

## Bio.Ed.515: Plant Systematics and Anatomy

Course No.: Bio.Ed.515(T)

Nature of the course: Theoretical

Level: M. Ed. in Biology

Credit hours: 2

Semester: First

Teaching hours: 32

Periods/week: 2

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### 1. Course Introduction

This course aims to provide advanced knowledge in the field of systematics, diversity and anatomy of plants. This course consists of four units with different topics that include systematics, diversity and life cycles of lower plants, non-flowering plants, higher plants including gymnosperms and angiosperms. The course also focuses on the adequate knowledge on economically useful plants of Nepal with the details on their anatomical development.

### 2. General Objectives

General objectives of this course are to:

- familiarize the students with the systematic position, habit, habitat, structure and life cycles of some important lower plants (algae, fungi), non-flowering plants (bryophytes and pteridophytes) and higher plants (gymnosperms) and taxonomic characters of angiosperms.
- provide the knowledge on modern trends in Plant Taxonomy.
- provide the students with the advanced knowledge on the economic importance of lower (algae, fungi) and higher plants (angiosperms and gymnosperms).
- illustrate the structure and functions of secondary bodies in plants.

### 3. Specific Objectives and Contents:

Specific Objectives	Contents
<ul style="list-style-type: none"><li>• Explain the general characteristic features and life cycle of <i>Polysiphonia</i>.</li><li>• Explain the economic importance of Algae regarding beneficial</li></ul>	<b>Unit I: Lower plants (10)</b> <b>1.1 Algae</b> 1.1.1. Systematic position, habit, habitat, structure and life cycle of <i>Polysiphonia</i> 1.1.2. Economic importance of algae 1.1.2.1. Beneficial effects of algae (In food, industries, nitrogen fixation, medicine)

<p>effects (such as in food, industries, nitrogen fixation, medicine and antibiotics, water purification, sewage disposal, radioactive wastes, land reclamation, source of growth substances, lens paper making) and harmful effects (such as death of fishes, animals and human beings, in problems in water purification, supply and pollution, salt damage by blue green algae and accidents due to blue green algae).</p> <ul style="list-style-type: none"> <li>• Describe the habit, habitat, structure and life cycle of <i>Penicillium</i>.</li> <li>• Explain the economic importance of fungi regarding useful effects viz. in food, industries, medicines and soil fertility and harmful effects viz. food spoilage, diseases to Human beings such as aspergillosis, moniliasis, cryptococcosis,</li> </ul>	<p>and antibiotics, water purification, sewage disposal, radioactive wastes, land reclamation, source of growth substances, lens paper making</p> <p>1.1.2.2. Harmful effects of algae (Death of fishes, animals and human beings, problems of water purification, supply and pollution, salt damage by blue green algae, Accidents due to blue green algae)</p> <p><b>1.2. Fungi</b></p> <p>1.2.1. Systematic position, habit, habitat, structure and life cycle and <i>Penicillium</i></p> <p>1.2.2. Economic importance of fungi</p> <p>1.2.2.1. Useful effects of fungi (In food, industries, medicines, soil fertility)</p> <p>1.2.2.2. Harmful effects of fungi (Food spoilage, diseases to Human beings - aspergillosis, moniliasis, cryptococcosis, coccidiomycosis, Plant diseases, (Black rust of wheat, loose smut of wheat, powdery mildew, leaf blight, late blight of potato etc.), timber destruction, Mushroom poisoning (<i>Amanita</i> sps, <i>Conocybe</i> sps, <i>Galerina</i> sps, <i>Lepiota</i> sps)</p>
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<p>cocidiomycosis, plant diseases such as black rust of wheat, loose smut of wheat, powdery mildew of wheat, leaf blight of maize, late blight of potato, timber destruction, Mushroom poisoning due to species of <i>Amanita</i>, <i>Conocybe</i>, <i>Galerina</i> and <i>Lepiota</i>.</p> <ul style="list-style-type: none"> <li>• Describe the habit, habitat, structure and life cycle of <i>Penicillium</i>.</li> <li>• Describe the habit, habitat, structure and life cycle of <i>Plagiochasma</i>.</li> <li>• Describe habit, habitat, structure, development and life cycles of <i>Pteridium</i>.</li> <li>• Discuss the economic importance of pteridophytes.</li> </ul>	<p>1.2.3. Systematic position, habit, habitat, structure and life cycle and <i>Penicillium</i></p> <p><b>1.3. Bryophyta</b></p> <p>1.3.1. Systematic position, habit, habitat, structure and life cycle of <i>Plagiochasma</i>.</p> <p><b>1.4. Pteridophyta</b></p> <p>1.4.1. Habit, habitat, external and internal structure, development and life cycles of <i>Pteridium</i></p> <p>1.4.2. Economic importance of pteridophytes.</p>
<ul style="list-style-type: none"> <li>• Give a short description of Gymnosperms.</li> <li>• Describe the distribution, external and internal structures, life</li> </ul>	<p><b>Unit II. Higher Plants (10)</b></p> <p><b>2.1. Gymnosperms</b></p> <p><b>2.1.1. Introduction</b></p> <p>2.1.2. Distribution, external and internal structures, life cycle and economic importance of <i>Cedrus</i></p>

<p>cycle and economic importance of <i>Cedrus</i>.</p> <ul style="list-style-type: none"> <li>• Discuss the modern trends in Plant Taxonomy such as external morphology, vegetative anatomy, cytotaxonomy, embryology and chemotaxonomy in relation to taxonomy.</li> <li>• Describe the systematic position, taxonomic features, affinities and economic importance of the following families: <ul style="list-style-type: none"> <li>A. Dicotyledons: Umbelliferae or Apiaceae, Polygonaceae and Euphorbiaceae</li> <li>B. Monocotyledons: Gingeraceae, Gramineae or Poaceae</li> </ul> </li> </ul>	<p><b>2.2. Angiosperms</b></p> <p>2.2.2. Modern trends in Plant Taxonomy</p> <p>2.2.2.1. External morphology in relation to taxonomy</p> <p>2.2.2.2. Vegetative anatomy in relation to taxonomy</p> <p>2.2.2.3. Cytotaxonomy in relation to taxonomy</p> <p>2.2.2.4. Embryology in relation to taxonomy.</p> <p>2.2.2.5. Chemotaxonomy in relation to taxonomy</p> <p>2.2.3. Systematic study, taxonomic features, affinities and economic importance of the following families:</p> <p>Dicotyledons: Umbelliferae or Apiaceae, Polygonaceae and Euphorbiaceae</p> <p>Monocotyledons: Gingeraceae, Gramineae or Poaceae</p>
<ul style="list-style-type: none"> <li>• Discuss the distribution, scientific names, families and economic importance of some medicinal, crop, timber and edible oil yielding</li> </ul>	<p><b>Unit III. Economic Plants (4)</b></p> <p>3.1. Important medicinal plants of Nepal</p> <ul style="list-style-type: none"> <li>• Bojho (<i>Acorus calamus</i>), Aswagandha (<i>Withania</i></li> </ul>

<p>plants of Nepal as mentioned in the content.</p>	<p><i>somnifera</i>), Bellodona (<i>Atropa belladonna</i>), Ashuro (<i>Justicia adhatoda</i>), Digitalis or Foxglove (<i>Digitalis purpurea</i>), Pudina (<i>Mentha arvensis</i>), Lasun (<i>Allium sativum</i>), Yarshagumba (<i>Ophiocordyceps sinensis</i>)</p> <p>3.2. Important crop plants of Nepal</p> <ul style="list-style-type: none"> <li>• Rice (<i>Oryza sativa</i>), Wheat (<i>Triticum aestivum</i>), maize (<i>Zea mays</i>).</li> </ul> <p>3.3. Important timber trees of Nepal</p> <ul style="list-style-type: none"> <li>• Sal (<i>Shorea robusta</i>), Sissoo (<i>Dalbergia sissoo</i>), Teak (<i>Tectona grandis</i>), Deodar (<i>Cedrus deodara</i>), Pine (<i>Pinus</i> sps)</li> </ul> <p>3.4. Important oil yielding plants of Nepal</p> <ul style="list-style-type: none"> <li>• Mustard (<i>Brassica</i> sps), Groundnut (<i>Arachis hypogea</i>), Sesame (<i>Sesamum indicum</i>), Sunflower (<i>Helianthus annus</i>)</li> </ul>
<ul style="list-style-type: none"> <li>• Explain the structure, functions and types of meristems in plants.</li> <li>• Explain the theories of differentiation of shoot and root apices.</li> <li>• Describe the anomalous secondary growth in dicot stems.</li> </ul>	<p><b>Unit IV. Plant Anatomy (8)</b></p> <p>4.1.1. Meristem</p> <p>4.1.1.1. Structure</p> <p>4.1.1.2. Function</p> <p>4.1.1.3. Classification</p> <p>4.1.2. Theories of differentiation of shoot and root apices (shoot apex-Apical Cell theory, Histogen theory and Tunica-Corpus theory; root apex-Histogen theory and Korper-Kappe theory).</p> <p>4.1.3. Anomalous secondary growth of dicot stem</p>

	<p>4.1.3.1. Anomalous position of cambium (<i>Bauhinia</i> sp)</p> <p>4.1.3.2. Abnormal behavior of normal cambium (<i>Bignonia</i> sp)</p> <p>4.1.3.3. Accessory cambium formation and its Activity (<i>Bougainvillaea</i>, <i>Boerhaavia</i>, <i>Mirabilis</i>)</p> <p>4.1.3.4. Extrastelar cambium (<i>Amaranthus</i>, <i>Achyranthes</i>, <i>Chenopodium</i>)</p>
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#### 4. Instructional Techniques

The instructional techniques are divided into two groups. The first group consists of general instructional techniques applicable to most of the units. The second group consists of specific instructional techniques applicable to the specific units.

