Re-Accredited by NAAC with 'A' Grade
VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
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-: પરિપત્ર :-

વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન બાયોસાયન્સ વિષય ચલાવતી અનુસ્નાતક કોલેજોનાં આચાર્યશ્રીઓને તથા ડિપાર્ટમેન્ટના વડાશ્રીને જણાવવાનું કે,M.Sc. Bio-Science Sem-III & IV નો નવા અભ્યાસક્રમ અંગે બાયોસાયન્સ વિષયની અભ્યાસસમિતિની તા.૧૯/૦૬/૨૦૨૦ ની સભાનાં ઠરાવ ક્રમાંકઃ ૨ અન્વયે નીચે મુજબ ભલામણ કરેલ છે. જે ભલામણ વિજ્ઞાન વિદ્યાશાખાનાં અધ્યક્ષશ્રીએ વિજ્ઞાનવિદ્યાશાખાની મંજૂરીની અપેક્ષાએ વિજ્ઞાન વિદ્યાશાખાવતી મંજૂર કરી એકેડેમિક કાઉન્સિલનેકરેલ ભલામણ એકેડેમિક કાઉન્સિલએ તેની તા.૩૦/૬/૨૦૨૦ ની સભાના **ઠરાવ ક્રમાંકઃ૮૬** અન્વયે સ્વીકારી મંજૂર કરેલ છે. તેની જાણ સંબંધકર્તા શિક્ષકો અને વિદ્યાર્થીઓને કરવી, તદ્ઉપરાંત તેનો અમલ કરવો.

બાયોસાયન્સ વિષયની અભ્યાસસમિતિની તા.૧૯/૦૬/૨૦૨૦ ની સભાનાં ઠરાવ ક્રમાંકઃ ૨

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૦–૨૧ થી અમલમાં આવનાર M.Sc. Bio-Science Sem-III & IV નાં M.Sc. Bio-Science(Botany), M.Sc. Bio-Science(Zoology), M.Sc. Bio-Science (Microbiology) નાં અભ્યાસક્રમ મંજુર કરી તે મંજૂર કરવા વિજ્ઞાન વિદ્યાશાખાને ભલામણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલની તા.૩૦/૦૬/૨૦૨૦ ની સભાનાં ઠરાવ ક્રમાંકઃ ૮૬

:: આથી ઠરાવવામાં આવે છે કે, બાયોસાયન્સ વિષયની અભ્યાસસમિતિની તા.૧૯/૦૬/૨૦૨૦ ની સભાના ઠરાવ ક્રમાંકઃ ૨ અન્વયે ભલામણ કરેલ અને વિજ્ઞાન વિદ્યાશાખાના અધ્યક્ષશ્રીએ વિજ્ઞાન વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ સ્વીકારેલ શૈક્ષણિક વર્ષ ૨૦૨૦–૨૧ થી અમલમાં આવનાર M.Sc. Bio-Science Sem-III & IV નાં M.Sc. Bio-Science(Botany), M.Sc. Bio-Science(Zoology), M.Sc. Bio-Science (Microbiology) નાં અભ્યાસક્રમમંજૂર કરવામાં આવે છે.

બિડાણઃ ઉપર મુજબ

ક્રમાંક : એકે./પરિપત્ર/૫૮૧૨ /૨૦૨૦
તા. ૧૫–૦૭–૨૦૨૦

ઈ.ચા. કુલસચિવ

પ્રતિ,

૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન બાયોસાયન્સ વિષય ચલાવતી અનુસ્નાતક કોલેજોનાં આચાર્યશ્રીઓ તથા ડિપાર્ટમેન્ટનાં વડાશ્રી.
૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા.
૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.

.....તરફ જાણ તેમજ અમલ સારૂ.

SYLLABUS

M.Sc. Biosciences (Botany)
Sem. III and IV

CHOICE BASED CREDIT SYSTEM (CBCS)

w.e.f. June 2020

Department of Biosciences

Veer Narmad South Gujarat University, Surat

M.Sc. Biosciences (Botany) Semester- III							
Subject Code	Subject Title	Theory Hours/ week	Practical Hours/week	External Marks	Internal Marks	Total Marks	Credit
Bios -(B)-301	Phycology, Mycology and Plant Pathology	4	-	70	30	100	4
Bios -(B)-302	Advances in Archegoniatae and Paleobotany	4	-	70	30	100	4
Bios -(B)-303	Developmental Biology	4	-	70	30	100	4
Bios -(B)-304 (Elective)	(i) Medicinal Plants OR (ii) Plant Biotechnology OR (iii) Horticulture	4	-	70	30	100	4
Bios -(B)-305	Practical Based on Bios -(B)-301 to 304	-	16	140	60	200	8
Total		**16**	**16**	**420**	**180**	**600**	**24**

M.Sc. Biosciences (Botany) Semester- IV							
Subject Code	Subject Title	Theory Hours/ week	Practical Hours/week	External Marks	Internal Marks	Total Marks	Credit
Bios -(B)-401	Angiosperm taxonomy	4	-	70	30	100	4
Bios -(B)-402	Plant Anatomy and Histo-Chemical Techniques	4	-	70	30	100	4
Bios -(B)-403	Research Methodology and Professional Skills	4	-	70	30	100	4
Bios -(B)-404	Dissertation/Industrial Training	-	12	105	45	150	6
Bios -(B)-405	Practical Based on Bios -(B)-401 to 403	-	12	105	45	150	6
Total		**12**	**24**	**420**	**180**	**600**	**24**

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Botany)**
Course Code	**BIOS -(B)-301**	**Semester**	**III**
Phycology and Mycology and Plant Pathology			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS -(B)-301 – PHYCOLOGY AND MYCOLOGY AND PLANT PATHOLOGY

Learning Objective and Outcomes:

- *This Course focuses on the classification and general accounts of Algae and Fungi. It also includes interaction between plant and pathogen.*
- *After learning units I, II & III the students will able to understand the classification of algae and fungi including general account of different classes.*
- *Students will be able to understand, in unit IV, the interaction between pathogen and plant. Learn the defense mechanism of plants against pathogen along with general interaction with non-pathogenic microbes.*

Unit-I Classification and Evolution in Algae

1.1 Classification (Fritsch's system and G. M. Smith system), pigments and storage food material, thallus organization, cellular organization, reproduction, life cycle patterns and alternati of generations in the Algae. Molecular taxonomy and recent developments in the algal classification.

1.2 General characters and type study of Cyanophyta, Chlorophyta, Euglenophyta, Xanthophyta.

1.3 General characters and type study of Bacillariophyta, Phaeophyta and Rhodophyta.

1.4 Origin of sex in the algae, Evolution in the algae, Fossil Algae.

Ref.

1. Brodie, J. and Lewis, J. (2007). (Ed.) Unravelling the algae: the past, present and future of algal systematics. CRC press, New York, pp. 335.
2. Bellinger, E. G. and Sigee, D. C. (2010). Freshwater algae: Identification and use as bioindicators. Wiley-Blackwell, UK, pp. 271.
3. Graham, L. E. and Wilcox, L. W. (2000). Algae. Prentice-Hall, Inc. pp. 640.
4. Lee, R. E. (2008). Phycology. Cambridge University Press, pp. 547.
5. Delevoryas Theodore, 1966. Plant Diversificaiton, Pub. Holt, Rinehart and Winston, Inc.
6. Gangulee HC, Kar AS, 1989. College botany Vol-II, Books and Allied (P) Ltd.

Unit-II Algae for Environment and Human Welfare

2.1 Algal Biotechnology: Algal culturing techniques in the laboratory, tissue and cell culture studies in seaweeds, cryopreservation, aquaculture (micro and macro algae cultivation). Algae in bioengineering, Chlamydomonas and Porphyra as modern experimental systems.

2.2 Algeae and Environmen: Bioremediation. Algae as pollution indicators. Algae in global warming-carbon capture by algae. Photo-bioreactors and raceway ponds. Biofertilizer-Nitrogen fixation in heterocyst. Algal blooms and cyanobacterial toxins.

2.3 Algal biofuels: Algal biodiesel, bio-ethanol and biological hydrogen production.

2.4 Industrial Phycology (Products, processes and applications): Seaweeds polysaccharides like Agar, Carrageenan and Alginates. Spirulina-single cell protein. Bioactive compounds from algae. Extracellular products and antimicrobial substances of cyanobacteria.

Ref.

1. Sahoo D., Seckbach J., 2015. The Algae World, Springer.

2. Barsanti L., Gualtieri P., 2014. Algae Anatomy, Biochemistry And Biotechnolgy, 2nd Ed., CRC Press, Taylor & Francis Group.
3. Fritsch, F.E.1945. The Structure and Reproduction of Algae. Cambridge University Press.
4. Vashishta, B.R.1999. Algae. S.Chand & Company, New Delhi.
5. Sharma O.P., 2007. Text book of algae. Tata McGrawHill, ISBN 007451928-X.
6. Dey and Harborne, 1997. Plant Biochemistry, Academic Press. (pg.273-Nitrogen fixation)

Unit-III Taxonomy and salient features of Fungi

1.1 Classification, general characters, thallus organization, life cycle patterns, reproductive structures of Myxomycotina, Zygomycotina, Mastigomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. An outline of classification system proposed by Ainsworth or Alexopoulos.

1.2 Fungi and Biotechnology: DNA barcoding for taxonomic identification of fungi. Economic importance of fungi, Fermentation technology & Enzyme and Production technology.

1.3 Evolution in Fungi. Fossil fungi-Occurrence and their significance. Chromista – Its present status in classification; general characters, classification up to orders.

1.4 Lichen: types, morphology and reproduction.

Ref.

1. Roger, 2011, Fungi, Algae, and Protists. Britannica Educational Publishing.
2. Mccoy Peter, 2016. Radical Mycology-A Treatise On Seeing & Working With Fungi. Chthaeus Press.
3. Carlile 2001. The Fungi, 2nd Ed, Academic Press.
4. Weber 2007. Introduction to Fungi. Cambridge University Press.
5. Alexopolus, C. J., Minms, C. W. and Blackwell, M. (1999). (4th edn) Indtroductory Mycology.Wiley, New york. Alford, R. A..
6. Deacon, J. W. (2006). Fungal biology. (4th Ed.) Blackwell publishing, ISBN. 1405130660.
7. Kendrick, B. (1994). The fifth kingdom (paperback), North America, New York, Publisher: 3rd edition, ISBN- 10: 1585100226.
8. Kirk et al., (2001). Dictionary of the fungi, 9th edition, published Wallingford : CABI, ISBN: 085199377X.
9. Mehrotra, R. S. and Aneja, K.R. (1990). An introduction to mycology. New age publishers, ISBN 8122400892.
10. Miguel U., Richard, H. and Samuel, A.(2000). Illustrated dictionary of the Mycology, Elvira Aguirre Acosta, Publisher: St. Paul, Minn: APS press, ISBN 0890542570.
11. Webster, J. and Rpland W. (2007). Introduction to fungi. (3rd Ed.), Cambridge University Press, 978-0-521-80739-5.

Unit-IV Plant Pathology

2.1 Plant- Pathogen Interaction

- Penetration and entry by plant pathogens
- Direct interaction models
- Indirect interaction models
- Case studies of economically important crop plants with causative agents:
  - Plant-virus interactions with emphasis on potyviruses and horticultural crops.
  - Plant-bacterial interactions with emphasis on *Erwinia* sp. and potatoes.
  - Plant-fungus interactions with emphasis on *Magnaporthe* sp. and rice.
  - Plant-nematode interactions with emphasis on *Meloidogyne* sp. and tomato.
  - Plant-insect interactions with emphasis on *Pieris* sp. and crucifers.
- Plant microbial interaction (symbiotic- Rhizobacteria, mycorrhiza, non-symbiotic)

2.2 Defense mechanisms (structural, chemical, SAR). Defense Response Genes.

2.3 Management of plant disease through biological control.

2.4 Defence through Genetically Engineering Disease-Resistant Plants.

Ref.

1. Agarios, G. N. (2005). Plant Pathology, 5th ed. Elsevier.
2. Chakraborty Supriyo, 2018. Plant Molecular Genetics, Scientific Pub.
3. Singh BD and Shekhawat NS, 2018. Molecuar Plant Breeding, Scientific Pub.
4. Aneja KR, 2003. Experiemntas in Microbilogy, Plant Pathology and Biotechnology, 4th Ed., New Age International Pub.
5. Kiraly Z, Klement Z, Solymosy F, Voros J, 1974. Methods in plant Pathology, Elsevier.
6. Mehrotra, R.S. and Aggarwal, A. (2013) Fundamentals of Plant Pathology, 2 Ed., Tata McGrawHill.
7. Mehrotra, R.S. (2000). Plant Pathology, Tata McGraw Hill.
8. Mims, C. A. et al (2000).MIMS' Molecular pathogenesis of Infectious Disease, 5th Ed. Academic Press.
9. Mitra, S. (2007). Genetic Engineering-Principles and Practise. Macmillan India Ltd, New Delhi.
10. Pandey, B. P. (2005) Plant Pathology: Pathogen and Plant disease, S. Chand & Company Ltd. New Delhi.
11. Buchanan B, Gruissem G and Jones R (2000) Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, USA.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Botany)**
Course Code	**BIOS -(B)-302**	**Semester**	**III**
Advances in Archegoniatae and Paleobotany			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS -(B)-302 – ADVANCES IN ARCHEGONIATAE AND PALEOBOTANY

Learning Objective and Outcomes:

- *This Course focuses on the classification and general accounts of Bryophytes, Pteridophytes, Gymnosperms and Fossil Records. It also includes the understanding of fossil formation and fossil study.*
- *After learning units I, II & III the students will able to understand the classification of Bryophytes, Pteridophytes and Gymnosperms including fossil records.*
- *Students will be able to understand, in unit IV, the formation of fossils and the method to study the fossils.*

Unit-I Bryophytes

1.1 Criteria and recent trends in the classification of Bryophytes. Origin and evolution of bryophytes. Vegetative and reproductive innovations of early land plants. Evolution of sporophytes in Bryophytes. Hormonal regulation of gametophyte development in bryophytes. A comparative study of phylogeny, habitat, morphology, anatomy, life cycle, gametophyte and sporophyte organization (with special reference to Indian forms):

- Takakiales, Calobryales, Monocleales, Sphaerocarpales, Marchantiales, Jungermanniales.

1.2 A comparative study of phylogeny, habitat, morphology, anatomy, life cycle, gametophyte and sporophyte organization (with special reference to Indian forms):

- Anthocerotales, Sphagnales, Andreaeales and Bryales.

1.3 Bryogeography and conservation . Economic importance of Bryophytes, Role of bryophytes in ecosystem dynamics and in the global carbon budget. Bryophyte association with microorganism and animals. Biologically active compounds in Bryophytes.

Ref.

1. Cavers, F. 1976. The Inter relationship of the Bryophyta. S.R. Technic (Book House), Ashok Rajpath, Patna.
2. Dyer, A.F. and Duickett, J.G. (Ed.). 1984. The experimental Biology of Bryophytes. Academic Press.
3. Parihar. N.S.1980. An Introduction to Embryophyta Vol. I. Bryophyta. Central Book Depot.
4. PremPuri, 1981. Bryophytes: Morphology, Growth and differentiation. Atma Ram and Sons, New Delhi.
5. Vashishta, P.C. 1999. Bryophyta. S. Chand & Co. New Delhi.
6. Shaw AJ and B Goffinet (2000) Bryophyte Biology. Cambridge University Press.
7. Geissler and Greene SW (1982) Bryophyte Taxonomy, methods, practices and floristic exploration. J Cramer, Germany.
8. Richardson DHS (1981) The Biology of mosses. John Wiley & Sons, Inc New York.
9. Arumugam N, Annie Ragland, Kumaresan V, 2010. Bryophytes. ISBN :9789384826123.
10. Delevoryas Theodore, 1966. Plant Diversificaiton, Pub. Holt, Rinehart and Winston, Inc.

