Outcome: 1. An ability to formulate, and solve problems on environmental systems. 2. An ability to apply effectively optimization techniques in environmental systems. 3. Develop ability to challenging engineering problems that involve constrained resource allocation. 4. Understand the scope of Computer application in Environmental Science and Engineering.
Unit 1 **8 HRS** Optimization problem statement, Classification of optimization problems. Classical optimization theory: Unconstrained optimization, Constrained optimization with equality and inequality, Method of Lagrange multipliers, kuhn- Tucker conditions.	**Unit 1** **8 HRS** Optimization problem statement, Classification of optimization problems. Classical optimization theory: Unconstrained optimization, Constrained optimization with equality and inequality, Method of Lagrange multipliers, kuhn- Tucker conditions.

Unit 2 **6 HRS** Linear programming: Construction of LP model, Simplex method, Big M and two phase methods, Special cases, Duality and sensitivity analysis, Economic interpretation of duality.	**Unit 2** **6 HRS** Linear programming: Construction of LP model, Simplex method, Big M and two phase methods, Special cases, Duality and sensitivity analysis, Economic interpretation of duality.
Unit 3 **7 HRS** Non-linear programming: Unconstrained optimization techniques, Classification of methods, Dichotomous optimization method, Steepes ascent, Newton method, Constrained optimization, Separable and quadratic programming.	**Unit 3** **7 HRS** Non-linear programming: Unconstrained optimization techniques, Classification of methods, Dichotomous optimization method, Steepes ascent, Newton method, Constrained optimization, Separable and quadratic programming.
Unit 4 **6 HRS** Dynamic programming: Multistage decision process, recursive relationships, Principle of optimality, Computational procedure in DP, DP applications, Problem of dimensionality.	**Unit 4** **6 HRS** Dynamic programming: Multistage decision process, recursive relationships, Principle of optimality, Computational procedure in DP, DP applications, Problem of dimensionality.
Unit 5 **8 HRS** Genetic algorithm: Introduction, Representation of decision variables, Objective function and constraints, GA operators. Introduction to Simulated annealing, Neural network based optimization and optimization of fuzzy systems.	**Unit 5** **8 HRS** Genetic algorithm: Introduction, Representation of decision variables, Objective function and constraints, GA operators. Introduction to Simulated annealing, Neural network based optimization and optimization of fuzzy systems.
Unit 6 **5 HRS** Scope of Computer application in Environmental Science and Engineering, Applications of optimization techniques to Environmental systems.	**Unit 6** **5 HRS** Scope of Computer application in Environmental Science and Engineering, Applications of optimization techniques to Environmental systems.
References- 1. Engineering optimization – S. S. Rao 2. Operation research – Taha. 3. Genetic algorithm – Goldberg.	**References-** 1. Engineering optimization – S. S. Rao 2. Operation research – Taha. 3. Genetic algorithm – Goldberg.

ESTE-2 Elective – II –ESTE – 22 Environmental Economics Design of Energy Efficient Buildings	
Old Syllabus	**New Syllabus**
Teaching Scheme : L : 3hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40	Teaching Scheme : L : 3hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40
	Course Objective: 1. To teach Green Buildings within the Indian Context. 2. To provide knowledge of Energy management options with

	various rating systems.
	Course Outcome: 1. Able to understand green building with Sustainable Site Selection as well as Orientation and Building envelop. 2. Able to use various concepts like energy and water conservation with additional knowledge of different rating systems for building. 3. Able to study of energy management options. 4. Understanding of various water conservation techniques.
Unit 1 6HRS Introduction – Ecology and Economics, Interlinking between Economy and Environment, Definition, scope and importance of Environment Economics, Environment Economics and Ecological Economics, Ecological Technologies, Natural resource valuation and accounting, valuation of tangible and intangible.	**Unit 1 6HRS** **Introduction** Green Buildings within the Indian Context, Sustainable Site Selection, Orientation, Building envelop, Building plan layout,Design of Doors and windows, Natural ventilation, Solar energy, Use of solar energyfor water heating, Solar concentrators, Solar photovoltaic panels, Direct and indirectlighting, comparison of various lighting devices- electric tubes, incandescent lamps,CFL and LED lamps, Indirect lighting devices like Light Tubes, Thermal Transmittance of Building
Unit 2 8 HRS Economics of Environmental Protection: Theory of Public goods, Market Inefficiency and Market failure, Externalities - Property Rights and Externalities , Non-Convexities and Externalities, Pigouvian taxes and subsidies, , Common Property Rights, The Problem of Social Cost , marketable pollution permits and mixed instruments (the charges and standards approach), Coase's bargaining solution and collective action. Economic Instruments for Environmental Protection, Command & Control versus Incentives and Subsidies - Available Policy Options - Effectiveness of these instruments, International Comparisons.	**Unit 2 6HRS** Buildings and climate, Cost Effective vs. Energy efficiency in buildings.Energy efficient buildings, Forms of energy, Embodied and Life cycle energy, Energy Efficiency in Building materials. Building Materials from Agro andIndustrial waste, Biomass resources, treated thatch, Concept of Embodied Energy, Embodied energy of various common building materials, Thermal propertiesof building components, Thermal storage, emissivity, reflectivity, Selection of materials and surface treatment for, Ventilation & lightening, Positioning of openings, Day lighting , Active and Passive Architecture,
Unit 3 8 HRS Environmental Evaluation: Economic principles of cost benefit analysis; Measurement of Environmental economic value of Renewable and Non-Renewable Resources ; Methods of valuation - Contingent Valuation Method, Travel Cost methods, Hedonic Market Methods. Market based instruments for controlling pollution; Cost of controlling greenhouse gases; Carbon trading and CDM mechanisms. Systems of Integrated environmental accounting ; Green accounting. Economic Growth and the Environment, Environmental Kuznets'	**Unit 3 8 HRS** Energy management options -Energy audit and energy targeting - Technological options for energy management Energy efficient lighting -Terminology -Cosine law of luminance –Types of lamps -Characteristics-Design of illumination systems -Good lighting practice -Lighting control -Steps for lighting energy conservation. Overview of the significance of energy use and energy processes in building -Indoor activities and environmental control -Internal and external factors on energy use and the attributes of the factors -

curve, Foreign Direct Investment Inflow and the Environmental quality.	Characteristics of energy use and its management -Macro aspect of energy use in dwellings and its implications Thermal comfort -Ventilation and air quality -Air-conditioning requirement -Visual perception -Illumination requirement -Auditory requirement.
Unit 4 7HRS Environmental Economics and Sustainable Development: Definition, concept and dimensions of Sustainability, Issues in Sustainable Development, Guiding principles of Sustainable Development, Strategic Planning for Sustainable Development, Sustainability Indicators. Models of Sustainability, Environmental Sustainability Index (ESI). Economic Reforms and Sustainable Development. National and Global Challenges of Sustainable Development, Instruments for implementing sustainability- Finding Right Prices, The Hardwick- Solow Rule, Critical Rental Capital; Safe Minimum Standard; Steady State Principles. Policy Implications for implementing sustainability.	**Unit 4 6HRS** Climate, solar radiation and their influences -Sun-earth relationship and the energy balance on the earth's surface -Climate, wind, solar radiation, and temperature -Sun shading and solar radiation on surfaces -Energy impact on the shape and orientation of buildings. Rain water harvesting, potable water and bore well recharging methods, Minimization of water use, Dual flush, waterless urinals, smart controlled water taps, Segregation and treatment of wastewater, Various treatment technologies like septic tank, Anaerobic filter, CWTS, biogas plants advanced treatment options like carbon bed, reverse osmosis, electrodialysis, ion exchange, recycling of treated wastewater for different non potable purpose,
Unit 5 6 HRS Eco-technologies and Environmental Economics: Eco-technology and its relevance to development of economics and evolution of environment, importance of eco-technology in reducing consumption of resources , minimizing production of wastes , reducing cost of products and in protection and conservation of natural resources; Classification of eco-technology; Need of extensive and vigorous research and development of Eco-technology on the basis of ecology principles.	**Unit 5 8 HRS** Building Form –Surface area and Fabric Heat Loss, utilizing natural energy, Internal Planning, Grouping of buildings. Building Fabrics -Windows and doors, Floors, Walls, Masonry, Ecological walling systems, Thermal Properties of construction material. Infiltration and ventilation, Natural ventilation in commercial buildings, passive cooling, modeling air flow and ventilation, Concepts of daylight factors and day lighting, daylight assessment, artificial lighting, New light sources. Cooling buildings, passive cooling, mechanical cooling. Recycling of Building materials.
Unit 6 5 HRS Environmental Economics, Eco-politics and Accounting : Polluter Pays Principle, Trade and Eco-politics , Pollution Export, Trans-boundary issues, Developmental priorities - Pre independence and Post-independence period - in India, Role of NGOs, Individuals , and Women in environmental protection in India. Rehabilitation and Resettlement Issues , Government Policies and Social Awareness for the Protection of Environment.	**Unit 6 6 HRS** Green Building Various softwares and Various rating systems LEED criteria, USGBS, CIII-Godrej Green rating, GRIHA,ASHRAE, CDM and Carbon trading, Environmental clearance of buildings. Environmental reporting and ISO 14001; climate change business and ISO 14064; green financing; financial initiative by UNEP, Energy awareness, monitoring energy consumption, Building Environmental Assessment-environmental criteria -assessment methods -assessment tools (e.g. LEED). Ecohomes, Sustainablearchitecture and urban design –principles of environmental

	architecture. Benefits of green buildings –Energy Conservation Building code -NBC -Case Studies –Green Buildings in Auroville and Dakshina Chitra, Tamil Nadu, India.
References- Allen V. Kneese and James L. Sweeney, eds. **Handbook of Natural Resource and Energy Economics**, Chapters 2,12,14,17, North Holland,1985. Bhattacharya, R.N. 2001. Environmental Economics: An Indian Perspective, Oxford University Press. Brundtland,G.H. 1987. Our Common Future: The World Commission on Environmental and Development. Oxford, UK: Oxford University Press.34.	**References-** 1. "Alternative Building Materials and Technologies"Rao 2. Krieder and A. Rabl, Heating and Cooling of Buildings -Design for Efficiency, McGraw Hill, 1994. 3. S.M. Guinnes and Reynolds, Mechanical and Electrical Equipment for Buildings, Wiley, 1989 4. Shaw, Energy Design for Architects, AEE Energy Books, 1991 5. ASHRAE, Handbook of Fundamentals, Atlanta, 1997 6. Public Technology, Inc. (1996). Sustainable Building Technical Manual: GreenBuilding Design, Construction, and Operations. Public Technology, Inc., Washington,DC. 7. Sim Van Der Ryn, Stuart Cowan, "Ecological Design", Island Press (1996) 8. Dianna Lopez Barnett, William D. Browning ,"A Primer on Sustainable Building", 9. Rocky Mountain Green Development Services,. 10. The HOK Guidebook to Sustainable Design, Sara Mendler and William Odell, JohnWiley. 11. David A. Gottfried, Sustainable Building Technical Manual., Public Technology Inc 12. Richard D. Rush, . Building System Integration Handbook., New York: John Wiley & Sons 13. Ben Farmer & HentieLouw., Companion to Contemporary Architectural Thought,London & New York: Routledge 14. Peter Noever (ed)., Architecture in Transition: Between Deconstruction and New Modernism., Munich: Prestel.

ESTE-2 Elective – II –ESTE – 23 Environmental Statistics and Experimental Designs Operational Health and Safety management	
Old Syllabus	**New Syllabus**
Teaching Scheme : L : 3hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40	Teaching Scheme : L : 3hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40
	Course Objective: 1. To get knowledge of principles of safety management. 2. To enable the students to learn about various functions and

	activities of safety division.
	Course Outcome: 1. Able to understanding of principles of safety management. 2. Able to work as safety engineer in industry 3. Interpret and apply legislative requirements for industrial standards with best practices in a variety of workplaces. 4. Be able to make aware about the hazards, causes of accidents to the site employees.
Unit 1 **7 HRS** Basic concepts: Variable, quantitative, discrete, continues, data: Data representation, tabulation, diagrammatic representation. Measures of central tendency and dispersion, mean, median, mode, percentiles, range, variance, standard deviation, coefficient of variation measuresskewness and kurtosis.	**Unit 1** **6 HRS** Hazards and causes of accidents, safety measures Physical , Chemical , Biological and Ergonomical Hazards ,Industrial Hazards, Electrical Hazards and Hazards in Construction IndustryFire and other Hazards Need for developing Environment, Health and Safety systems in work places. Status and relationship of Acts, Regulations and Codes of Practice. Role of trade union safety representatives. International initiatives. Safe use of machines and tools
Unit 2 **6 HRS** Probability: sample space, events, equally likely out comes probability of events (frequency approach). Addition and ultiplication Theorems and condition probability.	**Unit 2** **7 HRS** Safety legislation and standards for construction industry, Organization for safety, site management, safety manual and check lists Safety officer, safety committee, safety training, safety audit **Techniques of Environmental Safety** Elements of a health and safety policy and methods of its effective implementation and review. Functions and techniques of risk assessment, inspections and audits. Investigation of accidents- Principles of quality management systems in health and safety management.
Unit 3 **8 HRS** Standard distributions : Binomial, Poisson, normal, expon- ential. Computation of mean, variance and probability distribution function and generating function. Model sampling, simulation study. Correlation and regression: scatter plot, correlation coefficient, properties, rank correlation. Linear regression: Fitting of line and plane of regression.	**Unit 3** **5 HRS** Safety precautions and practices in various construction activities like excavation, concreting,scaffold erection and dismantle, concreting, steel erection and demolition of structures, Organising for safety, Health and Enviornment. Organisation : Structure, Function and responsibilities Safety Committee : Structure and function Safety and Health training, Stress and Safety.
Unit 4 **8 HRS** Methods of sampling: Simple Random sampling with and without replacement. Sampling distribution and standard deviation of sample mean. Testing of hypothesis: Null and alternative hypothesis, types of	**Unit 4** **8 HRS** Occupational hazards and personal protective equipment Legislative measures in industrial safety: Factories Act, 1948, Workman's Compensation Act, 1943,

errors, critical region. Testing of equality of proportion and for equality of means when variances are known and unknown. P-value chi-squre test of goodness of fit and of independence.	Employees State Insurance Act, 1948. Mines Act , Air (Prevention and control) Pollution Act, 1981, Water (Prevention and Control) Pollution Act, 1974, Boiler Vessels Act. Child Labour and Women Employee Act. The factories rules, History, Provisions under the factories Act and rules made there under with amendments, Functions of safety management. ILO Convention and Recommendations in the furtherance of safety, health and welfare.
Unit 5 **4 HRS** Basic concepts in Experimental Designs: Unit, treatment, Lay out of the experiment. Principles of designs of experiments, randomization, replication and local control. typical applications of experimental designs.	**Unit 5** **7 HRS** Management of accidents Principles of accidents prevention : Definition : Incident, accident, injury, dangerous occurrences, unsafe acts, unsafe conditions, hazards, error, oversight, mistakes, etc. Accident Prevention : Theories / Models of accident occurrences, Accident and Financial implications, Hazard identification and analysis, fault tree analysis, Eventtree analysis, failure modes and effects analysis, Job safety analysis - examples, Plant safety inspection - objectives and types check procedure inspection report.
Unit 6 **8 HRS** Analysis of variance: One way and two way classification. Mathematical model assumptions. Hypotheses, and their testing. ANOVA table . Standard designs : CRD, RBD and LSD, Lay-out, model, analysis, advantages.	**Unit 6** **7 HRS** **Education and Training** Requirements for and benefits of the provision of information, instruction, training and supervision. Factors to be considered in the development of effective training programmes. Importance of training-identification of training needs- Principles and methods of effective training methods –programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training – safety training to workers.Feedback and evaluation mechanism.
References- 1. Biostatistics : A foundation for Analysis in the Health Sciences 7/ Wayne W. Daniel, Wiley Series in Probability and Statistics. 2. Cochran& Cox: experimental designs. 3. Goon, Gupta& Dasgupta: Fundamentals of statistics Vol. I & II 4. Kempthorne: The design and analysis of experiment. 5."Geostatistics with Applications in Earth Sciences" By D.D. Sarma National Geophysical Research Institute (Council of Scientific and industrial Research) Hyderabad India Publication: Capital Publishing	**References-** 1. Safety and Health in Construction, ILO, 1992 2. Construction hazard & Safety handbook, R Hudson and R W King, Butterworths 3. R.K.Jain and Sunil S.Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers , New Delhi (2006) 4. Slote.L, Handbook of Occupational Safety and Health, John Willey and Sons, New York.

Company New Delhi Kolkata, 6. Rechard A. Johnson: Probability and Statistics for Engineers. 7. Hogg and Tanis : Probability and Statistical Inference. 8. Douglas C. Montgomery : Design and Analysis of Experiments.	5. Industrial Safety -National Safety Council of India. 6. Frank P Lees - Loss of prevention in Process Industries , Vol. 1 and 2, Butterworth- Heinemann Ltd., London (1991). 7. National Safety Council, "Accident Prevention Manual for IndustrialOperations", N. S. C. Chicago, 1988. 8. Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, NewYork, 1980. 9. Krishnan N.V. "Safety Management in Industry" Jaico Publishing House, Bombay, 1997. 10. John Ridley, "Safety at Work", Butterworth & Co., London, 1983. 11. Blake R.B., "Industrial Safety" Prentice Hall, Inc., New Jersey, 1973

7.ESTS-1Seminar-ISeminar-I	
Old Syllabus	**New Syllabus**
Teaching Scheme : P : 2 hrs/ Week/ studentCredits: 2	Teaching Scheme : P : 2 hrs/ Week/ studentCredits: 2
	Course Objective: 1. Providing knowledge of effective oral presentations. 2. To motivation about presentations skills.
	Course Outcome: **1.** Be able to understand the reading, understanding the research paper and able to develop skill tosummarize it with optimum words. **2.** Able to give presentation on allotted research topic. **3.** Able to recognize the need for lifelong learning. **4.** Understanding and given preference to new ideas, concepts, technologies in Environmental engineering.
The topic of seminar shall be based on area of Environmental Engineering & preferably considering new ideas, concepts, technologies & developments in the field of Environmental Sciences & Technologies. At least two oral presentations and submission of report in soft & hard copies is expected. Students shall deliver Seminar on the State-of-the-Art topic in front of Examiners and Student-colleagues. Prior to presentation, he/ she shall carry out the detailed literature survey from Standard References such as International Journals and Periodicals, recently published reference Books etc. and submit a report on the same along with computer based presentation copy to the concerned examiner/ guide at the end of the seminar. The assessment shall be based on selection of topic, its relevance to the	The topic of seminar shall be based on area of Environmental Engineering & preferably considering new ideas, concepts, technologies & developments in the field of Environmental Sciences & Technologies. At least two oral presentations and submission of report in soft & hard copies is expected. Students shall deliver Seminar on the State-of-the-Art topic in front of Examiners and Student-colleagues. Prior to presentation, he/ she shall carry out the detailed literature survey from Standard References such as International Journals and Periodicals, recently published reference Books etc. and submit a report on the same along with computer based presentation copy to the concerned examiner/ guide at the end of the seminar. The assessment shall be based on selection of topic, its relevance to the

present context, report documentation and presentation skills. Guide should spare for 2hrs / week/ student for seminar	present context, report documentation and presentation skills. Guide should spare for 2hrs / week/ student for seminar	

8.ESTC-14 Laboratory- I Water Quality analysisWater Quality analysis	
Old Syllabus	**New Syllabus**
Teaching Scheme : P : 2 hrs/ week Credits: 1	Teaching Scheme : P : 2 hrs/ week Credits: 1
	Course Outcome: Ability to take samples, analyze and interpret the results of water samples.
A performance based on Experiments, or assignment or Visit report	A performance based on Experiments, or assignment or Visit report
9.ESTC-15Laboratory- IIEnvironmental Chemistry and microbiologyRemote sensing and GIS applications in environmental Engineering	
Teaching Scheme : P : 2 hrs/ week Credits: 1	Teaching Scheme : P : 2 hrs/ week Credits: 1
	Course Outcome: Able to know use of various equipments in Remote sensing and GIS like GPS, DGPS and learn how to practical implementation in various environmental fields.
A performance based on Experiments, or assignment or Visit report	A performance based on Experiments, or assignment or Visit report
10.ESTC-16Laboratory- III Solid waste managementSolid and Hazardous waste management	
Teaching Scheme : P : 2 hrs/ week Credits: 1	Teaching Scheme : P : 2 hrs/ week Credits: 1
	Course Outcome: Be able to design and optimize techniques in treatment after study of physical and chemical analysis of Solid and Hazardous waste.
A performance based on Experiments, or assignment or Visit report	A performance based on Experiments, or assignment or Visit report

Shivaji University, Kolhapur First Year M. Tech Environmental Science and Technology (Semester II)	
1.ESTC-20Air Pollution and Control	**Air Pollution and Control**
Old Syllabus	**New Syllabus**
Teaching Scheme : L : 4hrs/ week Credits: 4 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40	Teaching Scheme : L : 4hrs/ week Credits: 4 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40
	Course Objective: 1. To provide the basic knowledge of air pollution and its control. 2. To develop a skill of design and operation of control devices for gaseous and particulate pollutants.

	Course Outcome: 1. Able to define air pollution and its control 2. Understanding design skills andoperation of control devices for gaseous and particulate pollutants. 3. Understand reduction of emissions from automobile source by different methods and Alternative fuels and their utilizations. 4. Ability to use the basic and advance air pollution knowledge in research and development.
Unit 1 6 HRS Physics of atmosphere, Solar radiation, Wind circulation, Lapse rate, Inversion, Stability conditions, Pasquil stability model, maximum mixing depth, Wind rose, Plume behavior, Heat island effect, Green house effect, Rain drop formation, Visibility, Photochemical reaction.	**Unit 1 6 HRS** Physics of atmosphere, Solar radiation, Wind circulation, Lapse rate, Inversion, Stability conditions, Pasquil stability model, maximum mixing depth, Wind rose, Plume behavior, Heat island effect, Green house effect, Rain drop formation, Visibility, Photochemical reaction.
Unit 2 7 HRS Dispersion of pollutants in the atmosphere, eddy diffusion model, the Gaussian dispersion model, point source, Line source, maximum ground level concentration, Determination of stack height, sampling time corrections, Effects of inversion trap.	**Unit 2 7 HRS** Dispersion of pollutants in the atmosphere, eddy diffusion model, the Gaussian dispersion model, point source, Line source, maximum ground level concentration, Determination of stack height, sampling time corrections, Effects of inversion trap.
Unit 3 7 HRS Particulate matter; Definitions of different particulate matter, Distribution and source of SPM, Terminal settling velocity, Hood and duct design, Particulate collection design.	**Unit 3 7 HRS** Particulate matter; Definitions of different particulate matter, Distribution and source of SPM, Terminal settling velocity, Hood and duct design, Particulate collection design.
Unit 4 8 HRS Control equipment for particulate matter; Settling chamber, Cyclone, Wet collectors, Fabric filter, Electrostatic precipitator, Problems on design of equipment, Component detailing collection efficiency.	**Unit 4 8 HRS** Control equipment for particulate matter; Settling chamber, Cyclone, Wet collectors, Fabric filter, Electrostatic precipitator, Problems on design of equipment, Component detailing collection efficiency.
Unit 5 5 HRS General control of Gaseous pollutants, Principles of absorption, Adsorption, Basic design of absorption and adsorption units, Incineration and after burner, Control of sulphuric dioxide, NOx.	**Unit 5 5 HRS** General control of Gaseous pollutants, Principles of absorption, Adsorption, Basic design of absorption and adsorption units, Incineration and after burner, Control of sulphuric dioxide, NOx
Unit 6 7 HRS Automobile source; Emission of pollutants from automobiles, Reduction of emissions by different methods, Alternative fuels and their utilizations. Strategy for effective control of air pollution in India.	**Unit 6 7 HRS** Automobile source; Emission of pollutants from automobiles, Reduction of emissions by different methods, Alternative fuels and their utilizations. Strategy for effective control of air pollution in India.
References- 1. Air Pollution – Wark and Warner.	**References-** 1. Air Pollution – Wark and Warner.

2. Air Pollution Vol. I and II– Stern. 3. Air Pollution and Control– Martin Crawford.	2. Air Pollution Vol. I and II– Stern. 3. Air Pollution and Control– Martin Crawford.

2.ESTC-21Industrial Waste treatmentEnvironmental Management systems	
Old Syllabus	**New Syllabus**
Teaching Scheme : L : 3hrs/ week T:1 Credits: 4 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40	Teaching Scheme : L : 3hrs/ week T:1 Credits: 4 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40
	Course Objective: 1. To study of ecological aspects and study of Environmental impact Assessment. 2. To study of Environmental Management Plan and ISO and ISO 14000 series
	Course Outcome: 1. Understanding ecological aspects and Environmental management systems. 2. Able to getting knowledge Environmental Management Plan and ISO and ISO 14000 series. 3. Develop an understanding of the differences in the structure and function of different types of ecosystems 4. Appreciate the purpose and role of EIA in the decision-making process with technical and social/ political limitations of EIA.
Unit 1 **6 HRS** Water use in industry, Industrial water quality requirements, Deterioration of water quality, Classification and characterization of Industrial wastewater, Monitoring of wastewater flow in industries, Quality and quantity variations in waste discharge, Water budgeting.	**Unit 1** **6 HRS** **Ecological aspects**: Salient features of major Eco Systems, Energy Transfer, Population Dynamics, Ecological imbalance, Preservation of Biodiversity. Land Pollution, Water Pollution due to sewage, industrial effluents and leachate, Groundwater contamination and control measures. Pollution due to Nuclear Power Plants, Radioactive Waste, Thermal pollution, causes and control. **Noise Pollution:** Decibel Levels, Monitoring, Hazards, Control measures
Unit 2 **5 HRS** Waste volume reduction, Waste strength reduction, Neutralization, Proportioning, Equalization. Reuse and recycling concepts.	**Unit 2** **8 HRS** **Environmental Impact Assessment (EIA)** Definitions and Concept, Scope, Objectives, Types of impacts, Elements of EIA, Baseline studies, Methodologies of EIA, Prediction of impacts and its methodology, Uncertainties in EIA, Status of EIAs in India Components - screening - setting - analysis - prediction of impacts - mitigation. Matrices -Networks - Checklists. Importance assessment

	techniques - cost benefit analysis -analysis of alternatives - methods for Prediction and assessment of impacts - air - water -soil - noise - biological - cultural - social - economic environments. Standards and guidelines for evaluation. Public Participation in environmentaldecision-making. EIA related to the following sectors - Infrastructure –construction and housing Mining –Industrial - Thermal Power - River valley and Hydroelectric – coastal projects-Nuclear Power. EIA for coastal projects.
Unit 3 **6 HRS** Treatment techniques for removal of specific pollutants in industrial , wastewaters, e.g., oil and grease, cyanide, fluoride, calcium, magnesium,toxic organics, heavy metals, radioactivity	**Unit 37 HRS** **Environmental Auditing:** Definitions and concepts, Scope and Objectives, Features of Effective auditing -programme Planning - Definition –Organisation of Auditing Programme - pre visit data collection Audit Protocol - Onsite Audit - Data Sampling- Inspections - Evaluation and presentation Exit Interview – Audit Report - Action Plan – Othertypes of Audits - Management of Audits -Waste Management Contractor Audits - Related Audits. Life cycle analysis,Environmental audit statement, Qualities of environment auditor. Environmental Impact Statement (EIS), Sustainable development. **Environmental Management Plan:** Definition, Importance, Development, Structuring, Monitoring, Cost aspects. Strategy for siting of Industries
Unit 4 **6 HRS** Treat ability aspects of raw industrial wastewater with domestic sewage, Partially treated industrial wastewater with domestic sewage, Completely treated industrial wastewater with domestic sewage. Stream and Effluent standards	**Unit 45 HRS** **Environmental management systems (EMS),** problems andstrategies, planning, decision-makingand management dimensions; Review of political, ecological and remedial actions; Future strategies, multidisciplinary approaches, Environmental policies and legislation in developed anddeveloping countries including India; Policies regarding Air, water, land, forestry, wild life, biodiversity, energy, human resources and multidimensional pollution; Role of internationalenvironmental institutions like U.N. etc.
Unit 5 **7 HRS** Common Effluent treatment plant: Concept, Objectives, Methodology, Cost benefit analysis, Design, Operation and maintenance.	**Unit 5** **7 HRS** **ISO and ISO 14000 Series**

	Introduction, Areas covered in the series of standards, Necessity of ISO certification. Environmental management system: Evolution, Need, Elements, Benefits, ISO 14001 requirements, Steps in ISO 14001 certification, ISO 14001 and sustainable development, Integration with other systems (ISO 9000, TQM, Six Sigma), Benefits of integration,OSHA 18000 SHE Audits Introduction to Geographical Information System (GIS) and Remote Sensing inEnvironmental Management. Role of remote sensing and GIS in Environmental Impact Assessment. Geo-indicatorsand environmental indicators. Cleantechnologies.
Unit 6 **10 HRS** Classification of industries. Manufacturing processes, Water usage, Sources, Quantities, and characteristics of effluents, Pollution effects, Methods of treatment, utilization and disposal, in industries viz. sugar, distillery, dairy, pulp and paper mill, fertilizer, tanning, steel industry, textile, petroleum refining, chemical and power plant.	**Unit 6** **7 HRS** Water (prevention and control of pollution) act 1974, The environmental act 1986, The Noise Pollution (Regulation and Control) Rules, 2000. Environmental economics, Environmental Labelling, Life-Cycle Assessment **Environmental Ethics:** Ethics in society, Environmental consequences, Responsibility for environmental degradation, Ethical theories and codes of Ethics, Changing attitudes **Socio-Economic Impact Assessment** Definition of social impact assessment. Social impact assessment model and the planningprocess. Rationale and measurement for SIA variables. Relationship between social impactsand change in community and institutional arrangements. Individual and family levelimpacts.
References- 1) Theories and Practices of Industrial waste treatment- Nelson Nemerow. 2) Waste water treatment: M.N.Rao& Datta. 3) IS Standard guide for treatment and disposal of various industries.	**References-** 1. "Environmental Impact Assessment", Canter (U.S.A) McGraw Hill publications, 1996. 2. "Environmental Auditing", Published by CPCB. New Dehli. 3. "Environmental Audit", A.K. Mhaskar, .Media Enviro Publications, 2002. 4. "ISO Standards". 5. "Environment Management Centre Website". 6. "Ecology", E.P. Odum. (Second edition) Oxford and IBH publishing Co.Pvt.Ltd, 1975.

3.ESTC-22Advance water and wastewater treatmentAdvance Water and Wastewater Treatment	
Old Syllabus	**New Syllabus**

Teaching Scheme : L : 3hrs/ week T: 1 Credits: 4 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40	Teaching Scheme : L : 3hrs/ week T: 1 Credits: 4 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40
	Course Objective: 1) To understanding of gas transfer concept and membrane filtration. 2) To study of Grit removal, Flotation, Chemical precipitation and Microbial growth kinetics with Theory and design of Sludge treatment and wetlands.
	Course Outcome: 1. Understanding gas transfer concept and membrane filtration. 2. Get knowledge about various technologies in Advance water and wastewater treatment. 3. Understand Design of aeration and grit chamber. 4. Knowledge of Modeling suspended and attached growth treatment processes.
Unit 1 **5 HRS** Gas transfer: Aeration systems, Energy requirement, Design of aeration systems. Membrane	**Unit 1** **5 HRS** Introduction,Gas transfer: Aeration systems, Energy requirement, Design of aeration systems.
Unit 2 **8 HRS** Membrane Filtration, Terminology, Process classification, Membrane configurations, Membrane operation for micro filtration, Ultra filtration and Reverse osmosis, Area requirement, Membrane fouling and its control, Application of membranes. Electro dialysis: Theory, Area and power requirement, Disposal of concentrate waste streams.	**Unit 2** **8 HRS** Membrane Filtration, Terminology, Process classification, Membrane configurations, Membrane operation for micro filtration, Ultra filtration and Reverse osmosis, Area requirement, Membrane fouling and its control, Application of membranes. Electro dialysis: Theory, Area and power requirement, Disposal of concentrate waste streams.
Unit 3 **6 HRS** Grit removal: Types of grit chambers, Characteristics, quantities, processes and disposal of grit, Design of grit chambers, Flotation: Objective, Types of flotation systems, Design considerations.Chemical precipitation for removal of phosphorous, heavy metals and dissolved inorganic substances.	**Unit 36 HRS** Grit removal: Types of grit chambers, Characteristics, quantities, processes and disposal of grit, Design of grit chambers, Flotation: Objective, Types of flotation systems, Design considerations.Chemical precipitation for removal of phosphorous, heavy metals and dissolved inorganic substances
Unit 4 **6 HRS** Microbial growth kinetics, Modelling suspended and attached growth treatment processes. Suspended growth processes for biological nitrification and de- nitrification, Biological nitrogen and phosphorous removal.	**Unit 46 HRS** Microbial growth kinetics, Modelling suspended and attached growth treatment processes. Suspended growth processes for biological nitrification and de- nitrification, Biological nitrogen and phosphorous removal.
Unit 5 **7 HRS**	**Unit 5** **7 HRS**

Anaerobic sludge blanket processes, Design considerations for Up flow Anaerobic Sludge Blanket process. Theory and design of Sludge treatment, sludge thickening, sludge drying, incineration, aerobic and anaerobic digestion of sludge.	Anaerobic sludge blanket processes, Design considerations for Up flow Anaerobic Sludge Blanket process. Theory and design of Sludge treatment, sludge thickening, sludge drying, incineration, aerobic and anaerobic digestion of sludge.
Unit 6 **8 HRS** Wetland and aquatic treatment systems; Types, application, Treatment kinetics and effluent variability in constructed wetlands and aquatic systems, Free water surface and subsurface constructed wetlands, Floating plants (water hyacinths and duckweed), Combination systems, Design procedures for constructed wetlands, Management of constructed wetlands and aquatic systems.	**Unit 6** **8 HRS** Wetland and aquatic treatment systems; Types, application, Treatment kinetics and effluent variability in constructed wetlands and aquatic systems, Free water surface and subsurface constructed wetlands, Floating plants (water hyacinths and duckweed), Combination systems, Design procedures for constructed wetlands, Management of constructed wetlands and aquatic systems.
References- 1. Wastewater Engineering treatment and reuse– Metcalf Eddy. 2. Theory and Practice of water and Wastewater treatment – Ronald Droste. 3. Physico-chemical processes of water purification – Weber 4. Wastewater Treatment for Pollution Control – Soli Arceivala.	**References-** 1. Wastewater Engineering treatment and reuse– Metcalf Eddy. 2. Theory and Practice of water and Wastewater treatment – Ronald Droste. 3. Physico-chemical processes of water purification – Weber 4. Wastewater Treatment for Pollution Control – Soli Arceivala.

4.ESTE 3-Elective III -31 Environmental Management Systems Industrial Waste Treatment	
Old Syllabus	**New Syllabus**
Teaching Scheme : L : 3 hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40	Teaching Scheme : L : 3 hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40
	Course Objective: 1. To identify, characterize and develop alternative treatment options for industrial waste 2. To manufacturing process study and water requirement with wastewater generation and conventional and non conventional techniques for treatment of industrial waste
	Course Outcome: 1. To know characteristics of industrial wastewater. 2. To understand water budget of industry with wastewater generation and conventional and non conventional techniques for treatment of industrial waste. 3. Able to plan location of industries, industrial estates and common effluent treatment plants. 4. Be able to carryout industrial water budgeting and performance studies for treatment plant.

Unit 1 **7 HRS** **Ecological aspects**: Salient features of major Eco Systems, Energy Transfer, Population Dynamics, Ecological imbalance, Preservation of Biodiversity. Land Pollution, Water Pollution due to sewage, industrial effluents and leachate, Groundwater contamination and control measures. Pollution due to Nuclear Power Plants, Radioactive Waste, Thermal pollution, causes and control. **Noise Pollution:** Decibel Levels, Monitoring, Hazards, Control measures	**Unit 1** **6 HRS** Water use in industry, Industrial water quality requirements, Deterioration of water quality, Classification and characterization of Industrial wastewater, Monitoring of wastewater flow in industries, Quality and quantity variations in waste discharge, Water budgeting.
Unit 2 **7 HRS** **Environmental Impact Assessment (EIA)** Definitions and Concept, Scope, Objectives, Types of impacts, Elements of EIA, Baseline studies, Methodologies of EIA, Prediction of impacts and its methodology, Uncertainties in EIA, Status of EIAs in India	**Unit 2** **5 HRS** Waste volume reduction, Waste strength reduction, Neutralization, Proportioning, Equalization. Reuse and recycling concepts.
Unit 36 HRS **Environmental Auditing:** Definitions and concepts, Scope and Objectives, Types of audit, Accounts audit, Environmental audit statement, Qualities of environment auditor. Environmental Impact Statement (EIS), Sustainable development. **Environmental Management Plan:** Definition, Importance, Development, Structuring, Monitoring, Cost aspects. Strategy for siting of Industries	**Unit 3** **6 HRS** Treatment techniques for removal of specific pollutants in industrial , wastewaters, e.g., oil and grease, cyanide, fluoride, calcium, magnesium,toxic organics, heavy metals, radioactivity
Unit 44 HRS **Environmental Ethics:** Ethics in society, Environmental consequences, Responsibility for environmental degradation, Ethical theories and codes of Ethics, Changing attitudes	**Unit 4** **6 HRS** Treat ability aspects of raw industrial wastewater with domestic sewage, Partially treated industrial wastewater with domestic sewage, Completely treated industrial wastewater with domestic sewage. Stream and Effluent standards
Unit 5 **7 HRS** **ISO and ISO 14000 Series** Introduction, Areas covered in the series of standards, Necessity of ISO certification. Environmental management system: Evolution, Need, Elements, Benefits, ISO 14001 requirements, Steps in ISO 14001 certification, ISO 14001 and sustainable development, Integration with other systems (ISO 9000, TQM, Six Sigma), Benefits of integration	**Unit 5** **7 HRS** Common Effluent treatment plant: Concept, Objectives, Methodology, Cost benefit analysis, Design, Operation and maintenance.
Unit 6 **9 HRS** Water (prevention and control of pollution) act 1974, The environmental act 1986, The Noise Pollution (Regulation and Control) Rules, 2000. Environmental economics, Environmental Labelling, Life-Cycle Assessment	**Unit 6** **10 HRS** Classification of industries. Manufacturing processes, Water usage, Sources, Quantities, and characteristics of effluents, Pollution effects, Methods of treatment, utilization and disposal, in industries viz. sugar, distillery, dairy, pulp and paper mill, fertilizer, tanning, steel industry,

	textile, petroleum refining, chemical and power plant.
References- 1. "Environmental Impact Assessment", Canter (U.S.A) McGraw Hill publications, 1996. 2. "Environmental Auditing", Published by CPCB. New Dehli. 3. "Environmental Audit", A.K. Mhaskar, .Media Enviro Publications, 2002. 4. "ISO Standards". 5. "Environment Management Centre Website". 6. "Ecology", E.P. Odum. (Second edition) Oxford and IBH publishing Co.Pvt.Ltd, 1975.	**References-** 1) Theories and Practices of Industrial waste treatment- Nelson Nemerow. 2) Waste water treatment: M.N.Rao& Datta. 3) IS Standard guide for treatment and disposal of various industries.

ESTE 3-Elective III -32 Remote Sensing and GIS Applications in Environmental Engineering	**Environmental PoliciesandLegislation**
Old Syllabus	**New Syllabus**
Teaching Scheme : L : 3 hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40	Teaching Scheme : L : 3 hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40
	Course Objective: 1. To provide knowledge and make students familiar with environmental issues and laws. 2. To provide knowledge of National and International policies, legislation related environmental.
	Course Outcome: At the end of course student will be able to 1. Understand the relation between constitution and environmental protection. 2. Able to Know aspects towards Environmental protection. 3. Study of Environmental Legislation and policies. 4. Understand various Environmental related Case laws.
Unit 1 **7 HRS** Concepts of remote sensing; Energy sources and Radiation principles, spectral characteristics of earth's surface and of atmosphere. Sensors and their characteristics; Radiometers, cameras, multi-spectral scanners and microwave systems. Aerial and satellite platforms.	**Unit 1** **8 HRS** **Introduction** Ancient Indian aspects towards Environmental protection- Historical development of various Environmental Legislations- sustainable development-pre and post independence period , Indian Constitution and Environment Protection, National environmental policies, Institutionalframework (SPCB/ CPCB/ MoEF), environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Riodeclaration,Various five year plans and the provision for Environment in these plans, National and International

	perspectives.
Unit 2 **6 HRS** Optical, infrared and microwave imagery, Analysis of imagery, Visual and machine interpretation of imagery, Ground truth data, Digital image processing.	**Unit 2** **7 HRS** **Environmental policies** –Policies for conservation and protection of natural resources like National water policy,sustainable developmental policy, National forest policy, other policies related toenvironment also personal properties and monuments, conflict between environmental protection and development, conservation strategy- management of natural resources, Evolving of new principles- Precautionary Principle and Polluter Pays Principle – Concept of absolute liability .
Unit 3 **8 HRS** Application of remote sensing – Land use and Land cover mapping, biodiversity, forestry and agriculture, soil erosion, water resources, wetland mapping, Wild life ecology, Environmental assessment, Environmental management, Urban and regional planning, Monitoring natural disasters.	**Unit 3** **8HRS** **Prevention and control of Pollution-** Role of central and state governments-Water Act,1974, Air Act,1981,Environment (Protection) Act**,**1986,Noise pollution and its control, Disposal of waste, laws on waste disposal and its control-Municipal Solid Waste Management Rules, Hazardous Waste Rules, Biomedical Waste Handling Rules– responsibilities of generators and role of Pollution Control Boards, Coastal Zone Regulation, Wildlife Protection Act 1972, Forest Conservation Act 1980, Amendments in various laws- Evaluation for strength and weakness of present Legal system.
Unit 4 **6 HRS** Fundamentals of GIS: Definition, Components, spatial data, thematic characteristics, rasters and vectors, databases and database management.	**Unit 4** **5HRS** **International Law and Environment Protection-** Trans –boundary pollution hazards, International convections in the development of Environmental Laws and its policy- from Stockholm to recent convections, IPCC, WHO and other international guidelines. Functions and powers of ministry of Environment and forest and pollution control Boards in centre and state
Unit 5 6 HRS Data input and Editing: Data stream, data encoding, map digitization and conversion, data analysis, network and surface analysis in GIS, analytical modelling, forms of GIS output, decision support systems, GIS project design and management.	**Unit 5 6 HRS** **Common law aspects of Environmental Protection-**Remedies under other laws – IPC, CRPC, CPC , Public Liability Insurance Act, Public Interest Litigation- Supreme Court Judgments in Landmark cases. Environmental Ethics,Role of NGO's in Environmental planning and education.
Unit 6 **7 HRS** GIS applications: Forestry, Bio-diversity, Environment, Soil resource management, Hydrological modelling, Public utilities (water distribution, sewerage, solid waste management).	**Unit 6** **6 HRS** Constitution and environment, role of Judiciary on environmental issues-Executive and legislative powers and their limitations.Case laws- Principles of case laws, statutory interpretations, site

	selection, land use planning, town planning act. Environmental management plan, environment management cells, rehabilitation and remediation. ISO: 14000 – its need, procedure to be followed to obtain ISO: 14000 certification, implicationsof ISO.
References- 1. Remote Sensing and Image Interpretation – Lillesand and Kiefer. 2. Introduction to the physics and techniques of Remote Sensing – Elachi. 3. Geographical Information System Vol. I and II– Longley. 4. An Introduction to GIS– Ian Haywood.	**References-** 1. CPCB, "Pollution Control acts, Rules and Notifications issued there under "Pollution Control Series – PCL/ 2/ 1992, Central Pollution Control Board, Delhi, 1997. 2. Shyam Divan and Armin Roseneranz "Environmental law and policy in India "Oxford University Press, New Delhi, 2001. 3. GregerI.Megregor, "Environmental law and enforcement", Lewis Publishers, London. 1994. 4.Pollution législation – A.K. Mhaskar, M/ s. Media Enviro, Pune 5. Environmental Audit – An overview, A. K. Mhaskar – M/ s. Media Enviro, Pune. 6. Matter Hazardous Laws Explained. A. K. Mhaskar M/ s. Media Enviro, Pune 7. Environmental impact assessment Larry W Canter McGraw Hill International Edition, New York 1996. 8. Environmental Impact Assessment, Lauren David P., Willy Interscience, New Jersey. 9. Environmental Impact Assessment, second edition, Larry W. Canter, McGraw-Hill International editions.
ESTE 3-Elective III -33EnvironmentalSanitationEnvironmentalSanitation	
Old Syllabus	**New Syllabus**
Teaching Scheme : L : 3 hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40	Teaching Scheme : L : 3 hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40
	Course Objective: 1. To provide knowledge of ecology and ecosystem. 2. To provide knowledge of transmission of diseases through air, water and food, control and prevention of diseases
	Course Outcome: 1. Able to know types of ecosystem,various food chain and web, population dynamics, imbalance of ecosystem.

	2. To understandMosquito and its control, house fly and its control, Rodent control. 3. Able to know Sanitation aspects in public places. 4. Understand basic elements of good housing.
Unit 16 HRS Ecology, man and his environment, types of ecosystem, food chain and web, population dynamics, imbalance of ecosystem causes and effects, Energy flow in nature, Non- conventional energy sources.	**Unit 16 HRS** Ecology, man and his environment, types of ecosystem, food chain and web, population dynamics, imbalance of ecosystem causes and effects, Energy flow in nature, Non- conventional energy sources.
Unit 25 HRS Vital Statistics, Sources, population growth and its control, factors affecting, infant mortality, Morbidity rates.	**Unit 25 HRS** Vital Statistics, Sources, population growth and its control, factors affecting, infant mortality, Morbidity rates.
Unit 37 HRS Transmission of diseases through air, water and food, control and prevention of diseases, Vectors as disease carriers, Vector and weed control, Pesticide use, Mosquito and its control, house fly and its control, Rodent control.	**Unit 37 HRS** Transmission of diseases through air, water and food, control and prevention of diseases, Vectors as disease carriers, Vector and weed control, Pesticide use, Mosquito and its control, house fly and its control, Rodent control.
Unit 47 HRS Sanitation aspects in food processing, dairy, public places, slaughterhouse, swimming pool, and industry. Building by laws for sanitation, Rural sanitation, Low-cost sanitation, Privies, Waterless toilet.	**Unit 47 HRS** Sanitation aspects in food processing, dairy, public places, slaughterhouse, swimming pool, and industry. Building by laws for sanitation, Rural sanitation, Low-cost sanitation, Privies, Waterless toilet.
Unit 58 HRS Basic elements of good housing, substandard housing and its effects, Ventilation and air- conditioning, house plumbing and drainage, backflow prevention, indirect waste piping. Industrial hygiene, sources of dust and gaseous pollutants, occupational hazard, exposure tolerance, protective measures, Legal control.	**Unit 58 HRS** Basic elements of good housing, substandard housing and its effects, Ventilation and air- conditioning, house plumbing and drainage, backflow prevention, indirect waste piping. Industrial hygiene, sources of dust and gaseous pollutants, occupational hazard, exposure tolerance, protective measures, Legal control.
Unit 67 HRS Noise Pollution, Decibel scales, Noise characteristics & measurement, Levels of noise and standards, Control measures of community and industrial noise.	**Unit 67 HRS** Noise Pollution, Decibel scales, Noise characteristics & measurement, Levels of noise and standards, Control measures of community and industrial noise.
Refrences- 1) Environmental Sanitation – Salvador. 1) Municipal Sanitation – Ethers and Steel. 2) Modern concepts of Ecology – H. D. Kumar. 3) Environmental Engineering and Sanitation – Salvato.	**Refrences-** 1) Environmental Sanitation – Salvador. 1) Municipal Sanitation – Ethers and Steel. 2) Modern concepts of Ecology – H. D. Kumar. 3) Environmental Engineering and Sanitation – Salvato.