Units	General Instructional Techniques	Specific Instructional Techniques
1	<ul style="list-style-type: none"> <li>• Lecture and discussion;</li> <li>Inquiry method, power point presentation, Internet search,</li> </ul>	<ul style="list-style-type: none"> <li>• Project work will be given to prepare a report on the economic importance of algae and fungi</li> <li>• Preparation of charts of life cycles of lower plants mentioned in the content.</li> </ul>
2	<ul style="list-style-type: none"> <li>• Lecture and discussion;</li> <li>Inquiry method, power point presentation</li> </ul>	<ul style="list-style-type: none"> <li>• Project work will be given to prepare the charts of angiospermic families.</li> <li>• Preparation of charts of life cycles Gymnospermous plants.</li> </ul>
3	<ul style="list-style-type: none"> <li>• Lecture and discussion;</li> <li>Inquiry method,</li> <li>Collaborative method,</li> <li>Internet search, power point presentation</li> </ul>	<ul style="list-style-type: none"> <li>• Project work will be given to prepare the group and individual report on economic importance of plants such as crop plants, medicinal plants, oil and timber yielding plants of Nepal.</li> </ul>

## Evaluation

### 5.1 Evaluation (Internal Assessment and External Examination)

Nature of course	Internal Assessment	Semester Examination	Total Marks
Theory	25 Marks	40 Marks	65 Marks

*Note: Students must pass separately in internal assessment and semester examination.*

#### 5.1.1. Internal Evaluation

**25 Marks**

Internal evaluation will be conducted by course teacher based on following activities:

1.	Attendance and participation in learning activities	5 Marks
2.	First assignment (written assignment)	5 Marks
3.	Second assignment (report writing and presentation)	5 Marks
4.	Third assignment/ Term exam	10 Marks
Total		25 Marks

**Note:** *First assignment/assessment might be a book review /article review, quiz, home assignment etc. according to nature of course. Second assignment/assessment might be a project work, case study, seminar, survey/field study and individual/group report writing, term paper based on secondary data or review of literature and documents etc. and third assignment will be term exam.*

#### 5.1.2. External Evaluation (Final Examination)

**40 Marks**

Examination Division, office of the Dean, Faculty of Education will conduct final examination at the end of semester. The marks distribution will be

1.	Objective questions (Multiple Choice Questions 10 x 1mark)	10 Marks
2.	Subjective short questions (6 questions with 2 'OR 'questions x 5 marks)	30 Marks
Total		40 Marks

## 6. Recommended books and Reference books

### Recommended Books:

Pandey, B. P. (2007). *Economic Botany*. S. Chand & Company Ltd., New Delhi. **(For Unit III)**

Pandey, S. N. and A. Chadha (2008). *Plant Anatomy and Embryology*. Vikash Publishing House Pvt. Ltd., New Delhi. **(For Unit IV)**

Pandey, S. N. and P. S. Trivedi (2007). *A Text Book of Botany. Vol. I. (Virus, Fungi, Lichens, Plant Pathology, Algae) (For Unit I). Vol. II. (Bryophytes, Pteridophytes and Gymnosperms)*. Vikash Publishing House, New Delhi. **(For Units I and Unit II)**

Sharma, O. P. (2006). *Textbook of Algae*. Tata Mc. Graw Hill Publishing Company Ltd., New Delhi. **(For Unit I)**

Sharma, O. P. (2008). *Textbook of Fungi*. Tata Mc. Graw Hill Publishing Company Ltd., New Delhi. **(For Unit I)**

Sharma, O. P. (2002). *Gymnosperms*. Pragati Prakashan, Meerut. **(For Unit II)**

Sharma, O. P. (2009). *Plant Taxonomy*. Mc. Graw Hill Education Pvt. Ltd., New Delhi. **(For Unit II)**

### Reference Books:

Alexopoulos, C. J., C. W. Mims and M. Blackwell (2007). *Introductory Mycology*. Wiley Student Edition,

Bhatnagar, S. P. and A. Moitra (2006). *Gymnosperms*. New Age International Publishers, New Delhi.

Bhatt, D.D. (1977). *Natural History and Economic Botany of Nepal*. Orient Longman Ltd., New Delhi.

DPR (2005). *Medicinal Plants of Nepal*. Department of Plant Resources, Ministry of Forests and Soil Conservation, Kathmandu.

Glime, J. (2007). *Economic and Ethnic Uses of Bryophytes. Flora North Am, 27.*



- Kayastha, B.P. (2002). *A Handbook of Trees of Nepal. Timber, Fodder, Fruit, Medicinal, Ornamental, Religious* (Eds. R. Joshi, S.M. Amatya, P. B. Thapa and B. Bhatta). Laligurans Pr. Press, Kathmandu.
- Lawrence, H. Lawrence, H. M. (1967). *Taxonomy of Vascular Plants*. Mc. Millons Company, New York.
- Maharjan, K.B. (2018). *Economic Botany (Vol I & II)*. K.B.Maharjan, Kirtipur, Kathmandu.
- Parihar, N. S. (1973). *An Introduction to Embryophyta Vol. II. Pteridophytes*. Central Book Depot. Allahabad.
- Pandey, B. P. (2009). *Taxonomy of Angiosperms*. S. Chand & Company Ltd., New Delhi.
- Rajbhandary, S. (2016). EdsJha, P.K., Siwakoti, M. and Rajbhandary, S. *Fern and Fern allies of Nepal*. Central Department of Botany, Kirtipur
- Saxena, N. B. (2006). *Plant Taxonomy*. Pragati Prakasan, Meerut, India.
- Singh, V., P. C. Pande and D. K. Jain (2007). *A Text Book of Botany. Algae, Fungi, Bacteria, Virus, Microbiology, Plant Pathology, Bryophyte, Pteridophyte and Gymnosperm*. Rastogi Publication, Meerut, India.
- Vashishta, B. R. and A. Kumar (2010). *Botany for Degree Students. Part III. BRYOPHYTA*. S. Chand & Company Ltd., New Delhi.
- Vashishta, P. C. (1998). *Plant Anatomy*. S. Chand & Company Ltd.
- Vasishta, P. C. (2006). *Botany for Degree Students. PTERIDOPHYTA*. S. Chand & Company Ltd., New Delhi.

## Bio. Ed. 515: Plant Systematics and Anatomy

Course No.	: Bio. Ed. 515 (P)	Nature of the course:	Practical
Level	: M. Ed. in Biology	Credit hour:	1
Semester	: First	Teaching hours:	48*
		Period per week:	3pds/day/week/gr * *(P)

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### 1. Course Introduction

This course includes practical works from Plant Systematics and Anatomy. The aim of this course is to provide knowledge and skills required for conducting practical classes at higher level of science education regarding morphology and life cycles of lower and higher plants as well as the anatomy of higher plants.

### 2. General Objectives

The general objectives of this course are to:

- provide advanced knowledge on morphology and life cycles of lower plants including algae, fungi, bryophytes and higher plants including Gymnosperms and Angiosperms.
- provide the students with the skills of preparing temporary and permanent slides of parts of lower plants.
- provide adequate knowledge on internal parts of higher plants.
- provide the students with the skills of preparing temporary and permanent slides of internal parts of higher plants.
- give knowledge and skills on the collection, preservation, identification of plants from the fields and submit the report.

### 3. Specific Objectives and Contents

Specific objectives	Contents
<ul style="list-style-type: none"><li>• Prepare the temporary slides of some available algae viz: <i>Chlamydomonas</i>, <i>Cladophora</i>, <i>Zygnema</i>, <i>Spirogyra</i>, <i>Ulothrix</i>, <i>Oedogonium</i>,</li></ul>	<b>Unit I. Lower Plants (5 × 3 = 15)</b> 1.1. Algae 1.1.1. Preparation of temporary slides of <i>Chlamydomonas</i> , <i>Cladophora</i> , <i>Zygnema</i> ,

<p><i>Hydrodictyon, Vaucheria, Nostoc, Oscillatoria</i> or any other available algae (at least 4 genera) also study their identification characters.</p> <ul style="list-style-type: none"> <li>• Study the vegetative and reproductive parts of the above-mentioned algae or other available algae from their permanent slides</li> <li>• Prepare the temporary slides of the somatic and reproductive parts of <i>Albugo, Aspergillus, Penicillium, Alternaria, Agaricus</i> or any other available genera (at least 1 genus from each of Phycomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes)</li> <li>• Study the characteristic features of somatic and reproductive parts of the following genera: <i>Saprolegnia, Phytophthora, Penicillium, Alternaria, Agaricus</i> (at least 2 genera) from their permanent slides.</li> <li>• Prepare and study the temporary and permanent slides of the external and internal structures of vegetative and reproductive parts of <i>Riccia, Marchantia, Pellia, Plagiochasma, Polytrichum</i> or any other available moss (at least 2 genera of Bryophytes).</li> <li>• Prepare the temporary and permanent</li> </ul>	<p><i>Spirogyra, Ulothrix, Oedogonium, Hydrodictyon, Vaucheria, Nostoc, Oscillatoria</i> and other available algae and study of their identifying characters.</p> <p>1.1.2. Study of the vegetative and reproductive parts of above-mentioned algae.</p> <p><b>1.2. Fungi</b></p> <p>1.2.1. Temporary slide preparation of Somatic and reproductive parts of following genera: <i>Albugo, Aspergillus, Penicillium, Alternaria, Agaricus</i></p> <p>1.2.2. Study the characteristic features of somatic and reproductive parts of <i>Saprolegnia, Phytophthora, Penicillium, Alternaria, Agaricus</i> from their permanent slides.</p> <p><b>1.3. Bryophytes</b></p> <p>1.3.1. Preparation of temporary and permanent slides and study of external and internal structures of <i>Riccia, Marchantia, Pellia, Plagiochasma, Polytrichum</i> or any other available moss.</p>
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<p>slides of internal and external structures of vegetative and reproductive parts of <i>Selaginella</i> and <i>Pteridium</i> or <i>Dryopteris</i> (at least 2 genera)</p>	<p><b>1.4. Pteridophytes</b> 1.4.1. Preparation of permanent slides of anatomical structures of <i>Selaginella</i> and <i>Pteridium</i> or <i>Dryopteris</i></p>
<ul style="list-style-type: none"> <li>• Prepare the temporary and permanent slides of internal structures of leaves of <i>Pinus</i> and <i>Cedrus</i>.</li> <li>• Study the internal structures of stems of <i>Taxus</i> and <i>Cedrus</i> from permanent slides.</li> <li>• Describe the taxonomical characters of the following families in semitechnical terms with their floral formula and floral diagrams: Dicotyledons: Umbelliferae or Apiaceae, Polygonaceae, Euphorbiaceae, Monocotyledons: Gingeraceae, and Poaceae (Gramineae)..</li> </ul>	<p><b>Unit II. Higher Plants (5 × 3 = 15)</b> 2.1. Gymnosperms 2.1.1. Internal structures of stems and leaves of <i>Pinus</i> and <i>Cedrus</i>. 2.2. Angiosperms 2.2.1. Systematic study of following families with floral formula and floral diagrams: 2.2.1.2. Dicotyledons: Umbelliferae or Apiaceae, Polygonaceae, Euphorbiaceae. 2.2.1.3. Monocotyledons: Gingeraceae, Poaceae (Gramineae),</p>
<ul style="list-style-type: none"> <li>• Visit field and collect, preserve, identify and submit the plants and field report (Individual)</li> </ul>	<p><b>Unit III. Field trip (2 × 3 = 6)</b> 3.1. Collection, preservation, identification and study of plants and submission of field trip report (Individual).</p>