Unit-II Pteridophytes

2.1 Origin and evolution, alternation of generation in Pteridophytes, capogamy and apospory. Morphological diversity and evolution of vegetative organs in Pteridophytes. The sporophyte- microphyll and megaphylls; sporangia structure, position, ontogeny types. The

gametophytes: Germination of fern spore, Development of fern prothallus.Classification and comparative study of *Psilopsida, Lycopsida, Sphenopsida* and *Pteropsida*.

2.2 Heterospory: Occurrence, causes and significance. Stelar theory; Telome theory. Fossilized Pteridophytes (*Rhynia, Lepidocarpon, Sphaenophyllum*, *Zygopteris , Pteridospermales*).

2.3 Culture of fern gametophyte for experimental investigation, Photomorphogenesis. Model system in *Ceratopteris, Trichomanes, Osmunda, Marsilea*. Symbiotic fungal associations in early land plants, Poikelohydry, Desiccation tolerance.

Ref.

1 Eames, E.J. 1983. Morphology of vascular plants. Standard University Press.
2 Rashid, A. 1999. Pteridophyta, Vikas Publishing House Pvt. Ltd. New Delhi.
3 Sharma, O.P. 1990. Textbook of Pteridophyta. Macmillan India Ltd. Delhi.
4 Sporne, K.R. 1986. The morphology of Pteridophytes. Hutchinson University Press.
5 SundaraRajan, S. 1999. Introduction to Pteridophyta. New Age International Publishers, New Delhi.
6 Dyer AF (Ed) (1979) The experimental Biology of Ferns. Academic London.
7 Sharma, 2014. Pteridophyta, McGraw Hill.
8 Delevoryas Theodore, 1966. Plant Diversificaiton, Pub. Holt, Rinehart and Winston, Inc.

Unit-III Gymnosperm

3.1 Classification of gymnosperms with general account on Pteridospermales (*Calymmatotheca*, *Hoeninghausi*), Glosopteridales, Caytoniales (*Caytonia*), Cycadales, Bennettitales (*Williamsonia* sp.), Pentoxylales and Corditales (*Cordaites* sp.)

3.2 Distribution, life cycle, anatomy and cone organization of Ginkgoales (*Ginkgo biloba*), Coniferales (Ephedrales (*Ephedra* sp.) Gnetales (*Gnetum* sp.) and Welwitschiales (*Welwitschia* sp.).

3.3 Origin of Gymnosperms: Evolution of pollination mechanisms and embryogeny of gymnosperms. Origin of gymnosperm stele. Homospory, Anisospory, Heterospory to ovule, Evolution of integument.

3.4 Propagation of conifers using plant tissue culture, somatic embryogenesis and synthetic seeds of conifers. Acclimatization and adaptive responses of conifers to environmental stresses. Impact of coniferous forest on human life.

Ref.

1. Vashishta, P.C. 1999. Gymnosperms, S. Chand & Company Ltd. New Delhi.
2. Bhatnagar SP and Moitra A (1996) Gymnosperms. New Age International (P) Limited, Publishers, New Delhi.
3. Singh Hardev (1978) Embryology of Gymnosperms. Encyclopedia of Plant Anatomy. Vol X Gebruder Borntraegrl, Berlin, Stuttgart.
4. Chamberlain, C.J. 2000. Gymnosperms. C B S Publishers and Distributors, New Delhi.
5. Chamberlain, C.J. 1955. Gymnosperms. Structure and Evolution.
6. Biswas, C. and Johri, B.M. 1999. The Gymnosperms. Narosa Publishing House, New Delhi.
7. Sporne, K.R.1986. Morphology of Gymnosperms. Hutchinson University Press.

Unit-IV Palaeobotany

4.1 Principles of Palaeobotany and geological time scale.

4.2 Processes of fossilization and types of fossils.

4.3 Methods of study of fossils and dating techniques.

4.4 Concept of organ genera in palaeobotany with fossil history of Bryophytes, Pteridophytes and gymnosperms-Psilophytopsida (*Asteroxylon, Horneophyton*), Lycopsida (*Protolepidodendron, Miadesmia, Stigmaria*), Filicopsida (*Zygopteris, Cladoxylon*), Cycadopsida (*Lyginopteris, Heterangium*).

Ref.

1. Arnold C.A., 1972. Introduction to Paleobotany.
2. Andrews H.N., 1961. Studies in Paleobotany.
3. Shukla A.C. and Mishra S.D. 1975. Principles of Paleobotany.
4. Stewart W.N., 1983. Paleobotany and the evolution of plants. Cambridge.
5. Sambamurty A.V.S.S., 2010. A Textbook of Bryophytes, Pteridophytes, Gymnosperms and paleobotany.
6. Annie Ragland, Kumaresan V., 2017. Pteridophytes, Gymnosperms and Palaeobotany. ISBN: 9789386519337.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Botany)**
Course Code	**BIOS -(B)-303**	**Semester**	**III**
Developmental Biology			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(B)-303 – DEVELOPMENTAL BIOLOGY

Learning Objective and Outcomes:

- *This Course focuses on the development of male and female reproductive organs of flowering plants called angiosperms. It gives complete idea of spore and gamete formations, gametophyte development in angiosperms and fertilization process.*
- *After learning units I, II & III the students will able to understand starting from the development of anther and ovule to the process of double fertilization leads to the development of embryo and endosperm.*
- *Students will be able to understand, in unit IV, the morphology of pollen grains and its application in various fields.*

Unit-I Reproductive Biology

1.1 Development of flower: Transition to flowering - vegetative to reproductive evocation, floral homoerotic mutations in *Arabidopsis, Antirrhinum* and *Petunia*. Axis development in flower.

1.2 Gender expression in monoecious and dioecious plants.

1.3 Development and Structure of Anther and the process of Microsporogenesis.

1.4 Development and Structure of Ovule and the process of Megasporogenesis.

Unit-II: Gametophyte Development

2.1 Developmental biology of male and female gametophytes. Regulation of anther and ovule.

2.2 Male sterility- mechanisms and applications, pollen embryogenesis.

2.3 Different types of embryo sacs, ultra structure of embryo sac, nutrition.

2.4 Pollen-pistil interaction. *In vivo* and *in vitro* pollen germination, pollen tube growth and guidance, self-compatibility mechanisms, incongruity.

***Ref*. (Unit I & II)**

1. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms, Vikas Publishing House Pvt. Ltd. New Delhi.
2. Johri, B.M. 1984. 1984. Embryology of Angiosperms. Springer Verlag. Berlin.
3. Maheswari, P. 1980. Recent Advances in the Embryology of Angiosperms.
4. Pandey, A.K. 1997. Introduction to Embryology of Amngiosperms. CBS Publishers and Distributors, New Delhi.

Unit-III Fertilization and Embryogenesis

3.1 Process of double fertilization, development of embryo and endosperm. Types of endosperms.

3.2 Evolutionary trend of pollination and pollinators.

3.3 Pollen wall development, pollen embryo.

3.4 Embryogenesis and seed development: Polarity during embryogenesis, pattern mutants, *in vitro* fertilization, apomixis, polyembryony.

Ref.

1. Pandey, S.N. and Chadha, A. 2000. Embryology. Vikas Publishing House Pvt. Ltd. New Delhi.
2. Parihar NS (1993) An Introduction to Embryophyta: Vol I – Bryophyta, Vol II –Pteridophyta, Central Book Dept. Allahabad.
3. Raghavan V (2000) Developmental Biology of Flowering Plants, Springer, Netherlands
4. Raghavan V (1997). Molecular Embryology of Flowering Plants. Cambridge. University Press.
5. Richards AJ (1986) Plant Breeding System, George Allen and Unwin.
6. Shivanna KR (2003) Pollen Biology and Biotechnology, Science Publishers.

Unit-IV: Palynology

4.1 Introduction, Pollen morphology, Palynotaxonommy.

4.2 Aeropalynology, Melissopalynology, Forensic palynology, Pollen allergy

4.3 Paleopalynology & Evolutoinary trends among pollen grains.

4.4 Pollen Biotechnology

Ref.

1. Kashinath Bhattacharya, 2006. A Textbook of Palynology. New Central Book Agency.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Botany)**
Course Code	**BIOS -(B)-304(i)**	**Semester**	**III**
Medicinal Plants (Elective)			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(B)-304(i) – MEDICINAL PLANTS (ELECTIVE)

Learning Objective and Outcomes:

- *This Course focuses on medicinal plants, parts used, ethnomedicine, Indian system of medicine, and modern herbal science, pharmacognosy and phytochemistry.*
- *After learning this student will be able to identify medicinal plants, will have the knowledge of herbal wealth of Gujarat and the method of conducting ethnomedicinal study and modern laboratory techniques for studing medicinal plants.*

Unit-I History of Herbal Science

1.1 History and development of herbal science in India and abroad:Sushrut, Charak (1 AD), Theophrastus (370 – 285 BC), Dioscorides (1 AD), Adanson.

1.2 Introduction to the literature on medicinal plants: Sushrut Samhita, Charak Samhita, Vagbhatta Samhita, Sharangdhar Samhita, Nighantu Adarsh of Bapalal Vaidya. Ethnovate heritage.

1.3 Introduction to Ayurvedic Pharmocopia of India and contemporary literature on medicinal plants.

1.4 Data bases of medicinal plants.

Ref.

1. Anjaria J., Parabia M.H., Dwivedi S. and Reddy M.N. (2002): Ethnovet Heritage- Indian EthnoVeterinary Medicine: An Overview. Pathik Enterprise, Ahmedabad.
2. Chopra R.N., Nayar S.L. and Chopra I.C. (1969): Glossary of Indian Medicinal Plants. Publication and Information Directorate, CSIR, New Delhi.
3. DerMarderosian A. and Beutler J.A. (Co edt. by) (2002): The Review of Natural Products (Volume I- II) (2ndedn.). Facts and Comparisons, Missouri, USA.
4. Kirtikar K.R. and Basu B.D. (1998): Indian Medicinal Plants (I to VIII Volumes) (2^{nd}edn.) (4^{th} Reprint) BishenSinghMahendrapal Singh, Dehradun
5. Rastogi R.P. and Mehrotra B.N. (1993): Compendium of Indian Medicinal Plants (Volumes I – VI). CSIR, Lucknow and Publication & Information Directorate, New Delhi.

Unit-II Identification and Application of Medicinal Plants

2.1 Identification, distribution and importance of Underground parts (roots, tubers, suckers): *Asparagus racemosus, Asparagus adscendens, Chlorophytum tuberosum, Chlorophytum borivilianum, Dashmool (Ideal vs. Reality), Bombax malabarica* (*Shemalmusli*), *Boerhavia diffusa, Tephrosia purpurea, Withania somnifera.*

2.2 Identification, distribution and importance of Bark: *Terminalia arjuna,Tecomella undulate, Moringa oleifera.*

2.3 Identification, distribution and importance of Leaves: *Justicia adhatoda, Centella asiatica, Ocimum sanctum, Vitex negundo, Cassia angustifolia, Abrus precatorius.*

2.4 Cultivation and processing of medicinal plants: *Withania somnifera, Chlorophytum tuberosum, Andrographis paniculata, Cassia angustifolia, Plantago ovata.*

Ref.

1. Ambasta S. P. (1986): The Useful Plants of India. Publication & Directorate, CSIR, New Delhi.
2. Sumy, Ved D.K. and Krishnan (2000): Tropical Indian Medicinal Plants Propagation Methods (1stEdn.) Foundation for Revitalization of Local Health Traditions, Banglore.
3. Handa S.S. and Kaul M.K. (edt. by) (1997): Supplement to Cultivation and Utilization of Medicinal Plants. Regional Research Laboratory, CSIR, Jammu-Tawi, J&K, India.

Unit-III Organoleptic Classification of Herbs and Pharmacology

3.1 Organoleptic Classification of herbs yielding Flowers: *Madhuca indica, Careya arborea, Hibiscus rosasinensis.*

3.2 Organoleptic Classification of herbs yielding Seeds & Fruits: *Emblica officinale, Embelia tsjerum-cottam, Semecarpus anacardium, Terminalia chebula, Terminalia bellirica, Gmelina arborea, Cassia tora, Cassia sophera.*

3.3 Organoleptic Classification of herbs yielding Exudates & Gums: *Sterculia urens, Acacia nilotica, Anogeissus latifolia, Bombax malabarica, Commiphora wightiana, Boswellia serrata.*

3.4 Pharmacological screening of herbal drugs: Evaluation of anti-diabetic agents, Evaluation of anti-malarial activity and Evaluation of anti-inflamatary activity.

Ref.

1. Anonymous (2002): WHO Monographs on selected Medicinal Plants (Volume I-II). World Health Organization, Geneva.
2. Mukherjee Pulok K and Houghton Peter J, 2009. Evaluation of Herbal Medicinal Products-Perspectives on quality, safety and efficacy. Pharmaceutical Press.

Unit-IV Pharmacognosy and Phytochemistry

5.1 Significance of Pharmacognosy. Introduction and Development of Standardization Parameters: Bitter value, Foaming index, Swelling index, Heavy metals, Afflatoxins

5.2 Glycosides: Anthraquinones, isothiocynates, flavonols, lactones, saponins and cardiac glycosides.

5.3 Alkaloids: Indoles, isoquinolines, tropanes, pyridine and piperidine, steroidal alkaloids.

5.4 Phenols and tannins: types, structure, role and applicaiton.

Ref.

1. Anonymous (1998): Quality Control Methods for Medicinal Plants Materials. World Health Organization, Geneva.
2. Anonymous (1999): Indian Herbal Pharmacopoeia (Volume I, II,III). Joint Publication of Regional Research Laboratory (CSIR), Jammu and Indian Drug Manufacturers' Association.
3. Khadabadi SS, Deore SL, Baviskar BA, 2016. Experimental Pharmacognosy & Phytochemsitry, Studera Press, Nwq Delhi.
4. Bhat S.V., Nagsampampagi B.A. and Sivakumar M. (2005) Chemistry of Natural Products, Narosa Publishing house, New Delhi.
5. Chauhan M. : Microscopic profile of powdered drug used in Indian System of Medicine (Volume I).
6. Evans W.C. (2002): Pharmacognosy (15thEdn.). Saunders Publications.
7. Harborne J. B. (1973): Phytochemical Methods. Chapman and Hall, London.
8. Mukherjee P.K.(2002): Quality Control of Herbal Drugs- An Approach to Evaluation of Botanicals (1stEdn.). Business Horizons Pharmaceutical Publishers, New Delhi, India.
9. Sadasivam S. and Manickam A (1996): Biochemical Methods (2nd. Edn.).New Age International Publishers, Tamilnadu Agriculture University, Coimbtore.
10. Raman N. (2005): Phytochemical Techniques and Plant Tissue Culture. Department of Botany, University of Madras, Chennai.

11. Ragunathan K. and Mitra R. (comp. &edt. by) (1999): Pharmacognosy of Indigenous Drugs (Volumes I – II) (Reprint). Central Council for Research in Ayurveda and Siddha, New Delhi, India.
12. Choma IM, Grzelak EM, 2010. Bioautography detection in thin-layer chromatography. J. of Chromatography A, 1218 (2011) 2684–2691.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-(B)-304(ii)**	**Semester**	**III**
Plant Biotechnology (Elective)			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(B)-304(ii) - PLANT BIOTECHNOLOGY (Elective)

Learning Objective and Outcomes:

- *This Course focuses on the steps involved during the development of transgenic plants, its applications, DNA fingerprinting and Plant tissue culture.*
- *After learning units I & II, the students will able to understand the process of the development of transgenic plants and their applications.*
- *After learning units III & IV, students will have an insight on different types of DNA fingerprinting techniques and importance of Plant tissue culture techniques.*

Unit-I Development of Transgenic Plant

1.1 Steps involved in the development of transgenic plants including the role of plant tissue culture.

1.2 Identification and isolation of the gene (Immunoprecipitation, gDNA and cDNA library, development of ESTs, PCR).

1.3 Isolation of DNA (genomic and plasmid) from various sources- Method and Principle.

1.4 Method of molecular cloning including vector, promoter, terminator, markers etc.

Ref.