5.ESTE-4-Elective-IV-41Operation and Maintenance of Environmental FacilitiesOperation and Maintenance of Environmental Facilities	
Old Syllabus	**New Syllabus**
Teaching Scheme : L : 3 hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40	Teaching Scheme : L : 3 hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40
	1. To study the importance of good Operation & Maintenance and use ofoperation manuals. 2. To study operation and maintenance of water, wastewater treatment systems and air pollution control devices.
	Course Objective: 1. To provide knowledge about Need of Operation and Maintenance. 2. To provide knowledge of Planning and Management.
	Course Outcome: 1. Understanding plan, prepare and schedule daily operations and inspections. 2. Able to identify, analyze and solve the operational problems. 3. Understand and carryout preventive maintenance. 4. Develop skills for handling the emergency situations related to the failures andeffective resource planning required for O& M
Unit 1 6 HRS **Introduction** Need of Operation and Maintenance (O & M), Basic principles, corrective and preventive maintenance, Detailed planes, drawings, operation manuals, computer usage in O and M.	**Unit 1 6 HRS** **Introduction** Need of Operation and Maintenance (O & M), Basic principles, corrective and preventive maintenance, Detailed planes, drawings, operation manuals, computer usage in O and M.
Unit 2 6 HRS **Water Supply system** Intakes pumps, transmission pipes, water treatment process control, Quantity and quality monitoring.	**Unit 2 6 HRS** **Water Supply system** Intakes pumps, transmission pipes, water treatment process control, Quantity and quality monitoring.
Unit 3 7 HRS **Water distribution system** Loss of carrying of pipes, pipe breaks and leakages, leak detection, record keeping, O and M of Appurtenances, Use of network models in O and M.	**Unit 3 7 HRS** **Water distribution system** Loss of carrying of pipes, pipe breaks and leakages, leak detection, record keeping, O and M of Appurtenances, Use of network models in O and M.
Unit 4 8 HRS **Wastewater facilities**	**Unit 4 8 HRS** **Wastewater facilities**

Sewerage system, Inspection methods, Manual and television, Cleaning and Rehabilitation, Safety in sewer inspection, O and M of wastewater treatment plant, Monitoring and operational problems, Corrective measures.	Sewerage system, Inspection methods, Manual and television, Cleaning and Rehabilitation, Safety in sewer inspection, O and M of wastewater treatment plant, Monitoring and operational problems, Corrective measures.
Unit 5 **8 HRS** **Air pollution control facilities** Regular inspection of devices, SPM control equipment, Gravity settlers, Cyclone Separators, Bag filters, Scrubbers, Electrostatic precipitator, Gaseous control devices, Incinerators and their trouble shooting.	**Unit 5** **8 HRS** **Air pollution control facilities** Regular inspection of devices, SPM control equipment, Gravity settlers, Cyclone Separators, Bag filters, Scrubbers, Electrostatic precipitator, Gaseous control devices, Incinerators and their trouble shooting.
Unit 6 **5 HRS** **Planning and Management** Organizational structure, work Planning, preparation and scheduling, cost estimates.	**Unit 6** **5 HRS** **Planning and Management** Organizational structure, work Planning, preparation and scheduling, cost estimates.
References- 1. "CPHEEO Manual On Water Supply And Treatment" 2. "CPHEEO Manual ON Sewerage And Sewage Treatment" 3. Industrial air pollution control system - Neumann	**References-** 1. "CPHEEO Manual On Water Supply And Treatment" 2. "CPHEEO Manual ON Sewerage And Sewage Treatment" 3. Industrial air pollution control system - Neumann

ESTE-4- Elective-IV-42Project Management Rural water supply and sanitation	
Old Syllabus	**New Syllabus**
Teaching Scheme : L : 3 hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40	Teaching Scheme : L : 3 hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40
	Course Objective: 1. To provide knowledge of environment and scope of sanitation in rural areas. 2. To provide knowledge of Specific Problem in rural water supply and Treatment.
	Course Outcome: 1. Understand magnitude of problems of rural water supply and sanitation. 2. Able to identify and understand rural issues of water supply and sanitation. 3. Acquiring skills and understanding about the development of these projects with cost effectiveimplementation and operation

	& maintenance. 4. Ability in effective resource planning for rural environmental projects.
Unit 1 3 HRS Introduction to project management, necessity, project lifecycle, key stake holders, management process groups and their responsibilities, concepts of project initiation	**Unit 1 5 HRS** Concept of environment and scope of sanitation in rural areas. Magnitude of problems of ruralwater supply and sanitation. Population to be covered, difficulties. National policy.
Unit 2 6 HRS Project planning, scope, work breakdown structure, scheduling, PM planning software, cost estimating and planning, responsibility matrix, resource allocation and leveling/ smoothening, Risk planning, procurement plans, communication and quality planning .	**Unit 2 7 HRS** Planning of water supply system: Design population and demand loads. Various approaches of Planning of water supply schemes in rural areas.
Unit 3 8 HRS Project implementation, developing project team, team structure, leadership styles, relationship building, negotiating conflict, motivation and ethics. Project closure and post project analysis.	**Unit 3 8 HRS** Selection and Development of preferred sources of water: springs, Wells, infiltration wells, radial wells and infiltration galleries, collection of raw water from surface source. Specific practices and problems encountered in rural water supply, Rainwater Harvesting, Groundwater Recharge.
Unit 4 6 HRS Project quality concepts, planning and assuring project quality, quality audit, SWOT analysis, quality control tools.	**Unit 4 6 HRS** Specific Problem in rural water supply and Treatment: Source Sustainability, Slippage, WaterQuality, Operation and Maintenance. Low cost treatment, appropriate technology for watersupply and sanitation.Improved methods and compact systems of treatment: Brief Details of multi-bottom settlers(MBS), diatomaceous earth filter, cloth filter, slow sand filter, chlorine diffusion cartridges.Water supply during fair, festival and emergencies.
Unit 5 8 HRS Risk management, identification, analysis, prioritizing, tools and techniques for acceptance, avoidance and mitigation and documentation.	**Unit 5 8 HR** Treatment and Disposal of Waste-water/ sullage: Community latrines: Different types and location of latrines, various methods of collection anddisposal of night soil.Simple waste water treatment units and systems in rural areas such as stabilization ponds, septictanks, Imhoff tank, soak pit etc. Disposal of waste water soak pits and trenches.
Unit 6 9 HRS Global Project management, preparation, planning challenges, politics, culture and law, pitfall avoidance, control and closure, Computerized	**Unit 6 6 HRS** Disposal of Solid Wastes. Composting, land filling, incineration, rural health. Other specificissues and problems encountered in rural sanitationBiogas plants: Definition, Objective, Methodology and

project management.	Construction, operation and Maintenance,Economic analysis, Benefits, Shortcoming
References- 1. "Practical Project Management", R. G. Ghattas and Sandra. 2. "Planning, Performing and Controlling", Angus Robert and Norman Gundersen. 3. "Project Principles and Applications", Moder and Phillips. 4. "Project Management with CPM, PERT and Precedence Diagrams", VN. 5. "Engineering Management", Stoner. PHI 6. "A Text book of Management", A.S.Deshpande. 7. "Essentials of Management", Koontz, Dounell and Weigrick. TMH 8. "Management and Organization", Kast and Rosinweig. TMH 9. "Quantitative Techniques in Management - Vol. I", L.C. Jhamb. Eurasia.	**References-** 1.Water supply for rural areas and small communities, Publication W. H. O. Geneva, 1959. 2.Rural water supply and sanitation, Wright Forest b., second Edition, Wiley Eastern New Delhi1956. 3. Low cost waste water treatment technology, Trivedi R. K., KaulS., ABD publications, Japan2001. 4. Rural Water Supply in developing countries, International development research centre.

ESTE-4- Elective-IV-43Environmental BiotechnologyEnvironmental Biotechnology

Old Syllabus	New Syllabus
Teaching Scheme : L : 3 hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40	Teaching Scheme : L : 3 hrs/ week Credits: 3 Evaluation Scheme: CIE SEE Minimum Passing Marks (25 + 25) 50 40
	Course Objective: 1. To provide knowledge of Genetic Engineering and Recombinant DNA Technology. 2. To teach air pollution and its control through biotechnology.
	Course Outcome: 1. Understand basic concepts in Environmental Biotechnology. 2. Able to know microbiology of waste water treatment. 3. Understanding air pollution control through biotechnology. 4. Able to study of various types of bioremediations.
Unit 15 HRS Concept of Environmental Biotechnology and Environmental Engineering, scope and importance. Genetic engineering structure of DNA, RNA, Replication of DNA, genetic code, Transcription, Protein synthesis.	**Unit 15 HRS** Concept of Environmental Biotechnology and Environmental Engineering, scope and importance. Genetic engineering structure of DNA, RNA, Replication of DNA, genetic code, Transcription, Protein synthesis.
Unit 27 HRS Introduction to Genetic Engineering and Recombinant DNA	**Unit 27 HRS** Introduction to Genetic Engineering and Recombinant DNA

Technology(RDT), Restriction endonucleases, Steps in gene cloning, c DNA and genomic library, Chemical synthesis of gene, Polymerase Chain Reaction (PCR), Vectors and their types, Selection of recombinant clones.	Technology(RDT), Restriction endonucleases, Steps in gene cloning, c DNA and genomic library, Chemical synthesis of gene, Polymerase Chain Reaction (PCR), Vectors and their types, Selection of recombinant clones.
Unit 38 HRS Microbiology of waste water treatment. a) Aerobic processes : Activated sludge, oxidation ditches, trickling filters, towers, rotating discs, rotating drums, oxidation ponds. b) Anaerobic processes : Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactor. Treatment schemes for waste waters of dairy, distillery, tannery, sugar and antibiotic industry.	**Unit 38 HRS** Microbiology of waste water treatment. a) Aerobic processes : Activated sludge, oxidation ditches, trickling filters, towers, rotating discs, rotating drums, oxidation ponds. b) Anaerobic processes : Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactor. Treatment schemes for waste waters of dairy, distillery, tannery, sugar and antibiotic industry.
Unit 45 HRS Air pollution and its control through biotechnology, Biotechnology in reduction of CO2 emission, Bioscrubbers, Biobeds, Biotrickling filters and their applications.	**Unit 45 HRS** Air pollution and its control through biotechnology, Biotechnology in reduction of CO2 emission, Bioscrubbers, Biobeds, Biotrickling filters and their applications.
Unit 57 HRS Microbiology of degradation of xenobiotic in environment – ecological considerations, decay behavior and degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides. Biological detoxification of cynide, oxalate, urea, petrochemical industry effluents, toxic organics, phenols.	**Unit 57 HRS** Microbiology of degradation of xenobiotic in environment – ecological considerations, decay behavior and degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides. Biological detoxification of cynide, oxalate, urea, petrochemical industry effluents, toxic organics, phenols.
Unit 68 HRS Bioremediation, Types of bioremediations, Bioaugmentation for bioremediation, Bioreactors, Bioremediation of herbicides, pesticides, hydrocarbons, oil spills. Novel methods of pollution control – Vermitechnology, Methane production, Root zone treatment, Membrane technology, Biodegradable plastics.	**Unit 68 HRS** Bioremediation, Types of bioremediations, Bioaugmentation for bioremediation, Bioreactors, Bioremediation of herbicides, pesticides, hydrocarbons, oil spills. Novel methods of pollution control – Vermitechnology, Methane production, Root zone treatment, Membrane technology, Biodegradable plastics.
Refrences- 1. Microbial Biotechnology: A. N. Glazer and H. Nikaids . 2. Molecular Biotechnology :Gleek and Pasternack. 3. Biotechnology : A Text Book of Industrial Microbilogy, T. D.Brock, 4. Industrial Microbiology :Presscott and Dunn. 5. Biotechnology : B. D. Singh , Kalyani Publishers.	**Refrences-** 1. Microbial Biotechnology: A. N. Glazer and H. Nikaids . 2. Molecular Biotechnology :Gleek and Pasternack. 3. Biotechnology : A Text Book of Industrial Microbilogy, T. D.Brock, 4. Industrial Microbiology :Presscott and Dunn. 5. Biotechnology : B. D. Singh , Kalyani Publishers.

6.ESTS-2 Seminar-II	Seminar-II
Old Syllabus	**New Syllabus**
Teaching Scheme : P : 2 hrs/ Week/ studentCredits: 2	Teaching Scheme : P : 2 hrs/ Week/ studentCredits: 2
	Course Objective: 1. Providing knowledge of effective oral presentations. 2. To motivation about presentations skills.
	Course Outcome: 1) Be able to understand the reading, understanding the research paper and able to develop skill to summarize it with optimum words. 2) Able to give presentation on allotted research topic. 3) Able to recognize the need for lifelong learning. 4) Understanding and given preference to new ideas, concepts, technologies in Environmental engineering.
The topic of seminar shall be based on area of Environmental Engineering & preferably considering new ideas, concepts, technologies & developments in the field of Environmental Sciences & Technologies. At least two oral presentations and submission of report in soft & hard copies is expected. Students shall deliver Seminar on the State-of-the-Art topic in front of Examiners and Student-colleagues. Prior to presentation, he/she shall carry out the detailed literature survey from Standard References such as International Journals and Periodicals, recently published reference Books etc. and submit a report on the same along with computer based presentation copy to the concerned examiner/guide at the end of the seminar. The assessment shall be based on selection of topic, its relevance to the present context, report documentation and presentation skills. Guide should spare for 2hrs / week/ student for seminar	The topic of seminar shall be based on area of Environmental Engineering & preferably considering new ideas, concepts, technologies & developments in the field of Environmental Sciences & Technologies. At least two oral presentations and submission of report in soft & hard copies is expected. Students shall deliver Seminar on the State-of-the-Art topic in front of Examiners and Student-colleagues. Prior to presentation, he/she shall carry out the detailed literature survey from Standard References such as International Journals and Periodicals, recently published reference Books etc. and submit a report on the same along with computer based presentation copy to the concerned examiner/guide at the end of the seminar. The assessment shall be based on selection of topic, its relevance to the present context, report documentation and presentation skills. Guide should spare for 2hrs / week/ student for seminar

7.ESTC-23 Laboratory- I Air pollution and Control	**Air pollution and Control**
Old Syllabus	**New Syllabus**
Teaching Scheme : P : 2 hrs/ week Credits: 1	Teaching Scheme : P : 2 hrs/ week Credits: 1
	Course Outcome: Demonstration andexperiments to improve knowledge of air pollution measuring devises handling on site actually.
A performance based on Experiments, or assignment or Visit report	A performance based on Experiments, or assignment or Visit report

8.ESTC-24 Laboratory- IIWastewater characterizationWastewater characterization	
Teaching Scheme : P : 2 hrs/ week Credits: 1	Teaching Scheme : P : 2 hrs/ week Credits: 1
	Course Outcome: An ability to take samples, analyze and interpret the results of wastewater samples.
A performance based on Experiments, or assignment or Visit report	A performance based on Experiments, or assignment or Visit report
9.ESTC-25 Laboratory- III Specific Treatment LabSpecific Treatment Lab	
Teaching Scheme : P : 2 hrs/ week Credits: 1	Teaching Scheme : P : 2 hrs/ week Credits: 1
	Course Outcome: Ability to take samples, analyze and interpret the results of water and wastewater samples.
A performance based on Experiments, or assignment or Visit report	A performance based on Experiments, or assignment or Visit report

(Semester III)

Shivaji University, Kolhapur First Year M. Tech Environmental Science and Technology (Semester III)		
Sr.No	**M. Tech (Environmental Sci. & Technology) Semester III Pre-revised syllabus**	**M. Tech (Environmental Sci. & Technology) Semester III Revised syllabus**
	Teaching Scheme : P : 2 hrs/ week Credits: 4	Teaching Scheme : P : 2 hrs/ week Credits: 4
1	**Industrial Training**	**Industrial Training**
	Industrial Training of Eight weeks at the end of First Year, Evaluation at end of III semester on the basis given report and Presentation to concern Guide.	Industrial Training of Eight weeks at the end of First Year OR Industrial Training will be split in two slots of four weeks during semester III. Evaluation at end of III semester on the basis given report and Presentation to concern Guide.
2	**Dissertation Phase – I**	**Dissertation Phase – I**
	Teaching Scheme : P : 5 hrs/ week Credits: 10	Teaching Scheme : P : 5 hrs/ week Credits: 10

(Semester IV)

Shivaji University, Kolhapur First Year M. Tech Environmental Science and Technology (Semester IV)		
Sr.No	**M. Tech (Environmental Sci. & Technology) Semester IV Pre-revised syllabus**	**M. Tech (Environmental Sci. & Technology) Semester IV Revised syllabus**
1	**Dissertation Phase – II**	**Dissertation Phase – II**
	Teaching Scheme : P : 5 hrs/ week Credits: 20	Teaching Scheme : P : 5 hrs/ week Credits: 20

Dissertation Phase – I and Dissertation Phase – II (III and IV Semester)

Student shall allowed to submit the dissertation phase I report only after the completion of minimum 50% work of the total project with intermediate / partial results of the dissertation project to the concern guide.Dissertation phase II report submit only after full-fledge demonstration of his/ her work to the concern guide. Assessment of the dissertation shall be based on design and implementation aspects, documentation and presentation skills, utility of the dissertation work and publications based on the same.

Annex. -Semester I

ESTC-14Water Quality analysis

Performance based on

A) List of Experiments:- (Any Six)

1. Determination of pH
2. Determination of Alkalinity
3. Determination of Hardness
4. Determination of Chlorides
5. Determination of Chlorine demand and Residual Chlorine
6. Determination of Turbidity
7. Determination ofFluorides
8. Determination of Sulphates
9. Determination of MPN
10. Determination of Iron

OR

B) Site visit to water treatment plant and report

OR

C) Assignments

ESTC-15Remote sensing and GIS applications in environmental Engineering

A. Assignment based on units

OR

B. Practicals based on :
   a) GPS Survey and Use of MAPSEND software
   b) Visual Interpretation of imagery and aerial photographs
   c) Digital Interpretation of imagery and aerial photographs
   d) Image Processing on IDRISI and CARTALINX
   e) Preparation of Thematic maps

OR

C. Practicals on GPS and DGPS

ESTC-16Solid and Hazardous Waste Management

A. Analysis of Solid Waste of ward/ village/ specified area - (Any 4**)**
   [1] Collection of Samples of Solid Waste
   [2] Determination of Composition
   [3] Bulk Density Measurement
   [4] Physical Characteristic (% by weight)
   [5] Chemical Characteristics:
   [6] Toxic Material Content
   [7] Determination of Moisture Content

OR

B. Visit waste processing and disposal sites in the city

OR

C. Assignment based on units

Semester II

ESTC-23Air Pollution and Control

A. Performance based on

1. Determination of Suspended Particulate Matter in the Atmosphere (High Volume Method)
2. Measurement of Meteorological parameters like Wind, Pressure, Temperature and Humidity
3. Sampling and analysis of sulphur dioxide in ambient air and Stack
4. Sampling and analysis of Nitrogen dioxide in ambient air and Stack
5. Sampling and analysis of Particulate Matter (PM10) in ambient air and Stack

6. Determination of PM2.5 in ambient air Gravimetric Method
7. Sampling and analysis protocol for ozone in ambient air
8. Sampling and analysis protocol for ammonia in ambient air
9. Sampling and Analysis of Benzo(a)pyrene& other PAHs in Ambient Air
10. Sampling and analysis of Lead, Nickel and Arsenic in ambient air and Stack
11. Determination of trace elements in Particulate matter sampled through air and soil

OR

B. Site visit to wastewater treatment plant and report

OR

C. Assignments

ESTC-24 WastewaterCharacterization

A. Performance based on

List of Experiments: - (Any Six)

[1] Determination ofDissolved Oxygen
[2] Determination of Biochemical Oxygen Demand
[3] Determination of Chemical Oxygen Demand
[4] Determination of Different Forms of Solids
[5] Determination of Sludge Volume Index
[6] Determination of Conductivity
[7] Determination of Heavy Metals
[8] Determination of Phosphate
[9] Determination of Nitrates
[10] Study of Various types of Micro Organisms
[11] Determination of Oil & Grease
[12] Determination of Volatile Acids
[13] Determination of Optimum Dose of Alum Using Jar Test Apparatus

OR

B. Site visit to wastewater treatment plant and report

OR

C.Assignments

ESTC-25Specific Treatment Lab

Performance based on Experiments, or assignment or Visit report at particular Industry/ Institute.

Estd. 1962
"A"" Accredited by NAAC (2021) With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR - 416 004, MAHARASHTRA
PHONE : EPABX – 2609000, www.unishivaji.ac.in, bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर - ४१६ ००४, महाराष्ट्र
दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग – ०२३१–२६०९०९४

Ref. No./SU/BOS/Humanities/560 Date :26/07/2023

To,

1. The Principal,
   All Concerenced Affiliated
   Colleges/Institutions,
   Shivaji University, Kolhapur

2. The Head,
   All Concerenced Department,
   Shivaji University, Kolhapur

Subject : Regarding syllabi of M. A. & M.R.S. Part I (sem. I & II) degree programme under the Faculty of Humanities as per National Education Policy, 2020 (NEP)

Sir/Madam,

With reference to the subject mentioned above I am directed to inform you that the University authorities have accepted and granted approval to the revised syllabi, equivalence and nature of question paper of M. A. & M.R.S. Part I (Sem. I & II) under the Faculty of Humanities as per National Education Policy, 2020. (NEP)

English	Hindi	Marathi	Sanskrit	History
Sociology	Economics	Political Science	Russian	Psychology
Bhasha Proudyogiki	M.R.S.			

This syllabi shall be implemented from the academic year 2023-24 onwards . A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in (Online Syllabus).

For students of Distance Education this syllabi be implemented from the academic yerar 2023-24.

You are therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully

Encl : As above

(Dr. S. M. Kubal)
Dy. Registrar

Copy to, For Information and necessary action.

Dean, Faculty of Humanities.	Computer Center/I. T. Cell.
Chairman, B.O.S./Ad-hoc Board under faculty of Humanities.	Eligibility Section.
Director, Board of Examinations & Evaluation	P. G. Seminar Section.
Appointment Section A & B	Distance Education Section.
O. E. Exam. 1 & 2 Section.	Affiliation Section (T. 1 & T 2)
P. G. Admission Section.	

SHIVAJI UNIVERSITY, KOLHAPUR

Established: 1962

A^{++} Accredited by NAAC (2021) With CGPA 3.52

New Syllabus For

Master of Arts [M. A. in Economics]

UNDER

Faculty of Humanities

M. A. Part - I (Sem - I and II)

STRUCTURE AND SYLLABUS IN ACCORDANCE WITH
NATIONAL EDUCATION POLICY - 2020
HAVING CHOICE BASED CREDIT SYSTEM
WITH MULTIPLE ENTRY AND MULTIPLE EXIT OPTIONS

(TO BE IMPLEMENTED FROM ACADEMIC YEAR 2023-24 ONWARDS)

INDEX

1. PREAMBLE:

In the era of globalization, the study of Economics has gained importance because of sustained interest of the developing countries in uplifting their economic condition by restructuring their economies to a greater diversity, efficiency and equity in consonance with their priorities. Accordingly, syllabus has been revised in view to understand recent trends in economics and interdisciplinary subjects along with theoretical and applied perspectives as well as skill development with the introduction of semester and multiple entries and exit options.

2. PROGRAMME LEARNING OUTCOMES :

- Identify economic issues related to the industry, business, public policy and society.
- Develop analytical, critical thinking skills and quantitative abilities and problem solve aptitude through academics.
- Encourage students to undertake research projects and research activities related to socio-economic problems, business, industry and human capital.
- Develop awareness of local, national and international economic conditions.
- Develop ability to analyze and evaluate business and government proposals, problem- solving forecasting and market conditions.
- Build human capital through holistic learning outcomes.

3. DURATION:

The Master of Arts in Economics programme shall be a full time course of two years / four semesters duration.

4. ELIGIBILITY FOR ADMISSION:

ANY GRADUATE FROM RECOGNIZED UNIVERSITY/HEI is eligible for admission for this course. The criteria for admission is as per the rules and regulations set from time to time by concerned departments, HEIs, university, government and other relevant statutory authorities.

5. MEDIUM OF INSTRUCTION:

The medium of instruction shall be ENGLISH. However, the students will have AN OPTION TO WRITE ANSWER-SCRIPTS IN ENGLISH AND MARATHI.

6. EXAMINATION PATTERN:

The pattern of examination will be Semester End Examination with Internal Assessment/Evaluation. During every semester, every student shall have to submit home assignments or present seminar papers or book review or internal examination carrying 20 marks / 10 marks, on the topics given by the respective course teacher.

7. SCHEME OF TEACHING AND EXAMINATION:

M. A. Programme (Economics) Structure for Semester I and II

Semester - I												
Teaching Scheme						Examination Scheme						
Sr. No.	Theory (TH)				Practical (PR)	Semester - end Examination (SEE)			Internal Assessment (IA)			
	Course Type	No. of Lectures per week	Hours	Credits		Paper Hours	Max	Min	Internal	Max	Min	
1	MM 1	4	4	4		3	80	32	--	20	08	
2	MM 2	4	4	4		3	80	32	--	20	08	
3	MM 3	4	4	4		3	80	32	--	20	08	
4	MM 4	2	2	2		2	40	16	--	10	04	
5	ME 1*	4	4	4		3	80	32	--	20	08	
6	RM	4	4	4		3	80	32	--	20	08	
Total		22	22	22			440		--	110		
									SEE + IA: 440 + 110 = 550			

Semester - II												
Teaching Scheme							Examination Scheme					
Sr. No.	Theory (TH)				Practical (PR)		Semester - end Examination (SEE)			Internal Assessment (IA)		
	Course Type	No. of Lectures	Hours	Credits	Hrs	Credits	Paper Hours	Max	Min	Internal	Max	Min
1	MM 5	4	4	4			3	80	32	--	20	08
2	MM 6	4	4	4			3	80	32	--	20	08
3	MM 7	4	4	4	--	--	3	80	32	--	20	08
4	MM 8	2	2	2			2	40	16	--	10	04
5	ME 2*	4	4	4			3	80	32	--	20	08
6	OJT / FP	-	-	-	4	4	Certified Submission of Dissertation/ OJT Report/ Project Report	80	32	Viva-Voce/ Presentation	20	08
Total		18	18	18	4	4		440			110	
										SEE + IA: 440 + 110 = 550		
Semester I and II		40	40	40	4	4		880	-	SEE + IA: 880 + 220 = 1100		
Total credits required for completing. M.A. I: 44 credits												

MM: Major Mandatory **-** There will be FOUR mandatory courses for each semester.
ME: Major Elective **(**Student should opt for ANY ONE course from the group of elective courses / basket).
RM: Research Methodology **-** It is a mandatory course.
OJT/FP: On Job Training - Internship / Apprenticeship or Field Project: It is a mandatory course. It should be completed during the period from the end of first semester to the end of second semester.

NOTE: Separate passing is mandatory for both, Semester End Examination and Internal Evaluation/Assessment.

8. STRUCTURE OF PROGRAMME:

Credit Distribution Structure for TWO YEAR PG Programme with Multiple Entry and Exit Options

M. A. I Economics (NEP)

Year	Level	Sem	Major		RM	OJT / FP	RP	Cum. Cr.	Degree
			Mandatory	**Electives** Choose ONE elective					
I	6.0	Sem I	**Course Code: Course Name (Credits)** MAU0325MML515G1: Micro Economic Analysis (4) MAU0325MML515G2: Monetary Economics (4) MAU0325MML515G3: Agricultural Economics (4) MAU0325MML515G4: Indian Capital Market (2)	**Course Code: Course Name (Credits)** MAU0325MEL515G1: Economics of Environment (4) MAU0325MEL515G2: Economics of Insurance (4) MAU0325MEL515G3: Principles and Practice of Co-operation (4) MAU0325MEL515G4: Economics of Education (4) MAU0325MEL515G5: Human Resource Development (4) MAU0325MEL515G6: Economics of Gender and Development (4) MAU0325MEL515G7: Economics of Livestock (4) MAU0325MEL515G8: Economy of Maharashtra (4)	**Course Code: Course Name (Credits)** MAU0325RML515G: Research Methodology (4)	-	-	22	

Continued ….

Year	Level	Sem	Major		RM	OJT / FP	RP	Cum. Cr.	Degree
			Mandatory	**Electives** Choose ONE elective					
I	6.0	Sem II	**Course Code: Course Name (Credits)** MAU0325MML515H1: Public Economics (4) MAU0325MML515H2: Ecological and Resource Economics (4) MAU0325MML515H3: Agricultural Development in India (4) MAU0325MML515H4: Contribution of Nobel Laureates to Economics (2)	**Course Code: Course Name (Credits)** MAU0325MEL515H1: Industrial Economics (4) MAU0325MEL515H2: Rural Development (4) MAU0325MEL515H3: Managerial and Business Economics (4) MAU0325MEL515H4: Regional Economics (4) MAU0325MEL515H5: Financial Markets and Institutions (4) MAU0325MEL515H6: Economic Thoughts of Dr. B. R. Ambedkar (4) MAU0325MEL515H7: Economics of Infrastructure (4) MAU0325MEL515H8: Mathematical Economics - I (4)	-	**Course Code: Course Name (Credits)** MAU0325OJL515G OJT: On Job Training (Internship, Apprenticeship) (4) / MAU0325FPL515G: Field Project (4)	-	22	PG Diploma (after 3 year Degree)
Cum. Cr. for PG Diploma			28	8	4	4	-	44	
Exit Option : PG Diploma (44 Credits) after Three Year UG Degree									

Credit Distribution Structure for TWO YEAR PG Programme with Multiple Entry and Exit Options

M. A. II Economics (NEP)

Year	Level	Sem	Major		RM	OJT / FP	RP	Cum. Cr.	Degree
			Mandatory	**Electives Choose ONE elective**					
II	6.5	Sem III	**Course Code: Course Name (Credits)** MAU0325MML515I1: Statistics in Economic Analysis(4) MAU0325MML515I2: Macro Economic Analysis (4) MAU0325MML515I3: Economics of Labour (4) MAU0325MML515I4: Demography (2)	**Course Code: Course Name (Credits)** MAU0325MEL515I1: Indian Public Finance (4) MAU0325MEL515I2: Economics of Insurance (4) MAU0325MEL515I3: Economics of Transport and Communication (4) MAU0325MEL515I4: Indian Economic Policy (4) MAU0325MEL515I5: Urban Economics (4) MAU0325MEL515I6: Economics of Energy (4) MAU0325MEL515I7: Mathematical Economics - II (4) MAU0325MEL515I8: Economics of Social Sector and Environment (4)	-	-	**Course Code: Course Name (Credits)** MAU0325RPL515I: Research Project I (4)	22	

Continued ….

Year	Level	Sem	Major		RM	OJT / FP	RP	Cum. Cr.	Degree
			Mandatory	**Electives Choose ONE elective**					
II	6.5	Sem IV	**Course Code: Course Name (Credits)** MAU0325MML515J1: International Economics (4) MAU0325MML515J2: Economics of Growth and Development (4) MAU0325MML515J3: Advanced Banking (4)	**Course Code: Course Name (Credits)** MAU0325MEL515J1: Co-operative Thought and Administration (4) MAU0325MEL515J2: Statistics for Economics (4) MAU0325MEL515J3: Global Business Logistics (4) MAU0325MEL515J4: Health Economics (4) MAU0325MEL515J5: Welfare Economics (4) MAU0325MEL515J6: Economic Thought of Chh. Shahu Maharaj (4) MAU0325MEL515J7: Economics and Law (4) MAU0325MEL515J8: Econometrics (4)	-	-	**Course Code: Course Name (Credits)** MAU0325RPL515J: Research Project - II (6)	22	PG Diploma (after 3 year UG or PG Degree after 4 - year UG)
Cum. Cr. for 1 Year PG Degree			26	8	-	-	10	44	
Cum. Cr. for 2 Year PG Degree			54	16	4	4	10	88	

9. COURSE CODE TABLE:

M. A. I Sem- I and II

Semester	Course Code	Title of New Course
I	MAU0325MML515G1	Micro Economic Analysis
I	MAU0325MML515G2	Monetary Economics
I	MAU0325MML515G3	Agricultural Economics
I	MAU0325MML515G4	Indian Capital Market
I	MAU0325MEL515G1	Economics of Environment
I	MAU0325MEL515G2	Economics of Insurance
I	MAU0325MEL515G3	Principles and Practice of Co-operation
I	MAU0325MEL515G4	Economics of Education
I	MAU0325MEL515G5	Human Resource Development
I	MAU0325MEL515G6	Economics of Gender and Development
I	MAU0325MEL515G7	Economics of Livestock
I	MAU0325MEL515G8	Economy of Maharashtra
I	MAU0325RML515G	Research Methodology
II	MAU0325MML515H1	Public Economics
II	MAU0325MML515H2	Ecological and Resource Economics
II	MAU0325MML515H3	Agricultural Development in India
II	MAU0325MML515H4	Contribution of Nobel Laureates to Economics
II	MAU0325MEL515H1	Industrial Economics
II	MAU0325MEL515H2	Rural Development
II	MAU0325MEL515H3	Managerial and Business Economics
II	MAU0325MEL515H4	Regional Economics
II	MAU0325MEL515H5	Financial Markets and Institutions
II	MAU0325MEL515H6	Economic Thoughts of Dr. B. R. Ambedkar
II	MAU0325MEL515H7	Economics of Infrastructure
II	MAU0325MEL515H8	Mathematical Economics - I
II	MAU0325OJL515G	On Job Training (Internship, Apprenticeship
II	MAU0325FPL515G	Field Project

M. A. II Sem - III and IV

Semester	Course Code	Title of New Course
III	MAU0325MML515I1	Statistics in Economic Analysis
III	MAU0325MML515I2	Macro Economic Analysis
III	MAU0325MML515I3	Economics of Labour
III	MAU0325MML515I4	Demography
III	MAU0325MEL515I1	Indian Public Finance
III	MAU0325MEL515I2	Economics of Insurance
III	MAU0325MEL515I3	Economics of Transport and Communication
III	MAU0325MEL515I4	Indian Economic Policy
III	MAU0325MEL515I5	Urban Economics
III	MAU0325MEL515I6	Economics of Energy
III	MAU0325MEL515I7	Mathematical Economics - II
III	MAU0325MEL515I8	Economics of Social Sector and Environment
III	MAU0325RPL515I	Research Project I
IV	MAU0325MML515J1	International Economics
IV	MAU0325MML515J2	Economics of Growth and Development
IV	MAU0325MML515J3	Advanced Banking
IV	MAU0325MEL515J1	Co-operative Thought and Administration
IV	MAU0325MEL515J2	Statistics for Economics
IV	MAU0325MEL515J3	Global Business Logistics
IV	MAU0325MEL515J4	Health Economics
IV	MAU0325MEL515J5	Welfare Economics
IV	MAU0325MEL515J6	Economic Thought of Chh. Shahu Maharaj
IV	MAU0325MEL515J7	Economics and Law
IV	MAU0325MEL515J8	Econometrics
IV	MAU0325RPL515J	Research Project - II

10. EQUIVALENCE OF THE PAPERS:

M. A. I Sem - I

Sem No.	Paper Code	Title of Old Paper	Credit	Sem No.	Course Code	Title of New Course	Credit
I	DSC- 1	Micro Economic Analysis	4	I	MAU0325MML515G1	Micro Economic Analysis	4
I	DSC- 2	Monetary Economics	4	I	MAU0325MML515G2	Monetary Economics	4
I	DSE- 1	Economics of Environment	4	I	MAU0325MEL515G1	Economics of Environment	4
I	DSE- 2	Agricultural Economics	4	I	MAU0325MML515G3	Agricultural Economics	4
I	DSE- 3	Economics of Insurance	4	I	MAU0325MEL515G2	Economics of Insurance	4
I	DSE- 4	Principles and Practice of Co-operation	4	I	MAU0325MEL515G3	Principles and Practice of Co-operation	4
I	DSE- 5	Economics of Education	4	I	MAU0325MEL515G4	Economics of Education	4
I	DSE- 6	Human Resource Development	4	I	MAU0325MEL515G5	Human Resource Development	4
I	DSE- 7	Economics of Gender and Development	4	I	MAU0325MEL515G6	Economics of Gender and Development	4
I	DSE- 8	Indian Capital Market	4	I	MAU0325MEL515H5	Financial Markets and Institutions	4
I	DSE- 9	Economics of Livestock	4	I	MAU0325MEL515G7	Economics of Livestock	4
I	DSE- 10	Economy of Maharashtra	4	I	MAU0325MEL515G8	Economy of Maharashtra	4

M. A. I Sem - II

Sem No.	Paper Code	Title of Old Paper	Credit	Sem No.	Course Code	Title of New Course	Credit
II	DSC - 3	Public Economics	4	II	MAU0325MML515H1	Public Economics	4
II	DSC- 4	Ecological and Resource Economics	4	II	MAU0325MML515H2	Ecological and Resource Economics	4
II	DSE- 11	Agricultural Development in India	4	II	MAU0325MML515H3	Agricultural Development in India	4
II	DSE- 12	Industrial Economics	4	II	MAU0325MEL515H1	Industrial Economics	4
II	DSE- 13	Rural Development	4	II	MAU0325MEL515H2	Rural Development	4
II	DSE- 14	Managerial and Business Economics	4	II	MAU0325MEL515H3	Managerial and Business Economics	4
II	DSE- 15	Financial Markets and Institutions	4	II	MAU0325MEL515H5	Financial Markets and Institutions	4
II	DSE- 16	Regional Economics	4	II	MAU0325MEL515H4	Regional Economics	4
II	DSE- 17	Contribution of Nobel Laureates to Economics	4	II	MAU0325MEL515H6	Economic Thoughts of Dr. B.R.Ambedkar	4
II	DSE- 18	Economic Thoughts of Dr. B.R.Ambedkar	4	II	MAU0325MEL515H6	Economic Thoughts of Dr. B.R.Ambedkar	4
II	DSE- 19	Economics of Infrastructure	4	II	MAU0325MEL515H7	Economics of Infrastructure	4
II	DSE- 20	Mathematical Economics-I	4	II	MAU0325MEL515H8	Mathematical Economics-I	4

11. Determination of CGPA, Grading and declaration of results:

Shivaji University has adopted 10 point Grading System as follows:

- **In each semester, marks obtained in each course (Paper) are converted to grade points:**
  - If the total marks of course are 100 and passing criteria is 40%, then use the following Table 1 for the conversion.
  - If total marks of any of the course are different than 100 (e.g. 50) and passing criterion is 40%, then marks obtained are converted to marks out of 100 as below:

$$Marks\ out\ of\ 100\ = \frac{Marks\ obtained\ by\ student\ in\ that\ course}{Total\ marks\ of\ that\ course} \times 100$$

and then grade points are computed using Marks out of 100 as per Table 1.

Table 1: Conversion of Marks out of 100 to grade point

Sr. No.	Marks Range out of 100	Grade point	Letter grade
1	80-100	10	O: Outstanding
2	70-79	9	A+: Excellent
3	60-69	8	A: Very Good
4	55-59	7	B+: Good
5	50-54	6	B: Above Average
6	45-49	5	C: Average
7	40-44	4	P: Pass
8	0-39	0	F: Fail
9	Absent	0	Ab: Absent

Table 2 : Conversion of Marks out of 50 to grade point (Passing: 20)

Sr. No.	Marks Range out of 50	Grade point	Letter grade
1	40-50	10	O: Outstanding
2	35-39	9	A+: Excellent
3	30-34	8	A: Very Good
4	28-29	7	B+: Good
5	25-27	6	B: Above Average
6	23-24	5	C: Average
7	20-22	4	P: Pass
8	0-19	0	F: Fail
9	Absent	0	Ab: Absent

- **Computation of Semester Grade Point Average (SGPA) :**
  Based on the grade points earned in each course in each semester, *Semester Grade Point Average (SGPA)* is computed as follows:

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student in that semester and the sum of the number of credits of all the courses undergone by a student in that semester. The SGPA of the i^{th} semester is denoted by S_i. The formula is given by

$$SGPA\ of\ semester\ i = S_i = \frac{\sum_{j=1}^{k} c_j \times G_j}{\sum_{j=1}^{k} c_j}$$

where c_j is the number of credit of j^{th} course , G_j is the grade points earned in the j^{th} course and k be the number of courses in i^{th} semester.

- **Computation of Semester Grade Point Average (SGPA) :**

Based on the SGPA of each semester, Cumulative Grade Point Average (CGPA) is computed as follows:

The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programmed,

$$CGPA = \frac{\sum_{i=1}^{m} C_i \times S_i}{\sum_{i=1}^{m} C_i}$$

Where C_i is the total number of credits in i^{th} semester, S_i is the SGPA of i^{th} semester and m is the number of semesters in the programme.

- **Based on CGPA, final letter grade is assigned as below :**

Table 3: Final Cumulative Grade Point Average (CGPA) and Final Grade for course

Sr. No.	CGPA Range	Grade	Grade Descriptions
1	9.50-10.00	O	Outstanding
2	8.86-9.49	A+	Excellent
3	7.86-8.85	A	Very Good
4	6.86-7.85	B+	Good
5	5.86-6.85	B	Above Average
6	4.86-5.85	C	Average
7	4.00-4.85	P	Pass
8	0.00-3.99	F	Fail
9	Nil	AB	Absent

Remarks:

1. B+ is equivalent to 55% marks and B is equivalent to 50 % marks. The final later grade is based on the grade points in each course of entire programme and not on marks obtained each course of entire programme.
2. The SGPA and CGPA shall be round off to two decimal points.

12. NATURE OF QUESTION PAPER AND SCHEME OF MARKING:

A) FOR FOUR CREDITS: Total Marks: 80

M.A. (ECONOMICS) PART: I, SEMESTER: I / II EXAMINATION, _____

TITLE OF THE PAPER _____ PAPER NO. _____

Subject Code:

Day and date: Total marks: 80

Duration: 03 hours

Instructions: 1. All questions are compulsory.

2. All questions carry equal marks.

Que. No. 1: Multiple choice questions (TEN) (02 marks each) 20

The patterns of MCQs are given below:

Pattern 1: Plain question with 4 alternatives. (6 MCQs for 12 Marks)

Pattern 2: Match the following with four alternatives (2 MCQs for 4 Marks)

Group 1	Group 2
1.	a)
2.	b)
3.	c)
4.	d)

A) 1-a, 2-b, 3-c, 4-d B) 1-b, 2-a, 3-c, 4-d
C) 1-c, 2-b, 3-a, 4-d D) 1-d, 2-b, 3-c, 4-a

Pattern 3: Give Two Statements (2 MCQs for 4 Marks)

1. 2.

Which is the correct option? (OR Which is the incorrect option?)

A) Statement 1 is True/Correct and Statement 2 is False/Incorrect

B) Statement 2 is True/Correct and Statement 1 is False/Incorrect

C) Both Statements are True/Correct

D) Both Statements are False/Incorrect

Que. No. 2: Short notes (any four out of six)(Answer Limit: 150-200 Words) 20

Que. No. 3: Short answer questions (any Two out of Four (answer limit: 300-400 Words) 20

Que. No. 4: Long answer question (any One out of Two) (answer limit: 600 – 800 Words) 20

B) FOR TWO CREDITS: Total Marks: 40

(For Indian Capital Market and Contribution of Nobel Laureates to Economics)

SHIVAJI UNIVERSITY, KOLHAPUR

M.A. (ECONOMICS) PART: I, SEMESTER: I / II EXAMINATION, _____

TITLE OF THE PAPER _____ PAPER NO. _____

Subject Code:

Day and date: Total marks: 40

Duration: 02 hours

Instructions: 1. All questions are compulsory.

2. All questions carry equal marks.

Que. No. 1: Multiple choice questions (FIVE) (02 marks each) 10

The patterns of MCQs are given below:

Pattern 1: Plain question with 4 alternatives. (3 MCQs for 6 Marks)

Pattern 2: Match the following with four alternatives (1 MCQs for 2 Marks)

Group 1	Group 2
1.	a)
2.	b)
3.	c)
4.	d)

A) 1-a, 2-b, 3-c, 4-d B) 1-b, 2-a, 3-c, 4-d

C) 1-c, 2-b, 3-a, 4-d D) 1-d, 2-b, 3-c, 4-a

Pattern 3: Give Two Statements (1 MCQs for 2 Marks)

1. 2.

Which is the correct option? (OR Which is the incorrect option?)

A) Statement 1 is True/Correct and Statement 2 is False/Incorrect

B) Statement 2 is True/Correct and Statement 1 is False/Incorrect

C) Both Statements are True/Correct

D) Both Statements are False/Incorrect

Que. No. 2: Short notes (any two out of four) (Answer Limit: 150-200 Words) 10

Que. No. 3: Long answer question (any One out of Two) (answer limit: 600 – 800 Words) 20

M. A. I SEM I

Course Name	**: Micro Economic Analysis**		
Type	**:** Major Mandatory		
Course Number	**:** MM 1		
Course Code	**:** MAU0325MML515G1		
Course Credits	**:** 4		
Marks	**:** Semester End: 80	Internal Assessment: 20	Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Understand the methods of elasticity of demand & demand forecasting.
- Explain production and cost theory.
- Classify actual market structure
- Illustrate the value and use of managerial theories of firm.