**Group ' B' : Plant Anatomy**

<b>Specific objectives</b>	<b>Contents</b>
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<ul style="list-style-type: none"> <li>• Prepare temporary and permanent slides of transverse sections of dicot stems with secondary growth.</li> <li>• Prepare temporary and permanent slides of transverse sections of dicot stem with anomalous secondary growth.</li> </ul>	<p><b>Unit III. Plant Anatomy (4× 3 = 12)</b></p> <p>3.1. Secondary growth of dicot stem of any two available plants.</p> <p>3.2. Anomalous secondary growth of any two plants mentioned in the content course (<i>Bougainvillea</i> stem and <i>Bignonia</i> stem or any other available stem)</p>
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#### 4. Instructional Techniques

Units	General Instructional Techniques	Specific Instructional Techniques
1	<ul style="list-style-type: none"> <li>• Lecture and discussion; Inquiry method, power point presentation, performing experiments, Interview, Record keeping,</li> </ul>	<ul style="list-style-type: none"> <li>• Performing experiments, Slide preparation, group work, Chart preparation</li> <li>• Preparation of charts of life cycles of lower plants mentioned in the content.</li> </ul>
2	<ul style="list-style-type: none"> <li>• Lecture and discussion; Inquiry method, power point presentation</li> </ul>	<ul style="list-style-type: none"> <li>• Performing experiments, Slide preparation, group work</li> <li>• Chart preparation of angiospermic families mentioned in the content.</li> <li>• Preparation of charts of life cycles Gymnospermous plants mentioned in the content</li> </ul>
3	<ul style="list-style-type: none"> <li>• Lecture and discussion; Inquiry method, Collaborative method, Internet search, power point presentation</li> </ul>	<ul style="list-style-type: none"> <li>• Project work will be given to prepare the group and individual report on economic importance of plants such as croppants , medicinal plants, oil and timber yielding plants of Nepal.</li> </ul>

**5. Evaluation****35 Marks**

Nature of course	Internal Evaluation	External Evaluation	Total Marks
Practical	15 Marks	20 Marks	35 Marks

**5.1 Internal Evaluation****15 Marks**

Marks distribution for practical internal evaluation will be as following.

1.	Attendance	5Marks
2.	Students' portfolios (Record book and books and article review etc.)	5Marks
3.	Participation, collaborative work and construction of teaching learning resources and planning for teaching learning ***	5Marks
	Total	15Marks

**5.2 External Evaluation****20 Marks**

Marks distribution for practical external evaluation will be as following.

1.	Experiment / project work report and presentation / study reports	15Marks
2.	Viva-voce	5 Marks
	Total	20Marks

**Note:**

*Students must pass both in internal as well as external assessment of practical examination*

*\* Practical teaching hours is 3 times more than teaching hours of theory (3x 16 = 48 hours)*

*\*\*A group consists of 15 students and one teacher will be assigned for a group.*

*\*\*\*Construction of models, charts, teaching aids, develop concept map etc. Also, the collection of materials / designing science lab, preparation of lesson plan, unit plan, annual plan, preparation of rubrics, developing test items of various levels etc. for teaching learning.*

## **6. Recommended and Reference Books for practical**

### **Recommended Books:**

Pandey, B. P. (2005). Modern Practical Botany Vol.1 and Vol II. S. Chand & Company Ltd., New Delhi.

Pandey, S. N. and A.Chadha (2008). *Plant Anatomy and Embryology*. Vikash Publishing House Pvt. Ltd., New Delhi. (For Unit IV).

## **Bio. Ed. 516: Animal Systematic and Anatomy**

Course No.	: Bio. Ed. 516 (T)	Nature of the course:	Theoretical
Level	: M. Ed. in Biology	Credit hours:	2
Semester	: First	Teaching hours:	32
		Period per week:	2

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### **1. Course Introduction:**

This course is designed for M.Ed. first semester students with a view to provide advanced knowledge on Systematics, Diversity and Life Cycle of lower and higher animals. It also provides the detailed knowledge on major phenomenon and characteristics of animals. Development is another sequential phenomenon occurring in all animals. It also includes anatomical development of higher animals.

### **2. General Objectives:**

The general objectives of this course are to:

- familiarize the students with the systematic position, habit, habitat, structure, importance, and life cycle of some important animals.
- enhance the knowledge of the students to prevent and control parasites.
- provide the knowledge of the significance of some animals.

### **3. Specific Objectives and Contents**

<b>Specific Objectives</b>	<b>Contents (32)</b>
<ul style="list-style-type: none"><li>• Describe the life cycle, disease caused, control and prevention of <i>Leishmania donovoni</i>.</li></ul>	<b>Unit I: Lower Animals</b> <b>1.1.Non-Chordata (Invertebrates)</b> 1.1.1 Life cycle, symptoms, control and prevention of <i>Leishmania donovoni</i> .
<ul style="list-style-type: none"><li>• Explain the affinities and systematic position of Porifera.</li></ul>	1.1.2 Affinities and systematic position of Porifera.
<ul style="list-style-type: none"><li>• Explain the meaning of polymorphism and various forms of zooids with different functions.</li></ul>	1.1.3 Polymorphism in Cnidaria.
<ul style="list-style-type: none"><li>• Differentiate between male and female worms and detail study of</li></ul>	1.1.4 Life cycle and symptoms, control and prevention of <i>Enterobius</i>



their life cycle, mechanism of control and prevention.	vermicularis.
<ul style="list-style-type: none"> <li>Describe the structure and complete life cycle with different developmental stages.</li> </ul>	1.1.5 Structure and life cycle of Nereis.
<ul style="list-style-type: none"> <li>Introduce the different types of mouthparts of insects with their different functioning mechanism.</li> </ul>	1.1.6 Different types of mouth parts of different insects.
<ul style="list-style-type: none"> <li>Explain different parts found in the mouthpart of cockroach.</li> </ul>	1.1.7 Detailed study of mouth parts of cockroach.
<ul style="list-style-type: none"> <li>Explain the meaning and mechanism of torsion with their effect.</li> </ul>	1.1.8 Torsion in Mollusca.
<ul style="list-style-type: none"> <li>Elaborate functioning of mechanism of water vascular system with their purpose.</li> </ul>	1.1.9 Water vascular system in Echinodermata.
<ul style="list-style-type: none"> <li>Describe the systematic position, habit, habitat and structure, life cycle including different developmental stages.</li> <li>Describe the affinities of Ctenophora</li> </ul>	<b>Unit II Minor Phyla (4)</b> 1.2.1 Hormiphora (structure and life cycle) 1.2.2 Affinities of Ctenophora.
<ul style="list-style-type: none"> <li>Explain major differences from non-chordates.</li> </ul>	<b>Unit III Higher animals</b> 1.3.1 Chordata
<ul style="list-style-type: none"> <li>Describe the structure and complete life cycle with differential stages of Balanoglossus.</li> </ul>	1.3.2 Balanoglossus (structure and life cycle)
<ul style="list-style-type: none"> <li>Explain skin, different types of scales, pigments found in Pisces.</li> </ul>	1.3.3 Pisces (skin, scales and coloration).
<ul style="list-style-type: none"> <li>Introduce Adoptive radiation and describe adoptive radiations in</li> </ul>	1.3.4 Adoptive radiation if Reptiles.

Reptiles.	
<ul style="list-style-type: none"> <li>Describe the flight and perching mechanism of birds.</li> </ul>	1.3.5 Aves (Flight and perching mechanism)
<ul style="list-style-type: none"> <li>Explain the systematic position, habit, habitat and life cycle of cow.</li> <li>Describe socio-economic significance of cow (Domesticating purpose, role in society, cow as goddess, use and sacred for rituals and treatment of diseases etc.)</li> </ul>	1.3.6 Mammals (Life cycle and socio-economic significance of cow)
<ul style="list-style-type: none"> <li>Describe comparative development of vertebrates.</li> <li>Explain mammalian integument and its derivatives.</li> </ul>	<b>Unit IV Anatomical Development of Vertebrate</b> 1.4.1 Comparative development fertilization, Morula and Blastula, Gastrulation, Organogenesis, fetal membranes, Kinds of Placenta. 1.4.2 Mammalian integument and its derivatives.

#### 4. Instructional Techniques

The instructional techniques are divided into two groups. The first group consists of general instructional techniques applicable to most of the units. The second group consists of specific instructional techniques applicable to the specific units.

##### 4.1. General Instructional Techniques

- Lecture method
- Demonstration method
- Discussion method
- Inquiry method
- Project method
- Collaborative method
- Internet search

- Preparation of charts
- Book reviews

#### 4.2. Specific Instructional Techniques

- Most of the units require project work, problem solving method and power point presentation.
- The teachers may assign the project work in different units.

### 5. Evaluation

#### 5.1 Evaluation (Internal Assessment and External Examination)

Nature of course	Internal Assessment	Semester Examination	Total Marks
Theory	25 Marks	40 Marks	65 Marks

Note: Students must pass separately in internal assessment and semester examination.

##### 5.1.1 Internal Evaluation

**25 Marks**

Internal evaluation will be conducted by course teacher based on following activities:

1. Attendance and participation in learning activities	5 Marks
2. First assignment (written assignment)	5 Marks
3. Second assignment (report writing and presentation)	5 Marks
4. Third assignment/ Term exam	10 Marks
<b>Total</b>	<b>25 Marks</b>

**Note:** First assignment/assessment might be a book review /article review, quiz, home assignment etc. according to nature of course. Second assignment/assessment might be a project work, case study, seminar, survey/field study and individual/group report writing, term paper based on secondary data or review of literature and documents etc. and third assignment will be term exam.