1 Ausubel Frederick M., Roger Brent, Robert E. Kingston, David D. Moore, J.G. Seidman, John A. Smith, Kevin Struhl (2003) Current Protocols in Molecular Biology. John Wiley & Sons (ISBN: 047150338X).

2 Brown T.A. Gene cloning.

3 Brown T.A. Genomes 3.

4 Channarayappa (2007). Molecular Biotechnology: Principles and Practices, CRC Press, ISBN-10: 1420051571, ISBN-13: 978-1420051575.

5 Dong Hao, Zhao Yijun, Wang Yingli and Li Hongmin, 2014. Recombinant proteins expressed in lettuce. Indian Journal of Biotechnology, 13 (4), pp 427-436.

Unit-II Methods of Gene Insertion and Applications of Transgenic Plants

2.1 Target cells for transformation and different methods of gene insertion.

2.2 Principle and protocol for Agrobacterium mediated gene transfer. Application of ELISA and Q-PCR for the detection of transgenic plant.

2.3 Applications of Transgentic Plants: Biotic and abiotic stress resistance, case and issue of Bt-Cotton and Bt-Brinjal, Herbicide resistance. Issues related with GM crops.

2.4 Molecular farming, enhancing nutrition (Golden Rice), post-harvest losses (Flavr Savr) and male sterile lines.

Ref.

1 Borton K.A., Binns A.N. 1983. Regeneration of intact Tobacco plants containing full length copies of genetically engineered T-DNA and transmission of T-DNA to R1 progeny. Cell 32:1033-1043.

2 Chawla H S, Introduction to Plant Biotechnology by, Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, 3rd Ed., ISBN- 9788120417328.

3 Das H.K. (2007) Textbook of Biotechnology, 3rd Ed., Wiley India (P) Ltd. (ISBN:81-265-1014-5).

4 Glick Bernard R., Pasternak Jack J. and Patten Cheryl L. (2010). Molecular Biotechnology-Principles and Applications of Recombinant DNA, 4th Ed., ASM Press (ISBN: 978-1-55581-498-4).
5 Gupta P K, 2004. Biotechnology and Genomics.
6 Antoniou M, Robinson C, Fagan J, 2012. GMO Myths and Truths, Earth Open Source.
7 Mousumi Debnath - Principle of Genetic engineering
8 Old and Primerose. Principle of gene manipulation.

Unit-III Molecular Breeding and Introduction of Plant Tissue Culture (PTC)

3.1 Application of molecular markers. Concept of dominant and co-dominant markers with examples of RAPD and RFLP.

3.2 Various techniques of molecular markers (SCAR, SSR, ISSR, SCoT, SNP, CAPS etc). Marker-Trait Association for Molecular Breeding.

3.3 Plant Tissue Culture (PTC): Introduction, applications and techniques (with the respective explants).

3.4 Micro-propagation: Ex-plant sterilization, various culture media and preparation, PGRs (types and interaction), inoculation method, culture conditions and hardening.

Ref.

1 Primrose and Twyman. Principles of Gene Manipulation & Genomics (7th Ed.).
2 Singh BD and Shekhawat NS, 2018. Molecuar Plant Breeding, Scientific Pub.
3 Purohit S.S. Biotechnology-Fundamentals and Applications. 4th Ed., Agrobios Pub. ISBN:8177542591.
4 Rastogi Smita and Pathak Neelam (2009) Genetic Engineering, 1st Ed. Oxford (ISBN-13: 978-0-19-569657-8; ISBN-10: 0-19-569657-3).
5 Rehm HJ, Reed G., Puhler A. and Stadler P. (1993). Biotechnology vol-2: Genetic Fundamentals and Genetic Engineering, Wiley India (ISBN: 978 81 265 2529 4).
6 Roger L. Miesfeld, 1999. Applied Molecular Genetics. Wiley-Liss Pub. (ISBN:0 471 15676 0).
7 Sandhya Mitra (1996) Genetic Engineering-Principles and Practice, Macmillan Pub. 1st Ed. (ISBN:0333-92547-5).
8 Satyanarayana U. (2005) Biotechnology, (ISBN:81 87134 90 9)
9 Singh B D (1998) Biotechnology, Kalyani Publishers, Ludhiana.
10 Tamarin Robert H. Principles of Genetics, Tata McGrow (ISBN 13: 978007048667b; ISBN 10: 0070486670).
11 Watson et al., Recombinant DNA: Genes and Genomes - A Short Course.
12 Winnacker Ernst L. From Genes to Clones.

Unit-IV Plant Tissue Culture (PTC)-Techniques and Applications

4.1 Method and application of cell culture including production of secondary metabolites.

4.2 Somaclonal and gametoclonal variations-Method and examples. *In vitro* pollination and fertilization.

4.3 Wide hybridization and Embryo rescue. Somatic embryogenesis and artificial seeds.

4.4 Haploid production. Protoplast isolation, somatic hybridization and cybridization.

Ref.

1. Bhojwani S.S. and Razdan M.K. (1996). Plant tissue culture: Theory and Practice- Elsevier.
2. De Kalyan Kumar (2008). Plant Tissue Culture.
3. George Edwin F., Hall M.A., De Klerk Geert-Jan. Plant Propagation by Tissue Culture, Vol.1, 3rd Ed.
4. Razdan M.K. Introduction to plant tissue culture.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-(B)-304(iii)**	**Semester**	**III**
Horticulture (Elective)			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(B)-304(iii) - HORTICULTURE (Elective)

Learning Objective and Outcomes:

- *This Course focuses on the scope of horticulture and its applications.*
- *After learning this the students will able to understand the process of plant propagatin techniques, identify ornamental and other useful species, their cultivation.*

Unit – I Scope of Horticulture and its Branches

1.1 Horticulture and its branches of study, brief history, scope, importance, necessity, advantages, prospectus and problems with respect to some horticultural crops. Biotechnology in the fields of horticulture-Concepts of tissues culture and its various applications in horticulture (micro-propagation).

1.2 Soil science: Its formation, types, component, properties (biological, chemical and physical). Acid Saline, alkaline soil and their reclamation, minerals nutrition and stress physiology.

1.3 Fertilizers: organic manures, biofertilizers and chemical fertizlizers. Significance of Rhizosphere microbiome.

1.4 Basic principles of irrigation, system and methods of irrigation. Possibility use of saline water in irrigation. Introduction of Hydroponics and Fogponics.

Ref.

1. Bhojwani, S.S. 1996. Plant Tissue Culture: Application and Limitations. Elsevier Science Publishers.
2. Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, ther Netherlands.
3. Raghavan,V,1999. Developmental Biology of Flowering plants.Sringer – Verlag, New York.
4. Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York.
5. Taiz, L, and Zeiger, E. 1998, Plant Physiology (2nd edition), Sinaer Associates, Inc.,Publishers, Massachusetts, USA.
6. Tomas, B. and Vince-Prue, D. 1997. Photoperiodism in Plants (2nd edition), Academic Press,San Diego,USA.
7. Bewley,J.D. and Black,M. 1994, Seeds:Physiology of Development and Germination.Plenum Press, New York.
8. Mushroom Cultivation Technology – by by R. Gogoi, Y. Rathaiah, T.R. Borah.
9. Mushroom Cultivation – 2018 by S.C. Tiwari & Pankaj Kapoor.

Unit – II Orchard and Garden Managment

2.1 Propagation methods: Selection and preparation of stock and scion, compatibility. Plant Propagation by sexual and asexual methods. Green House and Poly House Design and Applicaiton.

2.2 Planning and layout of orchards. Selection of species and orchard management in terms of soil, manure/fertilizer, erosion protection, mulching methods, irrigaton, drainage, identification and control of disease, use of pesticide and integrated pest management.

2.3 Landscape architecture: Different types of landscapes. Theme gardening: gardening in small places, kitchen gardening, terrace gardening, pots making, vertical gardening, use of different containers, esthetics behind gardening. The rock garden, succulents (*Sedum, Echeveria, Haworthia, Kalanchoe*) and cacti; aquatic garden. Bonsai, topiary, indoor & outdoor plants, home herbal garden. Different kinds of lawns, species and maintanace.

Ref.

1. Landscape Architecture In India, - 2013 by mohammad Shaheer, Geeta Wahi Dua, Adit Pal.
2. Landscape Architecture – Import, 5 May 2017 by Ryker Nelson.
3. Roy A. Larson, 1980. Introduction to Floriculture.
4. Asanthakumar K. and Bulti Merga, 2017. A Handbook on Floriculture And Landscaping.

Unit – III Olericulture and Cultivation Techniques

3.1 Definition and scope of Olericulture, importance of vegetables in human diet. Classification of vegetables crops, Types of vegetable garden, Location and site for vegetarian garden. Climate and soils for vegetables, Crop rotation.

3.2 Growing Vegetables-Transplantation & direct sown, irrigation and manuring of vegetable crops, Intercultural Operations in vegetables crops, Harvesting and marketing.

3.3 Cultivation of vegetable crops obtained from families Cucurbitaceae , Leguminosea, Solanaceae, Malvaceae, Amarantheceae, Chenopodiaceae, Zingiberaceae and Araceae.

3.4 Vegetable Preservation-Present Status, future scope, Nutritive value of fresh and processed vegetables, canning, dehydration and chemical preservation.

Ref.

1. Handbook Of Horticulture – 2003 by Chandha K L
2. Fundamentals Of Horticulture – 2018 by Jitendra Singh, Kalyani Publishers
3. Horticulture at a Glancer for ICAR's Exams, JRF, SRF, NET, ARS, IARI, Ph.D Paperback – 2016 by D Ram & B B Singh, DG,ICAR Trilochan Mohapatra
4. Kumar N. 2010. Introduction To Horticulture.
5. Sutaria R.N., 1988. A text book of Systematic Botany.

Unit – IV Pomology and Floriculture

4.1 Scope and importance of pomology and floriculture, Role of fruits in human nutrition, Classification of fruit crops.

4.2 Cultivation of tropical, sub-tropical and temperate fruits and flowers speceis.

4.3 Cold sorage and gamma-irradiaton, its importance; ripening chamber and fruit ripening. Processing of fruits including dehydraton, canning, pickleing and puree making.

4.4 Harvesting and processing of orchard products (fruits and flowers). Shelflife and marketing of fruits and flowers.

Ref.

1. Textbook of Pomology by Edgar Crombie Syrawood Publishing House, 2016.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Botany)**
Course Code	**BIOS -(B)-305**	**Semester**	**III**
Practical Based on Bios -(B)-301 to 304			
Course type	**Core Compulsory**	**Total Credit**	**08**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
16/week	**60**	**140**	**200**

BIOS-(B)-305 – Practicals Based on Bios-(B)-301 to 304

Following are the indicative list of the experiments. Changes can be done depending upon the departmental need and availability of the resources.

Bios -(B)-301 – Phycology and Mycology and Plant Pathology

Algae

1. Study of thallus structures of different groups of algae through preparation of whole mounts and sections.(based on the available speciemens, field trip collections and permanent slides).
2. Algal culture technique.
3. Assessment of phytoremediation potential of the algae.

Fungi

4. Mushroom cultivation.
5. Study of the representative genera belonging to Myxomycotina, Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina with respect to asexual and sexual structures and fruiting body (Ascocarp/Basidiocarp). (based on the available speciments and permenet slides)
6. Study of Lichen.(based on the available speciments and permenet slides)

Plant Pathology

7. Characterization of disease symptoms and identification of pathogenic organisms.
8. Isolation of microbes and gram staining of bacteria from infected plants /rhizosphere soil/seed borne fungi.
9. Isolation of *Bacillus thuringiensis* from soil sample and endospore staining.
10. Study the antimicrobial activity of *Trichoderma* fungi.
11. Isolation of DNA from fungus.
12. Estimation of total phenols and O-didhydroxyphenols (sugarcane and groundnut) as biochemical markers of enhanced resistance.
13. Estimation of activity of Phenylalanine ammonia lyase in healthy and diseased leaves (sugarcane).
14. Effect of phytoalexins on microbial growth.
15. Determination of Minimum Inhibitory Concentration (MIC) by pesticide.

Note: All the practicals should be based on the available speciments, permenet slides and existing facilities..

Bios -(B)-302 Advances in Archegoniatae and Paleobotany

1. Study of morphology and anatomy of thalloid and leafy forms of Bryophytes.: *Riccia, Targionia, Cyathodium, Plagiochasma, Dumartiera, Asterella (Fimbriaria),*

Conocephalum, Lunularia, Marchantia, Riccardia (Anura), Pellia, Porella, Anthoceros, Notothylas, Spahagnum, Pogonatum and Funaria. (As per availability of specimens).

2. Study structural modification in Marchantiales, Jungermanniales, Isobryales and Hypnobryales.
3. Monographic study of the sporophyte body of *Osmunda, Ophioglossum, Lygodium, Gleichenia, Cyathea, Pteris, Dryopteris, Adiantum and Polypodium*. (As per availability of specimens)
4. Study of fern gametophyte and variation is sorai (permanent slides & charts). Study permanent slide of Protonema of bryophyte.
5. Cytological studies of bryophytes/ferns.
6. Spore viability test of pteridophyte.
7. Study of vegetative and reproductive parts of gymnosperms.
8. Comparative anatomy of conifers and gnetales (permanent slides).
9. Study of specimens and permanent slides of fossils.

Bios -(B)-303-Developmental Biology

1. T.S. of an immature anther from floral bud to study the development of pollen.
2. Dissectin of an ovule to observe the cotyledon and radical in mature embryo.
3. Study of the stages of pollen and ovule development using permanent slides and electron micrographs.
4. Pollen *in vitro* germination methods: Sitting drop culture, suspension culture, surface culture.
5. Study of palynotaxonomy through pollen morphology of different families (Typhaceae, Gramineae, Casuarinaceae, Nyctaginaceae, Mimosaceae, Asclepiadaceae).
6. Observation of pollen in honey samples.
7. Correlation between fertility (stainability), viability (TTC and FDA staining) and germinability (*in vitro*) of pollen grains.
8. Assessment of stigma receptivity by localizing peroxidases, non-specific esterases and phosphatases.
9. Aniline blue fluorescence method to localize pollen tubes to study different aspects of pollen-pistil interaction.
10. Use of DNA fluorochromes to localize nuclei during pollen and ovule development.
11. Study of post-fertilization stages of zygote to embryo development with the help of permanent slides and electron micrographs.

Bios -(B)-304(i) Medicinal Plants (Elective)

1. Preparation of plant extract by soxhlet and calculation of percentage yield.
2. Extraction of essential oil through clevenger apparatus.
3. Isolation of curcumin from *Curcuma longa*.
4. Evaluate antimicrobial potential of medicinal plants.
5. Perform Thin Layer Chromatography from the plant extract.
6. Bioautography detection in thin-layer chromatography.
7. Calculation of foaming index and swelling index.
8. Preparation and characterization of ash obtained from plant material.

9. Quantitative estimation of phytochemicals from plants (alkaloids, flavonoids, tannins, phenols, terpenoids).
10. Testing of ghee and honey.
11. Identificaiton of herbal drugs (whole dried samples of root, seeds, bark, fruit, flower, leaves).