Module 1: Basic Concepts and Demand Analysis (Teaching Hours- 15, Credit- 01)

1.1 Concept of demand and demand function

1.2 Theories of consumer behavior: utility analysis, Indifference curve - income, price and substitution effects, Hicks and Slutsky Approach - Compensated demand curve and their applications

1.3 Revealed preference theory

1.4 Revision of demand theory by Hicks

Module 2: Theory of Production and Costs (Teaching Hours- 15, Credit- 01)

2.1 Least cost combination of inputs, multi-product firm, elasticity of substitution Euler's theorem

2.2 Cobb-Douglas, CES, VES

2.3 Translog production functions and their properties

2.4 Traditional and modern approaches to cost curves

Module 3: Market Structure: Price and Output Determination
(Teaching Hours- 15, Credit- 01)

3.1 Monopolistic competition – general and Chamberlin approaches to equilibrium, equilibriumof the firm and the group

3.2 Oligopoly – Non-collusive: Cournot, Bertrand, Edgeworth, Chamberlin, Kinked demand curve and Stackelberg's solution - Collusive: Cartels and mergers, price leadership and basingpoint price system models

3.3 Price and output determination under monopsony

3.4 Price and output determination under bilateral monopoly

Module 4: Alternative Theories of Firm and Distribution
(Teaching Hours- 15, Credit- 01)

4.1 Critical evaluation of marginal analysis; Baumol's sales revenue maximization model; Williamson's model of managerial discretion

4.2 Marris model of managerial enterprise; Full cost pricing rule; Bain's limit pricing theory

4.3 Neo-classical approach – Marginal productivity theory; Product exhaustion theorem

4.4 Elasticity of technical substitution, technical progress and factor shares

READING LIST:

1. Kreps, David M. (1990), A Course in Microeconomic Theory, Princeton University Press, Princeton.
2. Koutsoyiannis, A. (1979), Modern Microeconomics (2nd Edition), Macmillan Press, London
3. P. R. G. and A. W. Alters (1978), Microeconomic Theory, McGraw Hill, New York
4. Sen, A. (1999), Microeconomics: Theory and Applications, Oxford University Press, New Delhi
5. Stigler, G. (1996), Theory of Price, (4th Edition), Prentice Hall of India, New Delhi
6. Varian, H. (2000), Microeconomic Analysis, W. W. Norton, New York
7. Baumol, W. J. (1982), Economic Theory and Operations analysis, Prentice Hall of India, New Delhi
8. Hirshleifer, J. and A. Glazer (1997), Price Theory and Applications, Prentice Hall of India,New Delhi
9. Green, H. A. G. (1971), Consumer Theory, Penguin, Harmondsworth
10. Henderson, J. M. and R. E. Quant (1980), Microeconomic Theory: A Mathematical Approach, McGraw Hill, New Delhi
11. Da Costa, G. C. (1980), Production, Prices and Distribution, Tata McGraw Hill, New Delhi
12. Healthfields and Wibe (1987), An Introduction to Cost and Production Functions, Macmillan, London
13. Bain, J. (1958), Barriers to New Competition, Harvard University Press, Harvard
14. Bronfenbrenner, M. (1979), Income Distribution Theory, Macmillan, London
15. Graff, J. De V. (1957), Theoretical Welfare Economics, Cambridge University Press, Cambridge
16. Mishan, E. J. (1969), Welfare Economics: An Assessment, North Holland, Amsterdam
17. Green, H. and V. Walsh (1975), Classical and Neo-classical Theories of General Equilibrium, Oxford University Press, London
18. Hansen, B. (1970), A Survey of General Equilibrium Systems, McGraw Hill, New York
19. Quirk, J. and R. Saposnik (1968), Introduction to General Equilibrium Theory and Welfare Economics, McGraw Hill, New York
20. Weintrub, E. R. (1974), General Equilibrium Theory, Macmillan, London
21. Borch, K. H. (1968), The Economics of Uncertainty, Princeton University Press, Princeton

M. A. I SEM I

Course Name	**: Monetary Economics**		
Type	**:** Major Mandatory		
Course Number	**:** MM 2		
Course Code	**:** MAU0325MML515G2		
Course Credits	**:** 4		
Marks	**:** Semester End: 80	Internal Assessment: 20	Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Understand the significant role of money in the economy.
- Examine the theoretical aspects of money.
- Aware regarding the role of monetary and fiscal policy
- Demonstrate money multiplier

Module 1: Evolution and Flow of Money (Teaching Hours- 15, Credit- 01)

1.1 Evolution of Money- money and near Money - stock & flow concept of money
1.2 Functions of money– significance of money in economy
1.3 Circular flow of money; importance of circular flow of money
1.4 Velocity of circulation of money, concept of value of money

Module 2: Money Supply and Money Multiplier (Teaching Hours- 15, Credit- 01)

2.1 Money supply- determinants of money supply – money supply function- Approaches to money supply – money supply & liquidity
2.2 H theory of money supply – factors affecting H – Adjusted H--- Is H autonomous policy variable?
2.3 Money multiplier process: determinants
2.4 Derivation of money multiplier, deposit multiplier

Module 3: Demand for Money and Interest Rate (Teaching Hours- 15, Credit- 01)

3.1 Classical & Neo-classical views on holding money – Keynesian theory of demand for money– Post Keynesian (Baumol-Tobin approach) - Friedman‟s Quantity Theory of Money
3.2 Money & Prices: Fisher‟s Cash Transaction Approach – Cambridge Cash Balances Approach - Phillips Curve Hypothesis – Rational Expectations theory
3.3 Theories of Interest Rates: Classical Theory – Loanable Fund Theory
3.4 Liquidity Preference Theory- Hicks - Hansen Theory

Module 4: Monetary and Fiscal Policies: Income and Interest Rate Determination (Teaching Hours- 15, Credit- 01)

4.1 Factors determining the Term Structure of Interest Rates- Theories of Term Structure of Interest Rates (Expectation Theory, Segmented Market Theory, Risk Premium Theory andPreferred Habitat Theory).
4.2 Real balance effect – Patinkin‟s General Equilibrium Model

4.3 Transmission mechanism in monetary theory, Relative effectiveness of monetary and fiscal policy

4.4 Monetary Theories of Business Cycles (Hawtrey, Hayek), Easy & Dear monetary policy

READING LIST:

1. Bain, Keith & Howells,Peter (2009), Monetary Economics: Policy and Its Theoretical Basis,Palgrave.
2. Friedman, Ben & Hahn F.H. (Eds.), (1990), Handbook of Monetary Economics, Vols. 1, 2,& 3, North Holland Publishers
3. Gupta, S.B. (1983), Monetary Economics, S. Chand & Company, New Delhi
4. Mankiw N. Gregory(2012), Macroeconomics, Worth Publisher, New Yark
5. Mishkin Frederic (2007), The Economics of Money Banking and Financial Markets, 8th edAddison Wesley Longman Publishers
6. Niehans, J. (1984), International Monetary Economics, John Hopkins University Press, NewYork
7. Sheth. M. L (2016), Monetary Economics, Lakshi Narain Agarwal, Agra
8. Keynes, J. M., (1936), General Theory of Employment, Interest and Money. A. E. A., Readings inMonetary Theory
9. Halm, G. N., Monetary Economics
10. Chandler, L. V., Economics of Money and Banking
11. Sen, S. N., Central Banking in Underdeveloped Money Markets
12. H. Johnson, Essays in Monetary Theory
13. Don Patinkin, Money, Interest and Prices
14. Shaw, E. S., Money, Income and Monetary Policy A. C. L. Day, An Outline of MonetaryEconomics
15. M. Friedman, Essay on Money
16. Ghosh, B. N. & Ghosh Rama, Monetary Economics
17. Harris, L., Monetary Theory
18. J. D. Von Pischke, Finance at the Frontier: Debt, Capacity and Role of Credit in PrivateEconomy
19. RBI Reports
20. World Bank Reports
21. World Bank Reports
22. Friedman M, Essays on Money
23. Bhole, L. M., Financial Institutions and Markets: Structure, Growth and Innovation

M. A. I SEM I

Course Name	**: Agricultural Economics**
Type	**:** Major Mandatory
Course Number	**:** MM 3
Course Code	**:** MAU0325MML515G3
Course Credits	**:** 4
Marks	**:** Semester End: 80 Internal Assessment: 20 Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Learn about the structure and characteristics of the agricultural sector.
- Understand the various constraints specific to less developed agriculture.
- Understand theories regarding the operation of various institutions within the agricultural sector of less developed countries like India.
- Analyze agricultural problems and develop policies to overcome them.

Module 1: Agricultural Economics and Theories of Agricultural Development
(Teaching Hours- 15, Credit- 01)

1.1 Introduction to Agricultural Economics: Nature & scope of agricultural economics - utility of agricultural economics
1.2 Role of agriculture in economic development
1.3 Demand and supply behaviour in Agriculture: Elasticity of Demand – Approaches to study supply response- factors affecting supply response
1.4 Theories of agricultural development: (Schultz, Mellor, Hayami and Ruttan)

Module 2: Economics of Agricultural Production (Teaching Hours- 15, Credit- 01)

2.1 Basic concepts in agricultural Production: Agricultural production vis-à-vis industrial production – Features of modern agricultural production
2.2 Factor- Product Relationship: Meaning & uses of agricultural production function- Agro-technology & production function- production function with one variable factor (traditional & modern approach)
2.3 Factor-Factor Relationship: Optimum factor combination- Effects of changes in factor price on factor usage
2.4 Product-Product Relationship: Optimum Product Combination – Types of Enterprises Combinations

Module 3: Economics of Farm Management (Teaching Hours- 15, Credit- 01)

3.1 Farm management: Scope- Objectives- Farm management decisions-Types of Farming- Farm Size and Productivity – Farm Efficiency Measures
3.2 Principles of farm management: Principles of Factor Substitution- Principles of Equi-Marginal Returns – Opportunity Cost Principle
3.3 Minimum Loss Principle – Principle of Comparative Advantage – Time Comparison Principle
3.4 Management of farm Resources: Land, Labour and Capital

Module 4: Economics of Agricultural Risk Management (Teaching Hours- 15, Credit- 01)

4.1 Nature of Uncertainty in Agriculture: Price, Yield and Technological

4.2 Risks in Agriculture: Types of Risks: Climate, Drought, Production, Price, Financial, Market & Management Strategy

4.3 Risk Management Strategies: National Agricultural Insurance Scheme (NAIS), Crop Insurance as Risk Mitigation Tool

4.4 Crop Insurance, Weather Insurance, Farm Income Insurance, Livestock Insurance and Package Insurance

READING LIST:

1. Desai R G (2001): Agricultural Economics - Models Problems and Policy Issues, Himalaya Publishing House, Mumbai.
2. Kumar K N R (2015): Agricultural Production Economics, Volume-I, Daya Publishing House, A Division of Astral International Pvt. Ltd, New Delhi.
3. Lekhi R K & Singh Jogindar (2013): Agricultural Economics, Kalyani Publisher, New Delhi.
4. Reddy, Ram, Sastry & Devi (2010): Agricultural Economics Oxford & IBH publishing Co. Pvt. Ltd, New Delhi.
5. Sadhu A. N. & Singh Amarjit, Fundamentals of Agricultural Economics, (1996), Himalaya Publishing House, Bombay.
6. Soni, R. N. (1995), Leading Issues in Agricultural Economics, Arihant Press, Jalandhar.
7. Agriculture in Economic Development (1964), Carl Eicher and Lawrence Wit, McGraw Hill Book Company, New York
8. Bilgram, S. A. R. (1996), Agricultural Economics, Himalaya Publishing House, Delhi.
9. Bhende, M.J., 2005, Agricultural Insurance in India: Problems and Prospects, NABARD, Occasional Paper-44
10. Christopher Ritson (1977), Agricultural Economics – Principles and Policy, Czosby Luckwood Staples, London
11. Donald J. Epp & John W. Malone (1981), Introduction to Agricultural Economics, McMillion Publishing Company, Inc. New York.
12. GOI (2007), Report of The Working Group on Risk Management in Agriculture for the Eleventh Five Year Plan (2007-2012), GOI, New Delhi
13. Ghatak, S. and K. Ingerscent (1984), Agriculture and Economic Development, Select books, New Delhi.

M. A. I SEM I

Course Name	**: Indian Capital Market**
Type	**:** Major Mandatory
Course Number	**:** MM 4
Course Code	**:** MAU0325MML515G4
Course Credits	**: 2**
Marks	**:** Semester End: 40 Internal Assessment: 10 Total Marks: 50

Course Outcomes: After successful completion of this course, the students will be able to:

- Examine Indian capital markets.
- Understand the capital market and various instruments, organization of securities markets.

Module 1: Capital Market (Teaching Hours- 15, Credit- 01)

1.1 Capital Market: Meaning and Structure
1.2 Primary Market: Concept- New Issue Market-Instruments in Security Market
1.3 Listing of Securities: Meaning- Objectives- Classification- Advantages and Disadvantages
1.4 SEBI Guidelines Regarding Primary Market

Module 2: Secondary Market (Teaching Hours- 15, Credit- 01)

2.1 Secondary Market: Concept- Stock Exchange- Origin- Growth- Characteristics- Functions and Limitations
2.2 Secondary Market Instruments
2.3 Methods of trading – Trading Mechanism of Stock Exchange
2.4 Recent Developments in Capital Market

READING LIST:

1. Alex Kuznetsov (2006), The Complete Guide to Capital Markets for Quantitative Professionals, McGraw Hill Professional
2. Chakravarti R.,(2010), Capital Markets in India, SAGE Publishing, India
3. Deepak R. Raste (2011),Capital Market in India: Reforms and Regulations, New Century Publications
4. Gary Strumeyer (2017),The Capital Markets: Evolution of the Financial Ecosystem Wiley
5. Kanuk A.R., (2007),Capital Markets of India: An Investor's Guide,Johan Wiley & Sons
6. Niti Bhasin (2010),Financial Institutions and Financial Markets in India: Functioning and Reforms, New Century Publications
7. Pandey A., (2014), Capital Market and Financial System in India,New Century Publications
8. Ramchandra G.S., Dongare K.,(2015), A Practical Approach to the Study of Indian Capital Markets, Partridge India.

M. A. I SEM I

Course Name	**: Economics of Environment**
Type	**:** Major Elective
Course Number	**:** ME 1
Course Code	**:** MAU0325MEL515G1
Course Credits	**:** 4
Marks	**:** Semester End: 80 Internal Assessment: 20 Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Equip with the Economics of Environment and the issues therein.
- Analyse the environmental problems of development.
- Assess the environmental theory of development.
- Examine the environmental theory methods and instruments.

Module 1: Basics of Economics of Environment (Teaching Hours- 15, Credit- 01)

1.1 Economics of Environment: Meaning, Nature, Scope and Importance
1.2 Common Property Resources (CPRs)
1.3 Hardin's Hypothesis of The Tragedy of Commons
1.4 Eco-systems - Loss of Bio-diversity

Module 2: Environmental Problems of Development (Teaching Hours- 15, Credit- 01)

2.1 **Environmental Pollution**: Water, Air, Noise and Land: Causes and Remedies
2.2 **Global Environmental Problems**: Depletion of Ozone Layer – Global Warming and Climate Change
2.3 Trade and Environment - Polluter Pays Principle
2.4 **Agriculture and Environment**: Natural Farming – Large sized dams and Environment - Forest Depletion and Social Forestry

Module 3: Environmental Theory of Development (Teaching Hours- 15, Credit- 01)

3.1 Development and Environment Nexus – Environmental Kuznets Curve (EKC) Hypothesis
3.2 Sustainable Development – Green Economy - Carbon Footprint and Carbon Trading
3.3 Environment Friendly Size of Firm - Limits to Growth Theory
3.4 System of Environmental and Economic Accounting (SEEA) - Environmentally Corrected / Adjusted NDP / EDP

Module 4: Environmental Policy (Teaching Hours- 15, Credit- 01)

4.1 **Role of** Public, Private, and Co-operative Sector in Environmental Protection
4.2 **Environment Management Techniques**: Cost Benefit Analysis
4.3 Environmental Impact Assessment- Environmental Audit
4.4 **India's Environmental Policy:** Environmental Protection Laws Pollution Control Boards: CPCB and SPCBs

READING LIST:

1. Baumol, W. J. & W. E. (1997), The Theory of Environmental Policy, Prentice Hall, Englewood-Cliffs.
2. Bhardwaj, R. (1983), Managing Limits to Growth, Asian and Pacific Development Centre, Kula Lumpur.
3. Dorfman, R. & N. Dorfman (Eds.) (1977), Economics of the Environment, W. W. Norton, New York.
4. Nijkamp, P. (Ed.) (1976), Environmental Economics, Vol. I & II, Martinus Nijhoft, Leiden.
5. Charles Peering (1987), Economy and Environment Cambridge University Press, New York.
6. Ali, S. A. (1979), Resources for Future Economic Growth, Vikas Publishing House, New Delhi.
7. Rathore, M. S. (Ed.) (1996), Environmental and Development, Rawat Publications, Jaipur.
8. Garge, M. R. (Ed.) (1996), Environmental Pollution and Protection, Deep and Deep Publications, New Delhi.
9. Lodha, S. L. (Ed.) (1991), Economics of Environment, RBSA Publishers, Jaipur.
10. Rajlakshmi N. and Dhulasi B. (1994), Environomics, Allied Publishers Ltd., New Delhi.
11. Singh, G. N. (Ed.) (1991), Environmental Economics, Mittal Publications, New Delhi.
12. Mehta, C. S. (1994), Environment and Law, RBSA Publishers, New Delhi.
13. Karpagam, M. (1993), Environmental Economics, Sterling Publishers, New Delhi.
14. World Bank Report on Human Development.
15. The Hindu Survey of Environment: Annual Reports.
16. Bhattacharya R N (2006), Environmental Economics: An Indian Perspective, Oxford University Press, New Delhi.
17. Ulaganathan, Sankar (2006), Environmental Economics, Oxford University Press, New Delhi.
18. Hanley, Shogren and White (2004), Environmental Economics in Theory and Practice, McMillan India Limited, Delhi.
19. Hanley And Spash (1998), Cost Benefit Analysis and the Environment, Edward Elgar Publishing Limited, Glos, UK.
20. Singh & Shishodia (2010), Environmental Economics: Theory and Applications, Sage Publications, New Delhi
21. Government of India, Ministry of Environment and Forests, Annual Reports
22. Journal Down to Earth, New Delhi.
23. सिंग आणि शिशोदिया (२०१७), सेज पब्लिकेशन इंडिया, नवी दिल्ली

M. A. I SEM I

Course Name : **Economics of Insurance**
Type : Major Elective
Course Number : ME 2
Course Code : MAU0325MEL515G2
Course Credits : 4
Marks : Semester End: 80 Internal Assessment: 20 Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Understand insurance industry in India.
- Analyse the risk and risk management.
- Explain essentials of life and health insurance.
- Elucidate essentials of general insurance.

Module 1: Introduction to Insurance Economics (Teaching Hours- 15, Credit- 01)

1.1 Economic security; Human quest for economic security through time; Exposure to losses

1.2 Role of insurance; Definition of insurance; Evolution of insurance, Economic and legal perspectives, Social vs. private insurance; Life vs. non-life insurance; Classification of life, health and general insurance policies

1.3 Fundamentals of uncertainty and risk; pure risk and speculative risk

1.4 Expected utility and Decision making under uncertainty; Expected utility and the demand for insurance

Module 2: Risk and Risk Management (Teaching Hours- 15, Credit- 01)

2.1 Moral hazard and insurance demand; risk pooling and Risks transfer; Concept of risk management; Essentials of risk management; Elements of risk management – risk assessment; Risk control and risk financing; Worldwide risk sharing

2.2 Concept of reinsurance, Fundamentals of reinsurance, Types of reinsurers; Reinsurance distribution systems, Reinsurance markets in developing countries

2.3 Risk management and insurance in economic development, Insurance institutions as financial intermediaries; Insurance institutions as investment institutions; Insurance institutions in Indian capital market

2.4 Regulations governing investments of insurance institutions in India; Insurance Regulatory Development Authority (IRDA) rules in this regard

Module 3: Essentials of Life and Health Insurance (Teaching Hours- 15, Credit- 01)

3.1 Fundamentals of life and health insurance; Functions of life and health insurance; Mathematical basis of life insurance; Plans of life insurance

3.2 Legal aspects of life insurance; Provisions of policies; Selection and classification of risks; Basics of premium construction; Valuation and distribution of surplus

3.3 Individual health insurance; uses, types, evolution; Principles of underwriting of life and health insurance

3.4 Group insurance and superannuation (pension) schemes; Set-up and management of insurance companies

Module 4: Essentials of General Insurance (Teaching Hours- 15, Credit- 01)

4.1 Definition, Types, Importance- General insurance and economic development

4.2 Fundamentals of the following concepts: Common law Equity, Proposal/accidence, Indemnity, Insurable interest, Contribution subrogation, Representation; Utmost good faith, Material fact, Physical hazard, Moral hazard

4.3 Policy Endorsements conditions/warranties; Selection of risks; Inspection of risks; Rating and Calculation of premiums; Tariffs and non-tariffs

4.4 Marketing of general insurance; Technology development and general insurance

READING LIST:

1. Bailey, R. (Ed.) (199), Underwriting in Life and Insurance, LOMA, Atlanta, Goa.
2. Bhole, L. M. (1990), The Indian Financial System, Tata McGraw Hill, New Delhi.
3. Bickelhaupt, D. L. (1992), General Insurance, Irwin Inc., Burr. Ridge, III.
4. Black, K. Jr. and H. D. Skipper Jr. (2000), Life and Health Insurance, Prentice Hall, Upper Saddle River, New Jersey.
5. Finsinger, J. and M. V. Pauly (Eds.) (1986), The Economics of Insurance Regulation: A Cross National Study, Macmillan, London.
6. Graves, E. E. and L. Hayes (Eds.) (1994), McGill's Life Insurance, The American College Blyn Mawr, Pa.
7. Head, G. L. and S. Horn II (1991), Essentials of Risk Management, Volume I, Insurance Institute of America, Malvern, Pa.
8. Skipper, Jr. H. D. (Ed.) (1998), International Risk and Insurance: An Environmental Managerial Approach, Irwin McGraw Hill, Boston.
9. Tacchino, K. B. and D. A. Little (1993), Planning for Retirement Needs, The American College, Bryn Mawr, Pa.
10. Dionne, G. and S. E. Harrington (Eds.) (1997), Foundations of Insurance Economics, Kluwer Academic Publishers,
11. Boston Pteffer, I. and D. R. Klock (1974), Perspectives on Insurance, Prentice Hall Inc.,Englewood-Cliffs.
12. Yaari, M. E. (1965), 'Uncertain Life Time, Life Insurance and the Theory of Consumer,' Review of Economic Studies, Volume 32.
13. Brockelt, P. L., R. C. Witt and P. R. Hind (1991), An Overview of Reinsurance and the Reinsurance Markets, Journal of Insurance Regulation, volume 9, No. 3.
14. Elliot, M. W., B. L. Webb, H. N. Anderson and P. R. Kensicki (1995), Principles of Reinsurance, Insurance Institute of America, Malvern, Pa.
15. Friedman, M. and L. J. Savage (1947), the Utility Analysis of Choices Involving Risk, Journal of Political Economy, Vol. 56.

16. Ward, G. L., C. C. Lily III, d. S. Malecki and J. S. Rosenbloom (1984), Personal Risk Management and Insurance, Volume I, American Institute of Property and Liability Underwriters, Malvern, Pa.
17. William Jr., C. A. M. L. Smith and P. C. Young (1995), Risk Management and Insurance, McGraw Hill, New York.
18. Wu, C. and P. Colwell (1988), 'Moral Hazard and Moral Imperative', Journal of Risk and Insurance, Volume 55, No.1.
19. Coolier, P. and C. Mayer (1989), Financial Liberalization, Financial Systems and Economic Growth, Oxford Review of Economic Policy, Volume 6, No.4.
20. Outreville, J. F. (1990), The Economic Significance of Insurance Markets in Developing Countries, The Journal of Risk and Insurance, Volume 57, No.3.
21. Skipper, Jr., H. D. (Ed.) (1998), International Risk and Insurance: An environmental Managerial Approach, Irwin McGraw Hill, Boston.
22. United Nations Conference on Trade and Development (1987), The Promotion of Risk Management in Developing Countries, UNCTAD, Geneva.
23. Insurance Institute of India, Life Assurance Underwriting, (IC-22), Mumbai.
24. Benjamin, B. (1991), General insurance, Heinemann, London.
25. Drofman, M. S. (1994), Risk and Insurance, Prentice Hall, Englewood-Cliffs.
26. Insurance Institute of India, General Insurance (IC-34), Mumbai.
27. Casner, A. J. (1995), Estate Planning, Little Brown, Boston.
28. Government of India (1998), Old Age and Income Security (OASIS) Report (Dave Committee Report), Government of India, New Delhi.
29. Ivers, J. I. III and E. T. Johnson (Eds.) (1991), Readings in Wealth Accumulation Planning, The American college, Bryn Mawr, Pa.
30. Insurance Regulation and Development Authority (2001), IRDA Regulations, New Delhi.
31. Klein, R. W. (1995), Insurance Regulation in Transition, Journal of Risk and Insurance, Volume 62, No.3.

M. A. I SEM I

Course Name : **Principles and Practice of Cooperation**
Type : Major Elective
Course Number : ME 3
Course Code : MAU0325MEL515G3
Course Credits : 4
Marks : Semester End: 80 Internal Assessment: 20 Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Understand the principles and practice of co-operation.
- Explain the significant role of cooperation in the development of India.
- Evaluate co-operatives in India
- Explain agro-based cooperatives and non agricultural cooperatives.

Module 1: Meaning, Principles of Co-operation (Teaching Hours- 15, Credit- 01)

1.1 Meaning of Cooperation – Main Principles of Cooperation – Reformulation of principles – Significance of cooperation
1.2 Growth of Cooperation in India after Independence
1.3 Cooperative Credit Structure – Progress and Problems of Primary Agricultural Cooperative Societies, District Central Cooperative Banks, and State Cooperative Banks
1.4 Long term Rural Credit Structure

Module 2: Non-Agricultural Co-operatives in India (Teaching Hours- 15, Credit- 01)
(Organization, Progress and Problems with Special Reference to India)

2.1 Cooperative Consumers Societies
2.2 Cooperative Housing Societies
2.3 Cooperative Labour Societies
2.4 Industrial Cooperatives

Module 3: Agro Based Cooperatives (Teaching Hours- 15, Credit- 01)

3.1 Agricultural Cooperative Marketing
3.2 Dairy Cooperatives
3.3 Sugar Cooperatives
3.4 Fertiliser Cooperatives: IFFCO. KRIBHCO

Module 4: Co-operative Institutions in India (Teaching Hours- 15, Credit- 01)

4.1 National Bank for Agriculture and Rural Development
4.2 National Cooperative Development Corporation - National Agricultural Cooperative Marketing Federation
4.3 National Cooperative Union of India
4.4 KVIC

READING LIST:

1. Bedi, R. D., Theory, History and Practice of Co-operation with reference to Cooperation in Foreign countries.
2. Mathur, B.S., Cooperation in India (Latest Edition).
3. Hajela, T. N., Principles, Problem and Practice of cooperation, Ane Books Pvt. Ltd.; Student Edition edition (2015)
4. NABARD – Statistical Statement Relating to the Cooperative Movement in India – Part I & II.
5. Digby , World Cooperative Movement
6. Kulkarni, K. R. , Theory and Practice of cooperation in India and Abroad, Vols. I, II & III.
7. Kamat, G. S., New Dimensions in Cooperatives, Himalaya Publishing House
8. Dr. R. C. Dwivedi, (1997), Co-operative Identity, Concept and Reality, M/S Paramount Publishing House, New Delhi
9. Jugale, V. B., Koli, P. A., (2005), Reasserting the Co-operative Movement, Serials Publications, New Delhi.
10. Patil, J. F. & Patil, V. S., (2006) Problems and Prospects of Co-operative Movement, Shivaji University, Kolhapur

M. A. I SEM I

Course Name	**: Economics of Education**		
Type	**:** Major Elective		
Course Number	**:** ME 4		
Course Code	**:** MAU0325MEL515G4		
Course Credits	**:** 4		
Marks	**:** Semester End: 80	Internal Assessment: 20	Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Acquaint with Economics of education.
- Analyse the role of education in economic development.
- Enable to carry out the cost benefit analysis in education.
- Explain the financing of education, especially higher education.

Module 1: Introduction to Economics of Education (Teaching Hours- 15, Credit- 01)

1.1 **Economics of Education**: Meaning, scope and importance
1.2 Relationship between education and the economic system
1.3 Role of the economic system in financing of education
1.4 **Education as** an industry, consumption and investment

Module 2: Education and Economic Development (Teaching Hours- 15, Credit- 01)

2.1 Education and Economic Development
2.2 **Measuring the Contribution of Education to Economic Growth**: Cost Benefit Analysis- Correlation Approach, Residual approach, Manpower Forecasting Approach, Wage differential Approach
2.3 **Productivity and Wastage in Education**: Productivity of the educational system and Learning for productivity objectives- Wastage in education
2.4 **Internal and external efficiency of the Educational system**: Dual approach, Process approach, Product approach

Module 3: Cost-Benefit Analysis in Education (Teaching Hours- 15, Credit- 01)

3.1 **Cost-benefit analysis**: Meaning, Importance and Problems
3.2 Costs of Education - Benefits of Education - Cost -benefit ratio
3.3 Cost Effectiveness Analysis in Education
3.4 **Pricing of Education**: Micro and Macro aspects of pricing of education - Practical solution to the pricing of education

Module 4: Financing of Education (Teaching Hours- 15, Credit- 01)

4.1 **Sources of finance for education**: private, public, fees, donations, endowments and grants Grant-in- aid principles and practices with special reference to higher education
4.2 Government's role in financing education at different levels

4.3 Allocation of funds to Education in the 5-year Plans

4.4 **Expenditure of education** - public education at different levels (central state level) in India

READING LIST:

1. Balsara, M. (1996) New Education policy and Development Challenge, New Delhi. Kanishka Publishers.
2. Baxter C. And O'Leary, P. J. and Westoby A. (1977) Economics and Education Policy a Reader London Longman Group Ltd.
3. Banker G. S, (1964) Human Capital New York: University press.
4. Blaug. M (1972) an Introduction to the Economics of Education London: Penguin
5. Blaug, M. (ed) (1968). Economics of Education selected Readings. Vol. 1 and 2 London: Penguin Books.
6. Cohn, E. and Gesker (1990) T. G. The Economics of Education Oxford: Pergamon Press
7. Creedy J. The Economics of Higher Education: analysis of Taxes Versos Fees Able shot: Edward Elgar publishing limited
8. Enaohwo J. O (1990) economics of Education and the planning Challenge. New Delhi. Anmol Publications.
9. Garg V. P. (1985) The Cost Analysis in higher Education New Delhio, Metropolitan Book Co. Pvt Ltd.
10. Goel S. C. (1975) Education and Economics Growth in India Delhi. Macmillan,
11. Hallak J. (1990) Investing in the Future UNESCO: Pergamon press
12. Heggade, O. D. (1992) Economics of Education Bombay: Himalaya Publishing House
13. Johns R. I. & Morphet I: (1976) The Economics and financing of Education A system Approach New Jersey Prentice-Hall Inc.
14. Knight, J. B. and Sanot R. II (1990) duction. Productivity and Inequality. The World Bank Laxmidevi (ed) (1996) Encyclopaedia of Education Development and Planning Economics of Education Vol. V New Delhi. Anmol Publications Pvt. Ltd.
15. Levin M. R. & Shank A (eds.) (1970) Educational Investment in an Urban Society: Costs, Benefits and Public Policy, New York Teachers College press
16. Majumdar, T. (1983) Investment in Education and social Choice, Cambridge, Cambridge University Press.
17. Mingat A. & Tan Hee-peng (1988) Analytical tools for sectoral work in Education Baltipore: the joins Hopkins University press.
18. Muray T. R. (1990) The Encyclopadedia of Human Development and Education Oxford. Pergamon
19. Muzammil, M. (1989) Financing of Education. New Delhi House.
20. Naik J.P. (1965) Educational planning in India Bombay: Allied Publishers
21. Natarajan S. (1990) Introduction to Economics of Education New Delhi. Sterling
22. O'Donohue. M (1971) Economics Dimensions in Education Chicago: Aldine Alterton
23. Padmanabhan C. B. (1971) Economics of Educational Planning in India New Delhi. Arya Book Depot.

24. Panchamukhi P. R. (ed) (1989) Economics of Educational Finace Bombay, Himalaya publishing House
25. Pascharopoulos. G. (ed) 1987 Economics of education Researh and Studies Oxford, Pergamon Press.
26. Psacharopoulos G. and Woodhall (1986). Education of Development Washington The World Bank.
27. Ritzen J. M. M. (1977) Education Economic Growth and Income Distribution New York NorthHoland Publishing Co.
28. Saxena S. (1979) Educational Planning in India New Delhi Sterling Publishers Pvt. Ltd. sjeehan J. Economics of Education London George Allen and Unwin Ltd.
29. Shriprakash, Cost of Education (1996) New Delhi: Anamika Publishers and distributors.
30. Shriprakash and Chowdhurty S. Expenditure on Education, Theory, Models and Growth, New Delhi: NIEPA
31. Singh R. P. (ed) (1993) Private Initiative and Public Policy in Education New Delhi: Federation of Managements of Educational institutions.
32. Tilak J. B. G. (1989) Education and its Relation to Economic Grow Poverty and income distribution: past Evioen and Further Analysis washington D. C. The World Bank.
33. Tilak J. B. G. (1994) Education for Development in Asia New Delhi Sage publications.
34. Tilak J. B. G. (1992) Educational Planning at Grassroots New Delhi: Ashish publishing House.
35. Tilak , J. B. G. (1987). The Economics of Inequality in Education New Delhi: Sage publications.
36. Unesco (1972) Educational cost Analysis in Action : Case Studies for Planners Paris
37. Vaisey, J. (1958) The Costs of Education London: George and Allen & Unwin Ltd.
38. Vaisey, J. (1972) Economics of Education London: G Duck Worth and Co.
39. Vaizey, J. et al (1972). The Political Economy of Education London Gerald Duckworth & co. Ltd.
40. Veena, D. R. (1987) Education of Economic Growth New Delhi: Ashish publishing House. Ward, F. C. (ed) (1974) Education and Development Reconsidered New York: Praegar Publishers
41. Wykstra R. A. (ed) (1971) Education and the Economics of Human Capital New York: The Free press.

M. A. I SEM I

Course Name	**: Human Resource Development**
Type	**:** Major Elective
Course Number	**:** ME 5
Course Code	**:** MAU0325MEL515G5
Course Credits	**:** 4
Marks	**:** Semester End: 80 Internal Assessment: 20 Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Understand the basis of human resource development.
- Explain the relation between education, health and human development.
- Measure human development index.
- Find an employment opportunity in corporate body.

Module 1: Human Capital (Teaching Hours- 15, Credit- 01)

1.1 Human capital: Meaning, Sources, Human and Physical Capital
1.2 Human Capital and Economic Growth
1.3 Human Capital and Human Development
1.4 Distinction between Human Resource Development (HRD) and Human Development (HD)

Module 2: Education, Health and Human Development (Teaching Hours- 15, Credit- 01)

2.1 Education: Education as a tool of HR development and social change Education (Pre-primaryto Higher Education) system in India Problems and issues (Universalisation of education, vocationalisation of education, Quality improvement, Dropout rate etc.)
2.2 National Knowledge Commission, National Commission for Higher Education and Resaearch, IITs, IIMs
2.3 Health: As an essential and major component of HRD- Vital Statistics World Health Organisation (WHO): Objectives, structure, functions and its programmes
2.4 Govt. Health policies, schemes and programmes

Module 3: Human Resource Development in India (Teaching Hours- 15, Credit- 01)

3.1 Present status of population in India - quantitative aspects: size and growth, Sex, Age, Urbanand Rural - Qualitative aspects: Education and Healthcare. Population policy 2000- Population projection
3.2 Importance of Human Resource planning in modern societyComponents and factors involved in planning of Human ResourcesNature, types and problems of unemployment in India-Trends in Employment in India
3.3 Governmental and Voluntary Institutions engaged in development of manpower: NCERT, NIEPA, UGC, Open Universities
3.4 Problems and issues related to HRD

Module 4: Measurement of Human Development (Teaching Hours- 15, Credit- 01)

4.1 Need for indices – limitations of per capita GDP as an indicator, earlier indices 4.2 Physical Quality of Life Index (PQLI), Disability Adjusted Life Years (DALYs), Social Capability Index

4.3 Emergence of Human Development Index: HDI as compared to per capita GDP- Method of computing HDI- Critique of HDI

4.4 Other indices: Human Poverty Index (HPI I / HPI II)- Gender related Development Index (GDI)- Gender Empowerment Measure (GEM)- Happiness Index (HI)

READING LIST:

1. Aghion, P., E. Caroli, and C. Garcia-Penalosa, 1999, Inequality and Economic Growth: The Perspective of the New Growth Theories, Journal of Economic Literature, 37 (3).
2. Ahmad, E., J., Dreze, J. Hills and A. Sen (eds.), 1991, Social Security in Developing Countries, Clarendon Press for Wider, Oxford.
3. Ahn, T. K., Ostrom, E., (eds.), 2003, Foundations of Social Capital, Edward Elgar PublishingLtd., Cheltenham, U. K.
4. Aksah, M. M., 2000, „Reights Based Approach to Development and Right to Land‟,Background Paper for HDR, 2000, UNDP, New York.
5. Alderman, Harold, 2002, GenderDimensions of Safety Nets, The World Bank, WashingtonD.C.,http:/w.w.w.worldbank.org/wbi/socialsafetynets/courses/dc 2002/index.html.
6. Alesina, Alberto, and Roberto Perotti, 1994, The Political Economy of Growth: A CriticalSurvey of the Recent Literature, World Bank Economic Review, 9 (3).
7. Anand S. and S.M.R., Kanbur, 1993, Inequality and Development: A Critique‟, Journal of Development Economics, 41 (l).
8. Bardhan, Pranab, 1993, Symposium on Democracy and development, Journal of Economic Perspectives 7(9).
9. Chenery, H. and M. Ahluwalia, 1974, Redistribution with Growth, Oxford University Press, London
10. Chenery, H. and T. N. Srinivasan (eds.), 1988-1989), The Handbook of DevelopmentEconomics
11. Dasgupta, Partha and Martin Weale, 1992, On Measuring the Quality of Life, World Development 20(1)
12. DasguptaSukti, 2002, Organizing for Socio-Economic Security in India, International Labour Organisation, Geneva.
13. Evans, P., 1996, Government Action, Social Capital and Development: Reviewing the Evidence on Synergy, World Development, 24(6).
14. Field, J., 2004, Social Capital, Routledge, London and New York.
15. Fukuyama Francis, 1995, Social Capital and the Global Economy, Foreign Affairs 74(5).

16. Grinspun, A. (ed.), 2001, Choices for the Poor, Lessons from National Poverty Strategies, UNDP, New York.
17. Hooghe, M., D. Stolle (eds.), 2003, Generating Social Capital: Civil Society and Institutions in Comparative Perspective, Palgrave, New York
18. Huntington, Samuel, 1987, The Goals of Development, in Myron Weiner and Samuel P. Huntington, (eds.), Understanding Political Development, Little Brown and Com., Boston.
19. Kakwani, N., 1993, Performance in Living Standards: An International Comparison, Journal of Development Economics, 41(2).
20. Larrain, J., 1989, Theories of Development: Capitalism, Colonialism and Dependency, Polity Press, Cambridge.
21. Lewin, W. Arthur, 1955, The Theory of Economic Growth, Irwin, Homewood, IL.
22. Nussbaum Martha and AmartyaSen (eds.), 1991, The Quality of Life, Oxford University Press, Oxford.
23. Portes, Alejandro and Patricia Landolt, 1996, The Downside of Social Capital, The American Prospect, 7 (26).
24. Ranis, Gustav, Frances Stewart and Alejandro Ramirez, 2000, Economic Growth and Human Development, in Sakiko Fukuda-Parr and A. K. Shiva Kumar (eds.), Readings in Human Development: Concepts, Measures and Policies for a Development Paradigm, Oxford University Press, New Delhi.
25. Ray, Debraj, 1998, Development Economics, Princeton University Press, Princeton
26. Sen, Amartya, 1985, Well-being, Agency and Freedom: The Dewey Lectures, 1984, Journal of Philosophy, 82 (4).
27. Sen, Amartya, 1988, Capability and Well-being, WIDER Conference paper
28. Sen, Amartya, 1988, Freedom of Choice: Concept and Content, European Economic Review, 32 (2&3).
29. Streeten, Paul, Shahid Javed Burki, Mahbubul-Haq, Norman Hicks, and Frances Stewart, 1981, First Things First: Meeting Basic Human Needs in Developing Countries, Oxford University Press, New York.
30. Streeten, Paul, 2003, Shifting Fashions in Development Dialogue, in Sakiko Fukuda-Parr and A. K. Shiva, Kumar (eds.), Readings in Human Development
31. Concepts, Measures and Policies for a Development Paradigm, Oxford University Press, New Delhi
32. Streeten Paul, 1972, The Frontiers of Development Studies, Macmillan, London.
33. Todaro, Michael, P., 1997, Economic Development, 6th edition, Longman, New York .
34. United Nations Development Programme, 1990, Human Development Report, 1990, Oxford University Press, New York.
35. United Nations Development Programme, 2001, Human Development Report, 2001, Oxford University Press, New York.
36. World Bank, 1992, Governance and Development, Washington, D.C.,
37. World Bank, 1997, The State in a Changing World: World Development Report, 1997, Oxford University Press, Oxford
38. Alkire, S., 2002, Dimensions of Human Development, World Development, 30(2)

M. A. I SEM I

Course Name	**: Economics of Gender and Development**
Type	**:** Major Elective
Course Number	**:** ME 6
Course Code	**:** MAU0325MEL515G6
Course Credits	**:** 4
Marks	**:** Semester End: 80 Internal Assessment: 20 Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Understand the gender inequalities.
- Analyze the role of women in economic development.
- Evaluate the social security measures and social protection for women.

Module 1: Introduction to Gender Studies (Teaching Hours- 15, Credit- 01)

1.1 Importance and concepts of women studies: Difference between Gender and Sex – Patriarchy - Feminism - Gender Division of Work – Invisibility of Women's work – Gender Budget, Eco feminism - Gender Audit – Gender Mainstreaming

1.2 Women in patriarchal and matriarchal societies and structures, patrilineal and matrilineal systems and relevance to present day society in India

1.3 The concept of Gender Economics: Gender concerns in Economic theory

1.4 Amrtya Sen's Contribution to Women's issues

Module 2: Women and Development (Teaching Hours- 15, Credit- 01)

2.1 Bias in Conceptualizing and Measuring Women's Contribution to National Income

2.2 Measuring Gender Inequality in Human Development – Gender Related Development Index Gender Empowerment Measure

2.3 Women in Agriculture – Women in Industry – Women in Services

2.4 Gender Dimensions of SAP and International trade

Module 3: Women and Labour Markets (Teaching Hours- 15, Credit- 01)

3.1 Factors affecting Supply and demand for female labour in Developing countries

3.2 Studies of female work participation in agriculture, non-agricultural rural activities, informalsector, cottage and small-scale industries, organized industry, and service sector

3.3 Wage differentials in female activities: determinants of wage differentials: gender,education, skill, productivity, efficiency, opportunity

3.4 Structures of wage across regions and economic sector

Module 4: Social Security and Social Protection for Women
(Teaching Hours- 15, Credit- 01)

4.1 Social security of women: Need, Need for Gender Concerns in designing Social Security Policy, entitlements, ensuring economic independence and risk coverage, access to credit and insurance markets

4.2 Role of voluntary organizations, self-help groups in providing social security

4.3 Education and Health for Empowerment: State Policy and Programmes for promoting Women's Education, Gender dimension of National Health Policy

4.4 Health Programmes, National Rural Health Mission, Reproductive and Child Health Programme

READING LIST:

1. Boserup, E. (1970), Women's Role in Economic Development, George Allen and Unwin, London.
2. Desai, N. and M. K. Raj (Eds.) (1979), Women and society in India, Research Centre for Women Studies, SNDT University, Bombay.
3. Krishnaraj, M. R. M. Sudarshan and A. Shariff (1999), Gender, Population and Development, OxfordUniversity Press, New Delhi.
4. Seth, M. (2000), Women and Development: The Indian Experience, Sage Publications, New Delhi.
5. Srinivasna, K. and A. Shroff (1998), India: Towards Population and Development Goals, Oxford University Press, New Delhi.
6. Venkateswaran, S. (1995), Environment, Development and the Gender Gap, Sage Publications, New Delhi.
7. Wazir, R. (2000), The Gender Gap in Basic Education: NGOs as Change Agents, Sage Publications, New Delhi.
8. Kabeer, N. (1994), Reversed Realities: Gender Hierarchies in Development Thought, Kalifor Women, New Delhi.
9. Mies, M. (1998), Patriarchy and Accumulation on a world Scale: Women in the InternationalDivision of Labour, Zed Books, London.
10. Sen, G. and K. Brown (1985/1987), Development, Crises and Alternate Visions, Monthly Review Press, New York.
11. Amsdden, A. H. (Ed.) (1980), The Economics of Women and Work, Penguin, Harmondsworth.
12. Papola, T. S. and A. N. Sharma (Eds.) (1999), Gender and Employment in India, Vikas Publishing House, New Delhi.
13. Jhabwala, R. and R. K. Subramanya (2000) (eds.), The Unorganized Sector: Work Security and Social Protection, Sage Publications, New Delhi.
14. Narasimhan, S. (1999), Empowering Women: An Alternative Strategy from Rural India, Sage Publications, New Delhi.
15. Purushothaman, S. (1998), The empowerment of women in India: Grassroots Women'sNetworks and the State, Sage Publications, New Delhi
16. AmartyaSen and Jean Drèze (1995) India: Economic Development and Social Opportunity,Oxford University Press.
17. Mary E. John (2008), Women‟s Studies in India – A Reader, Penguim Books, New Delhi
18. Sanjoy Roy (2010) Women in Contemporary India: Realities and Perspectives, AkanshaPublishing House, New Delhi.

M. A. I SEM I

Course Name : **Economics of Livestock**
Type : Major Elective
Course Number : ME 7
Course Code : MAU0325MEL515G7
Course Credits : 4
Marks : Semester End: 80 Internal Assessment: 20 Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Understand the economics of livestock production.
- Get acquainted with the knowledge of employment opportunities in Livestock production.
- Explain the management system of livestock.