##### 5.1.2 External Evaluation (Final Examination)

**40 Marks**

Examination Division, Office of the Dean, Faculty of Education will conduct final examination at the end of semester. The marks distribution will be

1. Objective questions (Multiple Choice Questions 10 x 1mark)	10 Marks
2. Subjective short questions (6 questions with 2 'OR' questions x 5 marks)	30 Marks
Total	40 Marks

## 6. Recommended Books and References

Jordan, E.L. and Verman, Dr. P.S. (2011). *Invertebrate Zoology*. S. Chand and Company Ltd., New Delhi (**For Unit I.1: Nonchordata**).

Kotpal R.L. (2006). *Minor Phyla*. Rastogi Publication (For Unit I.3: Minor Phyla).

Kotpal R.L. (2007). *Moderntext book of Zoology (Vertebrates)*. Rastogi Publication, Meerut 250002 (**For Unit I.2: Chordata**).

Kotpal, R.L. (1978). *Zoology Phylum Books (Protozoa to Echinodermata)*. Rastogi Publications (**For Unit I.2: Non-chordata**)

### Reference Books:

Sandhu, G.S. and Harsha Bardhan Bhaskar (2005). *Textbook of Chordate, Set of 2 Vols.* Campus Books International.

Saxena, R.K. and Saxena, Sumitra (2008). *Comparative Anatomy of Vertebrates*. Published by Vinod Vasistha for Viva Books, New Delhi 110002.

## **Bio. Ed. 516: Animal Systematics and Anatomy**

Course No.	: Bio. Ed. 516 (P)	Nature of the course:	Practical
Level	: M. Ed. in Biology	Credit hour:	1
Semester	: First	Teaching hours:	48*
		Period per week:	3pds/day/week/gr * *(P)

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### **1. Course Introduction:**

This course is designed for M.Ed. first semester students to provide advanced knowledge and skills to do practical activities on **Systematics, Diversity and Anatomy of animals**. It includes practical activities and experiments on **Animal Systematics and Anatomy**

### **2. General Objectives**

The general objectives of this course are to:

- develop the skills of making fixatives and stain.
- develop the skills in preparing the temporary and permanent slides of different animals included in the syllabus.
- develop the skill in identifying different important internal organs of different animals.
- enhance the knowledge on identifying different animals in the field.
- enable to prepare the reports on different field work.

### **3. Specific Objective and Contents**

<b>Specific Objectives</b>	<b>Contents (48)</b>
<ul style="list-style-type: none"><li>• Prepare laboratory reagents (7)</li></ul>	<b>Unit 1 Preparation of laboratory reagents</b>  1.1 Prepare fixatives of available chemicals. 1.2 Prepare alcoholic grades. 1.3 Prepare stains as needed.
<ul style="list-style-type: none"><li>• Study the museum specimens of non-chordates included in the content</li></ul>	<b>Unit II Invertebrates (Lower animals)</b>  <b>(18)</b> 4.1.1. Museum specimens of invertebrates 4.1.2. Permanent slides of invertebrates

<ul style="list-style-type: none"> <li>• Prepare the permanent slides of important parts of non-chordates included in the content course.</li> <li>• Prepare the permanent slides of larvae, mouth parts, wings, legs of available insect.</li> </ul>	<p>(setae of earthworm) and parapodia of Neleis.</p> <p>4.1.3. Preparation of permanent slides of larvae of any insect, mouth parts, of any available insect.</p>
<ul style="list-style-type: none"> <li>• Study of the museum specimens of lower chordates to higher chordates included in the content course.</li> <li>• Study and prepare the permanent slides of scales of vertebrates.</li> <li>• Study of external organs of fish.</li> <li>• Dissect a fish to expose its internal organs of fish.</li> </ul>	<p><b>Unit III Vertebrates (Higher animals) (21 )</b></p> <p>5.1. Museum specimens of lower chordates to higher chordates.</p> <p>5.2. Preparation of permanent slides of scale of fish.</p> <p>5.3. Study external and internal organs of fishes.</p> <p>5.4. Bones of mammals.</p>
<ul style="list-style-type: none"> <li>• Visit the field and collect, preserve, identify the animals collected and submit the field report.</li> </ul>	<p><b>Field Trip (6)</b></p> <p>Collection, preservation, identification, classification of at least twenty animals of any particular area (with their salient features and color photographs) and submission of the field report.</p>

*Note: The figures in the parenthesis indicate the approximate teaching hours for the respective units.*

#### **4. Instructional Techniques**

- Performing experiments
- Interview
- Record keeping
- Project work
- Report writing

**5. Evaluation****35 Marks**

Nature of course	Internal Evaluation	External Evaluation	Total Marks
Practical	15 Marks	20 Marks	35 Marks

**5.1 Internal Evaluation****15 Marks**

Marks distribution for practical internal evaluation will be as following.

1.	Attendance	5Marks
2.	Students' portfolios (Record book and books and articles review etc.)	5Marks
3.	Participation, collaborative work and construction of teaching learning resources and planning for teaching learning ***	5Marks
	Total	15Marks

**5.2 External Evaluation****20 Marks**

Marks distribution for practical external evaluation will be as following.

1.	Experiment / project work report and presentation / study reports	15Marks
2.	Viva-voce	5 Marks
	Total	20Marks

**Note:** Students must pass both in internal as well as external assessment of practical examination

\* Practical teaching hours is 3 times more than teaching hours of theory (3x 16 = 48 hours)

\*\*A group consists of 15 students and one teacher will be assigned for a group.

\*\*\*Construction of models, charts, teaching aids, develop concept map etc. Also, the collection of materials / designing science lab, preparation of lesson

*plan, unit plan, annual plan, preparation of rubrics, developing test items of various levels etc. for teaching learning.*

**Recommended books and Reference**

Banerjee, V and Bharat, B (1994). A textbook of Vertebrate practical zoology,  
Thakurinari road, Patna

Verma, P.S (2010). A manual of practical zoology, non-chordates and chordates, S.  
Chand and company. Ltd. New Delhi.

Lal. S. S (2008). A practical zoology, Rastogi publication, Meerut



## **Bio. Ed. 517: Cytogenetics and Breeding**

Course No.	: Bio. Ed. 517 (T)	Nature of the course:	Theoretical
Level	: M. Ed. in Biology	Credit hour:	2
Semester	: First	Teaching hours:	32
		Period per week:	2

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### **1. Course Introduction:**

This course is designed for the students of Biology Education at M.Ed. level. It consists of four units on Cell Biology, Genetics, Animal and Plant Breeding. The course deals with the micro and macro constituents and functions of cells, cell organelles and important concepts on genetics. It also deals with the methods of plant and animal breeding and their uses in the production of improved varieties of crops and animals.

### **2. General Objectives**

The general objectives of this course are to:

- provide the detailed knowledge on the structure and functions of living cell and the cytoplasmic organelles.
- acquaint the students with the principles and concepts of genetics and breeding in plants and animals.
- familiarize the students with the development of new varieties of plants and animals.
- impart adequate knowledge on the cellular structure as well as on various stages of cell division.
- Help students acquire in depth knowledge of breeding in plants and animals.

### **3. Specific Objectives and Contents**

<b>Specific Objectives</b>	<b>Contents</b>
<ul style="list-style-type: none"><li>• Explain cell theory.</li><li>• Discuss the structural differences between prokaryotic and eukaryotic cells.</li><li>• Explain the structure and</li></ul>	<b>Unit I. Cytogenetics (12)</b> <b>1.1. Cell Biology</b> 1.1.1. Introduction to Cell Theory.

<p>functions of cytoplasmic organelles – plasma membrane, endoplasmic reticulum, plastid, ribosomes, mitochondria, lysosome.</p> <ul style="list-style-type: none"> <li>• Explain the structure, functions and role of nucleus and nucleolus.</li> <li>• Describe the physical nature of chromosome.</li> <li>• Explain the morphological nature of specialized types of chromosomes namely Polytene and Lampbrush chromosome.</li> <li>• Discuss on the general features of karyotype and its significance.</li> </ul>	<p>1.1.2. Prokaryotic and Eukaryotic cell</p> <p>1.1.3. Anatomy of cell</p> <p>1. 1.3.1. Plasma membrane</p> <p>1.1.3.2. Endoplasmic reticulum</p> <p>1.1.3.3 Plastids (introduction, morphology and Ultrastructure of chloroplast)</p> <p>1.1.3.4. Ribosome</p> <p>1.1.3.5. Mitochondria</p> <p>1.1. 3.6. Lysosome</p> <p>1.1.3.7. Nucleus (Introduction, occurrence, morphology and function)</p> <p>1.1.3.7.1. Nuclear membrane</p> <p>1.1.3.7.2. Nucleoplasm</p> <p>1.1.3.7.3 Chromatin fiber</p> <p>1.1.3.7.4. Nucleolus</p> <p>1.1.3.7.5. Chromosome (Physical nature)</p> <p>1.1.3.7.5.1. Size, Shape and Number</p> <p>1.1.3.7.5.2. Morphology</p> <p>1.1.3.7.5.3. Special types of chromosomes (Polytene and Lampbrush chromosomes)</p> <p>1.1.3.7.5.3.4. Karyotype (features and significance)</p>
<ul style="list-style-type: none"> <li>• Explain the scope and significance of Genetics.</li> <li>• Explain some important modifications of Mendelian laws.</li> <li>• Explain the meaning and causes of mutation.</li> </ul>	<p><b>1.2. Genetics (12)</b></p> <p><b>1.2.1. Scope and significance of Genetics</b></p> <p><b>1.2.2. Some important modifications of Mendelian Laws</b></p> <p>1.2.2.1. Genetic interactions (Interactions between</p>