Bios-(B)-304(ii) - Plant Biotechnology (Elective)

1. Isolation and detectin of plant genomic DNA.
2. DNA barcoding through amplification of ITS by PCR.
3. Performing DNA fingerprinting (SCAR & RAPD).
4. Construction of phylogenetic tree from RAPD data analysis.
5. Isolation of protein from plant and separation through SDS-PAGE.
6. Preparation of MS media for PTC.
7. Inoculation of leaf & node explants for callus induction & mass-multiplication.
8. Inoculation of Banana sucker for micropropagation.
9. Preparation of sodium alginate beads for encapsulation of somatic embryo or cells.

Bios-(B)-304(iii) - Horticulture (Elective)

1. Propagation Methods : Cutting. Air Layering and Grafting.
2. Olericulture of Fenugreek and Coriander for kitchen gardening.
3. Preparation of Panchagavya.
4. Effect of Panchgavya on Seed Germination in compare to control.
5. Analysis of Panchagavya (pH, Phosphate, Potassium, Organic Carbon, Ammonical Nitrogen, Nitrate Nitrogen, Total Bacterial Count, Phosphate Solubilizing Bacteria, Potassium Solubilizing Bacteria)
6. Preparation of Vermicompost
7. Analysis of Vermicompost (pH, Phosphate, Potassium, Organic Carbon, Ammonical Nitrogen, Nitrate Nitrogen)
8. Extraction of pigment from plants.
9. Natural dye and dying process (Bandhani).
10. DNA isolation from fruits.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-(B)-401**	**Semester**	**IV**
Angiosperms Taxonomy			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(B)-401 - ANGIOSPERMS TAXONOMY

Learning Objective and Outcomes:

- *This Course focuses on angiosperm taxonomy including different classification systems, rules for nomenclature, floristic diversity, economic botany and modern methods of taxonomical study, APG.*
- *After learning this the students will able to identify plant species correctly and will understand the concepts, merits and demarits of classical systems of classification, methods and importanc of naming of plant and to study the process of evoluation at work. The importance of plant for human welfare will be understood.*

Unit-I Classification of Angiosperms and Capacity Building in Plant Taxonomy

1.1 Definition, aims and principles (alpha and omega taxonomy). History of plant classification. Systems of Classification-Artificial, Natural and Phylogenetic with examples.

1.2 Study of Bentham and Hooker's system of classification.

1.3 Adopted principles, Concepts of primitive and advanced characters, Merits and Demerits of the classification systems (Engler & Prantle, Bessey, Hutchinson and Takhtajan). Angiosperm Phylogeny Group (APG) Classification.

1.4 Institutions/organizations/ministry of India: Botanical Survey of India (BSI), Gujarat Biodiversity Board, NMPB, Directorate of Medicinal & Aromatic Plants Research, MoEFCC, Ayush, ICMR, NIF, Shristi etc.

Ref.

1 Bhattacharya, Hait and Ghosh, 2007. A Textbook of Botany (vol-2), New Central Book Agency, ISBN 81-7381-555-0, Rs.350/-, pg.746.

2 Gurcharan Singh, 2010. Plant Systematics-An Integrated Approach, Third Edition, Science Pub., ISBN 978-1-57808-668-9.

3 Mondal AK, 2007. Advanced Plant Taxonomy, New Central Book Agency (P) Ltd.

Unit-II Plant Nomenclature and Taxonomic Literature

1.1 Origin and significance of binomial nomenclature. Understanding of ICBN (International Code of Botanical Nomenclature).

1.2 Nomenclature rules: ranks of taxa, rules of priority, alternative names, effective and valid publications, author's citation, retention and choice of names etc.

1.3 Name Types (Synonym, Tautonym, Typonyms, Metanyms, Homonym, Hyponyms, Autonym, Basionym and Nomen nudum). Typificatoin (Holotype, Isotype, Paratype, Syntype, Lectotype, Neotype, Topotype).

1.4 Construction of taxonomic keys (indented and bracketed) and their utilization. Intrduction to the Flora of Different States and Taxonomic Litratures (The Flora of British India Vol. I-VII- J.D. Hooker; Indian Medicinal Plants-Kirtikar & Basu; Hortus Malabaricus- Van Rheede; The flora of the Presidency of Bombay-Theodore Cooke; Species Plantarum & Genera Plantarum-Linnaeus; Manual of cultivated plant-Bailey H.

Ref.

1 Ashok Kumar, 2001. Botany in Forestry and Environment. Kumar Media (P) Ltd., ISBN 81-900502-0-6, Rs.177/-, pg.716.

2 Mukerjee Sushil Kumar, 1994. College Botany (Vol-III), New Central Book Agency, ISBN 81-7381-308-6, Rs.125, pg.487.

3 Sambamurty A.V.S.S., 2005. Taxonomy of Angiosperms, I.K. International Pvt. Ltd., ISBN 81-88237-16-7, Rs. 295/-, pg.892.

4 Pandey B.P., 2007. Botany for Degree Students (B.Sc. Second Year), S. Chand, ISBN 81-219-2810-9, pg.879.

Unit-III Floristic Studies, Biodiversity and Evolutoin of Angiosperms

3.1 Overview of Flora of Gujarat (G.L. Shah), Glimsis of the interesting plants of the world.

3.2 Century and National Parks. Biodiversity hotspots of India. Botanical Gardens: Rani Jijamata Udhyan-Mumbai, Waghai, Ooty, Coonoor, National Botanical Research Institute-Lucknow, Kolkota etc.

3.3 Origin and Evolution of Angiosperms: Theories and Fossil Records.

3.4 Evolutoin of characters in angiosperms.

Ref.

1. Shah G.L., 1978. Flora of Gujarat. Pub. Sardar Patel Univrsity.
2. Bhattacharya, Hait and Ghosh, 2007. A Textbook of Botany (vol-2), New Central Book Agency, ISBN 81-7381-555-0, Rs.350/-, pg.746.
3. Sutaria R.N., 1988. A text book of Systematic Botany.
4. Sammbamurthy AVSS, 2016. A Textbook of Modern Economic Botany, CBS Publishers.
5. Hill Albert F. Economic Botany-A Textbook of Useful Plants and Plant Products. McGRAW-HILL.
6. Daniel M., 2009. Taxonomy Evolution at Work, Narosa Pub., ISBN 978-81-7319-959-2.
7. Delevoryas Theodore, 1966. Plant Diversificaiton, Pub. Holt, Rinehart and Winston, Inc.

Unit-IV Modern Trends in Plant Taxonomy

4.1 DNA Barcoding: Significance, sequence candidates and methodology.

4.2 Modern concepts and trends in plant taxonomy as supportive evidences: Cytotaxonomy, Chemotaxonomy

4.3 Numerical Taxonomy (Taximetrics), Molecular Taxonomy, Cladistics.

4.4 Problems in evolutionary taxonomy: Monophyly and polyphyly, Parallelism and convergence, Homology and analogy.

Ref.

1. Dikshit Anupama, Siddiqui M.O., Pathak Ashutosh, 2016. Taxonomy of Angiosperms (Basic Concepts, Molecular Aspects & Future Prospects), Studera Press, ISBN 978-93-85883-07-1.
2. Sivarajan, V.V. 1999. Principles of Plant Taxonomy Oxford & IBH Publishing Co. Pvt Ltd. New Delhi.
3. Daniel M., 2009. Taxonomy Evolution at Work, Narosa Pub., ISBN 978-81-7319-959-2.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-(B)-402**	**Semester**	**IV**
PLANT ANATOMY AND HISTO-CHEMICAL TECHNIQUES			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(B)-402 - PLANT ANATOMY AND HISTO-CHEMICAL TECHNIQUES

Learning Objective and Outcomes:

- *This Course focuses on plant anatomy and anatomical techniques including the method of sectioning, fixation, staining to study the anatomical features of the plant.*
- *After learning this the students will able to understand the different anatomical features of the plant. Student will be able to understand different types of microtome, particular stain to locate phytochemical and the method of tissue processing for electron microscopy.*

Unit-I Histological Development (Vascular plants)

1.1 Meristems, patterns of cell fate, determination and lineage in root and shoot, leaf growth and differentiation. Leaf development, plastochron, phyllotaxy, development of trichomes and stomata.

1.2 Cambial variants, Secondary growth, wood development and its diversity.

1.3 Nodal Anatomy and evolution of vascular Plants.

1.4 Xylem and phloem differentiation and ultrastructure.

Ref.

1. Cutler, D. F. 1978. Applied Plant Anatomy. Orient Longman Publishers, New Delhi.
2. Easu, 1987. The Anatomy of seed plants. Wiley Eastern Ltd. New Delhi.
3. Fahn, A. 1989. Plant Anatomy, Peragamon Press, Oxford, New York.
4. Gahan, P.B. 1984. Plant Histochemistry and Cytochemistry, Academic Press, London.
5. Carlquist T.S. Comparative plant anatomy.
6. Carlquist S (2001). Comparative Wood Anatomy, Springer-Verlag, Germany.
7. Cutler DF (1978). Applied Plant Anatomy, Longman, United Kindom.
8. Cutter EG (1978) Plant Anatomy, Part I & II, Edward Arnold, United Kingdom.

Unit-II Wood Anatomy and Anatomical Adaptations

3.1 Anatomical adaptations for special habitats, biotic and abiotic stresses.

3.2 Applications of anatomical studies in systematics, archaeology, climate studies, pharmacology, forensic sciences and biomedical research.

3.3 Structure of wood, reaction wood, wood development and environmental factors, types of wood and wood defects.

3.4 Anatomical responses towards the Environmental Pollution.

Ref.

1. Dickinson WC (2000). Integrative Plant Anatomy, Harcourt Academic Press, USA.
2. Fahn A (1974) Plant Anatomy, Pergmon Press, USA & UK.
3. Fosket DE. (1994) Plant, Growth and Development: A Molecular Approach, Academic Press.
4. Hopkins WG. (2006). The Green World: Plant Development, Chelsea House Publication
5. Howell SH. (1998) Molecular Genetics of Plant Development, Cambridge University Press.
6. Leyser O and Day S (2003) Mechanism of Plant Development, Blackwell Press
7. Mauseth JD (1988). Plant Anatomy, The Benjamin/ Cummings Publisher, USA
8. Nair MNB (1998). Wood Anatomy and Major Uses of Wood, Faculty of Forestry, University of Putra Malaysia, Malaysia.

Unit-III Histo-chemical techniques-I

3.1 Scope of histochemistry and cytochemistry in Biology.

3.2 Chemistry of fixation. Types and application of biological stains-vital stains and fluorochromes.

3.3 Tissue processing techniques for light microscope.

3.4 Types of microtomes-Rotary, Sledge, Freezing Cryostat and Ultratomes.

Ref.

1. Gary, P. 1964. Hand Book of basic microtechnique, John Wiley & Sons, New York.
2. Johanson, W.A. 1984. Plant Microtechnique. McGraw Hill.
3. Ruzin, Z.E. 1999. Plant Microtechnique and Microscopy. Oxford University Press, New York.

Unit-IV Histo-chemical techniques-II

4.1 Tissue processing techniques for electron microscopy (SEM and TEM).

4.2 Detection and localization of primary metabolites- Carbohydrates (PARS reaction), Proteins (Coomassie brilliant blue staining), Lipids (Sudan Black method). Introduction to other methods.

4.3 Enzyme histochemistry (General design and applications). Effect of pollution on the Phytochemicals content and secondary metabolites–A study in context to Histochemistry.

Ref.

1. Harris, Electron microscopy in Biology.
2. Johanson, W.A. 1982. Botanical Histochemistry-Principles and Practice. Freeman & Co.
3. Kierman, J.A. 1999. Histological and Histochemical Methods. Butterworth Publications, London
4. Poarse, histochemistry, Vol. I and Vol.II.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-(B)-403**	**Semester**	**IV**
RESEARCH METHODOLOGY AND PROFESSIONAL SKILLS			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(B)-403 - RESEARCH METHODOLOGY AND PROFESSIONAL SKILL

Learning Objective and Outcomes: *The course is design to train student for research activity and communication skill at the end of the course student will be*

- *Able to understand the research problem and design and research work*
- *Able to write, prepare poste and present oral presentation*
- *Able to prepare CV and face the interview .*

Unit I: Basic of Research Methodology

1.1 Philosophy of the natural sciences: Traditional philosophy of science, Hypotheticodeductive method, the empirical turn in philosophy of science,

1.2 Research Methodology: Objective, Motivation, Types approach, Significance, method, methodology, research process, good research, Researchers in India;

1**.3 Research problems and Design:**Research problems:Definition, selection of problems, Defining problems, technique; Research Design: Meaning, Need, features, concept, types, and Experimental design;

1.4 Sampling design: Survey, design, steps, criteria, characteristics, types, random sample and sampling

Reference Books

1. *C R Kothari Research Methodology 2nd Ed, New Age International Publication, 2004*
2. *Petter Laake, Haakon Breien Benestad and Bjørn Reino Olsen, Research methodology in the medical and biological sciences, Academic Press Elsevier, 2007*
3. *Yogesh Kumar Singh, Fundamental of Research methodology and statistics, New Age International (P) Limited, Publishers, 2006*
4. *Phyllis G. Supino and Jeffrey S. Borer, Principles of Research Methodology- A Guide for Clinical Investigators, Springer, 2012*

Unit II: Thesis Preparation

2.1 Preparing a dissertation: Formatting guidelines, sections, raw data, tips, requirement

2.2 Thesis writing: Title, Introduction, Review of literature, methodology, Result, Discussion, references, additional components

2.3 Strategies for writing thesis: Eleven steps strategies

2.4 Defense of the thesis or dissertation: Structure of the oral examination, Preparation for the examining committee session,Conduct of the oral examination, Decision making regarding the oral defense, Follow-up

Reference Books

1. *R Raveendran, B Gitanjali,S Manikandan, A practical Approach to PG dissertation, 2nd Eidtion, PharmaMed Press, 2012*
2. *Aysha Divan, Communication Skill for the Biosciences, Oxford University Press, 2009.*
3. *James E. Mauch and Namgi Park, 5th Edition, Guide to the Successful Thesis and Dissertation, Marcel Dekker, Inc, 2003.*

Unit III: Scientific Presentation and Management

3.1 Writing a research Proposal and research Paper: Research Proposal: Components, writing, funding sources for bioscience research, peer review; Research Paper: Structure, Strategy, aim and content of paper, submission, peer-review

3.2 Delivering effective presentation: Oral presentation: Planning, Preparation, practicing, delivering, answering and evaluating presentation; Poster: Planning, Preparation and presentation

3.3 Management fundamental: Characteristics, nature, function, process, profession, role, level and evolution

3.4 Entrepreneurship fundamental: Concept, Evolution, Characteristics, Entrepreneur Intrapreneur, Ultrapreneur, role, barrier,

Reference Books

1. *Aysha Divan, Communication Skill for the Biosciences, Oxford University Press, 2009.*
2. *Jennifer Peat, Scientific Writing- Easy when you know how, BMJ Books. 2002*
3. *Janice R. Matthews and Robert W. Matthews, Successful Scientific Writing, 3rd Edition, Cambridge University Press, 2008*
4. *Veerabhadrappa Havinal, Management and entrepreneurship, New Age International publishers,2009*

Unit IV:Communication and Research Skills

4.1 Before Writing: Academic Writing, Writer's Mindset, Strategies to avoid procrastination

4.2 Elements of English Grammar: Basic Terms and Definitions, Similar meaning, different spelling, Similar spelling, different meaning, Proofreading, word uses, Active versus Passive Voice

4.3 Research information system: Computer and ICT in research, Ethics in communication

4.4 Networking: Networking, CV and interview preparation

Reference Books

1. *Marialuisa Aliotta, Mastering Academic Writing in the Sciences, CRC press, 2018*
2. *Janice R. Matthews and Robert W. Matthews, Successful Scientific Writing, 3rd Edition, Cambridge University Press, 2008*
3. *Aysha Divan, Communication Skill for the Biosciences, Oxford University Press, 2009.*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Botany)**
Course Code	**BIOS (B)-404**	**Semester**	**IV**
Dissertation/ Training			
Course type	**Core Compulsory**	**Total Credit**	**06**
Teaching time	**Examination Marking Scheme**		
Practical / Lab (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
12/week	**45**	**105**	**150**

BIOS(B)-404:DISSERTATION/ TRAINING

Student shall take anyone option from Dissertation or Training as per following guideline

Dissertation

- Students have to take up a small research project under the supervision of a teacher from the department or may carry the work in an industry / NGO / private laboratory with required facility/other university or institution.
- If a student is doing project outside the university all other arrangements are to be made by the student.
- Student has to submit the dissertation before the last date for the submission as declared by the university.