Module 1: Economics of Livestock Production (Teaching Hours- 15, Credit- 01)

1.1 Livestock farm techniques and economics- Animal techniques and farm economics Livestock farm system- Animal production system- Feeding and Forage system
1.2 Livestock production in India and world
1.3 Problems faced by livestock production industry
1.4 Importance of livestock in farming practices

Module 2: Employment Opportunities in Livestock Production (Teaching Hours- 15, Credit- 01)

2.1 Employment opportunities in livestock farming-Livestock management-livestock marketing
2.2 Opportunities in breeding: Cattle and buffalo breeding- processing- grading- daily care
2.3 Livestock Market: demand, supply and pricing-Quality and sanitary issues for livestock products: international standards
2.4 Employment opportunities in Livestock Industry

Module 3: Management of Livestock (Teaching Hours- 15, Credit- 01)

3.1 Feeding management System of feeding livestock's, feeding standards for livestock
3.2 Shelter management; Housing system, selection of sites and lay outs for animal houses, space required for livestock- environment and automation in livestock farming
3.3 General principles of management- Marketing Management- Women in livestock management
3.4 Importance and Methods of Breeding and reproduction management- breeding records Climate and reproduction- causes of fertility Disturbances

Module 4: Agriculture and Livestock Policies (Teaching Hours- 15, Credit- 01)

4.1 US Farm Bill- WTO: bilateral Agreement
4.2 Export of beef, meet and pork etc. Regulation for safe meet export
4.3 Global Practices of Livestock Management- International market for dairy, pork, beef, meat etc.
4.4 Pink revolution- Livestock Insurance

READING LIST:

1. 16th India Livestock Censes, Summery report All India Volume- IA, Livestock and Poultry, 1997, Government of India, Ministry of Agriculture.
2. Archana Ruhela and Malini Sinha, 2010, Livestock Economics, Oxford Book Company, Delhi
3. Eiri Board, 2008, Hand Book on Poultry Farming and Feed Formulation, Engineers India Research Institute, Delhi.
4. Humenik and Frank James, 1983, Livestock Waste Management, Beter World Books, Mishawaka, USA.
5. Jadhav, 2010, Handbook of poultry production and Management, Jaypee Brothers Medical Publisher Private Limited, London, UK
6. K. S. Gangadhar, 2009, Livestock economics: Marketing, Business management and accountancy, New India Publishing Agency, New Delhi
7. M. A. Iqbal, 2012, Livestock revolution and economic viability of the Farmers, Rajat Publication, Daryaganj, Delhi
8. N. S. R and C. K. Thomas, 2016, Livestock Production Management, Kalyani Publisher, New Delhi.
9. Report of the National commission on Cattle, July 2012, Department of Animal Husbandry and Dairying, Ministry of Agriculture, government of India.
10. Richard A. Battagalia, 2006, Handbook on Livestock Management,Pearson Publication
11. S. Das, 2016, Livestock Management, State Council of Educational, Research and Training, Karla. 12. U S Bureau of Agriculture economics, 1940, The livestock situation, U S Bureau.

M. A. I SEM I

Course Name	**: Economy of Maharashtra**
Type	**:** Major Elective
Course Number	**:** ME 8
Course Code	**:** MAU0325MEL515G8
Course Credits	**:** 4
Marks	**:** Semester End: 80 Internal Assessment: 20 Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Demonstrate the importance of the Maharashtra economy in the national economy.
- Identify the new techniques to develop agriculture in Maharashtra.
- Discuss the scope of industrial development of Maharashtra.
- Evaluate the public finance in Maharashtra.

Module 1: Introduction to Economy of Maharashtra (Teaching Hours- 15, Credit- 01)

1.1 Basic features of the economy of Maharashtra: Location, Structure, Land, Forest, Environment and Mineral resources
1.2 Demography of Maharashtra: Size, Growth rate, Literacy rate, Sex ratio, Urban and rural population, Migration
1.3 Growth and sectoral changes in SGDP since 1991
1.4 Place of Maharashtra in economic development of India

Module 2: Agricultural Development of Maharashtra (Teaching Hours- 15, Credit- 01)

2.1 Significance of agriculture in the economy of Maharashtra: Contribution in SGDP, Land use and cropping pattern, Production and productivity, Horticulture, Fisheries and Livestock
2.2 Agriculture finance: Credit provided by banks and financial institutions, Crop insurance, Agriculture, and budget of Maharashtra
2.3 Irrigation in Maharashtra: Watershed Development Programme, Jalyukt Shivar, Pani Foundation movement
2.4 Agrarian distress in Maharashtra- Agricultural policy of Maharashtra

Module 3: Industry and Service Sector (Teaching Hours- 15, Credit- 01)

3.1 Role of MIDC, SICOM, MSFC in industrial development
3.2 Strategies for industrial development in Maharashtra: SEZ, FDI
3.3 Role of service sector in economic development- Government initiatives for service sector development
3.4 Regional disparities in Maharashtra: Causes and remedies

Module 4: Public Finance (Teaching Hours- 15, Credit- 01)

4.1 Revenue: composition and trends in revenue
4.2 Expenditure: Growth and composition - Trends in deficit
4.3 Public debt: Growth and composition
4.4 District Planning and Development Council (DPDC): Structure, objectives, functions and Process

READING LIST:

1. Dastane Santosh- Asa Ha Maharashtra (Marathi Edition)
2. Government of Maharashtra: Economic Survey of Maharashtra, Various Issues.
3. Government of Maharashtra: Yojana magazine, Various Issues.
4. Kurulkar R. P. (1997): Maharashtrachi Arthvyavastha (Marathi) Vidya Prakashan, Ruikar Marg, Nagpur.
5. Maharashtra Rajya Niyojan Mandal (2002): Manav Vikas Ahawal, Maharashtra.
6. Munagekar Bhalchandra (2003) :The Economy of Maharashtra – Changing Structure and Emerging Issues, Dr. Ambedkar Institute of Social and Economic Change, Mumbai
7. PansareGovind (2012) :Maharashtrachi Arthik Pahani – Paryayi Drushtikon
8. Patil J.F.(2010) :Suvarna Mahotsavi Maharashtrachi Badalati Arthvyavastha (Marathi), Abhijit Pratap Pawar, Sakal Papers Ltd., 595, Budhwar Peth, Pune
9. Reserve Bank of India: Handbook of Statistics of Indian Economy
10. World Bank (2002) India: Maharashtra Reorienting Govt. to Facilitate Growth and Reduce Poverty

M. A. I SEM I

Course Name	**: Research Methodology**		
Type	**:** Research Methodology		
Course Number	**:** RM		
Course Code	**:** MAU0325RML515G		
Course Credits	**:** 4		
Marks	**:** Semester End: 80	Internal Assessment: 20	Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Get acquainted with the basic concepts of research and its methodologies.
- Select and define appropriate research problem and parameters.
- Use techniques of data analysis in research.
- Write a research report and thesis
- Write a research proposal (grants).

Module 1: Introduction to Research Methodology (Teaching Hours- 15, Credit- 01)

1.1 Research: Meaning – Objectives - Motivation - Types - Approaches - Significance
1.2 Research Methods versus Methodology
1.3 Research Process and basic research concepts (facts, concepts, hypothesis, and theory/paradigm/model)
1.4 Criteria of Good Research

Module 2: Research Problems and Research Design (Teaching Hours- 15, Credit- 01)

2.1 Research Problem: Meaning- Selection – Necessity - Technique Involved
2.2 Research Proposal and Design: Meaning - Need
2.3 Features of a Good Design - Important Concepts Relating to Research Design
2.4 Different Research Designs

Module 3: Sampling and Data Collection (Teaching Hours- 15, Credit- 01)

3.1 Census and Sample Survey - Steps in Sampling Design - Criteria of Selecting a Sampling Procedure, Concept of sample size
3.2 Characteristics of a Good Sample Design - Types of Sample Designs- How to Select a Random Sample?
3.3 Collection of Primary Data: Observation Method, Interview Method, Questionnaires, Schedules - Difference between Questionnaires and Schedules - Other Methods of Data Collection
3.4 Collection of Secondary Data - Selection of Appropriate Method for Data Collection - Case Study Method

Module 4: Analysis of Data & Report Writing (Teaching Hours- 15, Credit- 01)

4.1 Data Processing- Scrutiny, Classification, Editing and Tabulation – Problems

4.2 Elements /Types of Analysis - Statistics in Research: Basic Concept of Measures of Central Tendency- Dispersion - Regression and Correlation Analysis

4.3 Hypothesis: Meaning - Basic Concepts Concerning Testing -Procedure - Measuring the Power of a Hypothesis Test - Tests of Hypotheses: Important Parametric and Non Parametric Tests

4.4 Interpretation: Meaning - Why- Technique- Precaution -Report Writing: Significance - Steps- Layout - Types - Mechanics -Precautions

READING LIST:

1. Ackoff, Russell L., (1961) The Design of Social Research, Chicago: University of Chicago Press.
2. Ackoff, Russell L., (1962) Scientific Method, New York: John Wiley & Sons.
3. Allen, T. Harrell (1978) New Methods in Social Science Research, New York: Praeger Publishers.
4. Anderson, T.W., (1958) An Introduction to Multivariate Analysis, New York: John Wiley & Sons.
5. Bailey, Kenneth D.,(1978) "Methods of Social Research," New York.
6. Baker, R.P., and Howell, A.C., (1938) The Preparation of Reports, New York: Ronald Press.
7. Berdie, Douglas R., and Anderson, John F., (1974) Questionnaires: Design and Use, Metuchen N.J.: The Scarecrow Press, Inc.
8. Berenson, Conard, and Colton, Raymond, (1971) Research and Report Writing for Business and Economics, New York: Random House.
9. Best, John W., and Kahn, James V., (1986) "Research in Education," 5th Ed., New Delhi: Prentice-Hall of India Pvt. Ltd.
10. Bhandarkar and Wilkinson (2010) Methodology and Techniques of Social Science Research , Himalaya Publishing House, New Delhi
11. Bowley, A.L., (1937) Elements of Statistics, 6th ed. London: P.S. King and Staples Ltd.
12. Ghosh, B.N., (1982) Scientific Methods and Social Research, New Delhi: Sterling Publishers Pvt. Ltd.
13. Goode, William J., and Hatt, Paul K., (1952) Methods in Social Research, New York: McGraw-Hill.
14. Gopal, M.H., (1965) Research Reporting in Social Sciences, Karnatak University. Dharwad
15. Gopal, M.H., (1964) An Introduction to Research Procedure in Social Sciences, Bombay: Asia Publishing House.
16. Gupt , S. C. (2016) Fundamentals of Statistics, Himalaya Publishing House, New Delhi
17. Gupta, S. P. (2017) Statistical Methods, S Chand and Sons , New Delhi
18. Hans Raj (2000) Theory and Practice in Social Science Research, Surjeet Publications,
19. Kothari, C. R. (2004) Research Methodology: Methods and Techniques, New Age International (P) Ltd., New Delhi

M. A. I SEM II

Course Name	**: Public Economics**
Type	**:** Major Mandatory
Course Number	**:** MM 1
Course Code	**:** MAU0325MML515H1
Course Credits	**:** 4
Marks	**:** Semester End: 80 Internal Assessment: 20 Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Understand the role of government in economic planning and development.
- Examine the theory of public choice and public policy.
- Equip with theory of public expenditure and project evaluation.
- Analyse the theories of taxation and public budget.

Module 1: Role of Government in Development (Teaching Hours- 15, Credit- 01)

1.1 **Role of Government in a mixed economy**: Government as an agent for economic planning and development
1.2 **Human Wants and Goods**: Private, Public, and Merit
1.3 **Causes of Market failure**: Imperfections, Decreasing costs
1.4 Externalities- Economies and Diseconomies

Module 2: Theory of Public Choice and Public Policy (Teaching Hours- 15, Credit- 01)

2.1 Private and Public Mechanism for Allocating of Resources
2.2 **Problems of Revelation and Aggregation of Preferences:** Absolute and Relative Unanimity Principle – Political Interactions Costs Theory - Arrow's Impossibility theorem- An Economic Theory of Democracy - Politico- eco-bureaucracy Theory
2.3 **Provision of Public Goods**: Voluntary exchange model of Wicksell and Lindahl- Impossibility of decentralized provision of public goods (Contributions of Samuelson and Musgrave)
2.4 **Demand Revealing Schemes for Public goods -** Tiebout model- Theory of Club goods

Module 3: Theory of Public Expenditure and Project Evaluation
(Teaching Hours- 15, Credit- 01)

3.1 **Theories of Public Expenditure**: Smuelson's Pure theory of Public Expenditure - Wagner's law of increasing state activities- Wiseman Peacock hypothesis - Colin Clark Hypothesis
3.2 Criteria of Public investment- Project evaluation
3.3 Social Cost-Benefit Analysis
3.4 **Public Budget**: Classification of Public Budget- Performance and Programme budgeting- Zero base budgeting

Module 4: Theory of Taxation and Public Debt (Teaching Hours- 15, Credit- 01)

4.1 **Tax Incidence**: Meaning- Alternative Concepts – Measurement- Theories

4.2 **Theories of Taxation**: Benefit and Ability to pay approaches- Theory of optimal taxation- Excess burden of taxes

4.3 The problem of double taxation- Laffer Curve Theory – Goods and Services Tax (GST)

4.4 **Public Debt**: Sources- Classification- Importance- Burden - Methods of Redemption- Principles of Debt Management

READING LIST:

1. Atkinson, A. B. and J. E. Stiglitz (1980), Lectures on Public Economics, Tata McGraw Hill, New York.
2. Auerbach, A. J. and M. Feldstern (Eds.) (1985), Handbook of Public Economics, Vol. I, North Holland, Amsterdam.
3. Buchanan, J. M. (1970), The Public Finances, Richard D. Irwin, Homewood.
4. Goode, R. (1986), Government Finance in Developing Countries, Tata McGraw Hill, New Delhi.
5. Jha, R. (1998), Modern Public Economics, Routledge, London.
6. Menutt, P. (1996), The Economics of Public Choice, Edward Elgar, U. K.
7. Musgrave, R. A. (1959), The Theory of Public Finance, McGraw Hill, Kogakhusa, Tokyo.
8. Musgrave, R. A. and P. B. Musgrave (1976), Public Finance in Theory and Practice, McGraw Hill, Kogakusha, Tokyo.
9. Shoup, C. S. (1970), Public Finance, Aldine, Chicago.
10. Shome, P. (Ed.) (1970), Tax Policy: Handbook, Tax Division, Fiscal Affairs Department, International Monetary Fund, Washington D. C.
11. Cornes, R. and T. Sandler (1986), The Theory of Externalities, Public Goods and Club Goods, Cambridge University Press, Cambridge.
12. Duff, L. (1997), Government and Market, Orient Longman, New Delhi.
13. Herber, B. P. (1967), Modern Public Finance, Richard D. Irwin, Homewood.
14. Spulber, N. (1998), Redefining the State, Cambridge University Press, Cambridge.
15. Buchanan, J. M. (1968), The Demand and Supply of Public Goods, Rand McNally, Chicago.
16. Spulber, N. (1998), Redefining the State, Cambridge University Press, Cambridge.
17. Stiglitz, J. E. (1986), Economics of Public Sector, Norton, New York.
18. Dorfman, R. (Ed.) (1970), Measuring the Benefits of Government Investment, Brookings Institution, Washington.
19. Friedman, A. (1986), Welfare Economics and Social Choice Theory, Martins Nijhoff, Boston.
20. Glennester, H. and J. Hills (1998), The State of Welfare: The economic and Social Spending Oxford University Press, London.
21. Mishan, E. J. (1982), Cost-Benefit Analysis: An Informal Introduction, George Allen and Unwin, London.
22. Peacock, A. and D. J. Robertson (Eds.) (1963), Public Expenditure: Appraisal and Control, Oliver and Boyd, Edinburgh.

23. Phyrr, P. (1970), Zero Base Budgeting: A Practical Management Tool for Evaluating Expenses, John Wiley, New York.
24. Premchand, A. (1966), Control of Public Expenditure in India, Allied Publishers, New Delhi.
25. Sahni, B. S. (Ed.) (1972), Public Expenditure Analysis: Selected Readings, Rotherdam University Press.
26. Cutt, J. (1969), Taxation and Economic Development in India, Frederick A Praegar Publishers, New York.
27. Kaldor, N. (1955), An Expenditure Tax, George Allen and Unwin, London.
28. Musgrave, R. A. and C. Shoup (Eds.) (1970), Readings in the Economics of Taxation, George Allen and Unwin, London.
29. Barman, K. (1986), Public Debt Management in India, Uppal Publishing House, New Delhi.
30. Buchanan, J. M. (1958), Principles of Public Debt, A Defence and Restatement, Richard D. Irwin, Homewood.
31. Ferguson, J. M. (Ed.) (1964), Public Debt and Future Generations, North Carolina University Press, Chapel Hill.
32. Sreekantaradhya, B. S. (1972), Public Debt and Economic Development in India, New Delhi.
33. Peacock, A. and G. K. Shaw (1976), The Economic Theory of Fiscal Policy, George Allen and Unwin, London.
34. Bhargava, R. N. (1967), The Theory and Working of Union finance in India, Chaitanya Publishing House, Allahabad.
35. Bhargava, P. K. (1982), Centre State Resource Transfers in India, The Academic Press, Gurgaon.
36. Musgrave, R. A. (1977), Essays in Fiscal Federalism, Greenwood West Port.
37. Oates, W. E. (1972), Fiscal Federalism, Harcourt Brace and Johanowich, New York.
38. Reports of various Finance Commissions, Govt. of India.
39. Bhargava P. K. (1976), Taxation of Agriculture in India, Vora and Co., Bombay.
40. Bhargava, P. K. (1984), Some Aspects of Indian Public Finances, Uppal Publishing House, New Delhi.
41. Bhargava, P. K. (1991), India's Fiscal Crisis, Ashish Publishing House, New Delhi.
42. Borkar, V. V. (1971), Income Tax Reform in India, Popular Prakashan, Bombay.
43. Chelliah, Raja J. (Ed.) (1997), Towards, Sustainable Growth, Oxford University Press, New Delhi.
44. Dutt, R. (Ed.) (2001), Second Generation Economic Reforms in India, Deep & Deep Publications, New Delhi.
45. Gandhi, V. P. (1970), Some Aspects of India's Tax Structure, Vora and Company, Bombay.
46. Government of India (1992), Reports of the Tax Reforms Committee – Interim and Final (Chairman: Raja J. Chelliah).
47. Jain, A. K. (1975), Taxation of Income in India, Macmillan Company of India Ltd., New Delhi.
48. Jain, I. (1988), Resource Mobilization and Fiscal Policy in India, Deep & Deep Publications, New Delhi.
49. Kumar, A. (1999), The Black Economy in India, Penguin, Harmondsworth.
50. Mundell, S. (1999), Public Finance Policy: Issues for India, Oxford University Press, New Delhi.

M. A. I SEM II

Course Name	**: Ecological and Resource Economics**
Type	**:** Major Mandatory
Course Number	**:** MM 2
Course Code	**:** MAU0325MML515H2
Course Credits	**:** 4
Marks	**:** Semester End: 80 Internal Assessment: 20 Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Equip with the natural resources and the related issues.
- Analyse the sustainable development in different perspectives.
- Assess the exploitation of renewable and non-renewable natural resources.
- Discuss on the externalities and policy thereon.

Module 1: Scarcity of Natural Resources (Teaching Hours- 15, Credit- 01)

1.1 Introduction to Ecological & Resource Economics
1.2 **Natural Resources**: Renewable and Non-renewable
1.3 **Scarcity** of Natural resources- Natural Resources and Economic Development
1.4 **Methods of Valuation of Natural Resources**: Direct and Indirect

Module 2: Sustainable Development (Teaching Hours- 15, Credit- 01)

2.1 **Approaches to Sustainable Development**: Club of Rome approach – Steady State School
2.2 **Sustainable development** Concept and Indicators; Strong and Weak Sustainability - Possible Sustainability Rules
2.3 Bio-sphere and Economic growth - Intellectual Property Rights and Natural resources - Recycling of Natural Resources
2.4 **Optimal Extraction of Non Renewable Natural Resources**: Gray model – Hoteling Model

Module 3: Bio Economics (Teaching Hours- 15, Credit- 01)

3.1 Bionomic Equilibrium
3.2 Market Structure and Exploitation of Non-renewable Natural resources
3.3 Population growth models – Static economic models of Renewable Natural Resources with references to Fisheries
3.4 **Regulation of Harvesting of Natural Resources**: Taxes, Quota, Sole Ownership

Module 4: Externalities and Pollution (Teaching Hours- 15, Credit- 01)

4.1 **Externalities:** Meaning, Types and Measures
4.2 **Pollution:** Air, Water, Noise and Land; Causes and Measures
4.3 **Environmental Policy**: ***Market Processes/ Pricing/ Fiscal Techniques / Economic Incentives***; a)Effluent Charge/ Pollution tax b) Subsidies, c) Refundable Deposits, d) Pollution Permits , e) Allocation of Property Rights
4.4 **Coase's Theory** of Bargaining Solution and Collective Action

READING LIST:

1. Faber, Manstetten & Proops (2002). Ecological Economics, Edward Elgar Publishing Limited Glos, UK.
2. Barbier Edward (2003). Role of Natural Resources in Economic Development, Research Article Australian Economic Papers, Blackwell Publishing Ltd, University of Adelaide & South Australia
3. USAID, 2006, The Role of Property Rights in Natural Resource Management, Good Governance, and Empowerment of Poor
4. Schlger & Ostrom, 1992, Property Rights Regime and Natural Resources: A Conceptual Analysis, University Wisconsin Press
5. Karpagam M (2007) , Environmental Economics, Sterling Publishers Private Limited , New Delhi
6. Hanley and Spash (1998), Cost Benefit Analysis and the Environment, Edward Elgar Publsiinhing Limited, Glos, UK.
7. Hanley, Shogren and White(1997), Environmental Economics; In Theory and Practice, Macmillan India Limited, Delhi.
8. Singh and Shishodia (2010), Environmental Economics; Theory and Applications, Sage Publications India Private Limited, New Delhi.
9. Sen, Amrtya (1981-2011), Poverty and Famines, Oxford University Press, New Delhi.
10. Hartwick, J. M. & Olewiler, N. D., The Economics of Natural Resource Use.
11. Randall, A., Resource Economics
12. Barnet, H. J. and Morse, C., Scarcity and Growth: The Economics of Natural Resource Activity.
13. Conrad, J. M. & Clark, C. W., Natural Resource Economics: Notes and Problems.
14. Dasgupta, P., The Control of Resources.
15. Dasgupta, P. and Heal, G. M., Economics Theory and Exhaustible Resources.
16. Nadkarni, M. V. and others, Political Economy of forest Use and Management in India.
17. World Resource Institute, World Resources, Annual Reports, Other publications.
18. The Hindu Survey of Environment, Various issues.
19. Report on NCA. World Bank Reports, UNO Publications

M. A. I SEM II

Course Name	**: Agricultural Development in India**
Type	**:** Major Mandatory
Course Number	**:** MM 3
Course Code	**:** MAU0325MML515H3
Course Credits	**:** 4
Marks	**:** Semester End: 80 Internal Assessment: 20 Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Understand the nature, scope, challenges and opportunities in Agricultural Sector.
- Analyze the causes of agrarian distress and remedies.
- Elaborate the possible measures to reduce agrarian distress
- Prepare a plan for reforms regarding the Agriculture sector.

Module 1: Agriculture and Economic Development (Teaching Hours- 15, Credit- 01)

1.1 Role of Agriculture in Indian Economy – National Agricultural Policy Since 1991
1.2 Changing Land use and cropping pattern in India
1.3 Contract farming - Organic farming
1.4 Food security & Agricultural Development-Buffer Stock and Public Distribution System (PDS)

Module 2: Agricultural Technology and Irrigation (Teaching Hours- 15, Credit- 01)

2.1 Challenges before Agriculture Development-White Revolution (Dairy)
2.2 Blue Revolution (Fisheries), Need of Second Green Revolution
2.3 Agricultural Technology: Mechanization of Agriculture Biotechnology and Agriculture
2.4 Irrigation: Sources, Progress, Policies & Strategies in India – utilization of surface & ground water

Module 3: Agricultural Finance and Trade (Teaching Hours- 15, Credit- 01)

3.1 Sources of Agricultural Finance – Institutional & Non-institutional System
3.2 NABARD
3.3 RRBs - Kisan Credit Card scheme
3.4 Agriculture and International trade - WTO and Agriculture – Competitiveness of Indian agriculture

Module 4: Agricultural Marketing and Prices (Teaching Hours- 15, Credit- 01)

4.1 Agricultural Marketing: Marketing functions and efficiency marketable surplus-Farmer's Share, pricespread - Marketing Margin, Marketing Costs - Agricultural Marketing: problems and measures
4.2 Regulated Markets - Co-operatives Marketing – Direct marketing - Farmers Organisation inmarketing

4.3 Role of government in agricultural marketing; NAFED - NCDC- eNAM

4.4 Agricultural Prices: Need of Price Policy – Instruments of price policy CACP – National commissionon Agriculture- Impact of GST on Agriculture

READING LIST:

1. Acharya S S & Agrawal N L (2014): Agricultural Marketing in India, Oxford & IBH PVT. Co. Ltd,New Delhi.
2. Desai R G (2001): Agricultural Economics- Models Problems and Policy Issues, HimalayaPublishing House, Mumbai.
3. Lekhi R K & Singh Jogindar (2013): Agricultural Economics, Kalyani Publisher, New Delhi.
4. Mishra & Puri (2023): Indian Economy, Himalaya Publishing House, Mumbai.
5. Reddy, Ram, Sastry & Devi (2010): Agricultural Economics Oxford & IBH publishing Co. Pvt. Ltd,New Delhi.
6. Sadhu A. N. & Singh Amarjit, Fundamentals of Agricultural Economics, (1996), HimalayaPublishing House, Bombay.
7. Soni, R. N. (1995), Leading Issues in Agricultural Economics, Arihant Press, Jalandhar.
8. Bilgram, S. A. R. (1996), Agricultural Economics, Himalaya Publishing House, Delhi.
9. Bhalla G S (2004): Globalization and Indian Agriculture, State of Indian Farmer, A Millenniumstudy, Department of Agriculture & cooperation, Ministry of Agriculture, Government of India , Published by Academic Foundation , New Delhi.
10. Chand Ramesh (2002); Trade liberalization, WTO and Indian Agriculture, Mittal Publication, New Delhi.
11. Government of India (1976), Report of the National Commission on Agriculture, New Delhi.
12. Ghatak, S. and K. Ingerscent (1984), Agriculture and Economic Development, Select books, New Delhi.
13. Government of India, Five Year Plans, New Delhi.
14. Government of India (2001), Report of the Working Group on Organic and Biodynamic Farming forTenth Five Year Plan, Planning Commission, GOI, N. Delhi
15. Gulati Ashok, Sharma & Others (1994): How Competitive is India in Agro Export? An analysis ofselected Agro-products, Margin Vol.6, No.4 pp-844-864
16. Gulati & Hussain (2017): Farm & the Tax, The Indian Express, dated5th June 2017, PP-11.
17. Harold G. Halcrow, (1981), Economic of Agriculture, Mc-Graw Hill, International Book Company,Tokyo.
18. John W. Goodwin (1977), Agricultural Economics, Reston Publishing Company, Virginia.
19. John B. Penson, Oral Capps, C. Parr Rosson, (1999), Introduction to Agricultural Economics,Prentice Hall, New Jersey.
20. Meier, G. M. (1995), Leading Issues in Economic Development, Oxford University Press, New Delhi.

M. A. I SEM II

Course Name	**: Contribution of Nobel Laureates to Economics**
Type	**:** Major Mandatory
Course Number	**:** MM 4
Course Code	**:** MAU0325MML515H4
Course Credits	**: 2**
Marks	**:** Semester End: 40 Internal Assessment: 10 Total Marks: 50

Course Outcomes: After successful completion of this course, the students will be able to:

- Get acquainted with the ideas and works of Economists and thinkers who received Nobel Memorial Prize in Economics.
- Analyze the theories and models developed by Nobel Laureates.

Module 1: Economic Development and Economic Growth

(Teaching Hours- 15, Credit- 01)

1.1 Simon Kuznets, Wassily Leontief
1.2 Arthur W. Lewis
1.3 Theodore W. Schultz
1.4 Robert M. Solow

Module 2: Macro, Monetary and Financial Economics (Teaching Hours- 15, Credit- 01)

2.1 Milton Friedman, James Tobin
2.2 Harry M. Markowitz, William F. Sharpe
2.3 Myron S. Scholes, Merton H. Miller
2.4 Robert A. Mundell, Franco Modigliani

Reading List:

1. Friedman, M. (1957), A Theory of the Consumption Function, Princeton University Press, Princeton, New Jersey.
2. Friedman, M. (1959), The Demand for Money: Some Theoretical and Empirical Results, Journal ofPolitical Economy, Vol. 67.
3. Friedman, M. with A. J. Schwartz (1963), A Monetary History of the United States, UniversityPress, Princeton, New Jersey.
4. Friedman, (1968), Quantity theory in the International Encyclopedia of the Social Sciences
5. Friedman, M. (1969), The Optimum Quantity of Money and other Essays, Aldine Publishers,Chicago
6. Friedman, M. (1977), Inflation and Unemployment: Nobel Lecture, Journal of Political Economy,Vol. 85
7. Markowitz, H. M. (1952), The Portfolio Selection, The Journal of Finance, Vol. 7
8. Markowitz, H. M. (1991), Portfolio Selection – Efficient Diversification of Investments (2nd Edition), Basil Blackwell, Cambridge, Mass

9. Markowitz, H. M. (1976), Investment for the Long Run: New Evidence for an old rule, Journal ofFinance, Vol. 31
10. Markowitz, H. M. (1990), Foundations of Portfolio Theory: Nobel Lecture.
11. Miller, M. H. (1972), Rates of Return in Relation to Risk: A Reexamination of Some Recent Findings with Myron Scholes in Studies in the Theory of Capital Markets (Ed. M. Jensen), Wiley, New York.
12. Miller, M. H. (1988), The Modigliani – Miller Propositions after Thirty Years, Journal of EconomicPerspectives, Vol. 6.
13. Miller, M. H. (1991), Financial Innovations and Market Volatility, Oxford, New York
14. Miller, M. H. (1990), Leverage: Nobel Lecture
15. Modigliani, F. (1980), The Collected Papers of Franco Modigliani, Vol. 1, 2 and 3 (Edited by A.Abel), MIT Press, Cambridge, Mass.
16. Modigliani, F. (1949), Fluctuations in the Saving – Income Ratio : A Problem in EconomicForecasting, Studies in Income and Wealth, NBER, New York.
17. Modigliani, F. (1985), Life Cycle, Individual Thrift and the Wealth of Nations : Nobel Lecture
18. Scholes, M. with Fischer Black (1972), The Valuation of Option Contracts and a Test of MarketEfficiency, The Journal of Finance, Vol. 27.
19. Scholes, M. with Fischer Black (1973), The Pricing of Options and Corporate Liabilities, Journal ofPolitical Economy, Vol. 81.
20. Scholes, M. with Fischer Black and M. Jensen (1972), The Capital Asset Pricing Model: SomeEmpirical Tests in M. Jensen (Ed.) Studies in the Theory of Capital Markets
21. Sharpe, W. F. (1963), A Simplified Model for Portfolio Analysis, Management Science, Vol. 9.
22. Sharpe, W. F. (1964), Capital Asset Prices – A Theory of Market Equilibrium under Conditions ofRisk, The Journal of Finance, Vol. 19.
23. Sharpe, W. F. (1965), Risk aversion in the Stock Market: Some Empirical Evidence, The Journal ofFinance, Vol. 20.
24. Sharpe, W. F. (1970), Portfolio Theory and Capital Markets, McGraw Hill, New York
25. Sharpe, W. F. (1990), Capital Asset Prices with a without Negative Holdings: Nobel Lecture
26. Tobin, J. Essays in Economics, Vols. I to III, 1971, 75, 82, North Holland, Amsterdam
27. Tobin, J. (1980), Asset Accumulation and Economic Activity, Oxford University Press, Oxford
28. Tobin, J. and D. Hester (Eds.) 1967), Financial Markets and Economic Activity, John Wiley, NewYork
29. Tobin, J. (1967), Studies of Portfolio Behaviour, John Wiley, New York
30. Tobin, J. (1981), Money and Finance in the Macroeconomic Process: Nobel Lecture
31. Kuznets, S. (1937), National Income 1919-35, W. W. Norton, New York 82) Kuznets, S. (1933),National Income in Encyclopedia of the Social Sciences
32. Kuznets, S. (1953), Economic Change: Selected Essays in Business Cycles, National Income andEconomic Growth, W. W. Norton, New York
33. Kuznets, S. (1959), Six Lectures on Economic Growth, NBER, New York
34. Kuznets, S. (1965), Economic Growth and Structure: Selected Eassays, W. W. Norton, New York
35. Kuznets, S., Modern Economic Growth: Rate, Structure and Spread, Yale University Press, NewHaven.

36. Kuznets, S. (1979), Growth, Population, and Income Distribution: Selected Essays, W. W. Norton,New York
37. Kuznets, S., (1971), Modern Economic Growth: Findings and Reflections, Nobel Lecture
38. Lewis, W. A. (1954), Economic Development with Unlimited Supplies of Labour, ManchesterSchool, Vol. 22.
39. Lewis, W. A. (1954), Unlimited Labour: Further Notes, Manchester School, Vol. 22
40. Lewis, W. A. (1949), Overhead Costs – Some Eassays in Economic Analysis, George Allen andUnwin, London
41. Lewis, W. A. (1955), The Theory of Economic Growth, Macmillan, London
42. Lewis, W. A. (1979), The Slowing Down of the Engine of Growth: Nobel Lecture
43. Schultz, T. W. (1961), Investment in Human Capital, American Economic Review, Vol. 51
44. Schultz, T. W. (1963), The Economic Value of Education, Columbia University Press, New York
45. Schultz, T. W. (1968), Human Capital in International Encyclopedia of the Social Sciences
46. Schultz, T. W. (1972), Investment in Education: The Equity – Efficiency Quandary, Journal ofPolitical Economy: Supplement, Vol. 80
47. Schultz, T. W. (1979), The Economics of Being Poor: Noble Lecture
48. Solow, R. M. (1955-56), The Production of Function and the Theory of Capital, Review of Economic Studies, Vol. 23
49. Solow, R. M. (195-56), A contribution to the Theory fo Economic Growth, Quarterly Journal of Economics, Vol. 70
50. Solow, R. M. (1957), Technical Change and the Aggregate Production Function, Review of Economics and Statistics, Vol. 39
51. Solow, R. M. (1963), Capital Theory and the Rate of Return, North Holland, Amsterdam
52. Solow, R. M. (1970), Growth Theory: An Exposition, Oxford University Press, Oxford
53. Solow, R. M. (1987), Growth Theory and After: Nobel Lecture
54. Leontief, W. W. (19512), The structure of the American Economy: 1919-39,Second Edition, Oxford University Press, New York
55. Leontief, W. W. (Ed. (1953), Studies in the Structure of American Economy, Oxford University Press, New York.
56. Leontief, W.W. (166), Input-Output Economics, Oxford, New York
57. Leontief, W. W. (1966), Essays in Economics: Theories and Theorizing, Vols. I & II, 1966, 1977, Oxford, New York and London
58. Mundell, R. A. (1971), Monetary Theory, W. W. Norton, New York
59. Mundell, R. A. (1960), The Public Debt, Corporate Income Taxes and the Rate of Interest, Journal of Political Economy, Vol. 68.
60. Mundell, R.A. (1962), The Appropriate Use of Monetary and Fiscal Policy for Internal and External Stability, IMF Staff Papers, Vol.9.
61. Mundell, R. A. (1960), The Monetary Dynamics of International Adjustments Under Fixed and floating Exchange Rates, Quarterly Journal of Economics, Vol. 7

M. A. I SEM II

Course Name : **Industrial Economics**
Type : Major Electives
Course Number : ME 1
Course Code : MAU0325MEL515H1
Course Credits : 4
Marks : Semester End: 80 Internal Assessment: 20 Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Understand the importance of industrialization in economic development.
- Explain the market conduct and performance.
- Analyze basic issues in the industrial development of India
- Know actual market situation.

Module 1: Firms and Market Structure (Teaching Hours- 15, Credit- 01)

1.1 Concept and organization of a firm – ownership, control and objectives of the firm; Passive and active behaviour of the firm
1.2 Sellers' concentration; Product differentiation; Entry conditions; Economies of scale
1.3 Market structure and profitability; Market structure and innovation
1.4 Theories of industrial location – Weber and Sargent Florence; Factors affecting location

Module 2: Market Conduct and Performance (Teaching Hours- 15, Credit- 01)

2.1 Product pricing – Theories and evidence
2.2 Investment expenditure – Methods of evaluating investment expenditure; Theories and empirical evidence on Mergers and acquisitions and diversification
2.3 Growth of the firm – Size and growth of a firm; Growth and profitability of the firm; Constraints on growth
2.4 Productivity, efficiency and capacity utilization – Concept and measurement, Indian situation

Module 3: Indian Industrial Growth and Pattern (Teaching Hours- 15, Credit- 01)

3.1 Classification of industries; Industrial policy in India – Role of Public and private sectors
3.2 Recent trends in Indian industrial growth; MNCs and transfer of technology; Liberalization and privatization
3.3 Regional industrial growth in India; Industrial economic concentration and remedial measures
3.4 Issues in industrial proliferation and environmental preservation; Pollution control policies

Module 4: Industrial Finance (Teaching Hours- 15, Credit- 01)

4.1 Owned, external and other components of funds

4.2 Institutional finance: IDBI, IFCI, SFCs, SIDC, commercial banks, etc

4.3 Financial statement – Balance sheet, Profit and loss account; assessment of financial soundness, ratio analysis

4.4 GDRs and ADRs, Trends in External Resources flow

READING LIST:

1. Ahluwalia, I. J. (1985), Industrial Growth in India, Oxford University Press, New Delhi.
2. Barthwal, R. R. (1985), Industrial Economics, Wiley Eastern Ltd., New Delhi.
3. Cherunilam, F. (1994), Industrial Economics: Indian Perspective (3rd Edition), Himalaya Publishing House, Mumbai.
4. Desai, B. (1999), Industrial Economy in India (3rd Edition), Himalaya Publishing House, Mumbai.
5. Divine, P. J. and R. M. Jones et. al. (1976), An Introduction to Industrial Economics, George Allen and Unwin Ltd., London.
6. Government of India, Economic Survey (Annual).
7. Hay, D. and D. J. Morris (1979), Industrial Economics: Theory and Evidence, Oxford University Press, New Delhi.
8. Kuchhal, S. C. (1980), Industrial Economy of India (5th Edition), Chaitanya Publishing House, Allahabad.
9. Reserve Bank of India, Report on Currency and Finance (Annual).
10. Singh, A. and A. N. Sadhu (1988), Industrial Economics, Himalaya Publishing House, Bombay.
11. Bains, J. S. (1996), Industrial Organization, Cheltenham, U. K.
12. Harndeen, J. B. (1975), The Economics of Corporate Economy, Dunellen Publishers, New York.
13. Kamien, M. T. and N. L. Schwartz (1982), Market Structure and Innovation, Cambridge University Press, Cambridge.
14. Wiles, P. J. D. (1963), Price, Cost and Output, Praeger, New York.
15. Harndeen, J. B. (1975), The Economics of Corporate Economy, Dunellen Publishers, New York.
16. Kirkpatrick, C. M., N. Lee and E. I. Nixon (1984), Industrial Structure and Policy in Less Developed Countries, ELBS/George Allen and Unwin, London.
17. Menon, K. S. V. (1979), Development of Backward Areas through Incentives, Asia Publishing House, Bombay.
18. Smith, D. M. (1971), Industrial Location: An Economic and Geographic Analysis, John Wiley, New York.
19. Bagchi, A. and M. Banerjee (Eds.) (1979), Change and Choice in Indian Industry, Bagchi Publications, Calcutta.
20. Kelkar, V. L. and V. V. Bhanoji Rao (Eds.) (1996), India Development Policy Imperatives, Tata McGraw Hill, New Delhi.

21. Bhagwati J. and P. Desai (1972), India: Planning for Industrialization, Oxford University Press, London.
22. Brahmananda, P. R and V. R. Panchmukhi (Eds.) (1987), The Development Process of the Indian Economy, Himalaya Publishing House, Bombay.
23. Chakravarty, S. (1987), Development Planning: The Indian Experience, Oxford University Press, New Delhi.
24. Datta, B. (1992), Indian Planning at the Crossroads, Oxford University Press, New Delhi.
25. Ghosh, P. K. (1977), Government and Industry, Oxford University Press, New Delhi.
26. Joshi, V. and I. M. D. Little (1999), India: Macro Economics and Political Economy: 1964-1991, Oxford University Press, New Delhi.
27. Dhameeja, N. and K. S. Sastry (1998), Privatization: Theory and Practice, A. H. Wheeler, New Delhi.
28. Jalan, B. (1996), India's Economic Policy, Viking, New Delhi.
29. Joshi, V. and I. M. D. Little (1999), India: Macro Economics and Political Economy: 1964-1991, Oxford University Press, New Delhi.
30. Kelkar, V. L. and V. V. Bhanoji Rao (Eds.) (1996), India Development Policy Imperatives, Tata McGraw Hill, New Delhi.
31. Rama Murti, R. and R. Vernan (Eds.) (1991), Privatization and Control of State - owned Enterprises, The World Bank, Washington.
32. Sandesara, J. C. (1992), Industrial Policy and Planning – 1947-1991: Tendencies, Interpretations and Issues, Sage Publications, India Pvt. Ltd., New Delhi.
33. Gupta, L. C. (1969(, the Changing Structure of Industrial Finance in India, Oxford University Press, New Delhi.
34. Khan, M. Y. (1981), Indian Financial systems, Allied Publishers, New Delhi.
35. Sen, R. and B. Chatterjee (2001), Indian Economy: Agenda for the 21st Century (Essays in honour of Professor P. R. Brahmananda) Deep and Deep Publications Pvt. Ltd., New Delhi.
36. Dasgupta, P. S., Marglin and A. Sen (1972), Guideline for Project Evaluation, Unido Publications, New York.
37. Fog, B. (1959), Industrial Pricing Policies, North Holland, Amsterdam.
38. Koutsoyiannis, A. (1979), Modern Microeconomics, Macmillan, New York

M. A. I SEM II

Course Name	**: Rural Development**
Type	**:** Major Electives
Course Number	**:** ME 2
Course Code	**:** MAU0325MEL515H2
Course Credits	**:** 4
Marks	**:** Semester End: 80 Internal Assessment: 20 Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Understand the significant role of rural development in overall development of the country.
- Make solutions to the economic problems of rural societies.
- Involve in rural development
- Make policy suggestions for rural development of the country.