<ul style="list-style-type: none"> <li>Describe different types of mutation on the basis of origin: spontaneous and induced mutations with their causes and nature.</li> <li>Describe different types of mutations on the basis of change in chromosome morphology and number: chromosome mutation, Gene mutation and Polyploidy with their causes and nature.</li> </ul>	<p>Dominant factors, Complementary factors, Supplementary factors, Epistasis, Inhibitory Factor, Duplicate factor, Multiple factors, Lethal factor, Incomplete dominance)</p> <p>1.2.2.2. Pleotropic or many fold effects of a gene</p> <p>1.2.2.3. Penetrance</p> <p>1.2.2.4. Expressivity</p> <p>1.2.2.5. Significance of gene interactions</p> <p><b>1.2.3. Mutation</b></p> <p>1.2.3.1. Introduction</p> <p>1.2.3.2. Types</p> <p>1.2.3.2.1. On the basis of origin (Spontaneous and Induced)</p> <p>1.2.3.2.2. On the basis of chromosome number And morphology (Chromosome mutation, Gene mutation and Polyploidy)</p> <p>1.2.3.2.2.1. Chromosome mutation</p> <p>1.2.3.2.2.1.1. Types (Deficiency and deletion, Duplication, Translocation and Inversion)</p> <p>1.2.3.2.2.2. Gene mutation</p> <p>1.2.3.2.2.3. Polyploidy</p> <p>1.2.3.2.2.3.1. Euploidy</p> <p>1.2.3.2.2.3.2. Aneuploidy</p>
<ul style="list-style-type: none"> <li>Explain the determination of sex and the role of different types of chromosomes present in the gamete.</li> <li>Explain different theories on the mechanism of sex determination.</li> </ul>	<p><b>1.2.4. Sex determination (2)</b></p> <p>1.2.4.1. Introduction</p> <p>1.2.4.2. Different theories to explain mechanism of Sex determination</p> <p>1.2.4.2.1. Chromosome theory</p>

	<p>1.2.4.2.2. Genic balance theory</p> <p>1.2.4.2.3. Haplo diplo mechanism</p>
<ul style="list-style-type: none"> <li>• Describe different methods of plant improvement.</li> <li>• List improved and recommended varieties of paddy, wheat, maize and potato for different parts of Nepal.</li> </ul>	<p><b>Unit II. Plant Breeding (3)</b></p> <p>2.1. Introduction</p> <p>2.1.1. Different methods of plant improvement (Plant Introduction, Selection, Hybridization, Mutation Breeding)</p> <p>2.1.2. Improved and recommended varieties of paddy, Wheat, maize and potato for different altitudinal zones of Nepal</p>
<ul style="list-style-type: none"> <li>• Describe the techniques of animal breeding systems.</li> <li>• Describe the sustainable animal breeding.</li> <li>• Describe the socio-economic aspects of animal breeding.</li> <li>• Explain eugenics and euthenics.</li> </ul>	<p><b>Unit: III. Animal Breeding (3)</b></p> <p>3.1 Animal breeding systems</p> <p>3.2. Sustainable animal breeding</p> <p>3.3. Socio-economic aspects of animal breeding (Test tube babies, embryo transplantation, surrogate mother, and sex change due to hormone intake).</p> <p>3.4 Eugenics and Euthenics.</p>

*Note: The figures in the parenthesis indicate the approximate teaching hours for the respective units.*

#### **4. Instructional Techniques**

The instructional techniques are divided into two groups. The first group consists of general instructional techniques applicable to most of the units. The second group consists of specific instructional techniques applicable to the specific units.

#### 4.1. Instructional Techniques

Units		General Instructional Techniques	Specific Instructional Techniques
<b>Unit I. Cytogenetics</b>	<b>1.1. Cell Biology</b>	Lecture and discussion; Demonstration, power-point presentation; internet search	Group work, Chart Preparation of prokaryotic and eukaryotic cells, chloroplast, ribosome, mitochondria, chromosome and karyotype.
	<b>1.2. Genetics</b>	Lecture and discussion; power-point presentation; internet search	Book review, group work, Chart Preparation of modifications of Mendel's laws.
	<b>1.2.3. Mutation</b>	Lecture and discussion; power-point presentation; internet search	Group work, Chart Preparation for different types of mutation.
	<b>1.2.4. Sex determination</b>	Lecture and discussion; power-point presentation; Collaborative method, internet search	Group work, Chart Preparation for different mechanisms of sex determination.
<b>Unit II. Plant Breeding</b>		Lecture and discussion; Demonstration, power-point presentation; internet search	Group work, Brochure collection, Project work for different varieties of crops of Nepal and submit the report. To visit agricultural research centers for studying plant breeding and submit the group and individual report.
<b>Unit: III. Animal Breeding</b>		Lecture and discussion methods; Demonstration, Group work	Field study, Brochure collection, Information collection, Group and individual report preparation on animal breeding.

## 5. Evaluation

### 5.1 Evaluation (Internal Assessment and External Examination)

Nature of course	Internal Assessment	Semester Examination	Total Marks
Theory	25 Marks	40 Marks	65 Marks

*Note: Students must pass separately in internal assessment and semester examination.*

#### 5.1.1. Internal Evaluation

**25 Marks**

Internal evaluation will be conducted by course teacher based on following activities:

1. Attendance and participation in learning activities	5 Marks
2. First assignment (written assignment)	5 Marks
3. Second assignment (report writing and presentation)	5 Marks
4. Third assignment/ Term exam	10 Marks
Total	25 Marks

*Note: First assignment/assessment might be a book review /article review, quiz, home assignment etc. according to nature of course. Second assignment/assessment might be a project work, case study, seminar, survey/field study and individual/group report writing, term paper based on secondary data or review of literature and documents etc. and third assignment will be term exam.*

#### 5.1.2. External Evaluation (Final Examination)

**40 Marks**

Examination Division, office of the Dean, Faculty of Education will conduct final examination at the end of semester. The marks distribution will be

1. Objective questions (Multiple Choice Questions 10 x 1mark)	10 Marks
2. Subjective short questions (6 questions with 2 'OR ' questions x 5 marks)	30 Marks
Total	40 Marks

## Recommended books and References

### Recommended Books:

Banerjee, G C (1998). *A Textbook of Animal Husbandry*. Eighth edition, OXFORD & IBH Publishing CO. PVT. LTD, India (**For Unit - III**).

Dalton, D C (1985). *An Introduction to Practical Animal Breeding*. Second Edition, English Language Book Society, Collins Professional and Technical Books, London (**For Unit - III**).

Kanakaraj,P.( 2007).*A Text Book of Animal Genetics*,International Book Distributing Company, Second Updated edition, viii, 514 p, tables, figs, ISBN : 8181892046, (**For Unit - I**).

Roberties, E. P. P. De and E. M. F. De Roberties(2001). *Cell and Molecular Biology*. New Delhi. Waverly P. Ltd. (**For Unit I**).

Shukla, R. S. and P. S. Chandel (2007). *Cytogenetics, Evolution, Biostatistics and Plant Breeding*. S. Chand & Company Ltd. (**For Units - I, II and III**).

### Reference Books:

Bourdon, R. M. (2000). *Understanding Animal Breeding*. Prentice-Hall, Inc. Upper Saddle

Code-EFABAR. *Code of Good Practice for Farm Animal Breeding and Reproduction* (FOOD-CT-2003-506506). [www.code-efabar.org](http://www.code-efabar.org)

Crew, F.A. (2006). *Animal Genetics - The Science of Animal Breeding*, Home Farm Books; Edition (Jan.,2006) Freeman and Co. New York, U.S.A.

Gupta, V. N. G. P. Rao and M. Singh (2003). *Text Book of Botany. Part 2. Ecology, Physiology, Cytology, Cytogenetics, Embryology and Anatomy*. Students' Friends, Allahabad, India.

McGregor, H.C. (1993). *An Introduction to Animal Cytogenetics*. Chapman and Hall, London.

Nicholas, F. W. (1996). *Introduction to Veterinary Genetics*. Clarendon Press, Oxford, U. K.River, New Jersey.

Sinha, U. and Sunita Sinha (2005). *Cytogenetics, Plant Breeding and Evolution*.  
Vikash Publishing House Pvt. Ltd., New Delhi.

Strickberger M.R. (2010). *Genetics*. PHI Learning Pvt. Ltd., New Delhi.

Van Vleck, L.D, Pollak and E.A.B. Oltenace.( 1987). *Genetics for Animal  
Sciences*. W. H.



## **Bio. Ed. 517: Cytogenetics and Breeding**

Course No.	: Bio. Ed. 517 (P)	Nature of the course:	Practical
Level	: M. Ed. in Biology	Credit hour:	1
Semester	: First	Teaching hours:	48*
		Period per week:	3pds/day/week/gr * *(P)

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### **1. Course Introduction:**

This part of the course includes the practical activities and experiments on Cytogenetics and Breeding. Practical include field studies, laboratory exercises (analysis), and creative activities. This course includes practical works from **Cytogenetics and Breeding**. This course is expected to develop knowledge and skills for conducting Bio-practical classes at Higher secondary School and Bachelor of Science Education at the campus level in Cell Biology, Genetics and breeding in plants and animals.

### **2. General Objectives**

The general objective of this course are to:

- acquaint the students with the real -field based knowledge of ecosystem and community
- provide knowledge and skills on cell biology and Breeding
- develop skills to prepare temporary and permanent slides of different stages of mitosis and meiosis following cytological micro-techniques.
- explore various genetic traits of human beings
- engage students in field visit to any agricultural and horticultural farm and submit the report on plant and animal breeding works.