Training

Students have to undergo for attest 30 days training in any Industry or other organization under the supervision of the any faculty of the department.

At the end of the training student has to submit the detailed training report including the scientific review on the relevant topic of his training

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Botany)**
Course Code	**BIOS -(B)-405**	**Semester**	**IV**
Practical Based on Bios -(B)-401 to 403			
Course type	**Core Compulsory**	**Total Credit**	**6**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
12/week	**45**	**105**	**150**

BIOS-(B)-405 – Practicals Based on Bios -(B)-401 to 403

Following are the indicative list of the experiments. Changes can be done depending upon the departmental need and availability of the resources

Bios-(B)-401 - Angiosperms Taxonomy

1. Method for taxonomic description of angiosperm species.
2. Method to identify plant using Flora of Gujarat.
3. Type study of angiosperm families.
4. Identification of local flora from campus and surrounding area.
5. Technique of Herbarium preparation.
6. Taxonomic status, parts used and applicaiton of food, industrial and drug plants.
7. Isolation of plant DNA.
8. PCR amplification of ITS sequence.
9. Taxonomic identification through DNA barcoding using NCBI/BOLD database.

Bios-(B)-402 - Plant Anatomy And Histo-Chemical Techniques

1. Study of apical meristems with the help of dissections, whole mount preparations, sections and permanent slides.
2. Origin and development of epidermal structures (Stomata, trichomes, glands and lenticels).
3. Measurement of stomatal density and stomatal index on leaf/plant surfaces.
4. Study of xylem and phloem elements using maceration, staining, light and electron micrographs (xerophytes, hydrophytes and halophytes).
5. Study of secretory structures (nectaries and laticifers).
6. Study of nodal anatomy.
7. Study of secondary growth (normal and unusual) of selected woods with the help of wood microtome and permanent slides.
8. Demonstratoin of hand microtome and preparation of permanent slides.

Bios-(B)-403 - Research Methodology And Professional Skill

1. Searching of scientific literature
2. Digital research resources e-ShodhSindhu and Shodhgangaat INFLIBNET
3. Online grammar checking in scientific writing
4. References management by online tools
5. Plagiarisms checking
6. Preparation of graphs and tables to present the scientific data

7. Searching of approved and Index-Journal- UGC CARE, NAAS collection and Web of sciences/Scopus.
8. Searching of proper journals based on title and abstract of your research.
9. Preparation of scientific poster
10. Oral presentation on scientific topic
11. Preparation of curriculum vitae
12. Mock interview and group discussion skill

Reference

Surajit Das and Hirak Ranjan Dash, MicrobialBiotechnology- ALaboratory Manualfor Bacterial Systems, Springer, 2015.

Syllabus

M. Sc. Bioscience (Microbiology)

Semester III& IV

CHOICE BASED CREDIT SYSTEM (CBCS)

w.e.f. June 2020

Department of Biosciences
Veer Narmad South Gujarat University, Surat

M. Sc. Bioscience (Microbiology)Sem. III							
Subject Code	Subject Title	Theory Hours/ week	Practical Hours/week	External Marks	Internal Marks	Total Marks	Credit
Bios (M) -301	Microbial diversity	4	-	70	30	100	4
Bios (M) 302	Omics and Integrative Microbiology	4	-	70	30	100	4
Bios (M) 303	Medical and Pharmaceutical Microbiology	4	-	70	30	100	4
Bios (M) 304	Industrial Microbiology and Fermentation Technology	4	-	70	30	100	4
Bios (M) 305	Practical Based on Bios-301 to 304	-	16	140	60	200	8
Total		**16**	**16**	**420**	**180**	**600**	**24**

M. Sc. Bioscience (Microbiology) Sem. IV							
Subject Code	Subject Title	Theory Hours/ week	Practical Hours/week	External Marks	Internal Marks	Total Marks	Credit
Bios (M) 401	Microbial Genetics and Physiology	4	-	70	30	100	4
Bios (M) 402	Applied Microbiology	4	-	70	30	100	4
Bios (M) 403	Research Methodology and Professional Skills	4	-	70	30	100	4
Bios (M) 404	Dissertation/Training	-	12	105	45	150	6
Bios (M) 405	Practical Based on Bios-401 to 403	-	12	105	45	150	6
Total		**12**	**24**	**420**	**180**	**600**	**24**

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Micro)**
Course Code	**Bios (M) -301**	**Semester**	**III**
Microbial Diversity			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

Bios (M) 301:MICROBIAL DIVERSITY

Learning Objective and Outcomes: *This Course will focuses to to give students the knowledge about the microbial diversity. At the end of the course students will be able to*

- *Understand the diversity of microbial world*
- *Classify the microorganism*

Unit 1: Diversity and Taxonomy

1.1 Microbial Evolution and division of life: Origins and Early Evolution, Microbial evolution, Introduction to microbial classification, Taxonomic rank, Techniques for determining microbial taxonomy and phylogeny , The major divisions of life, phylogenetic tree, Bergey's manual of systematic bacteriology (Prescott),

1.2Taxonomy of prokaryotes: Procaryotic domains, Classification of Procaryotes and concept of bacterial species, Identification of Procaryotes, Numeric Taxonomy, Polyphasic Taxonomy

1.3Nomenclature and culture collection: Bacterial nomenclature, Etymology of nomenclature, Culture Collections

1.4Biodiversity and Microbial Ecosystems Functioning: Mathematical Approaches and Tools for the Study of Microbial Biodiversity, Variables and Methods for Studying Microbial Diversity, Procedures for the Study of Relations between Microbial Biodiversity-Ecosystem Function

References

1. Joanne Willey, Linda Sherwood, Chris Woolverton, Prescott's Microbiology, 7th edition, McGraw-Hill, 2015.
2. James W. Brown Principles of Microbial Diversity, ASM Press, Washington, 2016
3. David R Boone and George M. Garrity, Bergey's manual of systematic bacteriology 2nd Edition Vol. 1, springer, 2001.
4. Jean-Claude Bertrand,Pierre Caumette Philippe Lebaron et al., Environmental Microbiology: Fundamentals and Applications Microbial Ecology, Springer, 2015.

Unit 2: Phylogeny

2.1 Microbial Diversity: What is Microbial Diversity: Facets of microbial diversity, The fundamental similarity of all living things, Context and Historical Baggage: The evolution of evolutionary thought, Taxonomy and phylogeny, The false eukaryote-prokaryote dichotomy,

2.2 Phylogenetic Information: Deciding which organisms and sequences to use in the analysis, obtaining the required sequence data, Assembling sequences in a multiple-sequence alignment

2.3 Constructing a Phylogenetic Tree: Tree construction: the neighbor-joining method, How to read a phylogenetic tree

2.4 Tree Construction Complexities: Substitution models, Treeing algorithms, Bootstrapping, Alternatives to Small-Subunit rRNA Analysis

References

1. James W. Brown Principles of Microbial Diversity, ASM Press, Washington, 2016
2. David R Boone and George M. Garrity, Bergey's manual of systematic bacteriology 2nd Edition Vol. 1, springer, 2001
3. Jean-Claude Bertrand,Pierre Caumette Philippe Lebaron et al., Environmental Microbiology: Fundamentals and Applications Microbial Ecology, Springer, 2015

Unit 3 Microbial diversity

3.1 The Microbial Zoo: Bacterial Phyla, Few representative bacterial linages: Overview of Primitive Thermophilic Bacteria, Green Phototrophic Bacteria, Proteobacteria, Gram-Positive Bacteria, Spirochetes and Bacteroids, Deinococci, Chlamydiae, and Planctomycetes,

3.2 Bacterial phyla with few or no cultivated species: How do we know about these organisms?, Phyla with few cultivated and no cultivated species, Phylogenetic groups at all levels are dominated by uncultivated sequences, How much of the microbial world do we know about?

3.3 Archaea: General properties of the *Archaea*, Phylum *Crenarchaeota, Euryarchaeota, Korarchaeota, Nanoarchaeota*

3.4 Fungi: Characteristics and Classification of Fungi; Physiology of fungi- Morphology, Ultrastructure and function, Nutrition, Metabolism, Growth and Reproduction; Fungi in the Environment, Macrofungi and Lichens

References

1. James W. Brown Principles of Microbial Diversity, ASM Press, Washington, 2016
2. David R Boone and George M. Garrity, Bergey's manual of systematic bacteriology 2nd Edition Vol. 1, springer, 2001
3. Jean-Claude Bertrand,Pierre Caumette Philippe Lebaron et al., Environmental Microbiology: Fundamentals and Applications Microbial Ecology, Springer, 2015
4. Kevin Kavanagh, 3rd edition, Fungi Biology and Applications, John Wiley & Sons, Inc, 2018
5. Constantine John Alexopoulos, Introductory Mycology, 4th Edition, John Wiley & Sons, 2007
6. H C Dube, An Introduction to Fungi, 4th edition, Scientific publisher, 2012
7. K. R. Aneja, An Introduction to Mycology, New age international publishers, 2015
8. Marjorie Kelly Cowan and Heidi Smith, 5th Edition, Microbiology A systems Approach, McGraw-Hill Education, 2018

Unit 4 Protists and Viruses

4.1Protists:*Algae*:Characteristics and Classification of Algae, Selected Phyla of Algae, Roles of Algae in Nature; *Protozoa*:Characteristics and Classification of Protozoa, Medically Important Protozoa, Slime Molds

4.2 Viruses: History of bacteriophages, plant and vertebrate viruses;Nature of Viruses, Origin of Viruses, Phylogeny and Evolution of Viruses;

4.3 Viruses: Taxonomy, Classification and Nomenclature of Viruses

4.4Satellite Nucleic Acids: Viroids, Virusoid and Prions

References

1. John B. Carter and Venetia A. Saunders, Virology, Principles and Applications, John Wiley & Sons Ltd, 2007
2. Marjorie Kelly Cowan and Heidi Smith, 5th Edition, Microbiology A systems Approach, McGraw-Hill Education, 2018
3. Gerard J. Tortora, Berdell R. Funke, Christine L. Case, Microbiology: An Introduction, 13th Edition, Pearson, 2018
4. Marjorie Kelly Cowan and Heidi Smith, 5th Edition, Microbiology A systems Approach, McGraw-Hill Education, 2018
5. Principles of Molecular Virology, 4th Edition, Alan J. Cann, 2005
6. DinabandhuSahoo and Joseph Seckbach, The Algae World, Springer, 2016
7. Lynn Margulis and Michael J Chapman, Kingdoms and domains, Academic press, 2009
8. Brian W J Mahy and Brian W J Mahy Desk Encyclopedia of General Virology, Academic Press Elsevier, 2010
9. N. J. Dimmock, A. J. Easton, K. N. Leppard, 6th Edition, Introduction to Modern Virology, Blackwell Publishing Ltd, 2007

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Micro)**
Course Code	**Bios (M) -302**	**Semester**	**III**
Omics and Integrative Microbiology			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

Bios (M) -302: OMICS AND INTEGRATIVE MICROBIOLOGY

Learning Objective and Outcomes*: The course mainly emphasize on study concept development and application of omics and integrative science. After learning this course students will be able to understand*

- *Concept, Mechanism and application genomics, Proteomics and metagenomics*
- *Design the experimental protocol for genomics, Proteomics and metagenomics*
- *Analyze the results of for genomics, Proteomics and metagenomics*

Unit IGenomics

1.1 **NGS:**Concept, Mechanism and Application of Next Generation Sequencing technology

1.2**Sequencing Data:**Preprocessing of sequencing data, Genomics databases

1.3 **Tools and techniques:** Tools and techniques for Gene finding Genome annotation and

Comparative genomics

1.4**Case study** of Microbial genomics

Reference Books

1. *Michal Janitz. Next-Generation Genome Sequencing, Wiely*
2. *Lloyd Low, Bioinformatics A Practical Handbook of Next Generation Sequencing and Its Applications, World scientific*

3. *Andreas D. Baxevanis, Bioinformatics A Practical Guide to the Analysis of Genes and Protein*
4. *Rastogi, Bioinformatics Methods and application Genomics Proteomics and Drug Discovery, PHI learning*
5. *Jonathan Pevsner, Bioinformatics and functional genomics,*
6. *Primrose S.B, Principles of Gene Manipulation And Genomics,Wiley*
7. *FrédéricDardel, Bioinformatics Genomics and post-genomics,*
8. *Encyclopedia of Genetics, Genomics, Proteomics and Bioinformatics*
9. *Neil, Genomics, Proteomics and clinical bacteriology, Humana Press*

Unit II Proteomics

2.1 **Omics:**From Genomics to Proteomics
2.2 **Tools and techniques:** Wet lab tools and techniques for proteomics data generation
2.3 **Database**: Bioinformatics database and tools for proteomics analysis
2.4 **Case study** of microbial proteomics

Reference Books

1. *Twyman, Principles of Proteomics, Advanced text*
2. *Renie, The Proteomics in Practices, Wiley*
3. *Ian Humphery-Smith, Microbial proteomics, Wiely*
4. *Protein Biochemistry and Proteomics, Amsterdam, Elsevier*
5. *Xing Wang, Functional Proteomics, Humana press*
6. *Neil, Genomics, Proteomics and clinical bacteriology, Humana Press*
7. *Encyclopedia of Genetics, Genomics, Proteomics and Bioinformatics*
8. *Rastogi,Bioinformatics Methods and application Genomics Proteomics and Drug Discovery, PHI learning*
9. *Andreas D. BaxevanisBioinformatics A Practical Guide to the Analysis of Genes and Protein,*

Unit III System and Synthetic Biology

3.1 **Metabolomics:**Concept, tools and techniques and application for metabolomics
3.2 **Application**of metabolomics
3.3 S**ystems biology:**Concept, tools and techniques, and application of systems biology
3.4 **Synthetic biology:**Concept, tools and techniques, and application of synthetic biology

Reference Books

1. *Edward E.K. Baidoo, Microbial Metabolomics Methods and Protocols, Humana*
2. *Michael, Metabolomics in Practice, Wiley*
3. *Silas, Metabolome analysis,Wiely*
4. *David, Microbial Metabolomics Applications in Clinical, Environmental, and Industrial Microbiology,Springer*
5. *Bernhard, Systems Biology Properties of Reconstructed Networks, Cambridge University Press*
6. *Hiroaki Kitano, Foundations of Systems Biology, MIT press*
7. *Klipp, Systems Biology in Practice Concepts, Implementation and Application, Wiley*
8. *Pengcheng Fu, Systems Biology And Synthetic Biology, Wiely*
9. *Jens, Metabolomics A Powerful Tool in Systems Biology, Springer*

Unit IVMetaomics Approach

4.1 **Metagenomics:** Fundamental concepts, tools and techniquesof Metagenomics
4.2 **Metagenomics Application**: Revolutionary application of metagenomics
4.3 **Metatranscriptomics and Metaproteomics:** Concepts, tools, technique and application of metatranscriptomics and metaproteomics
4.4 Concepts tools, technique and application for Culturomics

Reference Books

1. *Nelson, Karen, Encyclopedia of Metagenomics, Springer, 2015*
2. *Wolfgang, Metagenomics Methods and Protocols, Humana Press, 2010*
3. Vipin Chandra Kalia, Mining of Microbial Wealth and MetaGenomics, Springer, 2017
4. Jacques Izard, Metagenomics for Microbiology, Elsevier, 2015
5. Camilla Benedetti, Metagenomics methods, applications and perspectives, Nova Publisher, 2014
6. John N. Abelson and Melvin I. Simo, Methods In Enzymology, Academic Press, 2004
7. Edward F. Delong, Methods in Enzymology Microbial Metagenomics, Metatranscriptomics, and Metaproteomics, Elsevier, 2013

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Micro)**
Course Code	**Bios (M) -303**	**Semester**	**III**
Medical and Pharmaceutical Microbiology			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

Bios (M) -303:MEDICAL AND PHARMACEUTICAL MICROBIOLOGY

***Learning Objective and Outcomes*:** *The course is designed to develop the basic understanding skill required for microbiology student for Medical and pharmaceutical sector. They will be able to*

- *Identify the diseases, Causative agent of various microbial disease of human*
- *Understand the concept and application of epidemiology*
- *Understand the need of microbial procedure in pharm industry*
- *Understand the Quality requirement and management*

Unit I Disease Biology

1.1 **Microbial Diseases** of the Skin, Eyes, Nervous System, Cardiovascular and lymphatic Systems,

1.2 **Microbial Diseases** of the Respiratory System, Digestive System, Urinary and Reproductive Systems

1.3 **Antimicrobials**: Antimicrobial Chemotherapy, Historical Introduction, Mode of action

1.4 **Drug Resistance:** History of Drug-Resistant Microbes, Evolutionary Biology of Drug Resistance, Pharmacology of Drug Resistance, Antimicrobial Resistance versus the Discovery and Development of New Antimicrobials.