Module 1: Introduction to Rural Development and Development Theories
(Teaching Hours- 15, Credit- 01)

1.1 Rural Development: meaning, nature, scope and importance
1.2 Measures of Development: level of Rural Development, Distribution of Income and Rural Poverty
1.3 Development Theories: The Modernization Theory - Theory of the 'Big Push' - Leibenstein's critical minimum Effort Thesis
1.4 Lewis Model of Economic Development - Gunnar Myrdal Thesis

Module 2: Rural Economy (Teaching Hours- 15, Credit- 01)

2.1 Rural Economy: Characteristics and problems - i. Agriculture- Productivity, prices, marketing, and irrigation, ii. Rural industries -Small scale and cottage industries
2.2 Rural credit - Institutional and non-institutional; Reorganization of rural credit – Co-operatives- Commercial banks- Regional rural banks- Role of NABARD
2.3 Basic Needs of Rural Economy; Housing, Health, Education, Training, Drinking Water Supply, Electricity, Sanitation, Rural Roads, Transport and Communication
2.4 Utilization of Human & Natural Resources

Module 3: Rural Development Agencies (Teaching Hours- 15, Credit- 01)

3.1 Rural Administration-Structure and Functions
3.2 Panchayati Raj Institutions (PRI's), Panchayati Raj Before and after 73rd Constitutional Amendment Act
3.3 NGOs: Role, Functions and Problems
3.4 Ministry of Rural Development (India and States): Structure and Functions

Module 4: Rural Development Programs (Teaching Hours- 15, Credit- 01)

4.1 Programs and policies regarding rural unemployment and poverty: NREGP; NRHM, ICDS, MDM, SSA, SGSRY
4.2 Rural water supply, Sanitation, housing programme
4.3 Food Security- Public Distribution System, Buffer Stock and Food Security Act
4.4 Microfinance, Self-Help Group (SHG) and Women Empowerment

READING LIST:

1. B.S. Khanna: Rural Development in India, New Delhi: Deep & Deep Publications, 1982.
2. Bhalla. G. S. (1994) "Economic Liberalization and Indian Agriculture" (Ed) Institute for Studies in Industrial Development, New Delhi.
3. Bhatnagar: Rural Development in India, New Delhi: Light and Life Publishers, 1978.
4. Brahrnananda, P. R., Narayan, B. K. and Kalappa, A. (Eds.) 1987, Dimensions of Rural Development in India, Bombay: Himalaya Publishing House.
5. Hoshiar Singh: Administration of Rural Development in India, New Delhi, Sterling Publishers, 1995.
6. Hoshiar Singh: Rural Development in India, Jaipur: Printwell Publishers, 1985.
7. John Mellor and Gunvant Desai (1986) “Agricultural Change and Rural Poverty”,Oxford University Press, Bombay.
8. Journal of Rural Development, National Institute of Rural Development, Hyderabad.
9. Katar Singh (1999), "Rural Development - principles policies and Management" Sage Publications, New Delhi.
10. Kurukshetra: A journal of Rural Development, Government of India.
11. Mahajan, V. S, (Ed.) 1993, Employment through Rural Development - Towards Sustainability, New Delhi: Deep & Deep Publications.
12. Ministry of Rural area and Employment “Programs for Change” GoI, New Delhi.
13. Mohinder Singh: Rural Development in India – Current Perspectives, New Delhi: Intellectual Publishing House, 1992.
14. NABARD (1999) “Review of working of Regional Rural Banks”, Mumbai.
15. Plan Documents, GoI, New Delhi.
16. S.N. Mishra: New Horizons in Rural Development Administration, New Delhi: Mittal Publications, 1989.
17. S.R. Maheswari: Rural Development in India, A Public Policy Approach, New Delhi: Sage Publications, 1985.
18. Satyasundaram (1999) “Rural Development" Himalaya Publishing House, New Delhi.
19. Singh, K. 1986, Rural Development: Principles, Policies and Management, New Delhi: Sage Publications
20. Desai Vasant: A Study of Rural Economics, H.P.H., Bombay

M. A. I SEM II

Course Name	**: Managerial and Business Economics**
Type	**:** Major Electives
Course Number	**:** ME 3
Course Code	**:** MAU0325MEL515H3
Course Credits	**:** 4
Marks	**:** Semester End: 80 Internal Assessment: 20 Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Understand the significant role of demand analysis in business decision making.
- Explain practical utility of elasticity of demand.
- Apply various concepts of price theory in business decisions
- Know actual market situation

Module 1: Demand Analysis (Teaching Hours- 15, Credit- 01)

1.1 Meaning and nature of managerial economics, Chief characteristics of managerial economics, Significance of managerial economics, Role of a managerial economist

1.2 Elasticity of demand- Point and Arc elasticity of demand, Price elasticity of demand and its types, Income and Cross elasticity of demand, Advertising elasticity of demand. Practical Utility of Price elasticity of demand

1.3 Demand forecasting- Steps involved in forecasting, Methods of demand forecasting, Trend Analysis

1.4 Linear regression equations and econometric methods

Module 2: Production Function and Cost of Production (Teaching Hours- 15, Credit- 01)

2.1 Short run analysis of production function - Law of variable proportion, Long run Production Function- Returns to scale, Cobb-Douglas production function

2.2 Isoquants, Isocost lines and choice of optimal input combination

2.3 Short run and long run cost curves, derivation of cost equations for total cost, Average and marginalcost

2.4 Traditional and Modern concept of costs

Module 3: Market Structure (Teaching Hours- 15, Credit- 01)

3.1 Perfect Competition: Price, output determination and equilibrium

3.2 Monopoly: Equilibrium, Price discrimination

3.3 Monopolistic Market: Price and output determination

3.4 Oligopolistic market - Price and output determination

Module 4: Theory of Pricing, Risk, Uncertainty and Decision Making

(Teaching Hours- 15, Credit- 01)

4.1 Price practices and strategies: Cost oriented pricing, cost-plus pricing, marginal cost pricing, rate of return and competition oriented pricing, going rate pricing, profit policy, planning and forecasting

4.2 Break-even analysis and planning for profit

4.3 Business decision making: Risk and uncertainty, Pay of matrix, Risk Premium and Risk Adjustment,Risk and Investment proposal

4.4 Decision under uncertainty: Maxmin and minmax strategies, Sensitivity analysis

READING LIST:

1. Dean. J, Managerial Economics, Prentice Hall, Englewood cliffs, New Jersey, 1951
2. Baumol, W. J., What can Economic Theory contribute to Managerial Economics, American Economic Review, Papers and Proceedings, May, 1961
3. Hanue D. C., Managerial Economics – Analysis for Business, Delusions, Longmanis, Landon, 1969
4. Mehta P.L.: Managerial Economics: Analysis, Problems and Cases, S. Chand & Sons New Delhi, 2001
5. Sumitra Pal: Managerial Economics, Cases and Concepts, Macmillan India Ltd. New Delhi, 2004
6. Dewedi D. N.: Managerial Economics, Vikas Publishing House, New Delhi, 2002
7. Gupta G. S.: Managerial Economics: Concepts and Cases, Tata McGraw Hill, New Delhi, 1996
8. Trivedi M. L. : Managerial Economics: Theory and Application, Tata McGraw Hill, New Delhi, 2002
9. Varshney & Maheshwari, Managerial Economics, S. Chand, New Delhi, 2002
10. Salvatore Domnik, Managerial Economics in a Global Economy, Thompson Asia Pvt Ltd, Singapore,2002
11. Paul G. Keat & PhilipK.Y.Young, Managerial Economics, Economics Tool for Today's Decision Makers, Person Publication, New Delhi, 2004
12. Manseield Edwin, Managerial Economics: Theory Application and Cases, W W Norton and co Inc,USA, 1996
13. Mithani D. M.: Managerial Economics: Theory and Application, Himalaya Publishing House, NewDelhi, 2003

M. A. I SEM II

Course Name : **Regional Economics**
Type : Major Electives
Course Number : ME 4
Course Code : MAU0325MEL515H4
Course Credits : 4
Marks : Semester End: 80 Internal Assessment: 20 Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Understand the significant role of region in economic development.
- Explain special micro economics.
- Apply the general theory of location
- Understand regional economic policy and regional development

Module 1: Introduction to Regional Economics (Teaching Hours- 15, Credit- 01)

1.1 Definition, Nature and scope
1.2 The concept of a Region
1.3 Time and space as additional variables in economic analysis
1.4 Regional account

Module 2: Spatial Micro Economics (Teaching Hours- 15, Credit- 01)

2.1 Spatial micro-economics and location theory, price equilibrium in geographically separated and inter-linked markets
2.2 Spatial monopolistic competition, shape and size of market areas in space economy
2.3 Spatial price discrimination, profit maximizing location of the firm – alternative objectives of the firm with regard to location choice –location inter-dependence
2.4 Hotelling formulation and its critique, economies and diseconomies of agglomeration

Module 3: Transport Costs and the General Theory of Location
(Teaching Hours- 15, Credit- 01)

3.1 Transport costs in Locational decisions
3.2 Weber and Isard's theory
3.3 General equilibrium approach of Losch and Lefebver to location
3.4 Obstacles to a General Theory

Module 4: Regional economic Policy, Formulation and Regional Development

(Teaching Hours- 15, Credit- 01)

4.1 Inter-regional objective function-consistence of national and regional objectives– Approach towards depressed and backward regions Canalization of inter regional migration regional income stabilization

4.2 Leveling of regional disparities, role of regional financial allocation by the Finance Commission. Development from above versus grassroots level approach

4.3 Western Maharashtra as a Region: its special structure, industrial, agricultural, demographic aspects, intra-regional variations in Maharashtra, intra-regional variations – in district and taluka

4.4 Remedial measures, policies and programme for regional development implemented in Maharashtra

READING LIST:

1. Isard, W. (Ed.) (1960), Methods of Regional Analysis, John Wiley, New York.
2. Friendrich, S. (1929), Weher's Theory of Location of Industry, Chicago University Press, Chicago
3. Richardson: Regional Economics, Redwood Press Limited, Wiltshive
4. Godbole, M. D. (1978), Industrial Dispersal Policies, Allied Publication, Bombay
5. Isard W. (1956), Location and space Economy, John Wiley, New York
6. Menon, K. S. V. (1979), Development of Backward Areas through Incentives, Asia Publishing House, Bombay
7. Smith, D. M. (1971), Industrial Location: An Economic and Geographic Analysis, John Wiley, New York
8. Barthwal, R. (1984), Industrial Economics, Wiley Eastern Limited, Delhi
9. Mayer, J. R. (1953), Regional Economics: A Survey, American Economic Review, Vols. I & II.
10. NCAEF (1963), Techno Economic Survey of Maharashtra
11. BrahmeSulabha, Kumud Pore and S. H. Pore (1975), Regional Planning: A Case Study of Maharashtra Region, Arth, Vidnyan Vol. XVII
12. GOI (1969), Report of the Working Committee for Identification of Backward Areas, Planning Commission, New Delhi.
13. Geoffrey, J. D. (1972), Regional Industrial Analysis and Development Methuen, London.
14. Govt. of Maharashtra (1984), Report of the Fact-Finding Committee on Regional Imbalances in Maharashtra.
15. Govt of Maharashtra: District level Reports

M. A. I SEM II

Course Name	**: Financial Markets and Institutions**
Type	**:** Major Electives
Course Number	**:** ME 5
Course Code	**:** MAU0325MEL515H5
Course Credits	**:** 4
Marks	**:** Semester End: 80 Internal Assessment: 20 Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Understand the significant role of financial institutions in the process of growth and development.
- Analyze financial markets.
- Explain the role of international financial institutions in the steady growth of the world.
- Provide practical experience and skill development modules in financial sector

Module 1: Nature and Role of Financial System (Teaching Hours- 15, Credit- 01)

1.1 Nature and Structure of Financial System, Functions and Role of Financial System

1.2 Financial System and Economic Development, Intermediaries in Financial Markets

1.3 All India Financial Institutions: IFCI, IDBI, NABARD

1.4 SIDBI, NHB, UTI, EXIM Bank

Module 2: Financial Markets (Teaching Hours- 15, Credit- 01)

2.1 Money Market: Concept, Structure and Submarkets, Financial Instruments and Importance of Money Market; Role of RBI and DHFI, Reforms in Money Market

2.2 Capital Market: Concept, Structure and Submarkets, Financial Instruments and Importance of Capital Market

2.3 Role of SEBI, Reforms in Capital Market

2.4 Stock Exchange: BSE, NSE, Multi Commodity Exchange (MCX)

Module 3: Risk Management in Financial Markets (Teaching Hours- 15, Credit- 01)

3.1 Types of Risks: Credit Risk, Liquidity risk, Market Risk, Interest rate Risk and Foreign Exchange Risk

3.2 Risk Management in financial Market

3.3 Risk Hedging Instruments: Derivatives-Forwards, Futures

3.4 Options and Swaps

Module 4: International Financial Markets and Institutions (Teaching Hours- 15, Credit- 01)

4.1 Foreign Exchange - Type of Exchange Rates, Nature and Functions of foreign Exchange Market, Participants of Forex Market

4.2 Biggest Stock Exchanges In The World - London Stock Exchange, New York Stock Exchange, Hong Kong Stock Exchange, Japan Exchange Group – Tokyo

4.3 International Financial Institutions- IMF, IBRD, Asian Development Bank (ADB)

4.4 International Finance Corporation (IFC) & Bank for International Settlement – BIS

READING LIST:

1. Bhole, L. M. (1999), Financial Institutions and Markets, Tata McGraw Hill Company Ltd., New Delhi
2. Bhole, L. M. (2000), Indian Financial System, Chugh Publications, Allahabad
3. Goldsmith, R. W. (1969), Financial Structure and Development, Yale, London
4. Hanson, J. A. and S. Kathuria (Eds.) (1999), India: A Financial Sector for the Twenty-first Century, Oxford University Press, New Delhi
5. Harker, P. T. and S. A. Zenios (2000) (Ed.), Performance of Financial Institutions, Cambridge University Press, Cambridge.
6. Johnson, H. J. (1993), Financial Institutions and Markets, McGraw Hill, New York
7. Khan, M. Y. (1996), Indian Financial System, Tata McGraw Hill, New Delhi.
8. Ohlson, J. A. (1987), The Theory of Financial Markets and Institution, North Holland, Amsterdam
9. Prasad, K. N. (2001), Development of India's Financial System, Saruo& Sons, New Delhi.
10. Robinson, R. I. and D. Wrightman (1981), Financial Markets, McGraw Hill, London.
11. Smith, P. F. (1978), Money and financial Intermediation: The Theory and Structure of Financial System, Prentice Hall, Englewood-Cliffs, New Jersey.
12. Bishop, P. and D. Dixon (1992), Foreign Exchange Handbook, McGraw Hill, New York.
13. Chandra, P. (1997), Financial Markets (4^{th} Edition), Tata McGraw Hill, New Delhi.
14. Machiraju, H. R. (1997), International financial Markets in India, Wheeler Publishing, Allahabad.
15. NSE (2012) Financial Markets: A Beginners' Module, Workbook from NSE
16. Smith, P. F. (1978), Money and Financial Intermediation: The theory and Structure of Financial System, Prentice Hall, Englewood-Cliffs, New Jersey.
17. Gupta, S. B. (2017), Monetary Economics, S. Chand & Company, New Delhi.
18. Rangaranjan, C. (1999), Indian Economics: Essays on Money and Finance, UBS Publication, New Delhi.
19. Verma, J. S. (1989), A Manual of Merchant Banking, Bharat Law House, New Delhi.
20. Fisher, G. E. and R. J. Jordon (1992), Security Analysis and Portfolio Management, Eastern Economy Edition, New Delhi.
21. Goss, B. a. and B. S. Yamey (1978), The Economics of Futures Trading, Macmillan, London.
22. R. B. I. (1985), Report of The Committee to Review the Working of the Monetary System (Chakravarty Committee), Bombay.
23. Weller, P. (1992), The Theory of Future Markets, Blackwell, Oxford.
24. Gupta, L. C. (Ed.) (1999), India's Financial Markets and Institutions, Society for Capital Research and Development, Delhi.
25. Brahmananda, P. R. (1982), IMF Loan and India's Economic Future, Himalaya Publishing House, Bombay.
26. Chamberlain, G. (1981), Trading in Options, Woodhed-Faulker, Cambridge.
27. Crocker, A. (1982), International Money: Issues and Analysis, The English Language Book Society, Nelson, London.

M. A. I SEM II

Course Name	**: Economic Thoughts of Dr. B. R. Ambedkar**
Type	**:** Major Electives
Course Number	**:** ME 6
Course Code	**:** MAU0325MEL515H6
Course Credits	**:** 4
Marks	**:** Semester End: 80 Internal Assessment: 20 Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Equip with the thoughts of Dr B R Ambedkar on Public Economics.
- Analyse the contribution to Monetary Economics.
- Examine the development policy suggested for India
- Assess the problems and remedies on Indian agriculture and related issues.

Module 1: Dr. B. R. Ambedkar on Public Economics (Teaching Hours- 15, Credit- 01)

1.1 Administration of East India Company
1.2 **East India Company**: Sources of Revenue - Heads of Expenditure - Overall Budgetary Position
1.3 Imperial Finance - Provincial Finance
1.4 Thoughts on Taxation

Module 2: Dr. B. R. Ambedkar on Monetary Economics
(Teaching Hours- 15, Credit- 01)

2.1 **Thoughts on Currency System in India**: From a Double Standard to a Silver Standard
2.2 Silver standard to Gold Standard - Gold Standard to a Gold Exchange Standard – Return to the Gold Standard
2.3 Debate between J M Keynes and B R Ambedkar
2.4 Thoughts on Central Bank

Module 3: Dr. B. R. Ambedkar on Development Policy (Teaching Hours- 15, Credit- 01)

3.1 Development Policy
3.2 Water Policy
3.3 Power / Electricity Policy
3.4 Education Policy

Module 4: Thoughts on Agriculture, Labour and Social Issues
(Teaching Hours- 15, Credit- 01)

4.1 Agricultural Problems and Remedies
4.2 Abolishment of Khoti System
4.3 Labour and Labour Welfare
4.4 Population Policy - Economic Analysis of Caste System

READING LIST:

1. Ambedkar, B. R. (1989), Writings and Speeches, States and Minorities, Government of Maharashtra, Vol 1, 1989.
2. Speech by the Hon'ble Dr. Ambedkar B R delivered in the Constituent Assembly on Thursday the 6th November, 1948 in support of the motion for consideration of the Draft Constituent as settled by the Drafting Committee.
3. Jadhav, Narendra (1991), Dr. Ambedkar's Economic Thought and Philosophy, Bombay Popular Prakashan, 1999.
4. Mungekar, B. L. (1998), Government Expenditure on Social Services in the post Reforms Period: An Ambedkarian Perspective, Paper presented to the National Seminar, Jawaharlal Nehru University(JNU), New Delhi on dated, 27th-29th, August.
5. Thorat Sukhdeo (1998), Ambedkar's Role in Economic Planning and Water Policy, Shipra Publications, New Delhi.
6. Reddy, Sateesh K. & P. Ramaiah (Ed), (1994), Dr.B.R.Ambedkar's Economic Philosophy, Delta Publishing House, New Delhi.
7. Ranga M. L. (1994), B.R.Ambedkar, Work and Relevance, Nagpur.
8. Ambirajan, S.(1999), Dr. Ambedkar's Contributions to Indian Economics, Economic and Political Weekly (EPW), November, 20.
9. Various Reports of the Government of India, Central Water Commission, GOI.
10. Kamble, G. S. Ph.D.Thesis (2009),"Contribution of Dr.B.R.Ambedkar to the Indian Economic Thoughts and Development:-A Analytical Study", Submitted to the Department of Economics, Shivaji Univesity, Kolhapur
11. Government of Maharashtra (1979), Writings and Speeches of Dr. B.R. Ambedkar, Volume No.1 Ministry of Education, Mumbai.
12. Government of Maharashtra (1979), Writings and Speeches of Dr. B.R. Ambedkar, Volume No.6 Ministry of Education , Mumbai.
13. Khairmode, C. B. (1992) Dr. Ambedkar Chartra, Vol. 7, Maharashtra Sahitya Mandal Bombay
14. Islahi, A.A. (1994), B. R. Ambedkar's contribution to the history of provincial decentralization of imperial finance, Online at https://mpra.ub.uni-muenchen.de/29723/ MPRA Paper No. 29723, posted 24. March 2011 07:12 UTC
15. Ambedkar, B. R. (1989) Untouchables and Untouchability (Social-Political-Religious) writing and speeches: (Vol. 5), Ed. Dept. Govt. of Maharahstra, India.
16. Ambedkar B. R. (1936) Annihilation of Caste, Government of Maharashtra, Writings and Speeches of Dr B R Ambedkar , Volume 1, Mumbai.
17. Ambedkar, B. R. (1990) "Who were Shudras?" Writing and Speeches – (Vol. 7), Ed. Department, Govt. Maharashtra, India.
18. Kamble , P. S. and Kombde , S. T. (2017), Contemporary Relevance of Contribution of Dr B R Ambedkar to Development of India, Proceedings of Two Days National Seminar, Department of Economics , Shivaji University, Kolhapur , India

M. A. I SEM II

Course Name	**: Economics of Infrastructure**
Type	**:** Major Electives
Course Number	**:** ME 7
Course Code	**:** MAU0325MEL515H7
Course Credits	**:** 4
Marks	**:** Semester End: 80 Internal Assessment: 20 Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Understand the economics of infrastructure.
- Aware of need and importance of PPP model in infrastructural development.
- Analyze infrastructure financing

Module 1: Infrastructure for Economic Development (Teaching Hours- 15, Credit- 01)

1.1 Concept and components of infrastructure- Role of infrastructure in economic development

1.2 Concepts and features of social and physical infrastructure, Indicators of infrastructure development: Investment – Spread – Availability – Utilization

1.3 Infrastructure as public good - Special characteristics of public utilities

1.4 The peak-load, Off-Load Problem- Methods of Pricing in Public Utilities

Module 2: Road and Railway Connectivity (Teaching Hours- 15, Credit- 01)

2.1 Road Connectivity: Classification - Importance and Problems

2.2 Public Private Partnership (PPP) Model: Need, Importance and issues of PPP Model in Road development

2.3 Railway Connectivity: Types, Progress and Problems- Pricing and Price Discrimination in Railway

2.4 Issues in Railway Services: Security- Punctuality- Convenience- Availability Quality- Reliability-Complexity

Module 3: Communication and Water Supply (Teaching Hours- 15, Credit- 01)

3.1 Telecommunication Sector - Oligopoly Market in Cellular Service Industry Pricing-Factor Affecting

3.2 Nature of Urban and Rural Water Supply - Pricing of Drinking Water Supply - investments - PublicSector and Community Collaboration

3.3 Power and Energy: Power Generation- Methods and Principles of Energy Pricing- Privatization ofElectricity

3.4 Renewable Energy Sources

Module 4: Infrastructure Financing (Teaching Hours- 15, Credit- 01)

4.1 Role of government in building and maintaining infrastructure assets
4.2 Project viability and evaluation- Criterion of Investment in infrastructure projects
4.3 Risk Management of Infrastructure Projects- Risk analysis techniques- Credit Rating of Infrastructure Projects
4.4 Sources of finance for infrastructure projects- Financial and Economic Appraisal of BOT Projects

READING LIST:

1. Akintoye, A., Beck, M., & Hardcastle, C. (Eds.). (2003). Public-Private Partnerships - Managing risks and opportunities. Oxford: Blackwell Science Limited
2. Crew, M. A. and P. R. Kleindorfer (1979), Public Utility Economics, Macmillan, London
3. Das, K. (2010), Lopsided Infrastructure, in Alternative Survey Group (Ed.), Alternative Economic Survey, India: Two Decades of Neo-liberalism, Daanish Books, Delhi, pp. 195-209.
4. Elena S. Prassas, Roger P. Roess (2013). Engineering Economics and Finance for Transportation Infrastructure, Volume 3 , Springer Science & Business Media, 2013
5. Finnerty, J. D. (1996). Project financing - Asset-based financial engineering. New York: John Wiley& Sons, Inc
6. Goel, M.M. (2011), Economics of Human Resource Management in India, VK Global Publications, New Delhi
7. Government of India (1997), The India Infrastructure Report, Vols. I, II and III, NCAER and Government of India, New Delhi. (Chairman: Rakesh Mohan).
8. Merna, T., & Njiru, C. (2002). Financing infrastructure projects (First ed.). London: Thomas Telford
9. Morris, S. (2007), Infrastructure, in Kaushik Basu (Ed.), The Oxford Companion to Economics in India, Oxford University Press, New Delhi
10. Nevitt, P. K., & Fabozzi, F. J. (2000). Project Financing (7 ed.). London, UK: Euromoney Books.
11. Panchamukhi, P R (1980): Economics of Health: A Trend Report in ICSSR, A Survey of Research in Economics, Vol. VI, Infrastructure, Allied Publishers, Delhi
12. Raghuram, G., Jain, R., Sinha, S., Pangotra, P., & Morris, S. (2000), Infrastructure Development and Financing: Towards a Public-Private Partnership: MacMillan
13. Raghuram, G., R. Jain, S. Morris, P. Pangotra and S. Sinha (Eds.) (1999), Infrastructure Development and Financing: Public Private Partnership, Macmillan India Ltd, New Delhi
14. Tinsley, R. (2002). Project Finance in Asia Pacific: Practical Case Studies. London, UK: Euromoney Books
15. UNIDO. (1996). Guidelines for infrastructure development through Build-Operate- Transfer (BOT) projects. Vienna: UNIDO
16. Walker, C., & Smith, A. J. (1995), Privatized infrastructure: the Build Operate Transfer approach. London: Thomas Telford

M. A. I SEM II

Course Name	**: Mathematical Economics - I**
Type	**:** Major Electives
Course Number	**:** ME 8
Course Code	**:** MAU0325MEL515H8
Course Credits	**:** 4
Marks	**:** Semester End: 80 Internal Assessment: 20 Total Marks: 100

Course Outcomes: After successful completion of this course, the students will be able to:

- Understand the simple calculus and its applications.
- Identify various applications of mathematical tools and techniques in developing economic relationships.
- Equip with important aspects of micro economics, macro economics through exercising mathematical tools

Module 1: Simple calculus and its Applications (Teaching Hours- 15, Credit- 01)

1.1 Function: Meaning, Concept and Types

1.2 Derivatives: Meaning, Concept, Rules of differentiation, partial derivatives, Rules of partial differentiation. Maxima and Minima in single and multivariable functions

1.3 Integration: Meaning, Concept, Rules of integration

1.4 Matrix: Meaning, Concept, Types, Algebraic Operations, Determinant of Matrix, Solution of Simultaneous equations using matrix

Module 2: Theory of Consumer Behaviour (Teaching Hours- 15, Credit- 01)

2.1 Utility: Cardinal and ordinal utility, Demand function, Ordinal utility maximization, Slutsky equation, income, substitution and price effects

2.2 Elasticity: Meaning, Concept and its applications

2.3 Consumer's surplus - Producer's Surplus: Meaning, Concept and its applications

2.4 Additive utility function, indirect utility function, linear expenditure system

Module 3: Theory of Production (Teaching Hours- 15, Credit- 01)

3.1 Production function: Short Run and Long Run, Homogeneous and Nonhomogeneous

3.2 Cobb-Douglas production function, CES production function and its properties

3.3 Producer's equilibrium: Constrained optimization of a producer

3.4 Multi-product firm and Production possibility curve, Empirical uses of production function analysis

Module 4: Theory of Cost and Market Structure (Teaching Hours- 15, Credit- 01)

4.1 Cost function, simple derivation of short run cost function, modern theory of cost, relation betweenAC and MC in short period

4.2 Market Structure- Types of various markets

4.3 Price and output determination in perfect competition, monopoly, monopolistic competition, duopoly,oligopoly

4.4 Market Equilibrium- Single and two-commodity market model, multi-market equilibrium, generalequilibrium

READING LIST:

1. Abel, A., B. S. Bernanke and B. Mcnabb (1998), Macroeconomics, Addison Wesley, Massachusetts
2. Allen, R. G. D. (1974), Mathematical Analysis for Economics, Macmillan Press and ELBS, London
3. Allen, R. G. D. (1976), Mathematical Economics, Macmillan, London
4. Arrow, K. J. and M. Intrilligator (Eds.) (1982), Handbook of Mathematical Economics, Volumes I, IIand III, North Holland, Amsterdam
5. Barro, R. J. and H. Grossman (1976), Money, Employment and Inflation, Oxford University Press,Oxford
6. Chiang, A. C. (1986), Fundamental Methods of Mathematical Economics, McGraw Hill, New York
7. Chung, J. W. (1993), Utility and Production: Theory and Applications, Basil Blackwell, London
8. Ferguson, C. E. (1976), Neo-classical Theory of Production and Distribution
9. Hadley, G. 91962), Linear Programming, Addison Wesley Publishing Co., Massachusetts
10. Henderson, J. M. and R. E. Quandt (2003), Microeconomic Theory: A Mathematical Approach,McGraw Hill, New Delhi.
11. Hiller, F. S. and G. J. Lieberman (1985), Operations Research, C. B. S., NewDelhi
12. Jha, R. (1991), Contemporary Macroeconomic Theory and Policy, Wiley Eastern Ltd., New Delhi
13. Jones, H. G. (1976), An Introduction to the Modern Theory of Economic Growth, McGraw HillKogakusha, Tokyo
14. Kothari, C. R. (1992), An Introduction to Operations Research, Vikas Pub. House, New Delhi
15. Kuhn, Harold W. (Ed.) (1997), Classics in Game Theory, Princeton, University Press, Princeton
16. Mankiw, N. G. and D. Romer (Eds.) (1991), New Keynesian Economics (2 Vols.), MIT Press,Cambridge, Mass
17. Mustafi, C. K. (1992), Operations Research: Methods and Practice, Wiley Eastern, New Delhi
18. Nash, J. F. (1996), Essays on Game Theory, Cheltenham, U. K

M. A. I, SEMESTER – II

Type	**: On Job Training**	
Course Name	**:** On Job Training	
Course Number	**:** OJ	
Course Code	**:** MAU0325OJL515H	
Course Credits	**:** 4	
Marks	**:** On Job Training Report	: 80
	Internal Assessment (Viva Voce)	: 20
	Total Marks	: 100

Course Outcomes: After successful completion of this On Job Training, the students will be able to:

- Understand the rules, regulations and the work procedures by adopting them in their day-to-day performance.
- Learn the practical methods of work by observing and assisting his / her senior.
- Equip with important skills like adaptability and flexibility and learn to become dexterous in any situation and gain expertise in various domains.
- Develop positive approach towards inevitable changes that occurs in the workplace.

Instructions for teachers and students while doing On-the-Job Training:

1. Selection of Institute / Organization / Consultant / Professional etc. should be based on the areas in the mandatory or elective courses in the concerned subject.

2. The Institute / Organization / Consultant / Professional etc., under whom the Training / Internship / Apprenticeship is expected, should be FORMALLY ASSIGNED (in written form) by concerned teacher to every student.

3. Submission of On-the-Job-Training Report duly signed and certified by concerned teacher / guide is A PRE-REQUISITE FOR APPEARING TO VIVA-VOCE EXAMINATION.

4. TWO COPIES of On-the-Job-Training Report in BOUND FORMAT should be submitted before Viva-Voce. One copy will be kept by department and the remaining will be returned to student.

Important Notes for Teachers:

1. Prepare a Draft Letter for getting permission from the appropriate authority within the Institute / Organization or from Consultant / Professional etc. for the On-the-Job-Training / Internship / Apprenticeship
2. Prepare an Appropriate Format for Writing the On-the-Job Training Report. Kindly see that the First Page and Certificate Page is common for all students. In the remaining part, try to maintain uniformity.

For Example:

The On-the-Job Training Report format may be as follows:

Student's Name: _____

Name of the College: _____

Class: _____ Semester: _____

Subject: _____

Year _____ Duration of Internship: _____

Internship Site/ Name of the Institution: _____

Institute / Organisation Supervisor's Name: _____

College Teacher who supervised: _____

Introduction:

This section should provide the area of interest, its' importance in contemporary world, the reasons for choosing this area as well as the institution / organization / consultant / professional etc.

Description of the organization:

This section should provide a brief overview of the organization where the internship will take place, including its mission, goals, and services and experience.

Duties and responsibilities:

This section should describe the specific tasks and responsibilities the student had during the internship, as well as any notable projects or activities they were involved in.

Reflection on learning outcomes and accomplishments:

This section should highlight the key learning and accomplishments the student achieved during the internship (skills, knowledge, attitude etc.). The student is expected to provide an in-depth reflection on the overall growth and impact of training.

Areas for improvement:

This section should address areas for improvement the student seen by him / her during the internship. He / she should reflect on how to overcome these challenges or plan strategies for improvement.

Conclusion:

This section should summarize the key takeaways from the internship experience.

Appendices:

This section should include following documents:

- Formal permission letter by Concerned Teacher / Guide sent to concerned Institution/Organization/Professional/Consultant etc.
- Formal Acceptance Letter by Institution/Organization/Professional/Consultant etc. for Training.
- Attendance sheet with Day, Date, Time, Number of Hours, Brief description of Training/ Learning activities, Signature of Institutional Authority, Signature of Concerned Teacher.
- Google Tagged photos of showing Attendance as well as Doing Work.
- Compliance Certificate with remarks duly signed by Institutional Authority.
- Other supporting material.

M. A. I, SEMESTER – II

Type	**: Field Project**	
Course Name	**:** Field Project	
Course Number	**:** FP	
Course Code	**:** MAU0325FP515H	
Course Credits	**:** 4	
Marks	**:** Dissertation / Project Report	: 80
	Internal Assessment (Viva Voce)	: 20
	Total Marks	: 100

Course outcomes: After successful completion of this Field Project, the students will be able to:

- To identify the research problems and formulate objectives.
- To choose appropriate methodology with proper tools and techniques.
- To analyze and interpret the data collected from different sources.
- To make decision or find out conclusions on the basis of data analysis.

Instructions for teachers and students while doing Field Project:

1. Selection of Field project should be related to the mandatory or elective courses in the concerned subject.

2. SEPARATE Field project should be FORMALLY ASSIGNED (in written form) by concerned teacher to every student. It should not be done in common.

3. Students are required to prepare the project report based on field work and studying the current trends in economics under the guidance of the project guide.

4. Submission of Field Project Report duly signed and certified by concerned teacher/guide is A PRE-REQUISITE FOR APPEARING TO VIVA-VOCE EXAMINATION.

5. TWO COPIES of Field Project Report in BOUND FORMAT should be submitted before Viva-Voce. One copy will be kept by department and the remaining will be returned to student.

Important Notes for Teachers:

1. Prepare an Appropriate Format of PERMISSION LETTER to be given to student to do the Field Project under the guidance of a concerned teacher.

2. Prepare an Appropriate Format for Writing the Field Report. Kindly see that the First Page and Certificate Page is common for all students. In the remaining part, try to maintain uniformity.

The format may be as follows:

Chapter I : Introduction and Research Methodology

Chapter II : Review of Literature / Theoretical Background / Conceptual Framework

Chapter III : Profile of the Organization / Area

Chapter IV : Analysis and Interpretation of the Data

Chapter V : Conclusion - It will include observations, findings, suggestions and conclusions.

Estd. 1962
"A++" Accredited by NAAC(2021) With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR - 416 004, MAHARASHTRA
www.unishivaji.ac.in, bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर - ४१६ ००४,महाराष्ट्र
दूरध्वनी - इंपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१—२६०९०९३/९४

SU/BOS/Science/480 **Date: 01/07/2023**

To,

The Principal, All Concerned Affiliated Colleges/Institutions Shivaji University, Kolhapur	The Head/Co-ordinator/Director All Concerned Department (Science) Shivaji University, Kolhapur.

Subject: Regarding syllabi of M.Sc. Part-II (Sem. III & IV) as per NEP-2020 degree programme under the Faculty of Science and Technology.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, nature of question paper and equivalence of M.Sc. Part-II (Sem. III & IV) as per NEP-2020 degree programme under the Faculty of Science and Technology.

M.Sc. Part-II (Sem. III & IV) as per NEP-2020			
1.	Mathematics	8.	Botany
2.	Mathematics (Distance Mode)	9.	Electronics
3.	Mathematics (Online Mode)	10.	Zoology
4.	M.Sc. Tech (Industrial Mathematics With Computer Application)	11.	Agro Chemical and Pest Management (AGPM)
5.	Geography	12.	Alcohol Technology
6.	Statistics	13.	Sugar Technology
7.	Applied Statistics and Informatics	14.	Geology

This syllabus, nature of question and equivalence shall be implemented from the academic year 2023-2024 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website **www.unishivaji.ac.in**)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2023 & March/April 2024. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Dy Registrar
Dr. S. M. Kubal

Copy to:

1	The Dean, Faculty of Science & Technology	8	P.G. Admission/Seminar Section
2	Director, Board of Examinations and Evaluation	9	Computer Centre/ Eligibility Section
3	The Chairman, Respective Board of Studies	10	Affiliation Section (U.G.) (P.G.)
4	B.Sc. Exam/ Appointment Section	11	Centre for Distance Education

ESTD: 1962
NAAC A^{++} Grade
CGPA 3.52

DEPARTMENT OF BOTANY

SHIVAJI UNIVERSITY, KOLHAPUR

M. SC. II BOTANY REVISED SYLLABUS

(AS PER NATIONAL EDUCATION POLICY 2020)

TO BE IMPLEMENTED FROM JULY - 2023

SHIVAJI UNIVERSITY, KOLHAPUR

DEPARTMENT OF BOTANY

Revised Syllabus for the Master of Science Part II in Botany
(National Education Policy 2020)
Applicable from academic year 2023 – 2024 (July 2023)

- For M.Sc. Part I (Semester I & II) as per Resolution No. …… dated ……. of Board of Studies in Botany and Resolution No. ……dated ……. of Academic Council of Shivaji University, Kolhapur.
- For M. Sc. Part II (Semester III & IV) as per Resolution No…….... dated …… of Board of Studies in Botany and Resolution No. ……dated …. ……. of Academic Council of Shivaji University, Kolhapur.

1. **Title:** M. Sc. Botany, Shivaji University, Kolhapur Revised Syllabus as per NEP 2020.
2. **Faculty:** Faculty of Science and Technology.
3. **Year of Implementation:** For M. Sc. I (Semester I and Semester II): From July 2022 and for M. Sc. II (Semester III and Semester IV): From July 2023.
4. **Preamble:** Education is fundamental for achieving full human potential, developing an equitable and just society and promoting national development. Providing universal access to quality education is the key to India's continued ascent and leadership on the global stage in terms of economic growth, social justice and equality, scientific advancement, national integration and cultural preservation. Universal high-quality education is the best way forward for developing and maximizing our country's rich talents and resources for the good of the individual, the society, the country and the world. India will have the highest population of young people in the world over the next decade and our ability to provide high-quality educational opportunities to them will determine the future of our country.

   Higher education plays an extremely important role in promoting human as well as societal well-being and in developing India as envisioned in its Constitution–a democratic, just socially-conscious, cultured and human nation upholding liberty, equality, fraternity and justice for all. Higher education significantly contributes towards sustainable livelihood and economic development of the nation. As India moves towards becoming a knowledge economy and society, more and more young Indians are likely to aspire for higher education.

   India has tremendous biodiversity, genetic as well as of species and ecosystems which is a biological capital of our country. It contains over 7 per cent of the world's biodiversity on 2.5 per cent of the Earth's surface. This diversity can be attributed to the vast variety of landforms and climates resulting in habitats ranging from tropical to temperate, and from alpine to desert.

   The number of plant species in India is estimated to be over 45,523 representing about 11.8 per cent of the world's flora. It is estimated that 32% of Indian plants are endemic

to the country and found nowhere else in the world. Among the plant species the flowering plants have a much higher degree of endemism, a third of these are not found elsewhere in the world. There are 17,527 species, 296 subspecies, 2215 varieties, 33 subvarieties and 70 forma, altogether 20,141 taxa of angiosperms under 2991 genera and 251 families in India, representing approximately 7% of the described species in the world. About 5725 species of flowering plants are broadly considered as endemics and represent 33.5% of the flora, of which, 3471 species are found in the Himalayas, 2051 in the Peninsular India and 239 in Andaman & Nicobar Islands. Gymnosperms are woody perennials, either shrubs or trees. There are 58 taxa growing in wild under 15 genera and 8 families in India. Though they are lesser in number, provide timber, wood, resins, tars and turpentine. Estimated number of pteridophytes (fern and fem-allies) are about 1200 taxa under 204 genera are distributed in different biogeographic regions of India. The Eastern Himalaya and the Northeast India with about 845 taxa in 179 genera, representing approximately 67% of the pteridophytes known from the country, followed by southern India, including Eastern and Western Ghats, with 345 taxa in 117 genera and Northern India, including Western Himalaya, with 340 taxa in 101 genera. Bryophytes less known group of plants, comprising about 2800 species, is the second largest group of green plants in India, next only to the angiosperms. About 16 genera and 678 species are endemic to India. Liverworts are represented by ca. 850 species under 140 genera and 52 families. Lichens are a symbiotic association of fungi and algae and constitute a dominant component of epiphytic and saxicolous vegetation. At present about 2021 species of lichens in 248 genera are known to occur in India. Fungi range from microscopic organisms to huge solid bodies. Approximately 14,500 species in 2300 genera are found in India of which ca. 3500 species are endemic. Algae represented by over 6500 species in ca. 666 genera, they are found growing in a variety of habitats ranging from fresh water, marine, terrestrial and to soil. Of which 1924 species are endemic to the country. The major portion of Indian algal flora accounting for ca. 390 genera and 4500 species followed by terrestrial algae (125 genera and 615 spp.); soil algae (80 genera and 1500 spp.); marine algae (169 genera and 680 spp.).

5. General objectives of the course:

a. Programme outcomes:

i) **Rational thinking**: To check assumptions for their accuracy and validity.

ii) **Biodiversity awareness**: To understand the local and global issues of environment and its sustainable development.

iii) **Continuous learning**: To develop ability to engage independently on the context of human society and technological changes.

iv) Solving problems related to food scarcity.

b. Course outcomes:

i) Working knowledge of the basic concepts of Botany i.e., cellular, ecological, molecular, physiological, ecological organizations and evolutionary biology of algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms.

ii) Students will learn several biophysical techniques such as electrophoresis, microscopy, biostatistics, bioinformatics, centrifugation, chromatography, spectroscopy, radioisotope and culture techniques.

iii) Identification and understanding of basic concepts, plant diseases and several processes related to physiology, ecology, cell and molecular biology and biochemistry of plants under stress conditions.

iv) Identification and classification of algae, fungi, bryophytes, pteridophytes, gymnosperms, angiosperms; evolution of reproductive structures, phylogeny and interrelationship of the selected genera.

v) Understanding of basic concepts of population and how individuals of a population interact with the ecosystem.

vi) Knowledge of plant pathology, identification of disease, their causal organisms, symptomology and defence mechanism of the plants against selected diseases.

vii) Study of organs, their development, experimental embryology, apomixes and its types, polyembryony, experimental induction of polyembryony, palynology and its role in horticulture, agriculture and oil exploration programs.

viii) Understanding the processes of natural selection, migration, mutation, genetic drift and variation and application of this knowledge in crop improvement.

ix) Acquisition of skills required for the production of disease-free plants, development of hybrids, development of plants with novel traits. Intellectual property rights, their importance, ecological risks and ethical concerns.

x) Commercial storage products, knowledge and value-added structural components and information about active components.

6. The entire course of M. Sc. (Botany) will be of **four Semesters** spread over two years.
7. Pattern of Examination: The examinations will be conducted **semester wise for both theory as well as practical courses.**
8. **Fee structure**: As per Shivaji University guidelines.
9. **Medium of Instruction**: English
10. **Structure of course:**

a. There shall be **four theory courses** and **four practical courses** in semester III. There shall be four theory courses, 3 practical courses and 1 project for semester IV. Each theory course shall have four units and each practical course shall have two units.

b. Department of Botany, Shivaji University, Kolhapur offers **two Open Elective Courses (OEC)** each of 100 marks for the students from other PG departments/ other than Botany of the Shivaji University which will be conducted as OEC–I in odd semester and OEC–II in even semester. For OEC maximum 50 students will be admitted at a time.

i) OEC–I: Plants – A Biological Capital – 60 Lectures (4 Credits).

ii) OEC–II: Plant Science, Human Progress and Prosperity – 60 Lectures (4 Credits).

c. The Department offers following specializations at M. Sc. II (Semester III and IV):

i) Plant Physiology

ii) Mycology and Plant Pathology

iii) Cytogenetics and Plant Breeding

iv) Energy, Ecology and Environment
v) Angiosperm Taxonomy
vi) Plant Biotechnology
vii) Marine Botany (Temporarily suspended)
viii) Palaeobotany (Temporarily suspended)

d. Practical: A total 800 marks examination will be conducted for practical courses at the end of 2nd semester (400 marks practical examination will be conducted) and at the end of 4th semester (350 marks examination will be conducted and 50 marks for project evaluation).

e. Project work Evaluation: By Internal and External Examiner at the end of Fourth Semester

11. Equivalence according with Titles and contents of papers:

Old Paper	**New Paper**
Paper-IX: Cytogenetics and Crop improvement	(CC-301): Cytogenetics and Crop improvement
Paper X: Biotechnology and Genetic engineering	(DSE-304): Biotechnology and Genetic Engineering
Paper XI: XI) Advanced Plant Physiology and Plant Biochemistry XI) Taxonomy of Fungi XI) Cytogenetics XI) Environment and its aspects XI) The Evolution and Classification of Angiosperms XI) General Marine Botany XI) Plant Tissue culture	CCS -302: CCS 302.1- Advanced Plant Physiology and Plant Biochemistry CCS 302.2- Taxonomy of Fungi CCS 302.3- Cytogenetics CCS 302.4- Environment and its aspects CCS 302.5- The Evolution and Classification of Angiosperms CCS 302.6- General Marine Botany CCS 302.7- Plant Tissue culture
Paper XII: XII) Plant Growth and Development XII) Integrated Disease management XII) Plant Breeding XII) Population and Community Ecology XII) Modern trend in Angiosperm Taxonomy XII) Physiology and Biochemistry of Marine Plants XII) Molecular Biotechnology and Genetic Engineering	CCS-303: CCS 303.1- Plant Growth and Development CCS 303.2- Integrated Disease management CCS 303.3- Plant Breeding CCS 303.4- Population and Community Ecology CCS 303.5- Modern trend in Angiosperm Taxonomy CCS 303.6- Physiology and Biochemistry of Marine Plants CCS 303.7- Molecular Biotechnology and Genetic Engineering
	CCPR-305: Practical (CCS-301, CCS-302,CCS-303, DSE-304)
	Non CGPA AEC-306 and ICT
M.Sc. II Semester IV	
Paper XIII: Plant Physiology and Metabolism	CC-401: Plant Physiology and Metabolism
Paper XIV: Biodiversity: Conservation and Utilization	CC-404: Plant Ecology and Evolution
Paper XV: XV) Stress Physiology of Plants XV) Industrial Mycology XV) Molecular Genetics	**CCS-402:** CCS 402.1-Stress Physiology of Plants CCS 402.2- Industrial Mycology CCS 402.3-Molecular Genetics

XV) Experimental Ecology and Energy Studies XV) Angiosperm Taxonomy Floristic and Biosystematics XV) Marine Ecology XV) Application and Prospects of Plant Tissue culture	CCS 402.4-Experimental Ecology and Energy Studies CCS 402.5-Angiosperm Taxonomy Floristic and Biosystematics CCS 402.6-Marine Ecology CCS 402.7-Application and Prospects of Plant Tissue culture
Paper XVI: XVI) Applied Plant Physiology XVI) Integrated Disease Management XVI) Special Approaches in Genetic improvements of Crop plants. XVI) Environmental issues, assessment and Restoration XVI) Phylogeny and Floral Biology of Angiosperms XVI) Applied Marine Botany XVI) Application, Regulation and Patenting Biotechnology	**CCS 403:** CCS 403.1- Applied Plant Physiology CCS 403.2- Integrated Disease Management CCS 403.3- Special Approaches in Genetic improvements of Crop plants. CCS 403.4- Environmental issues, assessment and Restoration CCS 403.5- Phylogeny and Floral Biology of Angiosperms CCS 403.6-Applied Marine Botany CCS 403.7-Application, Regulation and Patenting Biotechnology
	CCPR 405: Practical (401,402,403,DSE 404)
	Non CGPA- SEC:406 and Generic Elective

12. Special instruction if any: Passing in Non CGPA courses is mandatory.

13. A. Detailed titles of papers:

M. Sc. II, Semester III:

	Course No.	Course Code	Course Name	Credits		
CGPA	**M. Sc. II, Semester III: Core Course Botany (CC- 301 to 304) Theory**					
	Paper IX	CC-301	Cytogenetics and Crop improvement	**4**	**16**	**24**
	Paper X	CCS -302	CCS 302.1- Advanced Plant Physiology and Plant Biochemistry CCS 302.2- Taxonomy of Fungi CCS 302.3- Cytogenetics CCS 302.4- Environment and its aspects CCS 302.5- The Evolution and Classification of Angiosperms CCS 302.6- General Marine Botany CCS 302.7- Plant Tissue culture	**4**		
	Paper XI	CC-303	CCS 303.1- Plant Growth and Development CCS 303.2- Integrated Disease management CCS 303.3- Plant Breeding CCS 303.4- Population and Community Ecology CCS 303.5- Modern trend in Angiosperm Taxonomy CCS 303.6- Physiology and Biochemistry of Marine Plants CCS 303.7- Molecular Biotechnology and Genetic Engineering	**4**		
	Paper XI	CC-304/ CCO-304	Biotechnology and Genetic Engineering	**4**		
	M. Sc. II, Semester III: Core Course Botany (CCPR- 105) Practical					
	Practical	CCPR-305	Practical based on CCS-301, 302, 303, 304	**2 x 4**	**8**	

	IX - XII					
Non CGPA		AEC-306	Ability Enhancement Course	**2**		
Non CGPA		ICT	Information and Communication Technology	**2**		

M. Sc. II, Semester IV:

	Course No.	**Course Code**	**Course Name**	**Credits**		
CGPA	**M. Sc. II, Semester IV: Core Course Botany (CC- 401 to 404) Theory**					
	Paper-XIII	CC-401	CC-401: Plant Physiology and Metabolism	4	16	24
	Paper-XIV	CC-402	CCS 402.1-Stress Physiology of Plants CCS 402.2- Industrial Mycology CCS 402.3-Molecular Genetics CCS 402.4-Experimental Ecology and Energy Studies CCS 402.5-Angiosperm Taxonomy Floristic and Biosystematics CCS 402.6-Marine Ecology CCS 402.7-Application and Prospects of Plant Tissue culture	4		
	Paper-XV	CC-403	CCS 403.1- Applied Plant Physiology CCS 403.2- Integrated Disease Management CCS 403.3- Special Approaches in Genetic improvements of Crop plants. CCS 403.4- Environmental issues, assessment and Restoration CCS 403.5- Phylogeny and Floral Biology of Angiosperms CCS 403.6-Applied Marine Botany CCS 403.7-Application, Regulation and Patenting Biotechnology	4		
	Paper-XVI	CC-404/ CCO-404	Plant Ecology and Evolution	4		
	M. Sc. I, Semester II: Core Course Botany (CCPR- 205) Practical				8	
	Practical IX - XII	CCPR 405	Practical based on CC-401,402,403, 404	2x4		
Non CGPA		SEC:406	Skill Enhancement Course	2		
GE		GE-407	Horticulture and Green House Technology	2		

- **CCO**: Core Course Optional.
- CC- 104/ CCO- 104 **OR** CC- 204/ CCO- 204: Students of Botany may take this paper or they may opt out this paper and earn credits equivalent to this paper from other Departments or certified open sources.
- The syllabus for AEC-106 and SEC-206 courses is available on university website link: http://www.unishivaji.ac.in/syllabusnew/On-Campus-Science

B. Structure of the syllabus:

SEMESTER – I (DURATION 6 MONTHS)												
	Sr. No.	Course Code	Teaching Scheme			Examination Scheme						
			Theory and Practical			University Assessment (UA)			Internal Assessment (IA)			
			Lecture (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam Hours	Maximum Marks	Minimum Marks	Exam Hours	
CGPA	1	CC-101	4	4	4	80	32	3	20	8	1	
	2	CC-102	4	4	4	80	32	3	20	8	1	
	3	CC-103	4	4	4	80	32	3	20	8	1	
	4	CC-104/ CCO-104	4	4	4	80	32	3	20	8	1	
	5	CCPR-105	16	16	8	200	80	--	--	--	*	
Total (A)			--	--	24	520	--	--	80	--	--	
Non-CGPA	1	AEC-106	2	2	2	--	--	--	50	20	2	
SEMESTER – II (DURATION 6 MONTHS)												
CGPA	1	CC-201	4	4	4	80	32	3	20	8	1	
	2	CC-202	4	4	4	80	32	3	20	8	1	
	3	CC-203	4	4	4	80	32	3	20	8	1	
	4	CC-204/ CCO-204	4	4	4	80	32	3	20	8	1	
			16	16	8	200	80	--	--	--	*	
Total (B)			--	--	24	520	--	--	80	--	--	
Non-CGPA	1	SEC-206	2	2	2	--	--	--	50	20	2	
Grand Total (A+B)			--	--	48	1040	--	--	160	--	--	

C. Other Features:

i) Intake capacity/ Number of students at M. Sc. I will be 50 per year.

ii) The student may take exit after successful completion of M. Sc. I (Semester I & II) and acquire a certificate of 'PG Diploma in Botany'.