### 3. Specific objectives and Contents:

Specific objectives	Contents
<ul style="list-style-type: none"> <li>• Prepare the temporary and permanent slides of different stages of mitosis and meiosis following cytological micro-techniques such as pretreatment, fixation, staining, squashing, dehydration, mounting.</li> <li>• Prepare the temporary and permanent slides and identify different stages of mitotic cell divisions in <i>Allium cepa</i> or <i>Vicia faba</i>.</li> <li>• Identify different stages of mitotic cell divisions.</li> </ul>	<p><b>Unit I. Cell Biology (39)</b></p> <p>Cytological micro-techniques</p> <p>1.1.1. Root tip collection</p> <p>1.1.2. Pre-treatment</p> <p>1.1.3. Fixation</p> <p>1.1.4. Staining</p> <p>1.1.5. Squashing</p> <p>1.1.6. Dehydration</p> <p>1.1.7. Mounting</p> <p>1.2. Preparation of temporary and permanent slides</p> <p>1.2.1. Different stages of mitotic cell division in <i>Allium cepa</i> or <i>Vicia faba</i></p> <p>1.2.2. Study of cytological slides of different stages of Mitosis.</p>
<ul style="list-style-type: none"> <li>• Demonstrate nucleus in human's buccal epithelium.</li> </ul>	1.2.3. Human's buccal epithelium
<ul style="list-style-type: none"> <li>• Identify different stages of meiotic cell divisions.</li> </ul>	1.2.4. Study of cytological slides of different stages of Meiosis.
<ul style="list-style-type: none"> <li>• Identify different parts of Lampbrush chromosome.</li> </ul>	1.2.5. Study of Lampbrush chromosome
<ul style="list-style-type: none"> <li>• Study various genetic traits of human beings.</li> </ul>	1.2.6. Study of human genetic traits (ear lobe, color of eye, rolling of tongue. texture of hair or straight or curly hair)
<ul style="list-style-type: none"> <li>• Prepare the temporary and permanent slides and study different stages meiotic cell division in the developing anther of any available plant</li> </ul>	1.2.7. Different stages of Meiotic cell division in the developing anther of any available plant.
<ul style="list-style-type: none"> <li>• Prepare the charts of cells, cell organelles and cell division.</li> </ul>	Preparation of the charts of prokaryotic and eukaryotic cells, cell organelles and mitotic and meiotic cell divisions (Project Works)

<ul style="list-style-type: none"> <li>• Visit any agricultural and horticultural farm and prepare the report on the plant and animal breeding works.</li> </ul>	<b>Unit II. Breeding (9)</b> 2.1. Field visit and submission of field report about different techniques used in plant and animal breeding farms and present the report.
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#### 4. Instructional Techniques

Units	General Instructional Techniques	Specific Instructional Techniques
I	Lecture and discussion; power-point presentation, performing experiments; interview; record keeping	Performing experiments, Slide Preparation record keeping; group work, Chart Preparation
II	Lecture and discussion;	Field study, Brochure collection, Information collection, Internet search, Group and individual report preparation;

#### 5. Evaluation

**35 Marks**

Nature of course	Internal Evaluation	External Evaluation	Total Marks
Practical	15 Marks	20 Marks	35 Marks

#### 5.1 Internal Evaluation

**15 Marks**

Marks distribution for practical internal evaluation will be as following.

1.	Attendance	5Marks
2.	Students' portfolios (Record book and Books and article review etc.)	5Marks
3.	Participation, collaborative work and construction of teaching learning resources and planning for teaching learning ***	5Marks
	Total	15Marks

## 5.2 External Evaluation

20 Marks

Marks distribution for practical external evaluation will be as following.

1.	Experiment / project work report and presentation / study reports	15Marks
2.	Viva-voce	5 Marks
	Total	20Marks

**Note:** *Students must pass both in internal as well as external assessment of practical examination*

\* *Practical teaching hours is 3 times more than teaching hours of theory (3x 16 = 48 hours)*

\*\**A group consists of 15 students and one teacher will be assigned for a group.*

\*\*\**Construction of models, charts, teaching aids, develop concept map etc. Also, the collection of materials / designing science lab, preparation of lesson plan, unit plan, annual plan, preparation of rubrics, developing test items of various levels etc. for teaching learning.*

## 6. Recommended and Reference Books for Practical

### Recommended Books:

Pandey, B. P. (2005). *Modern Practical Botany*, Vol. I and Vol. II. S. Chand & Company Ltd., New Delhi.

Santra, S.C., T. P. Chatterjee and A. P. Das ((1999). *College Botany Practical*. Vol.I. New Central Book Agency (P) Ltd., Calcutta, India.

### Reference Books:

Ranjitkar, H. D. (2019). *Botany. A Practical Handbook*. A. K. Ranjitkar, Kalanki, Kathmandu

Sharma, A. K. and A. Sharma (1990). *Chromosome Techniques. Theory and Practice*. Butterworth and Co. Ltd.

Swaroop, H., Pathak, S.C. and Arora, S. (1981). *Laboratory techniques in modern biology* Kalyani publishers, New Delhi. India.

## **Bio. Ed. 518: Environmental Biology and Environmental Education**

Course No.	: Bio. Ed. 518 (T)	Nature of the course:	Theoretical
Level	: M. Ed. in Biology	Credit hour:	2
Semester	: First	Teaching hours:	32
		Period per week:	2

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### **1. Course Introduction:**

This course is designed to acquaint the students with the advanced knowledge and skills of “**Environmental Biology and Environmental Education**”. It deals with relationships among all living organisms to one another and their relationships to the physical environment. The course also deals with the current environmental problems and issues on global and national context and aims to give knowledge and skills to manage them. At the same time, it tries to address how certain human activities impact our environment and focuses on how we can change our behaviors to find the ways and means of reducing negative impacts.

### **2. General Objectives:**

The general objectives of this course are to:

- advance the knowledge of students on Environmental Biology
- acquaint the students with the ecosystem structures and functions
- enhance the knowledge on current global and national environmental issues particularly air and water pollution
- enable the students to aware of natural disasters and provide the knowledge for their management
- acquaint the students with the applications of biotechnology in environmental sectors
- provide knowledge about Environmental Education in national and global context
- acquaint the students with the curricula of environmental education of different universities of Nepal
- make students familiar with the government policy, plan and program of environmental education

### 3. Specific Objectives and Contents

Specific objectives	Contents (32 hrs.)
<ul style="list-style-type: none"> <li>• Introduce the Environmental Biology and its historical development</li> <li>• Discuss the components of Environmental Biology</li> <li>• Show the relationship between Biology and Environment</li> <li>• Explain brief introduction of Environmental Ethics</li> </ul>	<p><b>Group A</b></p> <p><b>Unit I. Environmental Biology (2 hrs.)</b></p> <p>1.1 Introduction</p> <p>1.2 Historical development of Environmental Biology</p> <p>1.3 Components of Environmental Biology</p> <p>1.4 Inter-relationship between biology and environment</p> <p>1.5 Need of Environmental Biology and Environmental Ethics</p>
<ul style="list-style-type: none"> <li>• Introduce the concept of ecosystems and explain ecosystem approaches in environmental management</li> <li>• Discuss the types of ecosystems and their developmental history</li> <li>• Discuss food chain, food web in ecosystem</li> <li>• Define community ecology and deal with its characteristics</li> <li>• Explain ecological succession and their types (Autotrophic, Heterotrophic, Autogenic and Allogenic)</li> <li>• Discuss general process of succession (migration, ecesis, colonization, stabilization and climax community)</li> <li>• Explain briefly climax concept</li> </ul>	<p><b>Unit II. Ecosystem Approach (4 hrs)</b></p> <p>2.1 Introduction, types and developmental history and approaches of ecosystem</p> <p>2.2 Structure and functions of ecosystems</p> <p>2.2.1 Food chain</p> <p>2.2.2 Food web</p> <p>2.2.3 Trophic structure</p> <p>2.2.4 Ecological pyramids</p> <p>2.2.5 Bio-accumulation and bio-magnification</p> <p>2.3. Community ecology and its characteristics</p> <p>2.4. Ecological succession</p> <p>2.4.1 Introduction &amp; their types</p> <p>2.4.2 General process of succession</p> <p>2.4.5 Climax concept</p> <p>2.4.6 Features of climax community</p>

<p>and features of climax community</p>	
<ul style="list-style-type: none"> <li>• Give brief introduction of air pollution</li> <li>• Explain the types and sources of indoor and outdoor air pollutants</li> <li>• Explain the effects of air pollutants in animals, vegetation</li> <li>• Explain the prevention and controlling measures of Air pollution</li> <li>• Give brief introduction of water pollution.</li> <li>• Explain dissolved oxygen (DO), chemical oxygen demand (COD) and biological oxygen demand (BOD).</li> <li>• Explain causes and effects of eutrophication.</li> <li>• Explain the effects water pollutants on environment, plants and animals.</li> <li>• Explain the controlling measures of water pollution.</li> </ul>	<p><b>Unit III. Pollution (4 hrs)</b></p> <p><b>3.1 Air Pollution</b></p> <p>3.1.1 Introduction</p> <p>3.1.2 Types and sources of indoor and outdoor air pollutants</p> <p>3.1.3 Effects of air pollutants in animals and vegetation</p> <p>3.1.4 Effects of air pollutants on human health</p> <p>3.1.5 Prevention and controlling measures of air pollution</p> <p><b>3.2 Water Pollution</b></p> <p>3.2.1 Introduction</p> <p>3.2.2 Dissolved Oxygen (DO)</p> <p>3.2.3 Chemical oxygen demand (COD)</p> <p>3.2.4 Biological oxygen demand (BOD)</p> <p>3.2.5 Eutrophication</p> <p>3.2.6 Effects of water pollution (plants, animals and human health)</p> <p>3.2.7 Prevention and control measures of water pollution</p>
<ul style="list-style-type: none"> <li>• Give introduction of climate change</li> <li>• Explain Natural and Anthropogenic cause of climate change</li> <li>• Discuss climate change impact</li> </ul>	<p><b>Unit IV. Current Environmental Issues (6 hrs.)</b></p> <p>4.1 Global warming and greenhouse gases</p> <p>4.2 Climate change</p> <p>4.2.1 Background, Sources of greenhouse gases and causes of climate change</p>