Reference Books

1. *Tortora, Funke and Case, Microbiology -An Introduction 12th Edition , Pearson, 2016*
2. *Robert W. Bauman, Microbiology with disease and body system, 5th Edition, Pearson, 2018*
3. *Roger Finch David Greenwood Richard Whitley S. Ragnar Norrby, Antibiotics and Chemotherapy, 9th Edition,, Elsevier, 2010*
4. *Peter Davey, Mark Wilcox et al., Antimicrobial Chemotherapy,7th Edition, Oxford University Press, 2015*
5. *Douglas L. Mayers, Mechanisms of Drug Resistance Humana Press, 2009*

Unit II Epidemiology

2.1 **Epidemiology:**Introduction to Epidemiology, Measuring disease frequency,

2.2 **Outbreak:** Descriptive epidemiology, Outbreaks Investigations

2.3 **Zoonotic Viruses:**Introduction: Conceptualizing and Partitioning the Emergence Process of Zoonotic Viruses from Wildlife to Humans

2.4 **Zoonotic disease:**Overview of important zoonotic disease, Bioterrorism

Reference Books

1. *Penny Webb and Chris Bain, Essential Epidemiology An Introduction for Students and Health Professionals, Cambridge university press, 2011*
2. *David D. Celentano, Gordis Epidemiology, Elesevier, 2019*
3. *B. Burt Gerstman, Epidemiology Kept Simple, An introduction to traditional and modern epidemiology, 3rd Edition Wiley, 2013*
4. *James E. Childs, Wildlife and Emerging Zoonotic Diseases: The Biology,Circumstances and Consequences of Cross-Species, Springer, 2007*
5. *Zoonotic Disease of Public health Importance, National Institute of Communicable Diseases, 2016*
6. *Rolf Bauerfeind, Zoonoses Infectious Diseases Transmissible from Animals to Humans,4thEidtion, ASM, 2016*

Unit IIIPharmaceutical Microbiology

3.1 **Procedures**: Concepts and technique of Microbiological Assays

3.2 **Assay:**Application of Microbiological Assays

3.3 **QC:**Fundamental and application of Microbiology Quality control

3.4 **QA:**Fundamental and application of Microbiology Quality Assurance

Reference Books

1. *William Hewitt, Microbiological Assays for Pharmaceutical Analysis-A rational approach, CRC, 2005*
2. *Stephen P. Denyer, Rosamund M. Baird, Guide to Microbiological Control in Pharmaceuticals and Medical Devices, 2nd Edition, CRC Press, 2006*
3. *Quality assurance in Microbiology, Rajesh Bhatia, CBS, 2000*
4. *Martine C.Easter, Rapid Microbiological Methods in the Pharmaceutical Industry, , InterpharmCRC, 2005*

Unit IV Quality Management

4.1 **Microbiological processes:**Procedures and application of Microbiological processes in Pharmaceutical industry

4.2 **Quality management**: Study of various quality management systems like GMP, GLP NABL etc.

4.3 **System Management:**Study of various ISO system in for industry like, Quality, Environment and social responsibility management

4.4 **Guideline:**Study of guideline for clinical research

Reference Books

1. *Hugo and Russell's Pharmaceutical Microbiology, , Blackwell Publishing, 2004*
2. *KanishkaBedi, Quality Management, Oxford, 2006*
3. *Guru Prasad Mohanta, Textbook on Clinical Research A Guide for Aspiring Professionals and Professionals, Pharma med, 2019*
4. *S K Gupta, Basic Principles of Clinical Research methodology, ICRI*
5. *Jurg P. Seiler, Good Laboratory Practice: The Why and the How, Springer, 2007*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Micro)**
Course Code	**Bios (M) -304**	**Semester**	**III**
Industrial Microbiology and Fermentation Technology			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

Bios (M) -304:INDUSTRIAL MICROBIOLOGY AND FERMENTATION TECHNOLOGY

Learning Objective and Outcomes:

The course has created to expose students to various industrial microbiology process after completing this course student will be

- *Able to understand the application of microbial process in the industry*
- *Able to understand the role and responsibility of Microbiologist in Industry*
- *Student will gain exposure to economic value of microbiology*

Unit I: Cultivation and Selection of Strains

1.1 Isolation and Screening: New Approaches to Microbial, Isolation and actinomycetes, Screening-Enzymes from Extreme Environments, Cell-Based Screening Methods, Metabolomics for the Discovery of Novel Compounds, Methods To Access Silent Biosynthetic Pathways (Richard)

1.2 Media, Growth: Nutrient Media for Cultivation of Industrial Microorganisms and Generation of Microbial Products;Pathways: Biosynthetic Pathways for Metabolic Products of Microorganisms, Processes for Overproduction of Microbial Metabolites for Industrial Applications

1.3 Stain Improvement: Selection and Improvement of Industrial Organisms for Biotechnological Applications; Culture preservation and inoculum development:storage at reduced temperature, storage in a dehydrated form, quality control of preserved stock, inoculum development, criteria for the transfer of inoculum, Development of inocula for yeast and bacterial processes

1.4 Sterilization: Significance and Processes of Sterility and sterilization

References

1 Richard H. Baltz , Manual of Industrial Microbiology and Biotechnology, ASM Press, 2010
2 Allan Whitaker and Peter F. Stanbury, Principles of Fermentation Technology, 3rd Edition, Elsevier, 2017
3 Nduka Okafor, Modern Industrial Microbiology and Biotechnology 2nd Edition, CRC press, 2018
4 G D Najafpore, Biochemical Engineering and Biotechnology, Elsevier, 2007

Unit 2 Bioreactor and Downstream Processes

2.1 Design of a fermenter: Basic functions of a fermenter, aseptic operation and containment, fermenter body construction, aeration and agitation, aeration system (sparger), achievement and maintenance of aseptic conditions

2.2 Instrumentation and control: Methods of Measuring Process Variables, On-Line Analysis of Other Chemical Factors, Control Systems, Computer Applications in Fermentation Technology

2.3 Downstream Processing-The recovery and purification of fermentation products: Removal of cells and solid matter, Precipitation, Filtration, centrifugation, Cell disruption, chromatography, membrane processes, Drying, Crystallization, whole broth processing

2.4 Biocatalysts, Immobilized Enzymes and Cells: Enzymes class, industrial use, production of enzymes, Immobilization of enzymes and cells and its practical application, Manipulation of microorganisms for higher yield of enzymes; Solid-State Fermentation: Aerobic and Anaerobic

References:

1 Allan Whitaker and Peter F. Stanbury, Principles of Fermentation Technology, 3rd Edition, Elsevier, 2017
2 Nduka Okafor, Modern Industrial Microbiology and Biotechnology 2nd Edition, CRC press, 2018
3 Richard H. Baltz , Manual of Industrial Microbiology and Biotechnology, ASM Press, 2010
4 E.M.T. El-Mansi, Fermentation Microbiology and Biotechnology, 3rd edition, CRC press, 2012
5 Henry C. Vogel, Celeste M. Todaro, Fermentation and Biochemical Engineering Handbook, William Andrew, Elsevier, 2014

Unit 3Fermentation of Industrially Valuable Metabolites

3.1 Production of Enzymes: Amylases, Proteases and other hydrolases

3.2 Production of Antibiotics: Penicillin, Streptomycin, Tetracyclines, Griseofulvin

3.3 Production of Organic acid and Solvents: Citric Acid, lactic acid, acetic acid, Gluconic acid;Solvent**:** Biofuel and Industrial Alcohol, Glycerol, Aceton-butanol

3.4 Production of Amino Acids and Vitamins: Glutamic Acid, L-Lysine and Aromatic Amino Acids; Production of vitamins

References:

1 A H Patel, Industrial Microbiology, 2nd Edition, Trinity, 2016
2 Nduka Okafor, Modern Industrial Microbiology and Biotechnology 2nd Edition, CRC press, 2018
3 G D Najafpore, Biochemical Engineering and Biotechnology, Elsevier, 2007
4 E.M.T. El-Mansi, Fermentation Microbiology and Biotechnology, 3rd edition, CRC press, 2012

Unit 4 Recombinant products and Effluent treatment

4.1**Production of polysaccharides and Polyester:** Dextran, Xanthan Gum and Polyhydroxyalkanoates,

4.2**Optimization:** Scale up and fermentation economics,Statistical Methods for Fermentation Optimization: OVAT and RSM; Theproduction of heterologous proteins

4.3**Escherichia coli produced recombinant protein**: Soluble versus insoluble production

4.4**Effluent treatment and Bi product:** Introduction, Disposal, treatment processes, By-products

References:

1 Allan Whitaker and Peter F. Stanbury, Principles of Fermentation Technology, 3rd Edition, Elsevier, 2017
2 Alexander N. Glazer, Hiroshi Nikaido, Microbial Biotechnology: Fundamentals of Applied Microbiology 2nd edition, Cambridge University Press, 2012
3 Garner G. Moulton, Fed-batch fermentation, Woodhead Publishing, 2014
4 Henry C. Vogel, Celeste M. Todaro, Fermentation and Biochemical Engineering Handbook, William Andrew, Elsevier, 2014

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Micro)**
Course Code	**Bios (M) -305**	**Semester**	**III**
Practical Based on BIOS-301 to 304			
Course type	**Practical**	**Total Credit**	**08**
Teaching time	**Examination Marking Scheme**		
Practical (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
16/week	**60**	**140**	**200**

Bios (M) -305: Practical Based on BIOS-301 to 304

Following are the indicative list of the experiments. Changes can be done depending upon the departmental need and availability of the resources

MICROBIAL DIVERSITY

1. Isolation and biochemical identification of Gram Negative bacteria - *E. coli, Enterobacter aerogenes, Proteus vulgaris, Pseudomonas aeruginosa, Shigella dysentery* and *Salmonella species* (*S. paratyphi A and B, S. typhi S. flexineri*) etc.
2. Isolation and biochemical identification of Gram Positive bacteria, *Bacillus species, Staphylococcus aureus* and *Streptococcus species* (*Enterococcus faecalis*) etc.
3. Isolation and identification of Actinomycetes bacteria
4. Isolation and screening of archaea
5. Isolation and identification of industrially important molds and fungi.
6. Isolation and identification of cyanobacteria / Algae

7. A study of Amoeba/ Ciliates /Malarial protozoa etc.
8. Isolation of bacteriophage from sewage water
9. Identification of bacteria by rapid kit and other systems
10. Online tool for bacterial identification based on morphological and biochemical characters
11. In silico analysis of Restriction Fragment Length Polymorphism
12. Identification of Microorganism with 16s rRNA Homology Technique
13. Perform the phylogenetic analysis using Clustal Omega analysis

OMICS AND INTEGRATIVE MICROBIOLOGY

1. Study of Various formats of sequencing data
2. Sequencing data quality assessment
3. Assembly of sequencing data
4. Study of Gene finding tools
5. Genome annotation
6. Study of Genome databases
7. 2 D gel data analysis
8. Proteomic Database and computational analysis
9. Trascriptomics data analysis
10. Community metagenomics study
11. Functional Metagenomics study
12. Metagenomics databases

MEDICAL AND PHARMACEUTICAL MICROBIOLOGY

1. Isolation and identification of Microorganism form clinical sample
2. Antibiotic sensitivity test by disc method
3. MIC and MBC study
4. Microbiological assay for inhibitory substances
5. Microbiological assay for growth promoting substance
6. Microbial limit test
7. Sterility testing
8. Effectively of antimicrobial preservative
9. LAL test
10. Molecular diagnostic technique of pathogens

INDUSTRIAL MICROBIOLOGY AND FERMENTATION TECHNOLOGY

1. Screening, production, extraction and purification of industrial enzymes- Amylase/ Protease/ Cellulase/ Pectinase/ Xylanase/Lipase of microorganisms
2. Solid-state fermentation for the production of industrial enzymes
3. Screening of production, extraction and purification of Dextran / Xanthan Gum
4. Screening, production, extraction and purification Poly-Beta Hydroxyl-Butyrate (PHB)
5. Screening, production, extraction and purification of antibiotic Penicillin /Streptomycin
6. Screening, production, extraction and purification of organic acid i.e. Citric Acid/Lactic acid/Acetic acid/Gluconic acid

7. Screening, production, extraction and purification of Amino AcidsGlutamic Acid/L-Lysine etc.
8. Screening, production, extraction and purification of vitamins
9. Screening, production, extraction and purification of alcohol / ethanol
10. Screening, production, extraction and purification of beer / wine
11. Screening, production, extraction and purification of Acetone-butanol

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Micro)**
Course Code	**Bios (M) -401**	**Semester**	**IV**
Microbial Genetics and Physiology			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

Bios (M) -401:MICROBIAL GENETICS AND PHYSIOLOGY

Learning Objective and Outcomes: *The course concentrate on understanding of mutation, mobile element and phage along with microbial bioprocess and physiological aspects of microorganisms. The aim of the course is to provide students with a deeper insight into the microbial genetics and physiological processes. On completion of the course the students will be able to*

- *Describe the Mutation, Mobile Element and Phage genetics details.*
- *Student will be correlate the Microbial Physiology, Anaerobic Bioprocesses and Metabolic Regulation and extremophiles biology.*
- *Student will be explain the traditional to modern aspects with practical application in genetics.*

Unit IBacterial and Phage genetics

1.1 **Molecular biology of Gene Transfer in Bacteria:** Transduction, Genetic Transformation, Conjugation and Plasmid Molecular Biology, Recombination

1.2 **Mutagenesis, Mutations, and Mutants**:Biochemical Basis of Mutations,Spontaneous Mutations, Mutagens, Isolation of Mutants, Mutagenesis,Reversion, Suppression, DNA Repair and Simple Recombination (Edward), **Transposable Elements:**Genomic Plasticity, Transposon, Insertion Sequences, Detection, Types of Bacterial Transposons, Transposition, Excision of Transposons, Genetic Phenomena,Phage Mu- DNA and replication, Retroviruses

1.3 **Genetics of other Intemperate Bacteriophages:** T Series phage, Single-Strand DNA Bacteriophages, RNA-Containing Bacteriophages, Bacteriophages Infecting Bacillus subtilis,Bacteriophages Infecting the Archaea