D. General guidelines:

i) There shall be at least a short tour (up to 3 days) and a long tour (not exceeding 15 days) per year for all M. Sc. I and M. Sc. II students. The long tour may be arranged to a region out of the state covering various Botanical Regions/ Research Institutes/ Centres and Universities. Tours are the part of curriculum and are obligatory to each student, failing which they will not be considered eligible to appear for the examination. Under unavoidable circumstances, if the student fails to attend the tour, he/ she has to produce justifiable evidence for not attending the tour. However, in lieu of tour the candidate will have to complete the work assigned by the Department.

ii) Following documents/ materials shall have to be produced by each student at the time of practical examination (at the end of each Semester):

a. Submission of a laboratory journal of practical records.

b. Submission of a set of micro preparations (semi-permanent/ permanent) of plant materials illustrating the subject matter of the relevant paper.

c. Submission of a field record book (**in his/ her own handwriting**) duly signed by the concerned teacher and at least 15 herbarium specimens (weeds and cultivated plants)/ preserved specimens per course collected by the candidate during the field work or excursion tour and regular visit to study area. Rare, endangered and threatened (RET) plant species should not be collected and used for submission.

M.SC. PART -II (SEMESTER III)

PAPER IX (CC 301): CYTOGENETICS AND CROP IMPROVEMENT

[TOTAL LECTURES: 60]

UNIT I:

- **Cytology**: Chromatin organization, Chromosome structure and packaging of DNA, Molecular organization of centromere and telomere, Nucleolus and ribosomal RNA genes, Euchromatin and heterochromatin, Karyotype analysis and evolution, Banding patterns.
- Chromosome tracking/introgression using FISH and GISH, localization and mapping of genes or genomic segments

UNIT II:

- **Genetics of Prokaryotes and Eukaryotes**: Mapping of prokaryotic and eukaryotic genome, Mobile genetic elements and their significance, Gene families. Process of crop evolution and stabilization of polyploids (cytogenetic and genetic stabilization).
- **Crop Genetic Resources**: Centres of origin of cultivated plants, Importance of genetic conservation, Global network for genetic conservation and utilization in major crops of world, Institutes engaged in conservation and improvement of crop genetic resources, Wild relatives of crop plants, Gene banks, Gene sanctuaries

UNIT III:

- **Population and Evolutionary Genetics**: Evolutionary theory and population genetics, Theory of allele frequencies, Changes in genetic structure of population: Natural selection, Migration, Mutation, Genetic drift.
- Genetic variation in natural populations. Gene flow and population structure.

UNIT IV:

- **Classical and modern methods of crop breeding and improvement**: Genetic variability in crop plants, Methods of breeding in self and cross pollinated crops, Heterosis and hybrid development Use of cytoplasmic male sterility in hybrid breeding, Breeding methods in asexual and clonally propagated crops, clonal selection, Marker assisted breeding.

M.SC. II SEMESTER - III
PAPER IX (CCPR 305.1): PRACTICAL COURSE

UNIT V:

- Determination of mitotic index
- Karyotype analysis of *Allium cepa*
- Isolation of plasmid from *E. coli*
- Orcein banding
- Field visit: National Research Institutes/NBPGR centre/Seed company

UNIT VI:

- Meiotic studies in *Allium cepa*
- Study of floral biology of crop plants
- Genetic problems on gene mapping in higher plants
- Centres of origin of crop plants
- Determination of allele frequency in population

REFERENCE BOOKS:

- **Bahekar V. S.** 1993. Problems in Genetics Vol. I Arati Prakashan , Aurangabad.
- **Chahal G. S. and Gosal S. S.** 2003, Principles and Procedures of Plant Breeding biotechnological and conventional approaches. Narosa Publishers, New Delhi.
- **Darnel, J., Lodish, H. and Baltimore, D. 1990** Molecular cell biology. Scientific American Books.
- **Gardner, E. J.** 1991 Principles of Genetics. John Wiley and sons, New York.
- **Jahier, J.** 1996 Techniques of plant Cytogenetics. Oxford and IBH Publishing.
- **Lewin, B.** 2008, Genes IX. Oxford University Press,
- **Mandal, A. K., Ganguli, P. K. and Banarjee, S. P.** 1991 Advances in plant breeding Vol. I and II. CBS Publishers & Distributors.
- **Mayo, O.** 1980. The theory of Plant Breeding. Clarendon Press, Oxford.
- **Mitra Sandhya** 1994 Genetics a blueprint of life. Tata McGraw- Hill Publishing Company Ltd, New Delhi.
- **Roy Darbeshwar** 2000, Plant breeding analysis and exploitation of variance. Narosa Publishers, New Delhi.
- **Russell P. J.** 1998. Genetics (Fifth edition) Benjamin / Cummings Publishing Company Canada.
- **Sharma J. R.** 1998 Statistical and Biometrical techniques in Plant Breeding New Age International Publishers, New Delhi.
- **Sharma, A. K. and Sharma, A**. 1980. Chromosome techniques- Theory and practice. Butterworth and Co. (Publishers) Ltd., London.
- **Sharma, J. R.** 1994 Principles and practice of plant breeding. Tata McGrow Hill Publ. Co. Ltd., New Delhi.
- **Singh, B. D.** 2000. Plant breeding- Principles and methods. Kalyani Publishers, Ludhiana.
- **Snustad D. P. and Simmons M. J.** 2003, Principles of Genetics, (Third edition) John Wiley and Sons Inc.
- **Strickberger, M. W.** 1968. Genetics. The Macmillan Company, New York.
- **Swaminathan, M. S., Gupta, P. K. and Sinha, U.** 1983. Cytogenetics of crop plants. Macmillan India Ltd., Delhi.
- **Swanson, C. P.** 1968. Cytology and Cytogenetics. Macmillan and Co. Ltd., London.

- **Sybenga, J.** 1975. Meiotic configurations. Springer Verlag, Berlin, Germany.
- **Winkler, U. Ruger W. and Wackernagel W.** 1979. Bacterial, phage and molecular genetics. Narosa Publication, New Delhi.

JOURNALS:

- Indian Journal of Genetics and Plant Breeding.
- Journal of Genetics.
- Journal of Cytology and Genetics.
- Cytologia.
- Caryologia.
- International Journal of Food Science and Technology.
- Plant Breeding.
- Theoretical and Applied Genetics.

M.SC. PART- II (SEMESTER III)

PAPER X (CCS- 302.1): PLANT PHYSIOLOGY

(SPECIAL PAPER I) ADVANCED PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY

[TOTAL LECTURES: 60]

UNIT I: [15]

- **Photosynthesis**: A brief outline of chlorophyll biosynthesis and the pigment organization in thylakoid membrane. Regulation of PCR Cycle and C_4 Pathway; RUBISCO and PEPCase; C_3 -C_4 intermediates.

UNIT II: [15]

- **Carbohydrate metabolism**: Regulation of starch and sucrose biosynthesis, Synthesis and degradation of cellulose, a brief idea of pectin biosynthesis and enzymes involved in pectin degradation.

UNIT III: [15]

- **Respiration:** Glycolysis in plants and its regulation, Regulation of Pentose Phosphate pathway and TCA Cycle, Regulation of electron transport chain and role of alternate oxidase.
- **Organic acid metabolism**: Metabolism and roles of oxalic acid, ascorbic acid and malic acid

UNIT IV: [15]

- **Secondary metabolites**: Shikimate pathway and its role in biosynthesis of secondary metabolites.
- **Phosphorus nutrition** – Forms of phosphorus in soil. Phosphorus uptake, factors controlling 'P' uptake, 'P' fractions in plants. Role of Pyrophosphate in plant metabolism.

PAPER X (CCSPR 305.2.1): PLANT PHYSIOLOGY: PRACTICAL COURSE - I

UNIT V:

- To study the effect of potassium on glycolytic enzyme pyruvate kinase.
- Estimation of starch.
- Study of Oxalic acid accumulation in leaf tissue.
- Estimation of Ascorbic acid.
- Estimation of Polyphenols.
- Estimation of Cellulose.

UNIT VI:

- Study of Phosphorus distribution in different plant parts.
- Study of enzyme inorganic pyrophosphatase.
- Study of effect of light on chlorophyll biosynthesis.
- Study of enzyme polygalacturonase.

REFERENCE BOOKS:

- **Bidwell, R. C. S.** (1979): Plant Physiology. Macmillan
- **Bonner, J.** and **Varner, J.E**. (1972): Plant Biochemistry. IBH.
- **Edwards G.** and **Walker D.,** eds. (1983). C3, C4: mechanisms, and cellular and environmental regulation, of photosynthesis. Oxford: Blackwell Scientific Publications.
- **Govindjee, H.** (ed.) (1982): Photosynthesis, Vol. 1 and Vol. 2. Academic Press, N.Y. (Vol. 1); 0-12- 294302-2 (Vol. 2))
- **Hopkins, W. C.** (1995): Introduction to Plant Physiology. Wiley, New York.
- **Krishnamurthy, H.N.** (1992): Physiology of Plant Growth and Development. Atma Ram and Sons, Delhi.
- **Marschner, H. W.** (1986): Mineral nutrition of Higher Plants. First Edition, Academic Press, Elsevier Science Ltd.
- **Marschner, H. W.** (2003): Mineral nutrition of Higher Plants. Second Edition, Academic Press, Elsevier Science Ltd.
- **Moore, T.C.** (1974): Research experience in Plant Physiology, A Laboratory manual. Springer-Verlag, Berlin.
- **Mukherjee, S.P.** and **Ghosh A.N**. (1996): Plant Physiology. New Central Book Agency (P) Limited Tata McGraw Hill.
- **Noggle**, **G.R**. and **Fritz, G. J**. (1976): Introductory Plant Physiology. Prentice- Hall, Inc., Englewood Cliffs, NJ.
- **Pessarakli, M.** (Ed.). (2001). Handbook of Plant and Crop Physiology, 2nd Edition, Revised and Expanded. Marcel Dekker, Inc., New York
- **Pessarakli, M.** (Ed.). (2005). Handbook of Photosynthesis, 2nd Edition, CRC Press, Taylor & Francis Publishing Company, Florida
- **Randhir Singh** and **Sawhney S. K**. (1988): Advances in frontier Areas of Plant Biochemistry. Prentice Hall of India

- **Sadasivam S.** and **Manickam A**. (1996): Biochemical methods. New Age International.
- **Salisbury, F. B.** and **Ross, C.W**. (1992): Plant Physiology IV ed. Cengage Learning
- **Smith, H.** (1975): Phytochrome and Photomorphogenesis. McGraw-Hill Inc.,US
- **Taiz, L.** and **Zeiger, F.** (1998): The Plant Physiology. Second Edition, Sunderland: Sinauer Associates.
- **Wilkins, M. B.** (1976): Physiology of Plant Growth and Development. McGrow-Hill Publishing Company Limited

JOURNALS

- Annual Review of Plant Physiology and Molecular Biology
- Annual Review of Plant Physiology
- Indian Journal of Plant Physiology
- Journal of Experimental Botany
- Physiologia Plantarum, Sweden
- Plant Physiology, Bethedsa, USA
- Plant Cell

M. SC. PART- II (SEMESTER III)
PAPER X (CCS- 302.2): MYCOLOGY AND PLANT PATHOLOGY
(SPECIAL PAPER I) TAXONOMY OF FUNGI

[TOTAL LECTURES: 60]

UNIT I: **[15]**

- **General features of fungi**
- **Various systems of classification of fungi**: Ainsworth (1973), Webster (1980) and Hawksworth *et al*. (1995).
- **Micrometry**: Study of micrometry and its significance in fungal taxonomy.
- **Culture**: Types of culture media and their preparation, special culture media.

UNIT II: **[15]**

- Criteria used in the classification of fungi.
- Morphology: External and Internal, Vegetative and Reproductive, Cytological and Genetical.

UNIT III:

- Criteria used in the classification of fungi
- Serological and Nutritional.
- Physiological and Biochemical.
- Host specificity.
- Ultrastructural and cultural.

UNIT IV:

- **Microtomy**: Types of microtomes, Techniques of microtomy, stains and fixatives used.
- Status of fungi and research in Mycology and Plant Pathology in India: An overview.

PAPER X CCSPR 305.2.2: MYCOLOGY: PRACTICAL COURSE I

UNIT V:

- Measurement of fungal dimensions and identification of fungal genera.
- Measurement of spore size and study of spore morphotypes, determination of standard deviation and frequency distribution, histogram and polygon.
- Preparation of culture media, PDA, Czapek Dox Agar and Richard's medium.

UNIT VI:

- Microtomy of fungal specimens.
- Isolation of fungi from soil and their identification and classification
- Isolation of fungi from water and their identification and classification.
- Isolation of fungi from air and their identification and classification.
- Isolation of fungi from their host and their identification and classification.

REFERENCE BOOKS:

- **Ainsworth**, **G.E., Sparrow, F. K. and A. S. Sussman.** 1973. The Fungi.Vol. I, II and III. Academic Press, New York.
- **Alexopoulous**, **C.J., C.W. Mims and M. Blackwell.** 1979. Introductory Mycology. A national book foundation, USA
- **Aneja K.R.** 1993 : Experiments in Microbiology,Plant Pathology and Tissue New Age international.
- **Barnett, H.L**. (1960): Illustrated genera of imperfect fungi. American Phytopathological Society, U.S.A.
- **Bessey**, **E.A.** (1967): Morphology and Taxonomy of fungi Blakiston Company, U.S.A.
- **Buller**,**A.H.R**.(1909-50):Researches on Fungi Vol.I-VIII. Longmans Green & Company, London, U. K.
- **Gangopadhyay, S**. (1994): Clinical Plant Pathology. Kalyani Publishers, Daryaganj, New Delhi.
- **Gangulee**, **H. S.** and **A. K. Kar** (1992): College Botany Vol. II. IV-A and IV-B. New Central Book Agency (P) Ltd., Kolkata. W. B.
- **Johanson**, **D.A**. (1940): Plant Microtechniques. McGraw-Hill Publishing Company Ltd., New York. U. S. A.
- **Kendrick**,**W.B**. (1979): Taxonomy of fungi imperfecti. Uni. Of Toronto Press, Canada
- **Pandey**, **B.P**.(1994): A Text Book of Botany: Fungi. International Publishing House, New Delhi.
- **Rangaswamy G**. (1975): Diseases of crop plants in India. PHI Learning Pvt. Ltd., M97 Cannaught Circle, New Delhi.
- **Raychudhary** , **S. R.** ***et al*.**(1975): Advances in Mycology and Plant Pathology.
- **Sharma**,**O. P.** (1989): Text Book of Fungi. Tata McGraw-Hill Education, 1989

JOURNALS

- Annual Review of Plant Pathology.
- Canadian Journal of Botany.
- Mycologia.
- Indian Journal of Plant Pathology.

M.Sc. PART- II (SEMESTER III)

PAPER XI (CCS- 302.3): CYTOGENETICS AND PLANT BREEDING

(SPECIAL PAPER- I) CYTOGENETICS

TOTAL LECTURES – 60

UNIT I:

- Introduction to cytogenetics. Mitotic and meiotic cell division
- Meiosis: modes of meiosis, Chromosome disjunction. Genetic control of meiosis, mechanism
- and theories of crossing over, Recombination models, Synaptonemal complex

UNIT II:

- Structural variations in chromosomes, their cytological consequences, Structural hybrids, B chromosome its origin and consequences.
- Evolutionary significance of chromosomal aberration, balanced lethal and chromosome complexes.
- Numerical variation in chromosomes, sources and consequences including syndromes, classification, natural and induced polyploids, Utilization of aneuploids in gene location/mapping and gene transfer.
- Role of polyploids in crop breeding. Evolutionary advantages of autopolyploids Vs allopolyploids

UNIT III:

- **Genome analysis in crop plants**: Triticales, Wheat, Cotton, Tobacco.
- Meiotic analysis in hybrids
- **Alien genetic resources in crop improvement**: Alien addition and substitution lines, hybrids between species with same chromosome number, alien translocation, hybrids between species with different chromosome number, gene transfer using amphidiploids, bridge species

UNIT IV:

- Apomixis; types of apomixes in higher plants, evolutionary significance in plant breeding and genetic disadvantages
- Chromosome hybridization case studies: production and use of haploids, dihaploids and double haploids in genetics and breeding.
- *Drosophila* genetics: Life cycle, special type of chromosome, genetic regulation of development
- in *Drosophila*

PAPER XI (CCPR 305.2.3): CYTOGENETICS AND PLANT BREEDING: PRACTICAL COURSE I

UNIT V

- Smear preparations in *Sorghum bicolor, Zea mays*, *Delphinium malbaricum*,
- *Lycopersicum esculentum*, *Coix lachryma-jobi*, *Solanum sp.*
- Meiotic analysis in plants (Stages, chiasma, chiasma terminalization by using photographs,
- Pachytene analysis).
- Meiotic studies in structural hybrids (*Setcreatia* sp *Cyanotis* sp)
- Study of B chromosome in *Maize/Drimia*
- Cytological analysis of polyploidy in plants.

UNIT VI:

- Study of life cycle in *Drosophila melanogaster*
- Special type of chromosomes in *Drosophila melanogaster*
- Study of bacterial conjugation
- Study of bacterial transduction
- Study of transformation in *E. coli*
- Induction of mutation and study of mutants in *E. coli*
- GUS expression in plants

REFERENCE BOOKS:

- **Khush G. S.** 1973. Cytogenetics of aneuploides. Academic Press New York USA.
- **Burnham C. R.** 1962. Discussions in Cytogenetics. Burgess Publishing Co. Minnesota.
- **Harti D. L. and Jones E. W.** 1998. Genetics: Principles and Analysis 4th Edition. Jones and Barew Publishers Massachusetts USA.
- **Karp G.** 1999. Cell and Molecular Biology : Concepts and Experiments, John Wiley and Sons Inc USA.
- **Fikui K. and Nakayama S.** 1996. Plant chromosomes; Laboratory Methods CRC Press Boca Ration Florida.
- **Gupta P. K.** 1999. Cytogenetics. Rastogi Publication Meerut.
- **Prasad G.** 1998. Introduction to Cytogenetics. Kalyani Publishers, New Delhi.
- **Sinha U. and Sinha S.** 1998. Cytogenetics, Plant Breeding and Evolution. Vikas Publishing house Pvt. Ltd. New Delhi
- **Swaminathan M. S., Gupta P. K. and Sinha U.** 1974. Cytogenetics of Crop Plants MacMillan India Ltd. New Delhi.
- **Swanson C. P., Merz T. and Young J.** 1973. Cytogenetics. Prentice Hill of India Private Ltd. New Delhi.

M. SC. PART- II (SEMESTER III)

PAPER X (CCS- 302.4): ENERGY, ECOLOGY AND ENVIRONMENT

(SPECIAL PAPER I) ENVIRONMENT AND ITS ASPECTS

TOTAL LECTURES: 60

UNIT I:

- **Abiotic Environment**: Liebig's Law of Minimum, Shelford's law of tolerance, Law of Limiting Factors.
- **Environment in Terrestrial Ecosystems**: Classification of Biotic and Abiotic atmosphere, Interaction between organisms in an ecosystem. Light effects on plant life.
- **Climate**: Classification of climate, structure of atmosphere, Edaphic factors, Climograph

UNIT II:

- **Soil Process**: origin and formation of soil, weathering process (Physical and chemical weathering Soil composition, Soil texture, Soil complex).
- **Soils:** Soil profile, Formation of humus.
- **Soil erosion,** Causes**,** Soil conservation methods, Soil types of India.

UNIT III:

- **Land use classification**, integrated land use planning and water shade management, Waste land development, concept of soil map.
- **Water:** Resources and Management. Surface and subsurface of water, Demand of Water (Agriculture, Domestic and Industrial), Hotspots of surface water, Role of state/ central commission in water resource management.

UNIT IV

- **Environment in aquatic ecosystem:**
- **Marine Environment**: Light, Waves, Currents, Winds, Tides, Zonation in the sea
- **Fresh water environment**: Wind, Current, Temperature

PAPER X: CCPR 305.2.4: ENVIRONMENT AND ITS ASPECTS: PRACTICAL COURSE I

UNIT V:

- Analysis of water samples from polluted and non-polluted lakes for DO.
- Determination of BOD at Room Temperature.
- Study of wilting coefficient.
- Study of effect of effluents on plant growth.
- Field visits to Industrial area

UNIT VI:

- Determination of quality of water by physical parameters (colour, EC, pH, TSS, TDS and TS).
- Study of MPN as hydrobiological indicator.
- Study of soil profile.
- Determination of organic matter from soil.
- Ecological instruments used in air and water pollution studies.

REFERENCE BOOKS:

- **Agarwal, S. K**. (1992): Fundamentals of Ecology. New Delhi: Ashish Publishing House.
- **Bradbury, I. K.** (1990): The Biosphere. Published by John Wiley & Sons, Chichester.
- **Das, S. M**. (1989): Handbook of Limnology and water pollution with practical Methodology. Published by South Asian Publishers, New Delhi.
- **Etherington, J. R**. (1975): Environment and plant ecology : aims and development. Publisher Wiley.
- **Freedman, H. I.** (1980): Deterministic mathematical models in population ecology. Marcel Dekker Inc., New York.
- **Greig Smith, P.** (1983): Quantitative Plant Ecology. *Publisher*: WILEYBLACKWELL
- **Grims, J. P.** ***et al*** (1988): Comparative Plant Ecology. Colvend, Dalbeattie, Kirkcudrightshire [Scotland]: Castlepoint Press.
- **Hashimoto, Y.** ***et al*** (1990): Measurement techniques in plant sciences. San Diego, Calif.: Academic Press
- **Kershaw, K. A.** (1964): Quantitative and dynamic ecology. Publisher: Edward Arnold
- Kormondy, E. J. (1996): Concept of ecology. Publisher: Benjamin Cummings.
- **Krebs, C. J**. (1978): Ecology. Harper & Row., New York.
- **Lieth, H. F**. ***et al*** (1973): Patterns of primary production in the biosphere. Kluwer Academic Publishers-Plenum Publishers.
- **Misra, K. C**. (1989): Manual of plant ecology. Oxford and IBH Publishing Co., New Delhi.
- **Misra, R.** and **Das, R. R**. (1971): Proceedings of the school of plant ecology. Publisher: Calcutta Oxford & IBH Pub. Co.
- **Odum, E. P**. (1971): Ecology. Publisher: Saunders.
- **Odum E. P**. (3rd ed. 1996): Fundamentals of Ecology. Natraj Publishers, Dehra Dun.
- **Pandeya S. C**. *et al* (1963): Research methods in plant ecology. Asia Publishing House.
- **Watt K. E. F**. (1973): Principles of Environment Sciences. Published by McGraw-Hill.

M. SC. PART- II (SEMESTER III)

PAPER X (CCS- 302.5): ANGIOSPERM TAXONOMY

(SPECIAL PAPER-I) THE EVOLUTION AND CLASSIFICATION OF ANGIOSPERMS

TOTAL LECTURES: 60

UNIT I:

- **Principles and Practices in Plant Taxonomy:** Definitions and concepts, importance of taxonomy and need for classification, hierarchical classification, Alpha and Omega taxonomy, taxonomy as synthetic discipline.
- **The New Global Taxonomy Initiatives:** Systematic agenda - 2000, systematic knowledge and value of biodiversity, the missions of systematic agenda-2000. Biodiversity strategy and systematics Agenda for 2020.
- **A Brief History of Pre-Darwinian Classifications:**
- Systems based on habit: Theophrastus, Albert Magnus, Otto Brunfels, Jerome Bock, Andrea Cesalpino, Jean Bauhin, Joseph Pitton de Turnefort, John Ray
- The sexual system: Carolus Linnaeus and his students
- Systems based on form-relationships: Michel Adanson, Jean B. A. P. M. de Lamarck, De Jussieu, De Candolle, Bentham and Hooker.

UNIT II:

- **A Brief History of Post Darwinian Classifications:** The evolutionary theory by Darwin and Wallace. Systems based on phylogeny:
- The Englarian School of thoughts: August Wilhelm Eichler, Adoph Engler, Alfred Rendle, Carl Christian Mez, August A. Pulle, Carl Skottberg, B. Hayata
- The Ranalian School of thoughts: Richard von Wettstein, Charles E. Bessey, Hans Hallier, John Hutchinson, Oswald Tippo, G. Gunderson, Lyman Benson.
- **Recent Systems of Classifications:** Broad outline of classification by Armen L. Takhtajan and R. M. T. Dahlgren
- APG IV: Basal angiosperms, Magnoliids, Monocots, Commelinids, Eudicots, Core Eudicots, Rosids, Fabids, Malvids, Asterids, Lamiids and Campanulids.

UNIT III:

- **Evolution of Flowering Plants:** Angiosperm apomorphies- Flower, Stamens, Reduced male gametophyte, Carpel, Two integuments, Reduced female gametophyte, Endosperm formation, Sieve tube members, Angiosperm specializations, Vessels. Origin of angiosperms.
- **Taxonomic Hierarchy:** Ranks of Taxa, Forms of scientific names; major categories: division, class, order, family; minor categories: genus, species and intraspecific categories.
- **Plant Morphology:** Plant structure - Roots, Stems, Leaves, Flowers, Perianth, Androecium, Nectaries, Gynoecium, Carpel, Pistil, Inflorescences, Fruits and seeds.

UNIT IV:

- **Morphological variations, systematic position, interrelationships, phylogeny and economic importance of following families:** ANITA GRADE, Hydatellaceae, Austrobaileyaceae; MAGNOLIIDS: Lauraceae, Piperaceae, Aristolochiaceae; MONOCOTS: Alismataceae,Hydrocharitaceae,Potamogetonaceae,Aponogetonaceae; COMMELINIDS: Commelinaceae, Typhaceae, Eriocaulaceae, Zingiberaceae, Costaceae, Musaceae.

PAPER X (CCPR 305.2.5): ANGIOSPERM TAXONOMY: PRACTICAL COURSE I

UNIT V:

- Exercises on nomenclature problems.
- Describing new taxon.
- Study of flowers of primitive families: Magnoliaceae, Lauraceae, Aristolochiaceae, Piperaceae, Ranunculaceae, Alismataceae, Nymphaeaceae.
- Identification of wild and cultivated plant species using regional and national floras.
- Study of different types of ovules and placentations.

UNIT VI:

- Descriptions, Sketching, classification and identification of families: ANITA GRADE- Hydatellaceae, Austrobaileyaceae; MAGNOLIIDS- Lauraceae, Piperaceae, Aristolochiaceae; MONOCOTS- Alismataceae, Hydrocharitaceae, Potamogetonaceae, Aponogetonaceae; COMMELINIDS- Commelinaceae, Typhaceae, Eriocaulaceae, Zingiberaceae, Costaceae, Musaceae.
- Any additional practical/s based on theory syllabus will be added whenever necessary.

REFERENCE BOOKS:

- **Cronquist, A**. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.
- **Cronquist, A.** 1988. The Evolution and Classification of Flowering Plants (2nd ed.). Allen Press, U.S.A.
- **Davis, P. H**. and **V. H. Heywood** 1991. Principles of Angiosperm Taxonomy. Today and Tommorow Publications, New Delhi.
- **Manilal, K. S**. and **M. S. Muktesh Kumar** [eds.] 1998. A Handbook of Taxonomic Training. DST, New Delhi.
- **Naik, V. N**. 1984. Taxonomy of Angiosperms. Tata McGraw-Hill, New Delhi.
- **Quicke, Donald L. J**. 1993. Principles and Techniques of Contemporary Taxonomy. Blakie Academic & Professional, London.
- **Taylor, D. V**. and **L. J. Hickey** 1997. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributers, New Delhi.
- **Lawrence, G. H. M**. 1951. Taxonomy of Vascular Plants. Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi.
- **Takhtajan, A.** 1969. Flowering plants-Origin and Dispersal. Oliver and Boyd, Edinburg.
- **Hutchinson, J.** 1959. Families of Flowering plants. Clarendon Press, Oxford.
- **Judd Walter S., Campbell, C. S., Kellogg, E. A., Stevens, P.F**. and **M. J. Donoghue**. 2008. Plant Systematics- A Phylogenetic Approach. Sinauer Associates, INC, Publishers. Sunderland, Massachusetts, USA.
- **Simpson, M. G**. 2010. Plant Systematics. Elsevier, Amsterdam.

M. SC. PART- II (SEMESTER III)
PAPER X (CCS- 302.6): MARINE BOTANY
(SPECIAL PAPER I) GENERAL MARINE BOTANY

TOTAL LECTURES: 60

UNIT I:

- **Marine environment and organisms**: Benthic & Pelagic environment, Classification of marine organisms-Plankton, Nekton, Benthos, Marine Plant Groups
- **Marine phytoplankton:** Classification & diversity, Buoyancy, Red tides
- **Microbial diversity in marine habitat:** Brief idea of Marine Fungi, Actinomycetes, Marine Bacteria, Viruses & Marine Lichens.
- **Coral reefs:** Types, Biology, Zooxanthellae, Reef algae & herbivores, Importance.

UNIT II:

- **Microalgae:** Classification & Salient features of Cyanophyta, Pyrrhophyta, Chrysophyta , Cryptophyta , Examples from each division.
- **Macroalgae**: Classification of Seaweeds, General characteristics, life cycle & type studies of Chlorophyta (*Ulva*, *Enteromorpha*), Phaeophyta (*Sargassum*, *Padina*) & Rhodophyta (*Gracilaria*, *Porphyra*), Evolution of thallus in different classes.

UNIT III:

- **Biodiversity of mangroves**: Definition of the term 'mangrove', biodiversity, brief idea of Creek, Estuary, Lagoon and Delta. Distribution & biogeography of Indian mangroves, East and west coast mangroves, Mangrove forest types.
- **Salient Features of Important Mangrove Families:** Rhizophoraceae, Sonneratiaceae, Avicenniaceae, Myrsinaceae, Acanthaceae. Mangrove associates.

UNIT IV:

- **Salt marshes**: Salt marsh flowering plants-Occurrence, Taxonomy, Distribution, Morphological and anatomical adaptations, Ecological roles, Salt marsh ferns, bryophytes, algae.
- **Sea grasses**: Taxonomy, Distribution, Morphological & anatomical adaptations, Ecological roles, Sea grasses & Human affairs.
- **Sand dunes**: Occurrence, Formation of coastal sand dunes. Classification, Embryo dune, Yellow dune, Grey dune, Succession in dune vegetation, Dune vegetation.

PAPER X (CCPR 305.2.6): MARINE BOTANY PAPER XI: PRACTICAL COURSE I

UNIT V:

- Study of characteristic features of Chlorophyta Ex. Enteromorpha, Chaetomorpha, Ulva, Caulerpa.
- Study of characteristic features of Phaeophyta Ex. Padina, Dictyota, Sargassum.
- Study of characteristic features of Rhodophyta Ex. Gracilaria, Gelidium , Hypnea.
- Sampling and identification of marine phytoplankton.
- Study of sand dune plants (Canavalia, Derris, Pandanus, Spinifex, Ipomoea etc.).

UNIT VI:

- Type study of mangroves from Avicenniaceae (*Avicennia* species)
- Type study of mangroves from Rhizophoraceae (*Rhizophora*, *Bruguiera*, *Ceriops*, *Kandelia*)
- Type study of mangroves from Sonneratiaceae (*Sonneratia*)
- Type study of mangroves from Myrsinaceae (*Aegiceras*) and Acanthaceae (*Acanthus*)
- Study of important mangrove associates.

Reference Books:

- **Alexopoulos**, **C.J**. & **Bold, H.C**. (1967). Algae & Fungi: Current Concepts in Biology Series. The Macmillan Company, London.
- **Chapman, V. J**. (1976). Coastal Vegetation. II nd edition Pergamon Press. New York
- **Chaudhuri. A. B.** (2007). Biodiversity of Mangroves.
- **Desikachary**, **T. V**. (1975). Marine Plants. N. C. E. R. T. New Delhi.
- **Kamat, N. D**. (1982). Topics in Algae. Sai Kripa Prakashan, Aurangabad
- **Kumar H. D. 1990.** Introduction to Phycology. Affiliated East West Press pvt. Ltd. publ. New Delhi.
- **Kumar H.D**. and **H.N. Singh** (1990). Algae. Affiliated East West Press pvt. Ltd. publ. New Delhi.
- **McConnaughey**, **B. H** (1974). Introduction to Marine Biology. 2nd ed. Mosby publisher.
- **Naskar Kumudranjan** (2004.) Manual of Indian Mangroves. Daya Publishing House, New Delhi.
- **Sambamurthy**,**A.V.S.S**.(2005). A Text Book of Algae. I. K. International Pvt. Ltd. New Delhi.

- **Santhanam, R.; Ramnathan,N.; Venkataramanjan K. & Jegathanam,G.** (1987). Phytoplankton of Indian Seas. & Aspects of Marine Botany.Daya Publication Home. Delhi.
- **Sen Neera** and **Kumudranjan Naskar**, (2003). Algal Flora of Sundarbans. Mangal Daya
- **Stein, J. R.** (1973) Handbook of Phycological Methods. Cambridge University Press.
- **Trainor**, **F. R**. 1978. Introductory Phycology. John Wiley, New York.
- **Vashishta**, **B. R**. (1995). Algae. S. Chand and Co. Ltd., New Delhi.

M. Sc. PART-II (SEMESTER III)

(CCS- 302.7): Plant Biotechnology

(SPECIAL PAPER I) PLANT TISSUE CULTURE

Total Lectures: 60

UNIT I:

Plant tissue culture: Objective and goals of Plant tissue culture; Laboratory design and development, operation and management

Plant tissue Nutrition: Basic principles of *in vitro* culture, Factors influencing morphogenesis and Physiological significance of tissue nutrition

Media preparation: Media preparation and handling, Sterilization technique, Equipment and apparatus, Procedure of media preparation and stock solution

UNIT II:

Types of Cultures: Explant culture, Callus formation and culture, Callus desiccation, Organogenesis, Meristem culture, Axillary bud culture, Protocols and schedule of observation.

Organ culture: anther, ovary culture, embryo rescue

Hardening of tissue cultured plants

UNIT III:

Cell suspension culture: Batch culture, continuous culture (Open, Closed), semi culture, Growth measurements, Synchronization of suspension culture cells, Application.

Cell line isolation

Somaclonal variation: Nomenclature; schemes for obtaining somaclonal variations- without invitro selection and with invitro selection; factors influencing somaclonal variation; Applications; Basis of somaclonal variations, Limitations; Gametoclonal variations.

UNIT IV:

Protoplast isolation, culture and somatic hybridization

Cell immobilization and synseed production

Cryopreservation: Introduction, principle, procedure, importance and future prospects

Paper X CCPR 305.2.7: PLANT BIOTECHNOLOGY PAPER XI: PRACTICAL COURSE I

UNIT V:

- Media preparation and Sterilization techniques
- Callus culture
- Meristem culture
- Organogenesis

UNIT VI:

- Technique of hardening
- Anther culture
- Cell suspension culture
- Embryo rescuing
- Visit to commercial greenhouse/ Tissue culture laboratory

Reference Books:

- **Bhojwani**, **S. S**. and **Razdan, M. K**. 1983. Plant tissue culture, theory and practice. Elsevier Publ.
- **Dixon**, **R. A.** 1985. Plant cell culture- a practical approach. Oril Press Oxford.
- **Doddas, J. H**. and **Roverts, L.W**.1985. Experiments in plant tissue culture. Cambridge Uni. press.
- **Evans *et al.*** 1983. Hand book of plant cell culture vol. I, II, III. McMillan Publ. Co., New York.
- **Gamborg**, **O. L**. and **Phillips, G. C.**1966. Plant, tissue and organ culture- fundamental Methods. Narosa Publishing House, New Delhi.
- **Narayanswamy**, S. 1997. Plant cell and tissue culture. Tata McGraw Hill Publishers, New Delhi.
- **Nelson**, **P. V**.1973.Greenhouse operation and management. Reston Publishing Co. Inc.
- **Old, R. W**. and **Primerose, S. B**. 2002. Principles of gene manipulation. Blackwell, Oxford, England.
- **Raghavan**, **V**. 1997. Molecular embryology of flower plants. Cambridge Uni. Press.
- **Ravishankar**, **G. A**. and Venkataraman, L. V. 1997. Biotechnological applications of plant tissue and cell culture. Oxford and IHB Publishing Co. Pvt. Ltd., New Delhi.
- **Reddy, S. M., Srivastava, H. P., Purohit, D. K. and Reddy, S. R.** 1997. Microbial biotechnology. Scientific Publishers, Jodhpur, India.
- **Reinsert, J. and Bajaj, Y. P. S.** 1976. Plant cell, tissue and organ culture. Springer Verlag, Berlin.
- **Street**, **H. E.** 1974. Tissue culture. Academic Press, New York.
- **Thorpe**, **T. A.** 1981. Plant tissue culture. Academic Press, New York
- **Vasil, I. K.** 1984. Cell culture and somatic cell genetics of plants (I). Laboratory procedures and their applications. Academic Press Inc.

M. Sc. PART-II (SEMESTER III)

Paper XI (CCS- 303.1): Plant Physiology

(SPECIAL PAPER II) PLANT GROWTH AND DEVELOPMENT

Total Lectures: 60

UNIT I:

Growth and morphogenesis: Photomorphogenesis; History and discovery of phytochromes and cryptochromes and their photochemical and biochemical properties. phytochrome biosynthesis, cellular localization, roles, mechanism of action of photo morphogenetic receptors.

UNIT II:

Pollen germination: Physiology of pollen germination and pollen-pistil interaction.

Senescence and PCD: Biochemical changes during senescence of leaves and petals. Regulation of senescence, Programmed Cell Death.

Seed Development: Biochemical changes during seed development.

UNIT III:

Post harvest physiology: Ripening of fruit and its regulation. Metabolism of leafy vegetables during storage.

Role of biotechnology and mutants in physiological studies.

UNIT IV:

Plant growth regulators: Discovery, role and possible mechanism of action of Triacontanol, Brassins, Salicylic acid, Jasmonates and Polyamines. Role of plant growth retardants- CCC, Maleic hydrazide,Trizoles and TIBA.

PAPER XI (CCPR 305.3.1): PLANT PHYSIOLOGY: PRACTICAL COURSE II

UNIT V:

- Hormonal regulation of leaf and petal senescence.
- Study of changes in RNA and Proteins during senescence.
- Study of changes in starch content during seed development.
- Study of changes in protein content during seed development.

UNIT VI:

- Study of enzyme pectinase/pectin methyl esterase during ripening of fruit.
- Study of changes in respiration rate during ripening of fruits.
- Study of lipid accumulation during development of oil seeds.
- Effect of chemical compounds on pollen germination.
- Study of effect of different PGRs on seedling growth and vigour.

Reference Books:

- **Bidwell, R. C. S.** (1979): Plant Physiology. Macmillan
- **Bonner, J.** and **Varner, J.E**. (1972): Plant Biochemistry. IBH.
- **Edwards G.** and **Walker D.,** eds. (1983). C3, C4: mechanisms, and cellular and environmental regulation, of photosynthesis. Oxford: Blackwell Scientific Publications.
- **Govindjee, H.** (ed.) (1982): Photosynthesis, Vol. 1 and Vol. 2. Academic Press, N.Y. (Vol. 1); 0-12- 294302-2 (Vol. 2))
- **Hopkins, W. C.** (1995): Introduction to Plant Physiology. Wiley, New York.
- **Krishnamurthy, H.N.** (1992): Physiology of Plant Growth and Development. Atma Ram and Sons, Delhi.
- **Marschner, H. W.** (1986): Mineral nutrition of Higher Plants. First Edition, Academic Press, Elsevier Science Ltd.
- **Marschner, H. W.** (2003): Mineral nutrition of Higher Plants. Second Edition, Academic Press, Elsevier Science Ltd.
- **Moore, T.C.** (1974): Research experience in Plant Physiology, A Laboratory manual. Springer-Verlag, Berlin.
- **Mukherjee, S.P.** and **Ghosh A.N**. (1996): Plant Physiology. New Central Book Agency (P) Limited Tata McGraw Hill.
- **Noggle**, **G.R**. and **Fritz, G. J**. (1976): Introductory Plant Physiology. Prentice- Hall, Inc., Englewood Cliffs, NJ.
- **Pessarakli, M.** (Ed.). (2001). Handbook of Plant and Crop Physiology, 2nd Edition, Revised and Expanded. Marcel Dekker, Inc., New York
- **Pessarakli, M.** (Ed.). (2005). Handbook of Photosynthesis, 2nd Edition, CRC Press, Taylor & Francis Publishing Company, Florida
- **Randhir Singh** and Sawhney S. K. (1988): Advances in frontier Areas of Plant Biochemistry. Prentice Hall of India

- **Sadasivam S.** and Manickam A. (1996): Biochemical methods. New Age International.
- **Salisbury, F. B.** and **Ross, C.W**.(1992): Plant Physiology IV ed. Cengage Learning
- **Smith, H.** (1975): Phytochrome and Photomorphogenesis. McGraw-Hill Inc.,US
- **Taiz, L.** and **Zeiger, F.** (1998): The Plant Physiology. Second Edition, Sunderland: Sinauer Associates.
- **Wilkins, M. B.** (1976): Physiology of Plant Growth and Development. McGrow-Hill Publishing Company Limited

Journals

- Annual Review of Plant Physiology and Molecular Biology
- Annual Review of Plant Physiology
- Indian Journal of Plant Physiology
- Journal of Experimental Botany
- Physiologia Plantarum, Sweden
- Plant Physiology, Bethedsa, USA
- Plant Cell

M. Sc. PART-II (SEMESTER III)

Paper XI (CCS- 303.2) **MYCOLOGY AND PLANT PATHOLOGY**

(SPECIAL PAPER II) INTEGRATED DISEASE MANAGEMENT

Total Lectures: 60

UNIT I:

Principles of plant pathology: History, Classification of crop diseases. Deficiency of micronutrients.

Seed pathology: Methods of detection of internal and external seed borne Fungi, Bacteria and Viruses, biodeterioration and mycotoxins.

UNIT II:

Role of enzymes and toxins in disease development. Cell wall degrading enzymes: Cellulolytic,

Pectolytic, Proteolytic and Lipolytic. Toxins: lycomarsmine, alternic acid, Fusaric acid, Piricularin, Victorin and aflatoxins.

UNIT III:

Physiology and Biochemistry of host pathogen interaction: Respiration, Photosynthesis, Proteins, Nucleic acids, phenols- phytoalexins and plant growth regulators.

UNIT IV:

Genetics of host pathogen interaction, gene for gene hypothesis, protein for protein hypothesis, antigen and antibody reaction. Immunoglobulins, application of immunological techniques, physiological specializations.

Paper XI (CCPR 305.3.2): MYCOLOGY AND PLANT PATHOLOGY: PRACTICAL COURSE II

UNIT V:

- Estimation of fungal enzyme (Cellulases, Amylases and Pectinases).
- Estimation of nucleic acids from healthy and infected plants.
- Use of biocontrol agents (*Trichoderma* spp.) against plant pathogens.
- Extraction and detection of aflatoxins from infected seeds.

UNIT VI:

- Estimation of protein from healthy and infected plants.
- Study of external and internal seed mycoflora.
- Immunological techniques-purification and fragmentation of immunoglobulins.
- Symptomology and histo-pathology of diseases mentioned in the theory.