<p>on vegetation and animals of Nepal with relevant case study</p> <ul style="list-style-type: none"> <li>• Suggest mitigation measures</li> <li>• Explain global warming</li> <li>• List the greenhouse gases</li> <li>• Explain acid rain</li> <li>• Explain ozone layer depletion</li> <li>• Explain sources, hazards, disposal problems and management of solid waste with relevant case</li> </ul>	<p>4.2 Climate change in Nepalese perspectives</p> <p>4.3 Impacts of climate change, adaption and mitigations</p> <p>4.4 Case studies on climate change</p> <p>4.5 Acid rain</p> <p>4.6 Ozone layer depletion</p> <p>4.7 Solid waste</p> <p>4.7.1 Sources</p> <p>4.7.2 Disposal problems and their management</p> <p>4.7.3 Case studies</p>
<ul style="list-style-type: none"> <li>• Define natural disaster</li> <li>• Explain briefly the Past major disasters in Nepal (Earthquake, Flood and Landslide, fire, epidemic, Glacier Lake outburst flood) with relevant case study from Nepal</li> <li>• Review briefly the disaster management in Nepal</li> <li>• List the major Organizations involved and their role in disaster management</li> <li>• Explain the scope and management measures in Nepal</li> <li>• Explain the major international disaster scenario including Tsunami, Katrina and El Nino</li> </ul>	<p><b>Unit V. Disaster Management (5 hrs.)</b></p> <p>5.1 Introduction to natural disaster</p> <p>5.2 Major Disasters in Nepal (Past events)</p> <p>5.2.1 Earthquake</p> <p>5.2.2 Flood and Landslide</p> <p>5.2.3 Fire</p> <p>5.2.4 Epidemics</p> <p>5.2.5 Glacier Lake outburst flood</p> <p>5.3 Case studies of major disasters in Nepal</p> <p>5.4 Overview of disaster management in Nepal</p> <p>5.5 Major Organizations involved and their role in disaster management</p> <p>5.6 Scope and management measures in Nepal</p> <p>5.7 International disaster scenario</p> <p>5.7.1 Tsunami</p> <p>5.7.2 Katrina</p> <p>5.7.3 El Nino</p>
	<p><b>Group B.</b></p>



<ul style="list-style-type: none"> <li>• Explain the historical perspectives of Environmental Education, its educational movements in Nepal.</li> <li>• Study the development of appropriate approaches in Environmental Education in Nepal regarding school/Higher Secondary level curricula.</li> <li>• Study approaches in development of EE and its impact on environment protection.</li> <li>• Discuss the international efforts on Environmental protection focusing on Tbilisi/Stockholm/Rio de Janeiro Conferences.</li> </ul>	<p><b>Unit I. Perspectives of Environment and Education (4 hrs)</b></p> <p>1.1. Environment and Education in Global context</p> <p>1.2 Environment and Educational movements in Nepalese context</p> <p>1.3 Environmental Education and its development in Nepal regarding</p> <p>1.3.1 Primary school curriculum</p> <p>1.3.2 Secondary school curriculum</p> <p>1.3.3 Higher secondary level curriculum</p> <p>1.4 Approaches in development of EE and its impact on environment protection</p> <p>1.5 International efforts on Environmental protection, Tbilisi /Stockholm / Rio de Janeiro Conference</p>
<ul style="list-style-type: none"> <li>• Explain present status of Environmental Education in higher education in Nepal.</li> <li>• Analyze the Environmental components in education curricula of the universities of Nepal.</li> <li>• Explain the present status of Environmental Education in higher education in Nepal.</li> <li>• Analyze the Environmental components in education curricula at universities of Nepal.</li> </ul>	<p><b>Unit II. Present Strategy of EE at Higher Education in Nepal/ SAARC (3 hrs)</b></p> <p>2.1 Country wise Present status of EE in higher Education of SAARC region</p> <p>2.2 Environmental components in education curricula at Universities of Nepal (Bachelor and Master level)</p> <p>2.2.1 Tribhuvan University</p> <p>2.2.2 Kathmandu University</p> <p>2.2.3 Pokhara University</p> <p>2.2.4 Far-Western University</p>
<ul style="list-style-type: none"> <li>• Study plan strategies for major activities of EE</li> <li>• Develop knowledge about government policy, plan and</li> </ul>	<p><b>Unit III. Government Policy, Plan and Program with regards to Environmental Education in Nepal (4 hrs)</b></p> <p>3.1 Environmental education in legal framework</p>

program regarding Environmental Education. <ul style="list-style-type: none"> <li>• Discuss environmental impact assessment, environmental auditing program and management</li> <li>• Give the concept of EIA</li> <li>• Discuss the processes of EIA</li> <li>• Explain the concept of EMS and auditing program in Nepal</li> </ul>	3.2 Environmental policy 3.3 Environmental Acts 3.4 Environmental Regulation 3.5 Environmental Impact Assessment (EIA) 3.5.1 Concept and processes of EIA 3.5.2 Concept of Environmental management system (EMS) and auditing program in Nepal
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#### 4. Instructional Techniques

The instructional techniques for this course are divided into two groups. First group consists of general instructional techniques applicable to most of the units. The second group consists of specific instructional techniques applicable to specific units.

##### 4.1 General Instructional Techniques

S.N.	Units	Name of Unit	Common Methods	Specific methods	Remarks
<b>Group A</b>					
1.	I	Environmental Biology	Lecture and discussion; power-point presentation	Demonstration method; internet search	
2.	II	Ecosystem Approach	Lecture and discussion; Power-point presentation	Demonstration method; Individual laboratory work; Field work	

3.	III	Pollution	Lecture and discussion; Power-point presentation	Demonstration method; Collaborative method  Project work Individual laboratory work; Field work; Problem solving and reports	
4.	IV	Current Environmental Issues	Lecture and discussion	Demonstration method; Project work; Field work; Case studies; Problem solving and reports	
5.	V	Disaster Management	Lecture and discussion; power-point presentation	Demonstration method; Collaborative method; Project work; Group work; Field work; Case studies; Problem solving and reports	

<b>Group B</b>					
6.	I	Perspectives of Environment and Education	Lecture and discussion; power-point presentation	Preparation of charts, presentations	
7.	II	Present Strategy of EE at Higher Education in Nepal/ SAARC	Lecture and discussion; power-point presentation	Project work; Internet search; preparation of charts, presentations,	
8.	III	Government Policy, Plan and Program with regards to Environmental Education in Nepal	Lecture and discussion; Power-point presentation	Internet search; preparation of charts, presentations	

## 5. Evaluation

### 5.1 Evaluation (Internal Assessment and External Examination)

Nature of course	Internal Assessment	Semester Examination	Total Marks
Theory	25 Marks	40 Marks	65 Marks

*Note: Students must pass separately in internal assessment and semester examination.*

#### 5.1.1. Internal Evaluation

**25 Marks**

Internal evaluation will be conducted by course teacher based on following activities:

1. Attendance and participation in learning activities	5 Marks
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2.	First assignment (written assignment)	5 Marks
3.	Second assignment (report writing and presentation)	5 Marks
4.	Third assignment/ Term exam	10 Marks
Total		25 Marks

**Note:** *First assignment/assessment might be a book review /article review, quiz, home assignment etc. according to nature of course. Second assignment/assessment might be a project work, case study, seminar, survey/field study and individual/group report writing, term paper based on secondary data or review of literature and documents etc. and third assignment will be term exam.*

### 5.1.1 External Evaluation (Final Examination) 40 Marks

Examination Division, office of the Dean, Faculty of Education will conduct final examination at the end of semester. The marks distribution will be

3.	Objective questions (Multiple Choice Questions 10 x 1mark)	10 Marks
4.	Subjective short questions (6 questions with 2 'OR 'questions x 5 marks)	30 Marks
Total		40 Marks

## 6. Recommended books and References

- ADB and ICIMOD, 2006. *Environmental Assessment of Nepal: Emerging Issues and Challenges*. ADB and ICIMOD, Kathmandu (Group **B- For Units III, IV**)
- Agrawal V.K. & Verma P.S. (1996) "*Environmental Biology*" S Chandra & Company Pvt. Ltd., New Delhi. (Group **A – For Unit I**)
- Asthana, D.K. & M. Asthana (2006). *A Text Book of Environmental Studies*. S. Chand. Comp Ltd., India. (Group **A- For Units III, IV**)
- Chattergie, A. K (2007). *Introduction to Environmental Biotechnology*, Prentice Hall of India, Pvt. Ltd, New Delhi (Group **A – For Unit II**)
- Cunningham, W.P & Cunningham, M.A. (2004). *Principles of Environmental Science: Inquiry and Applications*, Second Edition. Boston: Mc Grow Hill. (Group **A- For Units II, V VII**)
- De, A.K. (2008). *Environmental Chemistry*. New Delhi: New Age International Publishers, India (Group **A - For Unit II**)

- Dhameja, Suresh, K (2000). *Environmental Engineering and Management*, S.K. Kataria and sons, India (**Group A – For Unit IV**)
- GoN, (2008). *National Strategy for Disaster Risk Management*. Government of Nepal, Kathmandu (**Group B – For Unit VI**)
- Gupta, Debabrata. D (2008). *Environmental Awareness and Education*, AGROBIOS, India (**Group A- For Unit IV**)
- HMG/N (1993), *Working with NGOs-IUCN Nepal* (**Group B – For Unit I**)  
[http.www.google.com](http://www.google.com)
- Hyogo Framework for Action, 2005. *Building the Resilience of Nations and Communities to Disasters* World Conference on Disaster Reduction (A/CONF.206/6, United Nations) (**Group A- For Unit VI**)
- IUCN (2000) “*Environmental Education Source Book*” Kathmandu, Nepal. (**Group A –For Unit I, Group B – For Unit I**)
- Kaushik, C.P. and Kaushik, M., 2006. *Perspectives in Environmental Studies*. New Age International Pvt. Ltd. (**Group A- For Unit I, Group B- For Unit IV**)
- Khadka, R.B., et al (2013). *Environmental Impact Assessment, Processes, Methods, Practices in South Asia (Bangladesh, Bhutan, India and Nepal)*, School of Environmental Science and Management (SchEMS) and Institute of Environment and Development (IED), Kathmandu, Nepal (**Group B – For Unit III**)
- Krishnamacharyulu, V. and Reddy, G.S (2009). *Environmental Education*, Neelkamal Publications, India (**Group B – For Units I, V**)
- Lekhak, H.D. and Lekhak, B. (2009). *Natural Resources Conservation and Sustainable Development in Nepal*. Kshitiz Publications, Kathmandu (**Group A – Unit VII**)
- Miller Jr., J.T. (1995). *Living in the Environment*. Wadsworth Publishing Company, Belmont, California. (**Group A- For All Units**)
- MoE, (2010). *National Adaptation Program of Action (NAPA) to Climate Change*. Ministry of Environment, Kathmandu (**Group A- For Unit IV**)
- MoE, (2011). *Status of Climate Change of Nepal*. Ministry of Environment, GoN, Kathmandu (**Group A – For Unit IV**)
- Odum, E. P. (1996). *Fundamentals of Ecology*. Natraj Publishing, Dehradun, India
- Pandit C.N. (2001) “*Fundamentals of Environmental Education*” Second Edition, K.P. Pustak Bhandar, Dillibazar, Kathmandu. (**Group B – For Unit I**)