1.4 **Genetics of Temperate Bacteriophages**:Nature of the Temperate Response, Bacteriophage Lambda and Other Lambdoid Phages, P22, P2, P4, P1, SSV1 and SSV2

Reference Books

1. *Stanley R. Maloy, Microbial Genetics, Second Edition, Jones and Bartlett Publishers*
2. *Edward A. Birge,Bacterial and Bacteriophage Genetics 5th Edition, Springer, 2006*
3. *Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick, Lewin's GENES XII, Jones & Bartlett, 2018*
4. *Larry Snyder and Wendy Champness, Molecular genetic of bacteria, ASM Press, 2007*
5. *Jeremy W. Dale and Simon F. Park, Molecular Genetics of Bacteria, 5th Edition, John Wiley & Sons, Ltd, 2010*
6. *Albert G. Moat, John W. Foster, Michael P. Spector, Microbial Physiology, 4th Edition, Wiley-Liss, Inc, 2002*

Unit II Microbial Physiology

2.1 **Membrane:**Membrane transport - nutrient uptake and protein excretion

2.2 **Biosynthesis and microbial growth:** Molecular composition of bacterial cells, Assimilation of inorganic nitrogen and sulfate, Biosynthesis of Amino acid, Nucleotide, Lipid, Heme, saccharides, Polysaccharide, Assembly of cellular structure and growth

2.3 **Heterotrophic metabolism on substrates other than glucose:** Hydrolysis of polymers, Utilization of sugars, Organic acid, alcohols and ketones, Amino acid, Degradation of nucleic acid bases, Oxidation of aliphatic hydrocarbons and aromatic compounds, Utilization of methane and methanol, Incomplete oxidation

2.4 **Chemolithotrophy:** Reverse electron transport, Nitrification, Sulfur bacteria, Iron bacteria, Hydrogen and Carbon monoxide oxidation, Chemolithotrophs using other electron donors, CO2 fixation pathways in chemolithotrophs

Reference Books

1. *Byung Hong Kim and Geoffrey Michael Gadd, Bacterial Physiology and Metabolism,Cambridge University Press, 2008*
2. *Stanley R. Maloy, Microbial Genetics, Second Edition, Jones and Bartlett Publishers*

Unit III Anaerobic Bioprocesses and Metabolic Regulation

1.1 **Anaerobic fermentation:** Ethanol, Lactate, Butyrate and acetone-butanol-ethanol fermentations,Mixed acid and butanediol, Propionate, amino acids and nucleic acid bases, dicarboxylic acids

1.2 **Anaerobic respiration:** Denitrification, Metal reduction, Sulfidogenesis, Methanogenesis, Homoacetogenesis, Dehalorespiration,Syntrophic associations, Element cycling

1.3 **Metabolic regulation**: various mechanisms regulating enzyme synthesis

1.4 **Global regulation:** responses to environmental stress**,** various stresses and responses, Regulation through modulation of enzyme, Metabolic regulation and growth, Secondary metabolites,Metabolic regulation and the fermentation industry; Energy, environment and microbial survival- Survival and energy, Reserve materials in bacteria, Resting cells

Reference Books

1. Byung Hong Kim and Geoffrey Michael Gadd, Bacterial Physiology and Metabolism,Cambridge University Press, 2008
2. Jyotsna Rathi, Microbial Physiology Genetics and Ecology, Manglam Publications, 2009

Unit IV Extremophiles Biology

4.1 Introduction of extreme life and Concept of an extreme biology (David Wharton)

4.2 Occurrence, Ecology, physiology and biotechnological application of Hyperthermophiles, Thermophiles, Psychrophiles

4.3 Occurrence, Ecology, physiology and biotechnological application of Acidophiles, alkaliphiles, halophiles

4.4 Occurrence, Ecology, physiology and biotechnological application of Piezophiles, Xerophiles, Organic Solvent Tolerant, Radiation Resistant Organisms and polyextremophiles

Reference Books

1. *Om V. Singh, Extremophiles, A John Wiley & Sons, Inc,2013*

2. *Koki Horikoshi, Extremophiles Handbook, Springer*
3. *Ravi V Durvasula and D V Subba Rao, Extremophiles From Biology to Biotechnology, CRC Press, 2018*
4. *Frank Robb GarabedAntranikian& Dennis Grogan Arnold Driessen, Thermophiles CRC Press Taylor & Francis, 2008*
5. *Fred A Rainey, Aharon Oren, Methods in Microbiology Volume 35 Extremophiles, Academic press Elsevier, 2006*
6. *Jean-Claude Bertrand, Environmental Microbiology: Fundamentals and Applications, Springer 2011*
7. *David A.Wharton Life at the Limits Organisms in extreme environments, Cambridge University Press 2002*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Micro)**
Course Code	**Bios (M) -402**	**Semester**	**IV**
Applied Microbiology			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

Bios (M) -402:APPLIED MICROBIOLOGY

Learning Objective and Outcomes: *The subject offers the in-depth knowledge of the concepts, tools, techniques and process related to various field of applied Microbiology. On completion of the course the students will be able to*

- *Understand the application of Microbiology in agriculture, health and environment*
- *Know the responsibility of Microbiologist in the various industrial operation*
- *Understand the relation of Host Microbiome and its application*

Unit I Microbial Mediated Process

1.1 **Biofertilizer**: Concept, production, application, advantage and limitation of Biofertilizer

1.2 **Biopesticide:** Concept, production, application, advantage and limitation of Biopesticide

1.3 **Degradation processes**: Mechanism and application of Microbial Biodegradation and Bio Biodeterioration Process

1.4 **Cleaner Bioprocess:** Mechanism, Strategies and application of Bioremediation, Biogas, Biotransformation, Bioleaching, biomining

Reference Books

1. *Gareth M. Evans, Judith C. Furlong, Environmental Biotechnology Theory and Application, Wiley, 2003*
2. *A M Desmukh, Handbook of Biofertilizers and Biopesticides, Oxford India, 2007*
3. *OpenderKoul, Microbial biopesticides, Tailor and Francis*
4. *Travis, Microbial-Based Biopesticides Methods and Protocols, , Humana Press*
5. *Sangeetha. Environmental Biotechnology, , AAP press*
6. *Surajit Das, Microbial Biodegradation and Bioremediation, Elsevier, 2014*
7. *Alexander, Biodegradation and Bioremediation, 2Ed. Academic Press.*
8. *P Rajendran& P Gunasekaran, Microbial bioremediation, MJP Publishers*
9. *Allsopp, Introduction to Biodeterioration, 2Ed. Cambridge University Press.*

Unit II Waste Management and Nanotechnology

2.1 **Liquid waste:** Domestic water and Industrial waste water microbiology

2.2 **Solid Waste:**Solid Waste management and Biological waste management

2.3 **Nanomaterial**: Types of nanomaterial, properties, promise

2.3.1 **Application of Nanotechnology:** in Bioremediation, Biomedical and health sciences

Reference Books

1. *MukeshDoble Anil Kumar, Biotreatment of Industrial Effluents, Elsevier, 2005*
2. *Gabriel Bitton, Waste Water Microbiology, 3rd Ed, John Wiley & Sons, 2005*
3. *Ram Chandra, Advances in Biodegradation and bioremediation of Industrial Waste, CRC press, 2015*
4. *Nicholas, Butterworth-Heinemann,Handbook of water and waste water technologies, Elsevier, 2001*
5. *InduShekhar Thakur, Environmental Biotechnology, I K International, 2011*
6. *MogensHenze et al, Biological Wastewater Treatment Principles, Modelling and Design, IWA publishing, 2008.*
7. *John Pichtel, Waste management practices Municipal, Hazardous, and Industrial, CRC, 2014*
8. *Ram Prasad and Elisabet Aranda, Approaches in Bioremediation The New Era of Environmental Microbiology and Nanobiotechnology, Springer, 2018*
9. *Claudio Nicolini, Nanobiotechnology&Nanobiosciences,Pan Stanford Publishing Pte. Ltd. 2009*
10. *David E. Reisner, Bionanotechnology Global Prospects, CRC Press, 2009*
11. *StergiosLogothetidis, Nanomedicine and Nanobiotechnology, Springer, 2012*

Unit III Applied Approach

3.1 **Microbial fuel:** Concept, production, application, advantage and limitation

3.2 **Industrial Application:** Overview of various biopharmaceutical products: Antibodies and Vaccine

3.3 **Applied Concept:** Fundamental and application of Forensic Microbiology and Space Microbiology

3.4 **Food Microbiology**: Dairy Products, Non-Dairy Products

Reference Books

1. *Biofuels Engineering Process Technology , Biofuels Engineering Process Technology,McGraw hill, 2008*
2. *Gary Walsh, Biopharmaceuticals, 2nd Edition, ohn Wiley & Sons,2003*
3. *Bruce Budowle, Steven E. Schutzer, et al., Microbial Forensics, 2nd Edition, Academic press, 2015*
4. *James M. Jay, Modern Food Microbiology, 7th Edition, Springer, 2005*
5. *Michael P. Doyle and Michael P. Doyle, Food Microbiology: Fundamentals and Frontiers, 4th Edition, ASM Press, 2013*

Unit IV Host-Microbiome

4.1 **Host-microbiome**: Fundamentals, tools and techniques

4.2 **Interaction ofMicrobiome**: Interactions of Host-microbiota, Overview of Plant,Animal and human Microbiome

4.3 **Hologenome**: Symbioses and concept of Hologenome, Hologenome and holobiont theory, Tools and technique, Microbiotas are Part of Holobiont Fitness,

4.4 **Applied aspects of the hologenome**: Altered Microbiota and Their Metabolism in Host Metabolic Diseases, Prebiotics, Probiotics, Synbiotics, and Phage Therapy, Fecal Transplantation (Bacteriotherapy)

Reference Books

1. *Sarah K. Highlander, Encyclopedia of Metagenomics, Springer, 2015*

2. *Eugene Rosenberg and Ilana Zilber-Rosenberg, The Hologenome Concept: Human, Animal and Plant Microbiota, Springer, 2013*
3. *Jun Sun and Pradeep K. Dudeja, Mechanisms Underlying Host-Microbiome Interactions in Pathophysiology of Human Diseases, Springer 2018*
4. *Ravindra Pal Singh, Ramesh Kothari, Prakash G. Koringa, Satya Prakash Singh, Understanding Host-Microbiome Interactions - An Omics Approach, Springer Nature, 2017*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Micro)**
Course Code	**Bios (M) -403**	**Semester**	**IV**
Research Methodology and Professional Skills			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

Bios (M) -403: RESEARCH METHODOLOGY AND PROFESSIONAL SKILLS

Learning Objective and Outcomes: *The course is design to train student for research activity and communication skill at the end of the course student will be*

- *Able to understand the research problem and design and research work*
- *Able to write, prepare poste and present oral presentation*
- *Able to prepare CV and face the interview .*

Unit I: Basic of Research Methodology

1.1 Philosophy of the natural sciences: Traditional philosophy of science, Hypotheticodeductive method, the empirical turn in philosophy of science,

1.2 Research Methodology: Objective, Motivation, Types approach, Significance, method, methodology, research process, good research, Researchers in India;

1**.3 Research problems and Design:** Research problems:Definition, selection of problems, Defining problems, technique; Research Design: Meaning, Need, features, concept, types, and Experimental design;

1.4 Sampling design: Survey, design, steps, criteria, characteristics, types, random sample and sampling

Reference Books

1. *C R Kothari Research Methodology 2nd Ed, New Age International Publication, 2004*
2. *PetterLaake, Haakon BreienBenestad and BjørnReino Olsen, Research methodology in the medical and biological sciences, Academic Press Elsevier, 2007*
3. *Yogesh Kumar Singh, Fundamental of Research methodology and statistics, New Age International (P) Limited, Publishers, 2006*
4. *Phyllis G. Supino and Jeffrey S. Borer, Principles of Research Methodology- A Guide for Clinical Investigators, Springer, 2012*

Unit II: Thesis Preparation

2.1 Preparing a dissertation: Formatting guidelines, sections, raw data, tips, requirement

2.2 Thesis writing: Title, Introduction, Review of literature, methodology, Result, Discussion, references, additional components

2.3 Strategies for writing thesis: Eleven steps strategies

2.4 Defense of the thesis or dissertation: Structure of the oral examination, Preparation for the examining committee session,Conduct of the oral examination, Decision making regarding the oral defense, Follow-up

Reference Books

1. *R Raveendran, B Gitanjali,SManikandan, A practical Approach to PG dissertation, 2nd Eidtion, PharmaMed Press, 2012*
2. *Aysha Divan, Communication Skill for the Biosciences, Oxford University Press, 2009.*
3. *James E. Mauch and Namgi Park, 5th Edition, Guide to the Successful Thesis and Dissertation, Marcel Dekker, Inc, 2003.*

Unit III: Scientific Presentation and Management

3.1 Writing a research Proposal and research Paper: Research Proposal: Components, writing, funding sources for bioscience research, peer review; Research Paper: Structure, Strategy, aim and content of paper, submission, peer-review

3.2 Delivering effective presentation: Oral presentation: Planning, Preparation, practicing, delivering, answering and evaluating presentation; Poster: Planning, Preparation and presentation

3.3 Management fundamental: Characteristics, nature, function, process, profession, role, level and evolution

3.4 Entrepreneurship fundamental: Concept, Evolution, Characteristics, Entrepreneur Intrapreneur, Ultrapreneur, role, barrier,

Reference Books

1. *Aysha Divan, Communication Skill for the Biosciences, Oxford University Press, 2009.*
2. *Jennifer Peat, Scientific Writing- Easy when you know how, BMJ Books. 2002*
3. *Janice R. Matthews and Robert W. Matthews, Successful Scientific Writing, 3rd Edition, Cambridge University Press, 2008*
4. *VeerabhadrappaHavinal, Management and entrepreneurship, New Age International publishers,2009*

Unit IV:Communication and Research Skills

4.1 Before Writing: Academic Writing, Writer's Mindset, Strategies to avoid procrastination

4.2 Elements of English Grammar: Basic Terms and Definitions, Similar meaning, different spelling, Similar spelling, different meaning, Proofreading, word uses, Active versus Passive Voice

4.3 Research information system: Computer and ICT in research, Ethics in communication

4.4 Networking: Networking, CV and interview preparation

Reference Books

1. *MarialuisaAliotta, Mastering Academic Writing in the Sciences, CRC press, 2018*
2. *Janice R. Matthews and Robert W. Matthews, Successful Scientific Writing, 3rd Edition, Cambridge University Press, 2008*
3. *Aysha Divan, Communication Skill for the Biosciences, Oxford University Press, 2009.*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Micro)**
Course Code	**Bios (M) -404**	**Semester**	**IV**
Dissertation/ Training			
Course type	**Core Compulsory**	**Total Credit**	**06**
Teaching time	**Examination Marking Scheme**		
Practical / Lab (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
12/week	**45**	**105 (Paper of 3hrs)**	**150**

Bios (M) -204:DISSERTATION/ TRAINING

Student shall take anyone option from Dissertation or Training as per following guideline

Dissertation

- Students have to take up a small research project under the supervision of a teacher from the department or may carry the work in an industry / NGO / private laboratory with required facility/other university or institution.
- If a student is doing project outside the university all other arrangements are to be made by the student.
- Student has to submit the dissertation before the last date for the submission as declared by the university.

Training

Student have to undergo for attest 30 days training in any Industry or other organization under the supervision of the any faculty of the department.