Reference Books:

- **Agrios,** G. N. (2006). Plant Pathology (5th Edition). Academy Press, London.
- **Aneja**, K. R. (1993). Experiments in Microbiology, Plant Pathology and Tissue Culture. New Age international.
- **Cooke**, A. A. (1981). Diseases of Tropical and Subtropical Field, fiber and Oilplants.
- **Gangopadhyay**, S. (1994). Clinical Plant Pathology. Kalyani Publishers, Daryaganj, New Delhi.
- **Gangulee**, H. S. and Kar, A. K. (1992). College Botany Vol. II. New Central Book Agency (P) Ltd., Kolkata. W. B.
- **Jha**, D. K. (1993). Atext book on Seed Pathology. Vikas Publishing House Pvt. Ltd., 576 Masjid Road, jangpura, New Delhi-110014.
- **Kuljit**, J. (1969). The Biology of parasitic flowering plants. Uni. Of California Press, U. S. A.
- **Mahadevan**, A. and Shridhar, R. (1982). Methods in Physiological Plant. PHI Learning Pvt. Ltd., M97 Cannaught Circle, New Delhi.
- **Mehrotra**, R. S. (1980). Plant Pathology. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
- **Nair**, L. N. (2007). Topics in Mycology and Plant Pathology. New Central Book Agency (P) Ltd., Kolkata. W. B.
- **Neergard**, P. (1977). Seed Pathology. Vol. I & II, Macmillan Press, London.
- **Nyvall**, R. F. (1979). Field Crop Diseases Handbook.
- **Padoley**, S. K. and Mistry, P. B. A manual of plant Pathology.
- **Paul** Khurana, S. M. (1998). Pathological problems of Economic Crop Plants and their Management.
- **Plank**, J. E. Vander (1968). Plant Diseases, Epidemics and Control. Academy Press, London.
- **Plank**, J. E. Vander (1968). Disease Resistance in Plants. A. P. London and New York.
- **Rangaswamy, G**. (1975): Diseases of crop plants in India. Diseases of crop Plants in India. PHI Learning Pvt. Ltd., M97 Cannaught Circle, New Delhi.
- **Singh**, **R. S**. (1963): Plant Diseases. Oxford and IBH Publishing

M. Sc. PART- II (SEMESTER III)
Paper- XI (CCS- 303.3): Cytogenetics and Plant Breeding
(SPECIAL PAPER II) PLANT BREEDING

Total Lectures: 60

UNIT I:

Objectives of Plant Breeding, Domestication, Selection under domestication; Introduction, Quarantine; and Acclimatization of plants, Germplasm: Gene pool concept, Genetic erosion, Exploration and collection of germplasm, conservation and utilization, Mechanism of pollination control: self-incompatibility and male sterility, Concept of plant ideotype and its role in crop improvement.

UNIT II:

Inheritance of qualitative and quantitative characters, Biometrical techniques in plant breeding: Introduction, Assessment of variability, Components of variance, Genetic diversity, QTL and linkage maps. Heritability, estimation of variance components additive and dominance variances, combining ability GSC, SCA effects.

UNIT III:

Aids to Selection: Correlation coefficient analysis, Path analysis and Discriminant functions. Choice of parents and breeding procedures: Diallele, Partial diallele, Triallele, Line tester, Generation mean analysis, Biparental cross analysis with various designs and Varietal adaptation Cultivar development: testing, release and notification maintenance. Plant breeders' right and regulations for plant variety protection and farmers right, DUS testing

UNIT IV:

Breeding for biotic and abiotic stresses: Disease and Insect resistance; Drought, Salinity, Heat and cold resistance. Mutation breeding
Variety development and seed production

PAPER XII (CCPR 305.3.3) CYTOGENETICS AND PLANT BREEDING: PRACTICAL COURSE II

UNIT V

- Germplasm collection, cataloguing, data storage and retrieval
- To study crossability between cultivars
- Study of pollen germination and demonstration of incompatibility.
- Study of cytoplasm male sterility
- Designing field experiments
- Floral biology of self pollinated and cross pollinated species
- Genome analysis in wheat/*Gossypium*.

UNIT VI

- Metroglif analysis
- D^2 analysis
- Estimation of heritability
- Screening of germplasm for biotic and Abiotic stresses
- 5. To study the effect of mutagen on germination, seedling growth and on mitosis
- 6. Field and lab visits of self and cross pollinated plants
- 7. Induction of polyploidy using Colchicine.

Reference Books:

- **Singh, B. D.** 2000. Plant breeding- Principles and methods. Kalyani Publishers, Ludhiana.
- **Sharma, J. R.** 1994. Principles and practice of plant breeding. Tata McGrow Hill Publ. Co. Ltd., New Delhi.
- **Siddiqui B. A. and Khna S.** 1999. Breeding in crop plants. Mutation and In vitro mutation breeding . Kalyani Publishers New Delhi
- **IAEA 1995.** Induced mutations and Molecular techniques for crop improvement. Proc FAO/IAEA Symposium Vienna
- **IAEA 1991.** Plant Mutation Breeding crop improvement Proc. FAO/IAEA Symposium (Vol 1&2)Vienna
- **Micke A.** 1991. Induced Mutation for crop improvement. Gamma Field Symposia No.30 Institute of Radiation Breeding Pullman USA.
- **Allard R. W.** 1960. Principles of Plant Breeding John Wiley and Sons, New York.
- **Hays H. K., Immer F.R. and Smith D.C**. 1955. Methods of Plant Breeding. McGraw Hill Book Company Inc New York.
- **Fehr W. R.** 1987. Principles of Cultivar Development (2 Volumes) MacMillan Publishing Co. New York.
- **Poehlman J.M.** 1986. Breeding Field Crops AVI Publishing Company Connecticut. NEW YORK
- **Sharma J. R.** 1998. Statistical and Biometrical techniques in Plant Breeding New Age International Publishers New Delhi.
- **Singh R. K. and Singh B. D.** 1997. Biometrical Methods in Quantitative genetic Analysis. Kalyani Publishers, New Delhi.
- **Vijendra Das L. D.** 2000. Problems Facing Plant Breding CBS Publishers New Delhi

- **Rosielle A. A. and Hamblin J.** 1981 Theoretical aspects of selection for yield in stress and non- stress environments Crop Sci, 21: 932-946.
- **Levitt J.** 1980. Response of Plants to Environmental Stress: Water, Salt and Other stresses. Academic Press, New York.
- **Bulm A.** 1988. Plant Breeding for stress Environments. CRC Press Florida.
- **Chopra V. L.** 1989. Plant Breeding .oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
- **Roy Darbeshwar** 2000, Plant breeding analysis and exploitation of variance. Narosa Publishers New Delhi.

Journals:

- Indian Journal of Genetics and Plant Breeding.
- Journal of Genetics
- Caryologia
- Journal of Cytology and Genetics
- International Journal of Food Science and Technology
- Cytologia
- International Journal of Plant Breeding

.....

M.SC. PART- II (SEMESTER III)

PAPER XI (CCS- 303.4): ENERGY, ECOLOGY AND ENVIRONMENT

(SPECIAL PAPER II) POPULATION AND COMMUNITY ECOLOGY

TOTAL LECTURES: 60

UNIT I:

- **Population Ecology**: Population growth and regulation, Density dependent and Independent regulation: Role of different factors
- **Genecology:** Ecads, Ecotypes, Characteristics of Ecotype, Origin of new ecotype and significance, concept of niche.

UNIT II:

- **Community Ecology:** Methods of Community studies.
- **Units of vegetation**: Classification of communities, Physiognomic classification, Phytosociological classification.
- **Clementsian unit of vegetation:** Plant formation, Associations, Faciation, Lociation, Consociation, Society, Aspects of society**,** Main concepts.
- **Community Nature**: Individualistic and organismic nature of communities, community stratification.

UNIT III:

- **Functional Aspects of Community**: Community Periodism, Photoperiodism, Community Metabolism
- **Community Sability**: Maturation of Communities, Climax community, Regulation of communities.
- **Community Stability**: Edges and Ecotone Community as Indicator

UNIT IV:

- **Forest Ecology**: Scope and relevance, Forest types of India, Structure of forest ecosystem. Accumulation and decomposition of forest litter, Forest humus, the geochemical, biogeochemical cycling of nutrients.

- **Statistical thinking in Ecology**: Ecosystems and scale, theory, knowledge and research design, Ecological study unit, Experimental versus observation methods in ecology, hypothesis testing, formulating right problem, Publish or Perish.

PAPER XI (CCPR 305.3.4): POPULATION AND COMMUNITY ECOLOGY: PRACTICAL COURSE II

UNIT V:

- Study of litter production.
- Determination of similarity index and association index.
- Study of stratification and physiognomy.
- 4-5. Determination of IVI.
- Study of population growth curve.

UNIT VI:

- Study of vegetation by transects method.
- Measurement of biomass production.
- Biomass profile of the plant community.
- Comparison of plant communities from polluted and non-polluted areas.
- Statistical analysis of ecological data
- Study of population dynamics
- Visit to local protected or conserved area.

Reference Books:

- **Abe, T., Levin, S. A. and Higashi, M.** (1997) (ed.): Biodiversity an Ecological Perspective. Springer Verlag.
- **Bradbury I.K**.1990): The Biosphere.
- **Brij Gopal and Bhardwaj, N**. (1979): Elements of Ecology. Sahibabad: Vikas Publishing House PVT. Ltd.
- **Galston, K. J.** (1996): Biodiversity: A biology of numbers and differences. Kluwer Academic *Publishers*, Dordrecht, the Netherlands.
- **Greig Smith P.** (1983): Quantitative Plant Ecology. *Publisher*: WILEYBLACKWELL
- **Hamson, H. C. and Churchill, E. D.** (1961): The Plant Community. Rein hold *publishing* corporation, New York.
- **Hashimoto Y et al** (1990) : Measurement techniques in plant sciences. San Diego, Calif. : Academic Press.
- **Kormondy E. J.** (1996) (4th ed.): Concept of ecology. Publisher: Benjamin Cummings.
- **Krattiger, A. I. et al** (1994): Widening Perspectives on Biodiversity. Kluwer Academic***Publishers***.
- **Krebs C. J.** (1978) : Ecology. Harper & Row., New York.
- **Misra K. C**. (1989) : Manual of plant ecology. Oxford and IBH Publishing Co., New Delhi.
- **Nair, P. K. G**. (1990): Principles of Environmental Biology. Himalaya *Publishing* House (Bombay).
- **Odum E. P.** (3rd ed. 1996) : Fundamentals of Ecology. Natraj Publishers, Dehra Dun.
- **Pandeya S. C., Puri, G. S. and Singh, J. S**. (1968) : Research methods in plant ecology. Asia Publishing House.
- **Shukla, R. S. and Chandel, P. S**. (1983): Plant Ecology. Oxford and IBH.***publishers***, New Delhi, India.
- **Walter, H**. (1979); Vegetation of the Earth and Ecological Systems of Geobiosphere. Springer, New York.
- **Weaver, J. E. and Clements, F. S**. (1938): Plant Ecology. Springer, New York.
- **Willis, A. J.** (1973): Introduction to Plant Ecology. *Willis A J. Publisher.*
- **Yadav, P. S. and Singh, J. S**. (1997): Progress in Ecology vol. II. Today & Tomorrow's Printers & *Publishers*, New Delhi.

M. Sc. PART-II (SEMESTER III)

Paper XI (CCS- 303.5): Angiosperm Taxonomy

(SPECIAL PAPER II) MODERN TRENDS IN ANGIOSPERM TAXONOMY

Total Lectures: 60

UNIT I:

- **Embryology in relation to taxonomy:** Embryological characters of taxonomic importance, utilisation of embryological data in solving taxonomic problems at different levels.
- **Anatomy in relation to taxonomy:** Vegetative, wood and floral anatomy, anatomical characters of taxonomic importance, use of anatomical data in understanding interrelationship and evolution of angiosperms and solving taxonomic problems. **Palynotaxonomy:** Pollen morphology-Polarity, symmetry, NPC of pollen, exine stratification, excrescences, L/O pattern, palynogram; pollen characters of taxonomic importance

UNIT: II

- **Cytotaxonomy:** Chromosome number, Basic chromosome number, polyploidy, aneuploidy, chromosome morphology, karyotype, chromosome banding, meiotic analysis and plant systematics, scope and limitations.
- **Chemotaxonomy:** Origin of chemotaxonomy, classes of compounds and their biological significance, Stages in chemotaxonomic investigations, techniques, Use of chemical criteria in plant taxonomy; Proteins and taxonomy: seed proteins, techniques of protein electrophoresis, protein analysis procedures, analysis of amino acid sequence and its significance in systematics; serology and taxonomy: history, precipitation reaction, techniques, antigen, antisera, antibody, application of serological data in systematics.

UNIT: III

- **Ultrastructural systematics:** SEM and TEM studies and plant systematics; SEM and plant surface stucture, TEM and dilated cisterneae of endoplasmic reticulum and sieve element plastids, applications of data in the classification of higher taxa.
- **Molecular Systematics:** Molecular diagnostic tools, Restriction Fragment Length Polymorphism (RFLPs), Random Amplified Polymorphic DNA (RAPD), Polymerase Chain Reaction (PCR) analysis, specific applications of RAPD, AFLP in molecular systematics. Molecular data and systematic position of Hydatellaceae.
- **Plant geography, ecology and systematics:** Patterns of geographic distribution, Disjunction and Vicariance, Vicariance biogeography, Endemism, Centres of diversity, Ecological differentiation, Alien plants, Phenotypic plasticity

UNIT: IV

- **Morphological variations, systematic position, interrelationships, phylogeny and economic importance of following families:** EUDICOTS**:** Menispermaceae, Ranunculaceae, Nelumbonaceae; CORE EUDICOTS: Nyctaginaceae, Portulacaceae, Polygonaceae, Loranthaceae, Santalaceae. ROSIDS: Vitaceae, Zygophyllaceae, Oxalidaceae, Euphorbiaceae, Rhizophoraceae, Passifloraceae, Polygalaceae.

PAPER XI (CCPR 305.3.5): ANGIOSPERM TAXONOMY: PRACTICAL COURSE II

UNIT V:

1. Microtome technique for study of embryological characters
2. Study of wood characters: vessels, storied and nonstoried wood
3. Semipermanent pollen preparations by acetolysis and study of different pollen morphotypes.
4. Study of chromosomes and Karyotype analysis.
5-6. Interpretation of flavonoids/alkaloids data for taxonomy using chromatography.

UNIT VI:

1. Exercise on Numerical taxonomy
2. Study of plant surface attributes with the help of SEM photographs and sieve tube plastid and dilated cisternae of endoplasmic reticulum with the help of TEM photographs
3-6. Descriptions, Sketching, classification and identification of families:
EUDICOTS: Menispermaceae, Ranunculaceae, Nelumbonaceae;
CORE EUDICOTS: Nyctaginaceae, Portulacaceae, Polygonaceae, Loranthaceae, Santalaceae;
ROSIDS: Vitaceae, Zygophyllaceae, Oxalidaceae, Euphorbiaceae, Rhizophoraceae, Passifloraceae, Polygalaceae. Any additional practical/s based on theory syllabus will be added whenever necessary. (At least two local tours should be arranged to study vegetation, ecology and flowering of the region in first term. Student is supposed to submit herbarium specimens (50) and plant materials in the form of slides (5) and preserved specimens.)

Reference Books:

- **Bhojwani, S. S. and Bhatnagar, S. P. 1984**. Embryology of Angiosperms. Vikas Publ. House, New Dehli.
- **Cronquist, A. 1988**. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press, U.S.A.
- **Cronquist, A. 1981**. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.
- **Davis, P. H. and V. H. Heywood 1991**. Principles of Angiosperm Taxonomy. Today and Tommorow Publications, New Delhi.
- **Erdtman, G. 1952**. Pollen Morphology and Plant Taxonomy. Angiosperms. Almquist and Wiksell. Stockholm.
- **Fahn, A. 1979**. Plant Anatomy, Pergamon Press, London.
- **Erdtman, G. 1952**. Pollen Morphology and Plant Taxonomy. Angiosperms. Hafner Publ. Co. New York.
- **Johri, B. M. 1984**. Comparative embryology of Angiosperms. Ind. Nat. Sc. Acad. New Delhi.
- **Maheshwari, P. 1985**. An Introduction to Embryology of Angiosperms. Tata McGraw Hill, New Delhi.

- **Manilal, K. S. and M. S. Muktesh Kumar [ed.] 1998**. A Handbook of Taxonomic Training. DST, New Delhi.
- **Naik, V. N. 1984**. Taxonomy of Angiosperms Tata McGraw-Hill, New Delhi.
- **Nair, P. K. K. 1966**. Pollen morphology of Angiosperms. Periodical Expert Book Agency, New Delhi.
- **Quicke, Donald, L. J. 1993**. Principles and Techniques of Contemporary Taxonomy. Blakie Academic & Professional, London.
- **Taylor, D. V. and L. J. Hickey 1997**. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributers, New Delhi.
- **Lawrence, G. H. M. 1951**. Taxonomy of Vascular Plants. Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi .
- **Paech, K. and M. V. Tracey. 1956.** Modern Methods of Plant Analysis. Vol-I & II. Springer-Verlag.
- **Shivanna, K. R. and N. S. Rangaswamy. 1992**. Pollen Biology- A Laboratory Manual. Springer-Verla
- **Sharma A. K. and A. Sharma. 1980**. Chromosome Technique: Theory and Practices (3rd ed.) Butterworths, London.
- **Judd Walter S., Campbell, C. S., Kellogg, E. A., Stevens, P.F. and M. J. Donoghue 2008**. Plant Systematics-A Phylogenetic Approach Sinauer Associates, INC, Publishers. Sunderland, Massachusetts, USA.
- **Simpson, M. G. 2010**. Plant Systematics. Elsevier, Amsterdam.
- **Stace, C. A. 1989**. Plant Taxonomy and Biosystematics. Edward Arnold, London.

M. Sc. PART-II (SEMESTER III)

Paper XI (CCS- 303.6): Marine Botany

(SPECIAL PAPER II) PHYSIOLOGY AND BIOCHEMISTRY OF MARINE PLANTS

Total Lectures: 60

UNIT I:

- **Photosynthesis in Marine Algae**: Overview, light harvesting, Photosynthetic pigments (chlorophylls. phycobiliproteins, carotenoids), effect of low light condition. Photosynthetic carbon fixation- Dark Reactions, Inorganic carbon sources and uptake, Photosynthetic pathways in seaweeds, Light independent carbon fixation, C_3 versus C_4 characteristics of seaweeds. Carbon metabolism and calcification
- **Storage and Structural Components in Algae**: Seaweed polysaccharides; Alginates, Agars, Carrageenans, Fucoidan, Laminaran, Xylans, Mannans, Algal Starches, Polysaccharide synthesis, Low Molecular Weight compounds in algae-Fatty acids, Lipids, Steroids, Triterpenoids etc.

UNIT II:

- **Salt Regulation in Halophytes:** Salt regulation strategies, salt secretion through glands, Ultrastructure of salt glands, Salt glands in mangroves, Mechanism of salt secretion, Salt retransportation, Salt bladders, Leaf succulence, Selective ion absorption.
- **Salinity and Metabolism**: Water relations, osmoregulation and photosynthesis in mangroves. Significance of vivipary in mangroves. Salinity and Water relations in seagrass communities. Salinity, salt regulation and photosynthesis in salt marshes.

UNIT III:

- **Bioactive Compounds in Mangroves**: Chemical classes- Heterocyclic compounds, alkaloids, lignins & polysaccharides, lipids, flavonoids, phenolics, tannins, saponins, limonoids etc. Traditional Products, Toxicants & medicines from mangroves.
- **Mangrove Research and Activities:** Contributions of Indian and Global Institutions- UNESCO, UNDP, ITTO, ISME, NIO, MSSRF, GEER, ENVIS and SUK.

UNIT IV:

- **Mineral Nutrition in Algae:** Nutrient requirement, Essential elements, vitamins for growth of algae. Availability in sea water, Uptake, Factors affecting, Metabolic role of major elements and trace elements.
- **Algal Research**: Contributions of major Research Institutes- CSMCRI (Bhavnagar), Krishnamoorthy Institute of Algology (Mandapam, Chennai), NIO (Goa), Department of Botany (SUK).
- **Algal Biotechnology:** Present status & future prospects.

PAPER XI CCPR 305.3.6: MARINE BOTANY: PRACTICAL COURSE II

UNIT V:

- Estimation of pigments from marine algae-I: Chlorophylls a, b, c and d.
- Estimation of pigments from marine algae-II: Carotenoids and Phycobilins.
- Isolation of agar agar from seaweeds.
- Extraction of alginic acid from seaweeds.
- Estimation of total carbohydrates from marine algae.

UNIT VI:

- Phytochemical analysis of seaweeds through qualitative tests.
- Detection of phenols as bioactive compound in mangroves.
- Determination of alkaloids from mangroves.
- Estimation of total lipids from seaweeds.
- Estimation of tannins from of mangroves (bark, stems and leaves).
- Detection of bioactive compounds from mangroves using, phytochemical tests

Reference Books:

- **Chapman**, **V. J**. (1976): Costal Vegetation. IInd edition Pergamon Press.
- New York.
- **Ring, M.** (1982): The Biology of Marine Plants. Edward Arnold Publishers, London.
- **Gerald, E**. Ecophysiology of Economic Plants in Arid and Semiarid Land.
- **Jackson, D. F**. (1972): Algae and Man. Plenum Press.
- **Lobban**, **C. S**. & **Harrison, P. J.** (1985): Seaweed Ecology and Physiology. Cambridge University Press.
- **Lobban, C. S. And Wynne, M. J.** 1981. The Biology of Seaweeds. Botanical Monographs Volume 17. Blackwell Scientific Publications.
- **Sambamurthy**, **A. V. S. S**. (2005): A Text Book of Algae. 1st. Ed.I. K. International Pvt. Ltd. New Delhi.
- **Stein**, **J. R**. (1973): Handbook of Phycological & Biochemistry.
- **Stewart**, **W. D**. (1974): Algal Physiology & Biochemistry.
- **Tasks for Vegetation Science.** 1983. Physiology and Management of Mangroves. Vol. 8, Dr. W. Junk Publishers.
- **Waisel, Y.** (1972): Biology of Halophytes Academic Press, London and New York.

M. Sc. PART-II (SEMESTER III)

(CCS- 303.7): Plant Biotechnology

(SPECIAL PAPER II) MOLECULAR BIOTECHNOLOGY AND GENETIC ENGINEERING

Total Lectures: 60

UNIT I:

- Fundamentals of molecular biotechnology
- Vectors in gene cloning and their selection
- Molecular research procedure; Gene amplification, basic PCR, its modification, application, DNA polymorphism

UNIT II:

- Use of various enzymes in recombinant DNA technology Recombinant DNA and gene cloning, Techniques of restriction mapping, construction of chimeric DNA, cloning in bacteria and eukaryotes, molecular probes, southern northern and western blotting, dot and slot blots, constriction and screening of genomic and cDNA libraries, chromosome walking and chromosome jumping libraries

UNIT III:

- Isolation, sequencing and synthesis of genes: Isolation of genes, DNA sequencing, synthesis, gene synthesis machines plant genetic engineering: gene transfer technique

UNIT IV:

- **Genomics**: Human genome project, Nucleotide sequence databases
- **Proteomics:** Protein sequence information, composition and properties, Sequence comparison and protein databases
- **Enzymology**: IUB system, characteristics of enzyme and enzyme- substrate complex, Effect of temperature, pH, and substrate concentration on reaction rate
- **Immunology**: Immune system, Antibodies, Molecular biology of antibodies, Interferons and Vaccines

CCPR 305.3.7: PLANT BIOTECHNOLOGY PAPER XII: PRACTICAL COURSE II

UNIT V:

- Estimation and comparison of genomic DNA by UV-vis spectrophotometry
- DNA purification by gel electrophoresis
- Isolation of proteins
- Two- dimensional (2-D) paper chromatography of amino acids

UNIT VI:

- Genetic transformation: GUS
- Isolation of protoplast
- Restriction digestion of DNA
- Determination of optimum temperature for enzyme activity

Reference Books:

- **Chavala,** H. S. 1998. Biotechnology in crop improvement. International Book Distributing Co. New Delhi.
- **Glick**, B. R. and Pasternak, J. J. 1994. Molecular Biotechnology- Principles and applications of recombinant DNA. ASM Press, Washington.
- **Gupta**, P. K. 2000. Elements of Biotechnology. Rastogi Publisher, Meerut, India.
- **Jogdand**, S. N. 1997. Gene Biotechnology, Himalaya Publishing House, Mumbai, India.
- **Joshi,** P. 1998. Genetic Engineering and its applications. Agrobotanica.
- **Kakralya**, B. and Ahuja, I. 2001. Transgenic Plants-Promise or Danger. Agrobios, India.
- **Mitra,** S. 1996. Genetic Engineering- principles and practice. Mcmilan, India ltd.

M. Sc. PART- II (SEMESTER III)

(DSE- 304) Biotechnology and Genetic Engineering

Total Lectures: 60

UNIT I:

- Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors. *In vitro* mutagenesis and deletion techniques, gene knock-out in bacterial and eukaryotic organisms, RNA interference and CRISPER cas9.
- Process and Techniques in plant transformation, Binary vectors for plant transformation

UNIT II:

- DNA sequencing methods, strategies for genome sequencing.
- Methods for analysis of gene expression at RNA and protein level, large scale expression, such as micro array based techniques.
- Isolation, separation and analysis of carbohydrate and lipid molecules.
- RFLP, RAPD, SSR and AFLP techniques.

UNIT III:

- Concept, principle and applications of recombinant DNA technology
- Enzymes used in recombinant DNA technology, Restriction mapping, Cloning vectors, Construction of chimeric DNA
- Strategies for engineering resistant plants for biotic and abiotic stresses.
- Transgenic crops for nutritional quality improvement.

UNIT IV:

- Screening of transgenics using blotting techniques- Southern, Northern and Western.
- Genomics: *Arabidopsis* genome, Comparative genomics, Functional genomics
- Proteomics: Rationale, basic assumptions, methods for protein engineering
- Intellectual property rights (IPR) and protection (IPP): Concept, importance, ecological risks, ethical concerns and economic concerns.

Paper XII (CCPR 305.4.7): BIOTECHNOLOGY AND GENETIC ENGINEERING: PRACTICAL COURSE- II

UNIT V:

- Preparation of MS medium for Plant tissue culture and sterilisation techniques.
- Callus culture
- Micro propagation
- *Agrobacterium* mediated transformation (Hairy roots/ tumor formation)
- Isolation and culture of soil/ root nodule bacteria

UNIT VI:

- Isolation of genomic DNA.
- Agarose gel electrophoresis.
- Cell line isolation for secondary metabolites.
- Nucleotide sequence and BLAST.
- Patent filing pre-requisites

Reference Books:

- **Gupta, P. K.** 2010. Plant Biotechnology. Rastogi Publications, Meerut.
- **Glick, B, R. and Pasternak, J. J.** 1994. Molecular Biotechnology- Principles and Applications of Recombinant DNA. ASM Press, Washington D. C.
- **Gupta, P. K.** 2009. Biotechnology and Genomics. Rastogi Publications, Meerut.
- **Trehan, K.** 1994. Biotechnology. Wiley Eastern Limited, New Delhi.
- **Ramawat, K. G.** 2006. Plant Biotechnology. S. Chand and Company Ltd., New Delhi.
- **Trivedi, P. C.** (ed.) 2000. Plant Biotechnology- Recent Advances. Panima Publishing Corporation, New Delhi.
- **Chawla, H. S.** 1998. Biotechnology in Crop Improvement. International Book Distributing Company, Lucknow.
- **Aneja, K. P.** 1996. Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation. Weshwa Prakashan, New Delhi.
- **Sullia, S. B. and Shantharam, S.** 2005. General Microbiology. Oxford & IBH Publ. Ltd., New Delhi.
- **Tauro, P.; Kapoor, K. K. and Yadav, K. S.** 1996. An Introduction to Microbiology. Wiley Eastern Lmited, New Delhi.
- **Razdan, M. K.** 1994: An Introduction to plant tissue culture. Oxford & IBH Publ. Ltd., New Delhi.
- **Kumar, H. D.** 1993. Molecular Biology and Biotechnology, Vikas Publ., New Delhi.
- **Gamborg, O. L., Phillips, G. C.** 1995. Plant Cell, Tissue and Organ Culture-Fundamental Methods. Narosa Publ. House, New Delhi.
- **Reinhert, J. and Bajaj ,Y. P. S.** 1977. Applied and fundamental aspects of plant cell, tissue and organ culture, Springer Verlag, Berlin.
- **Dodds, J. H. and Roberts ,L. W.** 1985. Experiments in plant tissue culture. Cambridge University Press, Cambridge.
- **Boyce, C.O.L.** 1986. Novo's Handbook of Practical Biotechnology. Novo Industry.

M.Sc. II PART-II (SEMESTER IV)
(CC401): Plant Physiology and metabolism

Total Lectures: 60

UNIT I:

- Active and passive mechanisms of solute transport, Mechanisms of phloem loading and unloading of photoassimilates, source-sink relationship and its applications.

UNIT II:

- **Photosynthesis: P**hoto oxidation of water and C_3 pathway, RUBISCO, Sub classification of C_4 plants, PEPcase, ecological significance and modification of CAM.
- **Respiration:** Overview of plant respiration, Anaerobic respiration, Modern concept of electron transport and ATP synthesis. Inhibitors of respiration. Gluconeogenesis.

UNIT III:

- **Nitrogen metabolism:** Nitrate and ammonium assimilation; amino acid biosynthesis.
- **Secondary metabolites** - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

UNIT IV:

- **Plant hormones –** Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action of auxins, cytokinins, gibberellins and Abscisic acid.
- **Stress physiology –** Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

Paper XIII CCPR 405: PLANT PHYSIOLOGY AND METABOLISM

PRACTICAL COURSE

UNIT IV:

- Determination of lipid peroxidation in plants under stress.
- Determination of rate of respiration in germinating seeds under aerobic and anaerobic conditions.
- Estimation of free amino acid.
- Study of enzyme Nitrate reductase.
- Effect of PGR's on seed germination and seedling growth.

UNIT V:

- Estimation of enzyme Phenyl Alanine Ammonia Lyase.
- Separation of secondary metabolites using TLC.
- Measurement of RWC in plants under stress.
- Estimation of proline from stress and non-stress plants.

REFERENCE BOOKS

- **Bidwell, R. C. S.** (1979): Plant Physiology. Macmillan
- **Bonner, J.** and Varner, J.E. (1972): Plant Biochemistry. IBH.
- **Buchnan, B.B., Gruissem, W. And Jones, R.L. (2000)** Biochemistry and Molecular Biology of Plants. Wiley-Blackwell
- **Edwards G.** and Walker D., eds. (1983). C3, C4: mechanisms, and cellular and environmental regulation, of photosynthesis. Oxford: Blackwell Scientific Publications.
- **Govindjee, H.** (ed.) (1982): Photosynthesis, Vol. 1 and Vol. 2. Academic Press, N.Y. (Vol. 1); 0-12- 294302-2 (Vol. 2))
- **Hopkins, W. C.** (1995): Introduction to Plant Physiology. Wiley, New York.
- **Krishnamurthy, H.N.** (1992): Physiology of Plant Growth and Development. Atma Ram and Sons, Delhi.
- **Marschner, H. W.** (1986): Mineral nutrition of Higher Plants. First Edition, Academic Press, Elsevier Science Ltd.
- **Marschner, H. W.** (2003): Mineral nutrition of Higher Plants. Second Edition, Academic Press, Elsevier Science Ltd.
- **Moore, T.C.** (1974): Research experience in Plant Physiology, A Laboratory manual. Springer-Verlag, Berlin.
- **Mukherjee, S.P.** and Ghosh A.N. (1996): Plant Physiology. New Central Book Agency (P) Limited Tata McGraw Hill.
- **Noggle**, G.R. and Fritz, G. J. (1976): Introductory Plant Physiology. Prentice- Hall, Inc., Englewood Cliffs, NJ.
- **Pessarakli, M.** (Ed.). (2001). Handbook of Plant and Crop Physiology, 2nd Edition, Revised and Expanded. Marcel Dekker, Inc., New York

- **Pessarakli, M.** (Ed.). (2005). Handbook of Photosynthesis, 2nd Edition, CRC Press, Taylor & Francis Publishing Company, Florida
- **Randhir Singh** and Sawhney S. K. (1988): Advances in frontier Areas of Plant Biochemistry. Prentice Hall of India
- **Sadasivam S.** and Manickam A. (1996): Biochemical methods. New Age International.
- **Salisbury, F. B.** and Ross, C.W. (1992): Plant Physiology IV ed. Cengage Learning
- Sinha R.K. (2014) Modern Plant Physiology Second Edition, Narosa Publishing House Pvt. Ltd.
- **Smith, H.** (1975): Phytochrome and Photomorphogenesis. McGraw-Hill Inc.,US
- **Taiz, L.** and Zeiger, F. (1998, 2002, 2006): The Plant Physiology. Second Edition, Third Edition, Sunderland: Sinauer Associates.
- **Wilkins, M. B.** (1976): Physiology of Plant Growth and Development. McGrow-Hill Publishing Company Limited

Journals

- Annual Review of Plant Physiology and Molecular Biology.
- Annual Review of Plant Physiology
- Indian Journal of Plant Physiology.
- Journal of Experimental Botany.
- Physiologia Plantarum Sweden.
- Plant Physiology (Bethedsa, USA).
- Plant Cell

M.Sc. PART- II (SEMESTER IV)

(CCS402.1): Plant Physiology

(SPECIAL PAPER III) STRESS PHYSIOLOGY OF PLANTS

Total Lectures: 60

UNIT I:

- **Water stress**: Causes of water stress: Arid and Semiarid regions, Drought effect on physiological processes in plants, Mechanism of stomatal action, various mechanisms of drought resistance in plants, Antitranspirants, Drought hardening, Transgenic approach.
- **Flooding stress**: Nature of waterlogging stress. Effect of flooding stress on physiological processes in plants. Wetland and non-wetland species. Mechanism of waterlogging tolerance.

UNIT II:

- **Salt stress**: Definition of saline soil, Causes of soil Salinization. A brief outline of Salt affected soils in India, Physiological responses of plants to salinity stress, Halophytes and glycophytes mechanism of salinity tolerance in higher plants, Genetic engineering for salt tolerance.
- **Ionic stress**: Effect of ion toxicity (iron, zinc), heavy metals toxicity and aluminum toxicity in plants, Phytoremediation, Mechanism of aluminium tolerance, Transgenic approaches.

UNIT III:

- **Thermal stresses**: Effect of high and low temperatures on plant metabolism, Mechanisms of high and low temperatures tolerance, Cold hardening, Role of HSP.
- **Radiation stress:** Influence of high light intensity on photosynthesis, Photoprotection mechanisms, Effect of UV radiations on plants, Mechanism of UV tolerance.
- **Oxidative stress**: Generation of reactive oxygen species, Effect of ROS on metabolism,
- ROX detoxification mechanisms in plants, Transgenic approaches.

UNIT IV:

- **Gaseous stress**: Effect of elevated CO_2 concentration on plant metabolism, Effect of air pollutant SO_2 and O_3 on plants.
- **Biotic stress**: Effect of fungal infection on plant metabolism, Biochemical mechanism of disease resistance, Allelopathy.

PAPER XIV (CCPR 405.1): PLANT PHYSIOLOGY: PRACTICAL COURSE III

UNIT V:

- Measurement of osmotic potential of controlled and stressed tissue.
- Determination of chlorophyll stability index.
- Effect of foliar applications of some commercial PGR's and biotonics on crop productivity parameters (carbohydrate status).
- Study of effect of fungal infection on polyphenol oxidase activity.

UNIT VI:

- Study of free radicals scavenging enzymes, catalase in healthy and infected plants.
- Study of super oxide dismutase in healthy and infected plants.
- Study of effect of source manipulation on sink capacity in any crop plant.
- Study of effect of weedicides on some aspects of weed metabolism (chlorophylls/ nitrate reductase)
- Determination of Harvest Index (HI) of different crops (Wheat and chickpea)

Reference Books:

- **Buchnan, B.B., Gruissem, W. And Jones, R.L. (2000)** Biochemistry and Molecular Biology of Plants. Wiley-Blackwell.
- **Cherry, J. H. (ed.) (1989)** Environmental Stress in Plants: Biochemical and Physiological Mechanisms Associated with Environmental Stress Tolerance in Plants (NATO ASI Series G, vol. 19). Springer, Berlin.
- **Fitter, A.H. and R.K.M. Hay, (1987)** Environmental Physiology of Plants. Academic Press, San Diego, CA, 2nd. ed.
- **Hale, M.G. and Orcutt, D.M. (1987)** The Physiology of plants under stress. John Wiley and Sons, New York.
- **Kozlowski, T.T. (1984)** Flooding and Plant Growth. Ed. T.T. Kozlowski. Academic Press, Orlando, FL.
- **Levitt, J. (1980)** Responses of plants to environmental stresses: Vol.II, Water, Radiation, Salt and other. Academic Press, New York.
- **Mansfield, T.A. (1976)** Effects of Air Pollutants on Plants. CUP Archive
- **Mehrotra**, R. S. (1980): Plant Pathology. Tata McGraw-Hill
- **Paleg**, **L.G. and Aspinal, D. (1982)** The Physiology and Biochemistry of Drought resistant in Plants. Academic Press, Sydney.
- **Poljakoff-Mayber, A. and Gale, J. (eds.). (1975)** Plants in saline environments. Springer Verlag, New York, USA.
- **Rice, E. L. (1974)** Allelopathy, Academic Press, New York, San Francisco, London
- **Srivastava Y.N. (2009)**. Environmental Pollution APH Publishing Corporation, New Delhi
- **Turner, N. C., and Kramer, P. J. (1980)** Adaptation of Plants to Water and High Temperature Stress. Wiley, New York
- **Taiz, L. and Zeiger, F. (1998, 2002, 2008)**: The Plant Physiology. (Second Edition 1998, Third Edition2002, Fourth Edition 2008) Sunderland: Sinauer Associates.

Journals

- Allelopathy Journal
- Annual Review of Plant Physiology and Molecular Biology.
- Annual Review of Plant Physiology
- Indian Journal of Plant Physiology.
- Journal of Experimental Botany.
- Physiologia Plantarum, Sweden.
- Plant Physiology, Bethedsa, USA
- Plant Cell

M. Sc. PART-II (SEMESTER IV)
Paper XIV (CCS402.2): Mycology and Plant Pathology
(SPECIAL PAPER III) INDUSTRIAL MYCOLOGY

Total Lectures: 60

UNIT I:

- **Role of fungi in industry**: Scope and their utility.
- **Commercial fungal strains**: Selection, improvement, development and their maintenance.
- **Fermentation:**
- Industrial alcohol production through fermentation
- Industrial production of organic acids: citric, fumaric, itaconic and kojic acid.

UNIT II:

- Industrial production of enzymes: amylases, proteases, pectinases and invertases.
- Industrial production of vitamins: vitamin B_{12}, riboflavin, vitamin A.
- Industrial production of gibberellins.

UNIT III:

- Industrial production of antibiotics
- Production of ergot alkaloids.
- Economics of fermentation.

UNIT IV:

- Edible fungi, their nutritional value and role in cottage industry.
- Large and small scale cultivation technique of *Agaricus bisporus*, *Pleurotus* spp., *Volvariella volavacea* and their preservation, diseases and their control, cost benefit analysis.

PAPER XIV CCPR 405.2: MYCOLOGY & PLANT PATHOLOGY PRACTICAL COURSE III

UNIT V:

- Maintenance of fungal strains using different methods.
- Production of industrial alcohol by fermentation technique.
- Detection of citric acid from mycelial biomass using circular paper chromatography.
- Detection of antibiotics from mycelial biomass.
- Production of ergot alkaloid by using fungal elicitors.

UNIT VI:

- Preparation of spawn: Grain, Perlite and manure spawn.
- Cultivation of mushroom.
- Study of some enzymes (amylases, proteases, pectinases and invertases) of fungal origin.

Refernce Books:

- **Casida**, L. E. Jr. (1964). Industrial Microbiology. John Wiley and Sons, USA
- **Whipps**, J. M. and Lumsden, R. D. (1989). Biotechnology of fungi for improving plant growth. Press Syndicate of the University of Cambridge, UK
- **Turner** (1971). Fungal metabolism. Academic Press, USA
- **Atal** (1978). Indian Mushroom Science-I. Indo American Literature House
- **Kannaiyan** (1980). A hand book of edible mushrooms. Todays and Tomorrow's. Publ.
- **Purkhyastt** (1976). Indian edible mushrooms. Firma KLM, 1976 Cornell University
- **Smith**, J. F. and Barry, D. R. The filamentous fungi Vol.I Industrial Mycology Vol.II and III. Edward Arnold, London.
- **Dodge**, C.W. (1935). Industrial Mycology.
- **Prescott**, S. G. and Dunn, C. D. (1959). Industrial Microbiology. AVI Pub.n Com. Westport, CT
- **Christensen**, C. M. (1975): Mould, Mushrooms and Mycotoxins. University of Minnesota press, Minneapolis
- **Rose**, A. H. (1961). Industrial Microbiology. Butterworths, London
- **Singer**, R. (1961). Mushrooms and Truffles cultivation and utilization. Leonard Hill, Ltd.,
- **Rhodes**, A. and Fletcher, D. L (1966). Principles of industrial microbiology. Pergamon Press, Oxford, UK
- **Gray**, W. D. (1970). The use of fungi as food and food processing. Cleveland, Oh: CRC Press, USA
- **Lodder**, J. (1970). The Yeast. North- Holland, Amsterdam
- **Chang**, S. T. and Hays, W. A. (1978). The biology and cultivation of edible mushrooms. Academic Press, New York.
- **Aneja**, K. R. (1993). Experiments in Microbiology,Plant Pathology and Tissue Culture.
- **Onions**, A. H. S. D. Allsopp and Eggins, H. O. W. (1981). Smith's Introduction to Industrial Mycology. New Age International Publishers
- **Barger**, G. (1931). Ergot and Ergotism. Edward Arnold
- **Fletcher**, J. T.,White, P. F.and Gaze, R. H.(1989). Mushrooms: Pest and Disease Control. Inter- cept, Ltd., VCH Publishers, Suite 909, 220 East 23rd Street, New York,

M.Sc. PART-II SEMESTER IV
Paper XIV (CCS402.3): Cytogenetics and Plant Breeding
(SPECIAL PAPER- III) MOLECULAR GENETICS

Total Lectures: 60

UNIT I:

- Microbial Genetics: Genetic studies in microorganisms with special reference to *Escherichia coli* and *Agrobacterium* spp.
- Genetic exchange in bacteria- an overview (mutants, conjugation, Transduction and transformation) site directed mutagenesis.

UNIT II:

- The Genetics of Viruses: The structure and life cycle of bacterial virus, Mapping the bacteriophage genome (Phage phenotypes, genetic recombination in phage, fine structure and deletion mapping), T4 genetic map, bacteriophage X 174.
- Molecular analysis of DNA, RNA and proteins using blotting techniques and micro arrays; molecular markers (third and fourth Generation) and their uses.

UNIT III:

- **PCR and DNA sequencing**: PCR and its types. Classical methods for DNA sequencing,
- Automatic DNA sequencer, Restriction maps and molecular maps. Genome wide association studies (GWAS)

UNIT IV:

- **Bioinformatics, Genomics and Proteomics**: Bioinformatics tools for analyzing genomic information; Biological databases, Comparative genomics- Ancient duplications and Palaeopolyploidy, Phylogenetic analysis. Genomes of higher plants- *Arabidopsis,* Rice, Soybean, Maize and grapevine.
- Comparative genomics tools and techniques, macro and microsynteny, evolutionary principles and applications

(CCPR 405.3) CYTOGENETICS AND PLANT BREEDING PAPER XV
PRACTICAL COURSE III

UNIT V:

- *In silico* studies (Identification of SSRs, Primer designing and Similarity search analysis using different BLAST programs)
- Preparation of linkage map using mapmaker and join map
- QTL analysis using QTL Cartographer and QTL Network
- EST analysis in crops
- Study of polymorphism in crop plants using molecular markers (RAPD/ ISSR)
- Demonstration of southern blotting
- Phylogenetics analysis

UNIT VI:

- Study of restriction digestion analysis by gel electrophoresis
- Secondary metabolite production and analysis
- Anther culture and haploid production
- Cell line isolation
- Hairy root culture
- Study of transgenic plants
- Detection and estimation of protease inhibitors from cereals/pulses

Reference Books:

- **Twyman R. M.** 1998. Advanced molecular Biology. Viva Books Pvt. Ltd. New Delhi.
- **Wolfe S. L.** 1993. Molecular and cellular biology. Wadwith Publishing Co. California USA.
- **Lewin, B.** 2008, Genes IX Oxford University Press, New York.
- **Brown T. A.** 1998. Genomes. John Wiley and sons Singapore.
- **Alberts B. et al** 1994. Molecular biology of the cell 3rd Edition Garland Publishing, New York.
- **Singh B. D.** 1990. Fundamentals of Genetics. Kalyani Publishers Ludhiana.
- **Latchman D. S.** 1990. Gene regulation an eukaryotic perspective. Unwin Hyman Publication London.
- **Klug W. S. and Cummings M. R.** 1983. Concepts of Genetics. Charles E. Merrill Publishing Company London.
- **Jain H. K.** 1999. Genetics Principles, Concepts and Implications. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
- **Gupta P. K.** 1985. Genetics Rastogi Publications Meerut.
- **Griffith A. J. F. Miller J. H., Suzuki D. T., Lewontin R. C. and W. M. Gelbart** 1996. An introduction to Genetics Analysis. 6th Edition W. H. Freeman New York.
- **Strickberger M. W. 1996** Genetics 3rd Edition MacMillan Publishing Co. New Delhi.

Journals:

- Annual review of Microbiology
- Journal of Cytology and Genetics
- Cytologia
- Caryologia
- Indian Journal of Experimental Biology
- Journal of Experimental Botany
- Trends in Biotechnology (Elsevier)

M.Sc. II PART- II (SEMESTER IV)

(CCS402.4): Energy, Ecology and Environment

(SPECIAL PAPER III) EXPERIMENTAL ECOLOGY AND ENERGY STUDIES

Total Lectures: 60

UNIT I:

- **Ecological Methods**: Autecology and synecology, Bigger unit of vegetation, Seed output, Germination capacity. Various methods involved in aquatic studies.
- **Methods of community study**: Minimal area curve, Quadrats, point, Transects, Grid, Use of GPS in Mapping.
- Measurement of primary productivity in terrestrial and aquatic ecosystems.

UNIT II:

- **Systems Ecology**: Introduction and basic elements of system ecology.
- **Construction of model**: Conceptual model, Auxiliary variables, Forester diagrams.
- **Methods** to study ecology of genetic erosion to construct model and examples **Phytoremediation:** Classification of phytoremediation and their application.

UNIT III:

- **Energy Sources**: Biomass as a source of energy, Composition of biomass (cellulose, hemicelluloses, lignin), Terrestrial biomass, aquatic biomass.
- **Bio energy**: Energy plantation, Social forestry, Silviculture, Energy farms, Petroleum plants, Hydrocarbon from higher plants (Hevea, Euphorbia), Algal hydrocarbons

UNIT IV:

- **Energy from Waste**: Biogas production, Biomass to electricity, Bio village concept, Eco Cook stoves.
- **Rain harvesting**: Harvesting system and techniques, Methods and Advantages **Vermicomposting technology** – Role of earth worm, Process of vermin composting, applications.
- C**onventional energy sources:** Coal and Natural gas, Hydropower, Nuclear energy
- **Non-conventional energy:** Solar energy, Wind energy, Geothermal energy

PAPER XV (CCPR 405.4): ECOLOGY
PRACTICAL COURSE III

UNIT V:

- Survey and mapping of area by GPS.
- Seed germination under various treatments for tree species.
- Study of seed output and reproductive capacity.
- Study of petro crops and energy plants.
- 5-6 Study of effect of natural light intensity on primary productivity of an aquatic ecosystem.