- R. C. Dubey (1995). "A Textbook of Biotechnology" S Chand & Company, India.  
**(Group A – For Unit VI)**
- Sharma, P.D (1994). *Ecology and Environment*, RASTOGI Publication **(Group A – For Unit I)**
- Trivedi, P.D. and G. Raj (1991). *Environmental Biology*. Akashdeep Publishing House, New Delhi, India **(Group A- For Unit II)**
- Trivedi, R. N (1997). *A text book of environmental science*, Anmol publication **(Group A – For Unit V)**

### References

- Anonymous (1991). *Caring for the Earth (1991): A Strategy for Sustainable development/ IUCN/UNEP/ WWF*, Switzerland.
- Bandhu, D., H. Singh and AK Maitra (Ed. 1989). *Environmental Education and Sustainable Development* IES, New Delhi
- Butkos, R.A. & Kolmes, S.A. (2011). *Environmental Science and Theology in Dialogue*
- Das, P.C. (2011). *Environmental Biology*. AITBS Publishers, Delhi, India.
- HMG/N (1993), *The IUCN Environmental Law Centre*, the convention on Biological Diversity, An Implementary Guide.
- HMNG/N, Environmental Protection Council (1993). *Nepal Environment Policy and Action Plan*, Kath
- IUCN (1993). *Environmental Education in Nepal: A Review*
- IUCN/HMG (1998). *Environmental Education Source Book for Bachelor of Education Programme*. Faculty of Education, TU, IUCN.
- Joshi, A.R., Shrestha, S.L. and Joshi, K. (2003). *Environmental Management and Sustainable Development at the Crossroad*. Ankush, Kathmandu
- Kannan, K. (1997). *Fundamentals of Environmental Pollution*. S. Chand and Company Ltd., New Delhi, India.
- Khadka, R., B. D. Clayton and A. Mathema (2012) *Safe guarding the Future: Securing Shangrila, Intregating Environment And Development In Nepal: Achievement Challenge and Next Steps*, IEED/ AEMS
- Khadka, R., S. Gorzula and S. Guragain (2013). *Environmental Impact Assesment: Process, Method and Practice in South Asia*, Scheme, Pokhara University

- Koirala, M., Ramakrishnan P.S. and Saxena, K.G. (2011). *Environmental Determinants of Livelihood Related Food Production System in a Mid Himalayan Landscape, East Nepal. Livelihood Linked Environmental Determinants in Himalaya Landscape.* Lambert Academic Publishing, Germany.
- Martens P. and J. Rotmans (1999). *Climate Change: An Integrated Perspective.* Kluwer Academic Publishers
- Mishra, M.P. (2000). *Our Environment Pollution and future strategies.* S. Chand & Company., New Delhi, India.
- Misra, D.D. (2008). *Fundamental concepts in Environmental Studies.* S. Chand & Co. Ltd. New Delhi
- NPC / World Conservation Union (1995), *National Conservation Strategy,* Kathmandu.
- Odum, E. P. and Barrett, G. W. (2005), *Fundamentals of Ecology,* 5<sup>th</sup> Edition, Saunders Company, USA.
- Santhra S.C. (2004) *Environmental Science* New Central Book Agency
- Singh, H.R. (2005). *Environmental Biology.* S. Chand and Company Ltd., New Delhi, India.
- Talking H Hellemon, H. White, R (Ed. 2005). *Renewable Natural Resource Management for Mountain Communities.* ICIMOD, Nepal.
- Verma, P.S. and V.K. Agarwal (2001). *Environmental Biology.* S. Chand and Company Ltd., New Delhi, India.



## **Bio. Ed. 518: Environmental Biology and Environmental Education**

Course No.	: Bio. Ed. 518 (P)	Nature of the course:	Practical
Level	: M. Ed. in Biology	Credit hour:	1
Semester	: First	Teaching hours:	48*
		Period per week:	3pds/day/week/gr * *(P)

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### **1. Course Introduction:**

This part of the course includes practical activities/ experiments on Environmental Biology and Environmental Education. For the course, the practical's include field studies, laboratory exercises (analysis), and creative activities. These exercises are not only relevant to get a better understanding of environment but also provide hands-on experience at devising methods for preventing environmental degradation and maintaining the environmental sustainability.

### **2. General Objectives**

The general objective of this course are to:

- acquaint the students with the real -field based knowledge of ecosystem and community
- provide knowledge and develop practical skills on ecosystem, water pollution and related issues
- enable the students, appreciate to the ever-increasing environmental issues and need and applications of environmental education

### **3. Specific Objectives and Contents**

<b>Specific objectives</b>	<b>Contents (48 hrs.)</b>
<b>Group A: Environmental Biology</b>	
<ul style="list-style-type: none"><li>• Determine the density of different species in the community by quadrat method.</li><li>• Explore the frequency of different species in the community by quadrat method.</li></ul>	<b>Unit I: Ecosystem approach (8x3= 24 hrs.)</b>  <b>A. Community</b>  1. Determination of density of different species in the community by quadrat method of terrestrial ecosystem.  2. Determination of frequency of different species in the community by quadrat

<ul style="list-style-type: none"> <li>• Study on population density of butterfly by capture and recapture method.</li> <li>• Measure the primary productivity of grassland ecosystem by biomass method</li> <li>• Find out pH and temperature of water</li> <li>• Study the Producers, Consumers, Decomposers of Pond ecosystem</li> </ul>	<p>method of terrestrial ecosystem.</p> <p>3. Determination of population density of butterfly by capture and recapture method.</p> <p><b>B. Ecosystem</b></p> <p>4. <b>Grassland Ecosystem</b> Measurement of primary productivity of grassland ecosystem by harvest method</p> <p>5. <b>Pond Ecosystem</b></p> <ul style="list-style-type: none"> <li>• Abiotic components</li> <li>• Biotic components</li> </ul>
<ul style="list-style-type: none"> <li>• Compare the quality of water based on pH, temperature, transparency, total dissolved solids, dissolved oxygen and Electrical conductivity in the water samples of Lentic and Lotic environment.</li> </ul>	<p><b>Unit II: Water Pollution (4x3=12 hrs.)</b></p> <p>Measurement of water quality of Lentic and Lotic environment of following parameters:</p> <ul style="list-style-type: none"> <li>• Temperature and pH</li> <li>• Transparency</li> <li>• Total dissolved solids</li> <li>• Dissolved oxygen</li> <li>• Electrical conductivity</li> </ul>
<p><b>Group B: Environmental Education</b></p>	
<ul style="list-style-type: none"> <li>• Write a term paper on existing environmental education in science and science education courses of Nepal's school level/ higher secondary education level/ universities level and present on formal seminar</li> </ul>	<p><b>Unit I A: Environmental Education</b></p> <p style="text-align: right;"><b>(2x3= 6 hrs.)</b></p> <ul style="list-style-type: none"> <li>• Write a term paper on existing environmental education in science and science education courses of Nepal's school level/ higher secondary education level/ universities level</li> <li>• Present the term paper in the formal</li> </ul>

	seminar
<ul style="list-style-type: none"> <li>Identify environmental impacts and their mitigation measures in brick factory/ pharmaceutical Industry /dyeing Industry / hospitals at local level</li> </ul>	<p><b>Unit I B: Environmental Education</b></p> <p style="text-align: right;"><b>(2x3= 6hrs.)</b></p> <ul style="list-style-type: none"> <li>Identification of environmental impacts and their mitigation measures of brick factory/ pharmaceutical industry dyeing industry / hospitals at local level</li> <li>Present the term paper in the formal seminar</li> </ul>

*Note: The figures in the parenthesis indicate the approximate teaching hours for the respective units.*

#### 4. Instructional Techniques

S.N.	Units	Name of Unit	Common Methods	Specific methods	Remarks
<b>Group A: Environmental Biology</b>					
1.	I	Ecosystem approach	Lecture and discussion; power-point presentation, performing experiments; interview; record keeping	Field work; laboratory work; report preparation; group work	
2.	II	Water pollution	Lecture and discussion; Power-point presentation	Field work; laboratory work; report preparation; group work; case study	

<b>Group B: Environmental Education</b>					
3.	I A	Environmental Education	Lecture and discussion; Power-point presentation	Collaborative method Project work Problem solving and reports	
	I B	Environmental Education	Lecture and discussion; Power-point presentation	Collaborative method; problem solving; project work; report writing	

### 5. Evaluation

**35 Marks**

<b>Nature of course</b>	<b>Internal Evaluation</b>	<b>External Evaluation</b>	<b>Total Marks</b>
Practical	15 Marks	20 Marks	35 Marks

#### 5.1 Internal Evaluation

**15 Marks**

Marks distribution for practical internal evaluation will be as following.

1.	Attendance	5Marks
2.	Students' portfolios (Record book and Books and article review etc.)	5Marks
3.	Participation, collaborative work and construction of teaching learning resources and planning for teaching learning ***	5Marks
	Total	15Marks

#### 5.2 External Evaluation

**20 Marks**

Marks distribution for practical external evaluation will be as following.

1.	Experiment / project work report and presentation / study reports	15Marks
2.	Viva-voce	5 Marks
	Total	20Marks

**Note:**

*Students must pass both in internal as well as external assessment of practical examination*

*\* Practical teaching hours is 3 times more than teaching hours of theory (3x 16 = 48 hours)*

*\*\*A group consists of 15 students and one teacher will be assigned for a group.*

*\*\*\*Construction of models, charts, teaching aids, develop concept map etc. Also, the collection of materials / designing science lab, preparation of lesson plan, unit plan, annual plan, preparation of rubrics, developing test items of various levels etc. for teaching learning.*

**6. Recommended books for Practical**

APHA, AWWA, and WPCF (2005) *Standard Methods for the Examination of Water and Wastewater*. 21st Edition, American Public Health Association, Washington DC.

Sharma, P.D. (1993). *Environmental Biology*. Rastogi Publication, Meerut, India

Zobel, Jha, Behan and Yadav (1987). *A Practical Manual for Ecology*