UNIT VI:

- Setting up of an ecological model.
- Use of ecological model in the field study.
- Determination of Leaf Area Index (LAI).
- Induction of rooting.
- Statistical analysis of ecological data.
- Determination of calorific value of wood

Reference Books:

- **Agarwal S. K**. (1992): Fundamentals of Ecology. New Delhi: Ashish Publishing House.
- **Bradbury I. K**. (1990): The Biosphere. Published by John Wiley & Sons, Chichester.
- **Das S. M**. (1989): Handbook of Limnology and water pollution with practical Methodology. Published by South Asian Publishers, New Delhi.
- **Etherington J.R**. (1975): Environment and plant ecology: aims and development. Publisher Wiley.
- **Freedman H. I**. (1980): Deterministic mathematical models in population ecology. Marcel Dekker Inc., New York.
- **Greig Smith P**. (1983): Quantitative Plant Ecology. *Publisher*: WILEYBLACKWELL
- **Grims J. P.** ***et al*** (1988): Comparative Plant Ecology. Colvend, Dalbeattie, Kirkcudrightshire [Scotland]: Castlepoint Press.
- **Hashimoto Y** ***et al*** (1990): Measurement techniques in plant sciences. San Diego, Calif.: Academic Press
- **Kershaw K. A**. (1964): Quantitative and dynamic ecology. Publisher: Edward Arnold
- **Kormondy E. J**. (1996): Concept of ecology. Publisher: Benjamin Cummings.
- **Krebs C. J.** (1978): Ecology. Harper & Row., New York.
- **Lieth H. F.** ***et al*** (1973): Patterns of primary production in the biosphere. Kluwer Academic Publishers-Plenum Publishers.
- **Misra K. C.** (1989): Manual of plant ecology. Oxford and IBH Publishing Co., New Delhi.
- **Misra R. and Das R. R**. (1971): Proceedings of the school of plant ecology. Publisher: Calcutta Oxford & IBH Pub. Co.
- **Odum E. P**. (1971): Ecology. Publisher: Saunders
- **Odum E. P**. (3rd ed. 1996): Fundamentals of Ecology. Natraj Publishers, Dehra Dun.
- **Pandeya S. C**. ***et al*** (1963): Research methods in plant ecology. Asia Publishing House.
- **Watt K. E. F**. (1973): Principles of Environment Sciences. Published by McGraw-Hill.

M. Sc. PART II (SEMESTER IV)
Paper XIV: (CCS 402.5): Angiosperm Taxonomy
(SPECIAL PAPER III) ANGIOSPERM TAXONOMY FLORISTICS AND BIOSYSTEMATICS

Total Lectures: 60

UNIT I:

- **Floristic:** Need and significance of floristic studies, methodology, analysis and data presentation.
- **Taxonomic literature:** General taxonomic indexes, world floras and manuals, monographs and revisions, bibliographies, catalogues, review serials, periodicals, glossaries, dictionaries, cultivated and economic plants, maps and cartography, biographical references, dates of publication, location of type specimens, dictionaries and addresses, colour charts, outstanding botanical libraries.
- **Botanical keys:** Diagnostic, synoptic and artificial keys-Single access (sequential)-bracketed and indented keys and multi-access keys, edge-punched and body-punched (polyclave) keys, tabular and lateral keys; computerized keys, their merits and demerits.

UNIT: II

- **History of botanical exploration in India:** Beginning of botany in India, contributions made in earlier phase by Garcia d'Orta, C. Acosta, Van Rheede, John Burman, John Koenig, Robert Kyd, Buchanan, Roxburgh, N. Wallich, William Griffith, Robert Wight, Thomas Thomson, J. D. Hooker, Collet, Brandis, T. Cooke, Duthie, Fyson, Gamble, Haines, Parkinson, Prain, Santapau, and recent works with special emphasis on Maharashtra. Botanical Survey of India (BSI).
- **Biosystematics:** Aims, concepts of species, steps in biosystematic study, biosystematic categories- ecotype, ecospecies, cenospecies, comparium, methods in biosystematic studies, ecotypic variations and taxonomy, scope and limitations.

UNIT: III

- **Origin of agriculture and rise of food crops:** Introduction, food plants, origin and spread of *Homo sapiens*, centres of plant domestication of major crops, crop dispersal and distribution.
- **Plant domestication:** Introduction, Evolution of farming, Plant domestication, origin of crops, changes during domestication, genetic regulation of domestication syndromes, evolution of weeds, genetic diversity and domestication.
- **Crop plants and their wild relatives:** Cereal grains (rice, sorghum, wheat), legumes (chickpea, black gram, mung bean, cowpea, moth bean), starch plants (banana, yam), fruits (apple, citrus, grape, peach, strawberry), vegetables (cucurbits)

UNIT: IV

- **Morphological variations, systematic position, interrelationships, phylogeny and economic importance of following families:**
- ROSIDS**:** Rhamnaceae, Moraceae, Urticaceae, Cucurbitaceae, Begoniaceae, Casuarinaceae, Lythraceae, Onagraceae, Myrtaceae, Melastomataceae, Rutaceae, Meliaceae, Sapotaceae, Lecythidaceae, Solanaceae.

Paper XIV (CCPR 405.5): ANGIOSPERM TAXONOMY: PRACTICAL COURSE III

UNIT I:

- Herbarium technique
- Botanical keys
- Study of ecotypes/ variations in population of species
- Identification of taxa with the help of computerized key
- Study of weeds found in the region
- Study of crop plants and their wild relatives (cereals and legumes)

UNIT II:

- Study of crop plants and their wild relatives (Fruit and vegetables)
- Description, sketching, classification and identification of families: ROSIDS- Rhamnaceae, Moraceae, Urticaceae, Cucurbitaceae, Begoniaceae, Casuarinaceae, Lythraceae, Onagraceae, Myrtaceae, Melastomataceae, Rutaceae, Meliaceae, Sapotaceae, Lecythidaceae, Solanaceae and identification of wild and cultivated plants represented in local flora.
- Any additional practical/s based on theory syllabus will be added whenever necessary.

Reference Books:

- **Cronquist, A. 1981**. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.
- **Cronquist, A. 1988**. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press, U.S.A.
- **Davis, P. H. and V. H. Heywood 1991**. Principles of Angiosperm Taxonomy. Today and Tomorrow Publications, New Delhi.
- **Endress Peter, K. 1994**. Diversity and Evolutionary Biology of Tropical Flowers. Cambridge.
- **Judd Walter S., Campbell C. S., Kellogg, E. A., Stevens P.F. and M. J. Donoghue 2008**. Plant Systematics-A Phylogenetic Approach. Sinauer Associates, INC, Publishers. Sunderland, Massachusetts, USA.
- **Judd Walter S., Campbell C. S., Kellogg, E. A., Stevens P.F. and M. J. Donoghue 2008**. Plant Systematics-A Phylogenetic Approach. Sinauer Associates, INC, Publishers. Sunderland, Massachusetts, USA.
- **Lawrence, G. H. M. 1951**. Taxonomy of Vascular Plants. Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi.
- **Naik, V. N. 1984**. Taxonomy of Angiosperms. Tata McGraw-Hill, New Delhi.
- **Quicke, Donald, L. J. 1993**. Principles and Techniques of Contemporary Taxonomy. Blakie Academic & Professional, London.
- **Rao, R. R. 1994.** Biodiversity of India (Floristic Aspects). Bishen Singh Mahendra Pal Singh, Dehra-Dun.
- **Rao**, **R. R. 1994.** Biodiversity of India (Floristic Aspects). Bishen Singh Mahendra Pal Singh, Dehradun.
- **Richard, A. J. 1997**. Plant Breeding Systems. (2ed.) Chapman and Hall.
- **Shivanna, K. R. and B. M. Johri 1985**. The Angiosperm Pollen: Structure and Function. Wiley Eastern limited, New Delhi.
- **Taylor, D. V. and L. J. Hickey 1997**. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributers, New Delhi.

M. Sc. PART-II (SEMESTER IV)
Paper XIV (CCS 402.6): Marine Botany
(SPECIAL PAPER III) MARINE ECOLOGY

Total Lectures: 60

UNIT I:

- **Marine environment**: Exposed coasts, estuaries, oceans**.**
- **Abiotic factors** - Geological factors- oceans, ocean floor, classification of coasts. Physical factors- light, temperature, water movements (waves, tides, currents), Chemical factors-sea water, salinity, O_2 & CO_2 in sea water, ionic concentration & nutrients.
- **Biotic factors**: Food webs & chains, succession in marine communities, biological interactions.
- **Zonation of marine algae**: Intertidal, submerged, sublittoral zonation pattern, seasonality.

UNIT II:

- **Ecology of mangroves**: Morphological, anatomical and physiological adaptations in mangroves. Vivipary and it's role in mangroves. Zonation and succession in mangroves.
- **Faunal components of mangrove habitat**- Invertebrates, birds, reptiles, fishery resources, mammals, sediment fauna.
- **Mangrove conservation, restoration & management**
- **Legal Framework:** Forest Conservation Act, Coastal Regulation Zone (CRZ), Biodiversity and wild life act.

UNIT III:

- **Coastal vegetation and organic matter export:** Decomposition, Detritus food chain, Ecological role of microbes. Microbial diversity in mangrove ecosystem - N_2 fixing, PO_4-solubilizing, S-reducing, methanogenic bacteria, Actinomycetes and fungi in mangrove ecosystem.
- **Coral Reefs**: Occurrence, distribution and types. Formation and erosion of coral reefs. Calcification, nutrient cycling, reef micro and macro algae, natural and anthropogenic stresses, management & restoration of coral ecosystem, concept of marine park/ marine protected areas.

UNIT IV:

- **Marine pollution**: Types, sources, heavy metal pollution-effects on algal metabolism, oil spills, fate of oil and effect on algal metabolism, synthetic organic chemicals-herbicides, insecticides, industrial chemicals (pcbs), complex wastes and eutrophication, pulp mill effluent, domestic wastes, radioactive pollution, biological damage and indirect damage, management and restoration. Biomagnification.
- **Ecological role of mangrove ecosystem:** Screening of solar radiations, control of cyclones, flood, prevention of coastal erosion, support for fishes and wild life population, protection to other ecosystems.

PAPER XIV (CCPR 405.6): MARINE BOTANY: PRACTICAL COURSE III

UNIT V:

- Determination of EC, pH, salinity and chlorinity of seawater.
- Determination of nitrate content of seawater.
- Determination of phosphate content from seawater.
- Study of salts glands, trichomes, sclereids in mangroves.

UNIT VI:

- Study of vivipary in mangrove families.
- Study of faunal members from mangroves ecosystem.
- Determination of oil and grease / hydrocarbon content of polluted sea water
- Study of zonation pattern in mangroves.
- Determination of sulphate content from marine sediment/soil.

Reference Books:-

- **Chapman,**V. J. (1976).Costal Vegetation.2 nd edition Pergamon Press. New York.
- **Daves**, C. J (1985). Marine Botany Physiology and Ecology of Seaweeds.
- **Dawson** (1960). Marine Botany.
- **Gerald**, E. Ecophysiology of Economic Plants in Arid and Semiarid Land.
- **Lobban,** C. S. & Harrison, P. J. (1985). Seaweed Ecology and Physiology. Cambridge University Press.
- **McConnaughey**, B. H (1974). Introduction to Marine Biology.
- **Naskar**, Kumudranjan, Dwijendra Narayan Guha ,Bakshi. Mangrove Swamps of the Sundar bans. An Ecological Perspective. Naya Prakash.
- **Naskar,** Kumundrajan and Rathindranath Mandal (1999). Ecology and Biodiversity of Indian Mangroves, Vol. I and II.
- **Pandey** B.P. (1994). Algae. S. Chand and Co. Ltd., New Delhi. Current trends in life science, Vol.23: Agromicrobes, Today and Tomarrow. Publ. New Delhi.
- **Parsons,** T. R., Maita,Y & Lalli, C. M. A Manual of Chemical and Biological Methods for Sea Water Analysis.
- **Ranade, D. R. & Gadre, R. V. (1988).** Microbial Aspects of Anaerobic Digestion. Laboratory
- **Saenger**, **P. (2002).** Mangrove Ecology, Silviculture and Conservation. Springer.
- **Soepadmo, E. A. N. Rao and Macintosh, D. J. (1988).** Proceedings of Asian Symposium. Mangrove Environment Research Management, Kuala Lumpur.
- **Stein**, **J. R. (1973)** Handbook of Phycological Methods. Cambridge University Press.
- **Tait, R. V. (1981)** Elements of Marine Ecology.
- **Zha, M. N. (1999)**. Current Trends in Life Sciences Vol.23, Agromicrobes. Today and Tomorrow. Publi. New Delhi.

M. Sc. PART-II (SEMESTER IV)
Paper XIV (CCS 402.7): Plant Biotechnology
(SPECIAL PAPER III) APPLICATION AND PROSPECTS OF PLANT TISSUE CULTURE

Total Lectures: 60

UNIT I:

- Application of biotechnology in conservation of plant generic resources: *In- situ* conservation, *Ex- situ* conservation
- **Application of tissue culture in agriculture**: Plant improvement through tissue culture technology; production of resistant lines to biotic and abiotic stresses

UNIT II:

- Applications of tissue culture in horticulture, forestry and sericulture: micropropagation of Banana, Bamboo, *Tectona*, *Nothapodytes* and *Morus* Tissue culture in orchids and *Gerbera*
- Prospects in plant tissue culture industry in India; Applications in public sector

UNIT III:

- Secondary metabolite production from callus and cell suspension,
- Biotransformation, process design and product recovery from cultured plant cells. Factors affecting product yield, bioreactors
- Secondary metabolites from immobilized plant cells; production of single cells proteins

UNIT IV:

- Transgenic plants for crop improvement: Resistance to abiotic stresses (salt, oxidative, herbicide and drought resistance); Resistance to biotic stresses (fungi, insect and virus resistance) Molecular farming, edible vaccines

Paper XIV (CCPR 405.7): PLANT BIOTECHNOLOGY

PRACTICAL COURSE III

UNIT V:

- *In vitro* culture of any RET plant species
- Screening of cell cultures for abiotic (PEG)/ biotic (fungal) stress
- Micropropagation of Banana
- *In vitro* germination of orchid seeds
- Micropropagation of *Gerbera*

UNIT VI:

- Hairy root culture
- Production of synseeds and cell immobilization
- Effect of elicitor (Chitosan) on production of secondary metabolites from cell culture
- Study of transgenic plants (Bt/ Terminator/ edible vaccines etc.)

Reference Books:

- **Altman**, A. 1998. Agricultural Biotechnology. Marcel Dekker, New York.
- **Chavala**, H. S. 1998. Biotechnology in crop improvement. International Book Distributing Co. New Delhi.
- **Glick**, B. R. and Pasternak, J. J. 1994. Molecular Biotechnology- Principles and applications of recombinant DNA. ASM Press, Washington.
- **Gupta**, P. K. 2000. Elements of Biotechnology. Rastogi Publisher, Meerut, India.
- **Kakralya**, B. and Ahuja, I. 2001. Transgenic Plants-Promise or Danger. Agrobios, India.
- **Ravishankar**, G. A.and Venkataraman, L. V. 1997. Biotechnological applications of plant tissue and cell culture. Oxford and IHB Publishing Co. Pvt. Ltd., New Delhi.
- **Reddy**, S. M., Srivastava, H. P., Purohit, D. K., and Reddy, S. R. 1997. Microbial biotechnology. Scientific Publishers, Jodhpur, India.
- **Schlegel,** H. G.1995. General microbiology. Cambridge University Press.
- **Trehan**, K.1994.Biotechnology. Wiley Eastern Ltd. New Delhi.

M. Sc. PART-II (SEMESTER IV)
Paper XV (CCS403.1): Plant Physiology
(SPECIAL PAPER IV) APPLIED PLANT PHYSIOLOGY

Total Lectures: 60

UNIT I:

- **Crop growth and its regulation**: Growth analysis of crop plants and its significance. Factors controlling crop productivity, Harvest Index (HI), Water Use Efficiency (WUE).
- **Nutriophysiology**: Foliar diagnosis of critical nutrient status. Applications of lime and gypsum lime as soil additives. Role of chelates in mineral utilization. Foliar applications of mineral elements. Biofertilizers, CO_2 as a fertilizer.

UNIT II:

- **Reproductive physiology:** Role of PGRs in flowering, sex determination and fruit development.
- Ethylene and post-harvest physiology.
- Source-Sink capacity in crop plants and its significance.

UNIT III

- **Plant growth regulators in agriculture and horticulture:** Mode of applications of PGR's, Pre sowing soaking treatment, foliar application and other modes
- **Roles**: Ethylene and ethylene generating compounds, long chain alcohols, Brassinosteroids, plant growth retardants, amino acid mixtures and other commercial products. Biotonics.

UNIT IV:

- Invading weeds, crop-weed interaction, weedicides and their mode of action
- Physiological aspects of transgenic crops.
- A brief idea of crop physiological research in India.

Paper XV (CCPR 405.3.1): PLANT PHYSIOLOGY

PRACTICAL COURSE IV

Project work based on special papers.

Reference Books

- **Asana, R.D. and Sarin, M.N. (1968)** Crop physiology in India. Tech. Bull. 16. Indian Coun. Agric. Res. (Agric. Ser.)
- **Buchnan, B.B., Gruissem, W. And Jones, R.L. (2000)** Biochemistry and Molecular Biology of Plants. Wiley-Blackwell
- **Evans**, L.T. (1972): Crop Physiology. Some Case Histories. Cambridge, NY
- **Fageria,** N. K. (1992): Maximizing crop yield. CRC Press
- **Fitter, A.H. and R.K.M. Hay (1987)** Environmental Physiology of Plants. (Second Edition) Academic Press, San Diego, CA
- **Gupta U.S. (1988)** Progress in Crop Physiology. Oxford and IBH. Pub. Co.
- **Gupta U.S. (1995)** Production and Improvements of Crops for Drylands. Oxford and IBH. Pub. Co.
- **Krishnamurthy, H.N.** (1992): Physiology of Plant Growth and Development. Atma Ram and Sons, Delhi.
- **Nickell, L.G. (1982)** Plant Growth Reggulators- Agricultural Uses. Springer Verlag, New York
- **Pessarakli, M.** (Ed.). (2001). Handbook of Plant and Crop Physiology, 2nd Edition, Revised and Expanded. Marcel Dekker, Inc., New York
- **Taiz, L. and Zeiger, F. (1998, 2002, 2008)**: The Plant Physiology. (Second Edition 1998, Third Edition 2002, Fourth Edition 2008) Sunderland: Sinauer Associates.

Journals

- Annual Review of Plant Physiology and Molecular Biology.
- Annual Review of Plant Physiology
- Indian Journal of Plant Physiology.
- Journal of Experimental Botany.
- Physiologia Plantarum Sweden.
- Plant Physiology (Bethedsa, USA).
- Plant Cell.

M. Sc. PART-II (SEMESTER IV)

(CCS403.2): Mycology and Plant Pathology

(SPECIAL PAPER IV) INTEGRATED DISEASE MANAGEMENT

Total Lectures: 60

UNIT I:

- **Methods of disease diagnosis**: Field observation, isolation and identification of Pathogens.
- **Integrated management of plant diseases**: Definition of IDM, international approach, Quarantine laws, Culture methods, avoidance of pathogen, breeding and use of disease resistant varieties. Seed certification.

UNIT II:

- Chemical methods, formulation and classification of fungicides, contact and systemic fungicides, uptake and mode of action. Seed, soil, plant treatments of fungicides, fungicide resistance in plant pathogens and their management. Antibiotics and biological control of plant pathogenic fungi. Biological control agents, VA-Mycorrhiza, *Trichoderma viride,T. harzianum, Pseudomonas flurescans, Glomus* spp. Use of botanicals and other biopesticides.

UNIT III:

- **Integrated management of some important diseases**: History, symptomology, pathogen, etiology and management: Jowar (Head and Grain smut), Bajara (Green ear), Wheat (Rust and Bunt), Rice (Blast), Groundnut (Leaf spot and Rust), Sunflower (Downy mildew), Soybean (Mosaic), Cotton (Angular leaf spot).

UNIT IV:

- **Integrated management of some important diseases:** Sugarcane (Whip smut and Grassy shoot), Banana (Blight), Citrus (Canker), Grapes (Powdery mildew, Anthracnose, Downy mildew), Pigeon pea (Wilt), Bhendi (Yellow vein mosaic virus), Potato (Early and late blight), Tomato (Early blight).

Paper XV (CCPR 405.3.2): MYCOLOGY AND PLANT PATHOLOGY: PRACTICAL COURSE IV

Project work based on special papers.

References Books

- **Lalithakumari** D. (2000). Fungal Protoplast: A Biotechnological Tool: Oxford and IBH Publishing Co. Pvt.Ltd.
- **Mathews**, R. E. F. (1970). Plant Virology. Academic Press, New York
- **Tilak,** S.T. (1998). Aerobiology. Satyajeet Prakashan
- **Kenneth** M. Smith (1968). Plant Viruses. Acacdemic Press, New York
- **Bawden**, F. C. (1964). Plant Viruses and Virus Diseases. Biotech Books, New Delhi
- **Mehrotra,** R. S. (1980). Plant Pathology Tata McGraw-Hill Publishing Company Ltd.
- **Agrios**, G. N. (2006). Plant Pathology (5th Edition). Academic Press, New York
- **Ny Vall**, R. F. (1979). Field Crop Diseases Handbook. Wiley
- **Singh**, R. S. (1963). Plant Diseases.—
- **Padoley**, S. K. and P. B. Mistry: A manual of Plant pathology. International Book House, New Delhi
- **Gangopadhyay**, S. (1984): Clinical Plant Pathology Kalyani Publishers

M.Sc. PART-II SEMESTER IV

Paper XV (CCS 403.3): Cytogenetics and Plant Breeding

(SPECIAL PAPER IV) SPECIAL APPROACHES IN GENETIC IMPROVEMENT OF CROP PLANTS

Total Lectures: 60

UNIT I:

- Functional genomics: Genome annotation
- RNA interference mechanism, synthesis and its applications, Virus induced gene silencing
- (VIGS), VIGS in plant genomic research
- Transcriptomics and methods of transcriptome analysis

UNIT II:

- Quantitative trait loci (QTL), Methods of QTL analysis by using molecular markers.
- Mapping population (RIL, NILS, DH, back cross) their mechanism an development.
- Bulk segregation analysis. Allele Mining for crop improvement: Approaches for allele mining, significance of novel alleles, applications of allele mining.
- Marker assisted selection for crop improvement: Selection of markers, breeding schemes involved, gene pyramiding applications of MAS.
- Epigenetics and Epigenomics for crop improvement

UNIT III:

- Tissue Culture: Anther culture, production of haploids, embryo rescuing and its uses in crop improvement.
- Production of secondary metabolites, cell line isolation, hairy root culture with some important secondary metabolite production and use of bioreactors.
- Production of biotic and abiotic resistant plants using tissue culture.

UNIT IV:

- Transgenics: a) Methods of gene transfer and its expression
- b) Transgenic crops for biotic and abiotic stresses, nutritional quality improvement,
- c) Transgenic crops field testing and regulatory measures

Paper XV (CCPR 405.3.3.): CYTOGENETICS AND PLANT BREEDING: PRACTICAL COURSE IV

Project work based on special papers.

Reference Books:

- **Thimmaiah S. R.** 1999, Standard methods of biochemical analysis. Kalyani Publishers Ludhiana.
- **Mitra Sandhya** 1996, Genetic Engineering Macmillan India Ltd.
- **Lal R. and Lal S.** 1993, Genetic engineering of plants for crop improvement. CRC Press.
- **Winkler, U. Ruger W. and Wackernagel W.** 1979. Bacterial phage and molecular genetics. Narosa Publication New Delhi.
- **Chawala H. S.** 2000 Introduction to Plant Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd.
- **Vidhyashekaran P.** 1993 Molecular biology and tissue culture from crop pest and disease management. Daya Publishing House New Delhi.
- **Kumar U.** 2005 Methods in Plant Tissue culture Agrobios Jodhpur India.
- **Razdan M. K.** 2003 Introduction to plant tissue culture. Oxford and IBH publishing Co. Pvt. Ltd.
- **Gustafson J. P.** 1990 Gene manipulation in plant improvement I and II. Plenum Press London.
- **Old R. W. and Primrose S. B.** 1989 Principles of Gene Manipulation. Blackwell Scientific Publ Oxford UK.
- **Razdan M. K. and Cocking E.C.** 2000 Conservation of plant genetic recourses in vitro. Oxford and IBH publishing Co. Pvt. Ltd.
- **Razdan M. K. and Bhojwani S. S.** 1996, Plant tissue culture: Theory and practice a revised edition. Elsevier Science.
- **Gupta P. K.** 2010 Plant Biotechnology. Rastogi Publications Meerut.
- **Singh B. D.** 2003 Biotechnology Expanding Horizons. Kalyani publishers Ludhiana.
- **Trigiano R. N. and Gray D. J. 2000** Plant tissue culture concepts and laboratory exercises. CRS press LLC.
- **Manibhushanrao K. and Mahadevan A.** 1996 Recent developments in biocontrol of plant pathogens. Today and Tomorrow's printers and publishers New Delhi.
- **Reinert J. and Bajaj Y. P. S.** 2000 Plant cell, Tissue and Organ culture. Springer – Verlag. New York,
- **Chrispeels M. J. and Sadava D. E.** 1994 Plants, Genes and Agriculture. Jones and Barlett Publishers Boston, USA.
- **Gustafson J. P.** 2000 Genomes. Kluwer Academic Plenum Publishers New York USA.
- **Brown T. A.** 1999 Genomes. John Wiley and Sons Pvt. Ltd. Singapore.
- **Liu Ben Hui** 1998 Statistical Genomics: Linkage Mapping and QTL Analysis. CRC Press LLC Florida USA.
- **Wennacker Ernst L.** 1987 From Genes to Clones; Introduction to Gene Technology VCH publishers Weinheim (Federal Republic of Germany)

- **Mount D. W.** 2001 Bioinformatics Sequence and Genome Analysis. Cold Spring Harbour Laboratory. New York.
- **Jagota A.** 2000 Data Analysis and Classification for Bioinformatics. Published by
- Bioinformatics by the bay Press. University of Michigan, USA
- **Durbin R, Sean R., Eddy, Anders Krogh, Graeme M.**1999 Biological Analysis-Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press.
- **Andreas Baxevanis, B. F. Francis Ouellette and B. F. Cuellette** 1998 Bioinformatics: A Practical Guide to the analysis of Genes and Proteins, Wiley Publishers, New York

Journals:

- Indian Journal of Biotechnology
- Indian Journal of Experimental Biology
- Journal of Experimental Botany
- Trends in Biotechnology (Elsevier)
- Trends in biochemical Sciences (Elsevier)
- Journal of Molecular Plant Pathology
- Journal of Plant Biotechnology
- International Journal of Food Science and Technology.

M.Sc. II PART- II (SEMESTER IV)
Paper XV (CCS 403.4): Energy, Ecology and Environment
(SPECIAL PAPER IV) ENVIRONMENTAL ISSUES, ASSESSMENT AND RESTORATION

Total Lectures: 60

UNIT I:

- **Air pollution**: Classification, Acidic precipitation, causes and consequences. Air pollution control measures monitoring devices. Environmental issues.
- **Water pollution**: Classification of water pollutants. Oxygen demanding pollutants and their activity. Pathogens, nutrients, salts, heat, heavy metals and pesticides. Radioactive and oil pollutants. Self-purification of natural streams. Oxygen sag analysis.

UNIT II:

- **Environmental issues**: Ozone – Positive and negative influence of ozone. Air quality loss, nuclear winter, vehicular and industrial gases, global climate change
- **Land degradation**: Loss of soil fertility, mining. Causes and control measures. Sustainable land-management.

Unit III:

- **Environmental impact assessment:** Concept, scope and objectives of EIA, Biological monitoring programme, Bio indicators and environmental monitoring, Remote sensing and GIS
- Environmental impact assessment, Methodology, Component of EIA, Environmental management, Indian environmental law.

UNIT IV:

- **Natural resources**: Types of resources, Conservation and management of resources Soil resources, Forest resources, ecological and economic significance.
- **Recycling of natural resources:** Waste management, Waste disposal.
- **Ecotourism and Eco-friendly measures**: Guideline, Sustainability of ecotourism.

Paper XV (CCPR 405.3.4): ECOLOGY PAPER XVI: PRACTICAL COURSE IV

Project work based on special papers.

Reference Books:

- **Adriano, D. C**. and **Johnson, A. H**. (1989): Acidic precipitation, vol. II. John Wiley *Publishers*.
- **Balkrishnan, M., Borgstrom, R. and Bie, S. W.** (1994): Tropical Ecosystems. Oxford and IBH *Publishing* Co.
- **Dash,M. C.** (1993): Fundamentals of Ecology. Tata *Mc*.Graw Hill *Publishing*Company Ltd. New Delhi.
- **De, A. K**. (1994): Environmental Chemistry. New Age international *publishers.*
- **Good, R. E. *et al*** (1978): Fresh water wetlands. Margraf *Publishers.*
- **Gregory S.** (1988): Recent climatic changes: A regional approach. Kluwer Academic *Publisher.*
- **Lal, J. B.** (1987): Environmental Conservation. *Publisher*: International Book Distributors.
- **Misra K. C**. (1989): Manual of plant ecology. Oxford and IBH Publishing Co., New Delhi.
- **Owen, M. and Black, J. M.** (1990): Waterfall Ecology. Blackie *Publishers*, Glasgow, Scotland.

M. Sc. PART-II (SEMESTER IV)
Paper XV (CCS 403.5): Angiosperm Taxonomy
(SPECIAL PAPER IV) PHYLOGENY AND FLORAL BIOLOGY OF ANGIOSPERMS
Total Lectures: 60

UNIT I:

- **Origin of Angiosperms:** Pre-cretaceous and Cretaceous fossil angiosperms, time of origin of angiosperms, cradle of angiosperms, probable ancestors of angiosperms-*Isoetes*-monocotyledon theory, Coniferales-amentiferae theory, Gnetales-angiosperm theory, Anthostrobilus theory, Caytonian theory, Stachyospory-phyllospermae theory, Pteridosperm theory, Pentoxylales theory and Durian theory, monophyletic verses polyphyletic origin of angiosperms.
- **Fossil Angiosperms of India:** A brief account of fossil angiosperms of India-Palmae: *Palmoxylon, Rhizopalmoxylon, Palmocarpon*; Cyclanthaceae: *Cyclanthodendron, Tricoccites*; Pandanaceae: *Viracarpon;* Musaceae: *Musa cardiospermum*; Gramineae: *Graminocarpon*; Sonnertiaceae: *Sonnertioxylon, Sonnertiorhizos, Sahnianthus, Enigmocarpon*; Guttiferae: *Indocarpa*, Myrtaceae: *Sahnipushpam*; Malvaceae: *Sahniocarpon*, *Harissocarpon, Daberocarpon, Chitaleypushpam*. Fossil angiosperms and palaeoecology of India.

UNIT II:

- **Floral Biology-I**: Evolution of flower, evolution of floral biology in basal angiosperms, co-evolution of flowering plant and insects, sex in flowers, sex distribution in plants, types of pollination, chasmogamy and cleistogamy; biology of floral parts-calyx, corolla, androecium, pollen, style and stigma.

UNIT-III

- **Floral Biology-II:** Anemophily, haydrophily, ornithophily, cheiropterophily, entomophily- beetle, fly, bee, wasp, *Catasetum*, fig wasp, butterfly, moth, carpenter bee pollination; floral diversity and evolutionary steps toward asclepiad flowers.

UNIT IV

- **Morphological variations, systematic position, interrelationships, phylogeny and economic importance of following families:** ASTERIDS-Convolvulaceae, Boraginaceae, Rubiaceae, Apocynaceae, Oleaceae, Scrophulariaceae, Bignoniaceae, Lentibulariaceae, Verbenaceae, Lamiaceae

PAPER XV (CCPR 405.3.5): ANGIOSERM TAXONOMY: PRACTICAL COURSE IV

Project work based on special papers.

Reference Books:

- **Cronquist, A.** 1988. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press, U.S.A.
- **Cronquist, A.** 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.
- **Davis, P. H. and V. H. Heywood.** 1991. Principles of Angiosperm Taxonomy. Today and Tommorow Publications, New Delhi.
- **Manilal, K. S. and M. S. Muktesh Kumar [ed.].** 1998. A Handbook of Taxonomic Training. DST, New Delhi.
- **Naik, V. N.** 1984. Taxonomy of Angiosperms Tata McGraw-Hill Publication Com. Ltd. New Delhi.
- **Quicke, Donald, L. J.** 1993. Principles and Techniques of Contemporary Taxonomy. Blakie Academic & Professional, London.
- **Rao, R. R.** 1994. Biodiversity of India (Floristic Aspects). Bishen Singh Mahendra Pal Singh, Dehra-Dun.
- **Taylor, D. V. and L. J. Hickey.** 1997. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributers, New Delhi.
- **Lawrence, G. H. M.** 1951. Taxonomy of Vascular Plants. Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi .
- **Shivanna, K. R. and B. M. Johri.** 1985. The Angiosperm Pollen: structure and Function. Wiley Eastern limited, New Delhi.
- **Endress Peter, K.** 1994. Diversity and Evolutionary Biology of Tropical Flowers. Cambridge.
- **Richard, A. J.** 1997. Plant Breeding Systems. (2ed.) Chapman and Hall.
- **Nayar, M. P.** 1996. Hot Spots of Endemic Plants of India, Nepal and Bhutan. Tropical BotanicaGardens and Research Institute, Palode, Kerala
- **Ahmedullah, M. and M. P. Nayar.** 1987. Endemic Plants of the Indian Region Vol I. Botanical Survey of India.
- **Synge, Hugh (ed.).** 1980. The biological aspects of Rare Plant Conservation. John Wiley & Sons.
- **Judd Walter S., Campbell C. S., Kellogg, E. A., Stevens, P.F. and M. J. Donoghue**. 2008. Plant Systematics. Sinauer Associates, INC,Publishers. Sunderland, Massachusetts, USA.
- **Percival, M. S.** 1965. Floral Biology. Pergamon Press, London.

M. Sc. PART-II (SEMESTER IV)

(CCS403.6): Marine Botany

(SPECIAL PAPER IV) APPLIED MARINE BOTANY

Total Lectures: 60

UNIT I:

- **Primary Production:** Overview, GPP and NPP, Oceanic Production, effect of light and nutrients, Biomass harvesting/ harvest method, litter fall, chlorophyll method, gas exchange technique. Standing crop, light and dark bottle method, ecological indices.
- **Methods of Mangrove Analysis**: Collection by field methods-Transect, Quadrat, Phytosurvey. Geological Methods-Location, Elevation, Use of remote sensing technique in mapping of vegetation, Use of GPS.

UNIT II:

- **Collection and Preservation of Marine Algae**: Methods of collection, chemical preservation, herbarium technique.
- **Seaweed Mariculture**: Commercial cultivation of economic seaweeds, Scientific bases for seaweed mariculture, Techniques of seaweed mariculture- *Porphyra, Laminaria, Undaria, Kappaphycus Gracilaria* etc Future prospects.

UNIT III:

- **Utilization of Seaweeds**: Human food, sea vegetables, fodder, fertilizer and manure, kelp industry, antibiotics and drugs, phycocolloides and their applications. Algal Products- Soda and Potash, Iodine, Trace elements. Use of algae as Bio fuel.
- **Laboratory Culture of Algae**: Use of natural and synthetic culture media, types of culture, requirements/conditions of growth, difficulties in getting axenic culture

UNIT IV:

- **Coastal Bioresources**: Bioresource profile. Wild bioresources - food, feed, fodder, fire wood, timber, medicinal products, potential genetic resources, ornamentals. Domestic bioresources - crops, cereals, pulses, oil crops, horticultural crops, livestock, aquaculture, apiculture.
- **Nursery Techniques in Mangroves**: Nursery practices-collection of seed/ propagule/seeding material, storage, sowing of seeds, shading, watering, disease control and transplantation.
- **Mangrove Plantation Techniques:** Direct and indirect methods, zonation, season, gap filling, soil condition etc.

Paper XV (CCPR 405.3.6): MARINE BOTANY: PRACTICAL COURSE IV

Project work based on special papers.

Reference Books:

- **Beck**. Biotechnology of Microalgae.
- **Bhosale**, L. J. (2005). Mangroves of Maharashtra. (Field Guide). Shivaji University,Kolhapur.
- **Chapman**,V. J. (1976). Costal Vegetation. II nd edition Pergamon Press. New York.
- **Jackson**. D. F. (1972). Algae and Man. Plenum Press.
- **Kannupandi**, T. (1998). Coral Reefs of India. State of Art Report. ENVIS Publication Series 2/98.
- **Krishnamurthy**, V. (1985). Marine Plants. (A.G. Untawale, Asso. Editor), Seaweed Research and Utilization Association, Madras.
- **Santhanam**, R., Ramnathan,N., Venkataramanjan K. & Jegathanam, G. (1987). Phytoplankton of Indian Seas. & Aspects of Marine Botany.Daya Publication Home. Delhi.
- **Stein**, J. R. (1973) Handbook of Phycological Methods. Cambridge University Press.
- **Stoermer,** E. F. & Smol, J. P. The Diatoms. Applications for Environment and Earth Sciences
- **Swaminathan** M. S. Research foundation (2003). Bioresources Status in Selected Costal Location. National Bioresource Development Board (Department of Biotechnology) Govt. of India.
- **Trainor**, F. R. Introductory Phycology.

M. Sc. PART-II (SEMESTER IV)

(CCS 403.7): Plant Biotechnology

APPLICATION, REGULATION AND PATENTING BIOTECHNOLOGY

Total Lectures: 60

UNIT I:

Biotechnology in Agriculture:

- Bioethical principles for agricultural biotechnology, ethical aspects and public acceptance.
- Biological Nitrogen Fixation: Mechanism of N_2 fixation, Symbiotic N_2 fixation, Mechanism of N_2 fixation in root nodules, Nod genes, Nif genes, Hup genes.
- Use of microbes in Industry and agriculture

UNIT II:

- Application of biotechnology in environmental protection: Pollution control, phytoremediation immobilized microbial cells, wastewater treatment, microbes in leaching of metals.
- Economic and legal issues of biotechnology

UNIT III:

- Regulating the use of biotechnology in recombinant DNA technology, food, food ingredients and GMO's – cost benefit analysis of GMO's.
- Global biotech scenario, public verses private enterprises, international organizations involved in biotechnological inventions, cooperative programmes.
- Biotechnological spotlights

UNIT IV:

- Intellectual property; Intellectual Property Rights (IPR) and its protection, IPR and Plant Genetic Resources, GATT and TRIPS
- Patent systems in India, sources of patent information: a case study
- Patenting biotechnological inventions: Patent of higher plants, patent of genes and DNA sequences, plant breeder's right and farmer's right

Paper XV (CCPR 405.3.7): PLANT BIOTECHNOLOGY: PRACTICAL COURSE IV

Project work based on special papers.

Reference Books:

- **Altman**, A. 1998. Agricultural Biotechnology. Marcel Dekker, New York.
- **Gupta**, P. K. 2000. Elements of Biotechnology. Rastogi Publisher, Meerut, India.
- **Glick**, B. R. and Pasternak, J. J. 1994. Molecular Biotechnology- Principles and applications of recombinant DNA. ASM Press, Washington.
- **Mitra**, S. 1996. Genetic Engineering- principles and practice. Mcmilan, India ltd. Technology information, forecasting and assessment council.
- **(TIFAC).** 2002. Sources of patent information and patent agents. Technology Bhavan, New Delhi. Technology information, forecasting and assessment council.
- **(TIFAC).** 2002. Lecture notes on patents. Technology Bhavan, New Delhi.

M.Sc. PART- II (SEMESTER- IV)
Paper-XVI (DSC 404): Plant Ecology and Evolution

Lectures: 60

Unit-I:

- **Major Ecosystems**: types of biomes
- **Terrestrial biomes**: grassland, tropical rainforest, temperate deciduous forest.
- **Aquatic biomes**: 1. Fresh water ecosystem – lotic and Lentic
  2. marine ecosystem – ocean, sea, estuary
- **Species interaction**: concept of allelopathy, parasitism, mutualism, commensalism, competition and predation.

Unit-II:

- **Population Ecology:** Characteristics of a population; population growth curves; population regulation, life history strategies (r and K selection).
- **Concept of metapopulation**: demes and dispersal, interdemic extinctions, age structured populations.
- **Community Ecology:** Nature of communities; community structure and attributes; level of species diversity and its measurement, edges and ecotones.

Unit- III:

- **Ecological Succession:** Types; mechanisms; changes involved in succession, concept of climax.
- **Emergence of evolutionary thoughts:** Lamarck; Darwin-concepts of variation,
- adaptation struggle, fitness and natural selection; Spontaneity of mutations; the evolutionary synthesis.

Unit- IV:

- **Origin of cells and unicellular evolution:** Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparane and Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes Phytogeographical regions of India, Environmental educational programmes (UNESCO, MAB, Biosphere reserve, UNEP, WWF)

Paper XVI (CC 404/ CCO 404): Plant Ecology and Evolution

Practical Course

Unit 1:

- Study of Phytoplankton
- Evaluation of Abiotic components of Aquatic ecosystem (pH, temperature, Transparency).
- Determination of Phytomass.
- Study of species diversity index.
- Study of Population dynamics
- Determination of field capacity of Soil

Unit 2:

- Determination of residual chlorine from water sample.
- Determination of frequency, Density, Abundance, Dominance and IVI of the plant
- community.
- Estimation of DO and free CO_2
- Study of morphological and anatomical characteristics of plants under pollution stages.
- Allelopathic analysis of the plants.
- Preparation of Ecological report

References

- **Agarwal, S. K**. (1992): Fundamentals of Ecology. New Delhi: Ashish Publishing House.
- **Bradbury, I. K.** (1990): The Biosphere. Published by John Wiley & Sons, Chichester.
- **Das, S. M**. (1989): Handbook of Limnology and water pollution with practical Methodology. Published by South Asian Publishers, New Delhi.
- **Etherington, J. R**. (1975): Environment and plant ecology: aims and development. Publisher Wiley.
- **Freedman, H. I.** (1980): Deterministic mathematical models in population ecology. Marcel Dekker Inc., New York.
- **Greig Smith, P.** (1983): Quantitative Plant Ecology. *Publisher*: WILEYBLACKWELL
- **Grims, J. P.** ***et al*** (1988): Comparative Plant Ecology. Colvend, Dalbeattie, Kirkcudrightshire [Scotland]: Castlepoint Press.
- **Hashimoto, Y.** ***et al*** (1990): Measurement techniques in plant sciences. San Diego, Calif.: Academic Press
- **Kershaw, K. A.** (1964): Quantitative and dynamic ecology. Publisher: Edward Arnold
- Kormondy, E. J. (1996): Concept of ecology. Publisher: Benjamin Cummings.
- **Krebs, C. J**. (1978): Ecology. Harper & Row., New York.

- **Lieth, H. F**. ***et al*** (1973: Patterns of primary production in the biosphere. Kluwer Academic Publishers-Plenum Publishers.
- **Misra, K. C**. (1989): Manual of plant ecology. Oxford and IBH Publishing Co., New Delhi.
- **Misra, R.** and **Das, R. R**. (1971): Proceedings of the school of plant ecology. Publisher: Calcutta Oxford & IBH Pub. Co.
- **Odum, E. P**. (1971): Ecology. Publisher: Saunders
- **Odum E. P**. (3rd ed. 1996): Fundamentals of Ecology. Natraj Publishers, Dehra Dun.
- **Pandeya S. C**. *et al* (1963): Research methods in plant ecology. Asia Publishing House.
- **Watt K. E. F**. (1973): Principles of Environment Sciences. Published by McGraw-Hill.
- **Sharma,P.D**. (2019): Ecology and Environment, Thirteenth edition.Rastogi publication.

.

DEPARTMENT OF BOTANY
(CHOICE BASED CREDIT SYSTEM) SEM I/ III
Generic Elective Course Botany (GE 407)
Botany and Human Welfare

Total Lectures:30

Unit-I: Plants, Human and Environment

- Introduction to plants, plant resources and their importance in progress, prosperity and survival of human race.
- Plants as key solution for major global problems viz. Energy, pollution control, agricultural productivity, global warming, climate change, soil fertility and conservation etc.

Unit-II: Plants and plant products

- Vegetables, oil yielding plants, wild edible plants, food crops, spices and condiments, Forage- fodder plants
- Fibre yielding plants, textile fibres, cordage fibres, fibres for stuffing
- Important timber yielding plants and non-wood forest products
- Petro and sericulture crops
- Resin, dye, tannin and gum yielding plants and their applications in industry
- Grasses, their economic importance and human civilization

References

- **Jain, S. K.** 2004. A manual of ethnobotany. 2nd edition, Scientific publishers, India.
- **Ramanamurthy, G. V.** 1985. Advances in Oilseeds Production and Technology. ICAR, New Delhi
- **Gill, N. T. and K. C. Vear and D.J. Barnard.** 1980. Agricultural Botany. 3rd revised edition. Duckworth, London.
- **Jha, L.K. and P. K. Sarma**.1993. Agrofrestry: Indian Perspective. Ashish Publishing House, New Delhi
- **Varghese, E.** 1996. Applied Ethnobotany: A case study among the Kharias of Central India. Deep Publications, New Delhi.
- **Chapman S. R. and Carter L.P. 1976.** Crop Production: Principles and Practices. Freeman and Company, San Francisco, USA.
- **EL Bassam, N.** 1998.Energy Plant Species: Their Use and Impact on Environment and Development. Routledge.
- **Aiyer, A. K.** 1966. Field crops of India. Banglore Printing and Publishing Company, Bangalore.
- **Shiva Vandana, V. M. Meherhomji and N.D. Joryal.** 1992. Forest Resources-Crises and Management. Natraj Publishers, Dehradun.
- **Jha, L. K. and P. K. Sen Sarma.** 1994. Forestry for the People. Ashish Publishing House, New Delhi.
- **Dogra, P.D. and R C. Dhiman (eds.).** 1994. Forestry Research and Education in India. INSA, New Delhi.
- **Wickens, G.E, N. Haq, P.Day (eds.). 1986.** New Crops for Food and Industry. Chapman and Hall, New York.