At the end of the training student has to submit the detailed training report including the scientific review on the relevant topic of his training

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Micro)**
Course Code	**Bios (M) -405**	**Semester**	**IV**
Practical Based on BIOS-401 to 403			
Course type	**Practical**	**Total Credit**	**06**
Teaching time	**Examination Marking Scheme**		
Practical (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
12/week	**45**	**105**	**150**

Bios (M) -405: Practical based on paper 401 to 403

Following are the indicative list of the experiments. Changes can be done depending upon the departmental need and availability of the resources

MICROBIAL GENETICS AND PHYSIOLOGY

1. Plasmid Curing from Bacterial Cell
2. Conjugation in Bacteria
3. Transduction in Bacteria
4. Plasmid Profile Analysis
5. Isolation and identification of Auxotrophic mutant
6. Induction of mutation
7. Isolation of thermophiles/ Psychrophiles/Acidophiles/alkaliphiles/ halophiles
8. Study of CO2 sequestering bacteria
9. Cultivation and detection of Anaerobic bacteria
10. Compatible solute production in extremophiles
11. Degradation of aliphatic hydrocarbons by bacteria

APPLIED MICROBIOLOGY

1 PGPR study
2 Microbial Biodegrading study
3 Microbial Bioremediation study
4 Microbiological analysis of domestic water
5 Microbiological analysis of waste water
6 Nano particle preparation
7 Microbiological analysis of food and dairy product
8 Host microbiome data analysis
9 Study on Probiotic

RESEARCH METHODOLOGY AND PROFESSIONAL SKILLS

1. Searching of scientific literature
2. Digital research resources e-ShodhSindhu and Shodhganga at INFLIBNET
3. Online grammar checking in scientific writing
4. References management by online tools
5. Plagiarisms checking
6. Preparation of graphs and tables to present the scientific data

7. Searching of approved and Index-Journal- UGC CARE, NAAS collection and Web of sciences/Scopus.
8. Searching of proper journals based on title and abstract of your research.
9. Preparation of scientific poster
10. Oral presentation on scientific topic
11. Preparation of curriculum vitae
12. Mock interview and group discussion skill

Reference

Surajit Das and HirakRanjan Dash, Microbial Biotechnology- A Laboratory Manual for Bacterial Systems, Springer, 2015

Syllabus

M. Sc. Bioscience (Zoology) Sem. III and IV

CHOICE BASED CREDIT SYSTEM (CBCS)

w.e.f. June 2020

Department of Biosciences
Veer Narmad South Gujarat University, Surat

M. Sc. Bioscience (Zoology) Semester- III							
Subject Code	Subject Title	Theory Hours/ week	Practical Hours/week	External Marks	Internal Marks	Total Marks	Credit
Bios-(Z)-301	Structure and Function in Invertebrates and Vertebrates	4	-	70	30	100	4
Bios-(Z)-302	Histology and Histochemistry	4	-	70	30	100	4
Bios-(Z)-303	Animal Taxonomy, Wildlife and Conservation	4	-	70	30	100	4
Bios-(Z)-304	Animal Biotechnology	4	-	70	30	100	4
Bios-(Z)-305	Practical Based on Bios-(Z)-301 to 304	-	16	140	60	200	8
Total		**16**	**16**	**420**	**180**	**600**	**24**

M. Sc. Bioscience (Zoology) Semester- IV							
Subject Code	Subject Title	Theory Hours/ week	Practical Hours/week	External Marks	Internal Marks	Total Marks	Credit
Bios-(Z)-401	Applied Reproductive Biology	4	-	70	30	100	4
Bios-(Z)-402	Applied Zoology	4	-	70	30	100	4
Bios-(Z)-403	Research Methodology	4	-	70	30	100	4
Bios-(Z)-404	Dissertation/ Training	-	12	105	45	150	6
Bios-(Z)-405	Practical Based on Bios-(Z)-401 to 403	-	12	105	45	150	6
Total		**12**	**24**	**420**	**180**	**600**	**24**

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-(Z)-301**	**Semester**	**III (Zoology)**
Structure and Function in Invertebrates and Vertebrates			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(Z)-301 Structure and Function in Invertebrates and Vertebrates

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Unit-I

1.1 Protozoa: Locomotion, nutrition, patterns of feeding and digestion, reproduction

1.2 Porifera: Skeleton, canal system and reproduction.

1.3 Cnidaria: Polymorphism, defensive structures and their mechanism; coral reefs and their formation; metagenesis, locomotion,

1.4 Platyhelminthes and Nemathelminthes: Parasitic adaptation; general features and life history of Fasciola, Taenia, Ascaris and Wuchereria and their pathogenic symptoms.

Ref:

1. *Invertebrate structure and function E, J.W.Barrington*
2. *Lehninger Principles of Biochemistry, Nelson, WH free Man*
3. *Biochemistry Dr. C. B. Powar Dr. G.R. Chatwal, Himlaya Publishing House*
4. *Invertebrate zoology by Jordan and Verma*

UNIT-II

2.1 Annelida: Coelom and metamerism; modes of life in polychaetes,

2.2 Arthropoda: Patterns of reproduction, Larval forms and parasitism in Crustacea; vision and respiration in arthropods; (Prawn, cockroach and scorpion); modification of mouth parts in insects (cockroach, mosquito, housefly, honey bee and butterfly); metamorphosis in insect and its hormonal regulation, social behaviour of Apis and termites. Excretory organs, Circulation and transport.

2.3 Mollusca: Feeding, respiration, locomotion, torsion and detorsion in gastropods.

2.4 Echinodermata: Feeding, respiration, locomotion, larval forms

Ref:

1. *Invertebrate structure and function E, J.W.Barrington*
2. *Lehninger Principles of Biochemistry, Nelson, WH free Man*
3. *Biochemistry Dr. C. B. Powar Dr. G.R. Chatwal, Himlaya Publishing House*
4. *Invertebrate zoology by Jordan and Verma*

Unit-III

3.1 Pisces: Respiration; Gills, Air bladder or swim bladder, accessory respiratory organs mechanism of locomotion and fish migration.
3.2 Amphibia: Origin of tetrapods, parental care, paedomorphosis.
3.3 Reptilia; Origin of reptiles, skull types, status of Sphenodon and crocodiles.
3.4 Aves: Origin of birds, Birds as flying machine; various types of flights, migration.

1. *Chordate zoology, Jordan and Verma*
2. *Modern textbook of Zoology (Vertebrates), R L Kotpal*

UNIT-IV

4.1 Mammalia: Origin of mammals, dentition, general features of egg laying mammals,pouched-mammals, aquatic mammals and primates
4.2 endocrine glands (pituitary, thyroid, parathyroid, adrenal, pancreas) and their interrelationships.
4.3 Comparative functional anatomy of various systems of vertebrates (integument and its derivatives, locomotory organs, digestive system, respiratory system).
4.4 Comparative functional anatomy of various systems of vertebrates (Excretory system, circulatory system including heart and aortic arches, urino-genital system, brain and sense organs (eye and ear).

Ref:

1. *Chordate zoology, Jordan and Verma*
2. *Modern textbook of Zoology (Vertebrates), R L Kotpal*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-(Z)-302**	**Semester**	**III (Zoology)**
Histology and Histochemistry			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(Z)-302 Histology and Histochemistry

UNIT-I

1.1 Tissue processing; steps involved in tissue preparation, steps in tissue processing; Fixation, Post fixation steps, Microtomy, Staining

1.2 Basic microtomy techniques used for Light Microscopy and Electron Microscopy, visualizing of specific molecules, interpretation of structures in tissue sections

1.3 Some special chemicals and instruments required in the Light Microscopy and Electron Microscopy; For PAS staining, to label enzyme, to label other biochemical molecules

1.4 Enzyme histochemistry and its application and techniques

Ref:

1. *Text book of histology, N.N.Majumdar*
2. *Histology, R.O.Greep*
3. *Basic histology L.C.Junquiera, J.Carbeuro&Cantapoulous, 14th edition*
4. *Inderbir Singh's Text book of Human Histology*

UNIT-2

2.1 Histological aspects of epithelial tissue; classification, simple epithelium pseudostratified epithelium, stratified epithelium, basement membrane, projection from cell membrane, functions of connective tissue

2.2 Histological aspects of connective tissue; fibres of cmnnective tissue, cells of connective tissue, intracellular ground substance of connective tissue, different forms of connective tissue, functions of connective tissue

2.3 Muscle tissue; skeletal muscles, cardiac muscles, smooth muscles, myoepithelial cells.

2.4 Nervous tissue; Tissue constituting in nervous system, structure of neurons, neuroglia, synapse, ganglia.

Ref:

1. *Text book of histology, N.N.Majumdar*
2. *Histology, R.O.Greep*
3. *Basic histology L.C.Junquiera, J.Carbeuro&Cantapoulous, 14th edition*
4. *Inderbir Singh's Text book of Human Histology*

UNIT-III

3.1 Histological aspects of Digestive system; oral cavity, teeth, tongue, salivary gland, oesophagus, stomach, small intestine, large intestine, colon, rectum, anal canal.

3.2 Histological aspects of Respiratory system; common features of nasal passage, nasal cavities, pharynx, larynx, trachea, bronchi, lungs

3.3 Histological aspects of Excretory system; kidney, ureters, urinary bladders, urethra

3.4 Histological aspects of male and female reproductive system; ovary, oviduct, uterus, cervix, vagina. External genitalia, mammary gland, testes, intra testicular ducts, excretory genital ducts, accessory glands, penis

Ref:

1. *Text book of histology, N.N.Majumdar*

2. *Histology, R.O.Greep*
3. *Basic histology L.C.Junquiera, J.Carbeuro&Cantapoulous, 14th edition*
4. *Inderbir Singh's Text book of Human Histology*

UNIT -IV

4.1 Histological aspects of Circulatory system; heart, tissue of vascular walls, vasculature
4.2 Histological aspects of Skin; epidermis, dermis, subcutaneous tissue, hair, nails, skin glands sensory receptors
4.3 Histological aspects of some glands; pituitary, adrenal gland, pancreas, thyroid, parathyroid, diffuse neuroendocrine system.
4.4 special senses; Eye; structure of eye ball, outer fibrous coat, uvea, retina, lens, accessory visual organs.

Ref:

1. *Text book of histology, N.N.Majumdar*
2. *Histology, R.O.Greep*
3. *Basic histology L.C.Junquiera, J.Carbeuro&Cantapoulous, 14th edition*
4. *Inderbir Singh's Text book of Human Histology*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-(Z)-303**	**Semester**	**III (Zoology)**
Animal Taxonomy, Wildlife and Conservation			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(Z)-303 Animal Taxonomy, Wildlife and Conservation

UNIT-I

1.1 Taxonomy: Basic concepts of biosystematics, taxonomy and classification, taxonomic characters, taxonomic procedure; collection, fixation, preservation,
1.2 Process of species identification, Taxonomic keys: different kinds of taxonomic keys, their merits and demerits.
1.3 Modern concepts and recent trends of Taxonomy; Chemotaxonomy, Cytotaxonomy, Molecular taxonomy
1.4 International Code for Zoological Nomenclature (ICZN): operative principles, interpretation and application of important rules, Type concept: Process of typification of different zoological types, Zoological nomenclature and formation of scientific names of different taxa

Ref:

1. *Principles of systematic Zoology (2 nd Edition) by E. Mayr and P.D. Ashlock*
2. *Evolutionary Biology by Eric C. Mitkoff*
3. *Principles of Animal Taxonomy by G.G. Simpson*
4. *Animal Taxonomy by H.E. Goto*
5. *International Code of Zoological Nomenclature official publication*
6. *A Textbook of Zoology Vol. I by Parker &Haswell (Revised)*

UNIT- II

2.1 Wildlife Habitat: components, classification, function and importance. Concept of Biosphere conservation; Overview of Biosphere Reserves of India.

2.2 Methods of studying free living animals in their natural habitat: Occurrence records, Transects, Quadrates, Marking; consideration prior to marking, noninvasive marking techniques, invasive marking techniques tagging; ear, wings, other appendages, body and jaws, branding, tissue removal and telemetry in animal ecological studies.

2.3 Wildlife Capture & Handling; permit requirement, equipments, observation and trapping techniques; general considerations, bird observing, spotlighting opportunistic observation of scats, tracks and signs predator scat collection call playback nest boxes, rock rolling, searching litter and debris (systematic searching), rock rolling, searching litter and debris (systematic searching) cage traps, elliott traps, vertebrate pitfall traps, hair tubes, ultrasonic detection harp traps, trip lining mist and cannon netting, electrofishing netting

2.4 Hygiene, specimens, euthanasia and transport; safety and hygiene, safety and hygiene, euthanasing animals, transport, temporary storage.

Ref:

1. *General Guidelines for Wildlife Capture & Handling, The Centre for Environmental Management (CEM), Federation University Australia*
2. *Wild life marking techniques, Nova J. Silvy, Roel Lopez, Markus Peterson*

UNIT-III

3.1 The rise of conservation biology; Introduction, Early conservationists, The emergence of conservation biology as a science, The Rio Summit and Biodiversity Convention 147 Conservation biology and the conservation movement

3.2 Selecting protected areas; Introduction, What is a protected area?History of protected area designation, Criteria for measuring conservation value of areas, Practical approaches to protected area designation

3.3 Design and management of protected areas; Designing protected areas, Managing protected areas, Management of semi-natural communities, Monitoring change in protected areas

3.4 Protecting species. I. In situ conservation; Commoness and rarity among species, Assessing and categorising threat to species from human activity, managing small population, Measuring species decline, Genetic management of small populations, Genetic management of species, Sustainable harvesting of populations

Protecting species. II. Ex situ conservation and reintroduction; What is ex situ conservation and when is it necessary Ex situ conservation of plants, Ex situ conservation of animals: captive breeding, Species reintroduction, Direct species translocation, Population reinforcement

Ref:

1. *Conservation Biology Andrew S. Pullin*
2. *Conservation of Biological Resources by E. J. Milner-Gulland and R. Mace*
3. *The New Face of Environmental Management in India by A. Sawhney*
4. *Wildlife wealth of India by T.C. Majupura*
5. *The biology, ecology and behaviour of endangered species by R.L. Eaton*
6. *Fundamentals of Wildlife management by R. Gopal*
7. *Bology in Theory and Practice by G. Caughley and A. Gunn*

UNIT-IV

4.1 Wildlife Law Enforcement in India; About TRAFFIC, About WWF-India, An Overview of Wildlife Trade, Wildlife Trade in India, About CITES, Wildlife Crime as Transnational Organised Crime, Internet as a Tool for Illegal Wildlife Trade

4.2 Some Methods of Poaching in India, Prevention of Wildlife Offences, Scene of Wildlife Crime, Post-mortem, Weapons of Crime, Intelligence Gathering, maintaining a Criminal Profile Directory, Conducting Interrogation, Securing Electronic Evidence, Some Modes of Concealment of Illegal Wildlife Products, Guidelines for an Arrest, Interpol and the Fight against Wildlife Crime

4.3 Major conservation movements in India; Project Tiger, Project Elephant, Project Hangul, Project crocodile, National legislations for protecting wildlife and biological resources; Wildlife Protection Act-1972, Biodiversity Act- 2002

4.4 Over view of National parks of Gujarat; Marine National Park, Blackbuck National Park, Gir National Park, Vansda National Park, Overview of Sanctuaries of Gujarat: 23 Sanctuaries

Ref:

1. *Handbook on Wildlife Law Enforcement in India, Samir Sinha, WWF India, Natraj Publisher*
2. *Conservation of Biological Resources by E. J. Milner-Gulland and R. Mace*
3. *The New Face of Environmental Management in India by A. Sawhney*
4. *Wildlife wealth of India by T.C. Majupura*
5. *The biology, ecology and behaviour of endangered species by R.L. Eaton*
6. *Fundamentals of Wildlife management by R. Gopal*
7. *Bology in Theory and Practice by G. Caughley and A. Gunn*
8. *Wildlife Crime Investigation A Hand book for Wildlife Crime Investigation Officers, Wildlife Crime Control Bureau Ministry of Environment and Forests Government of India*

9. *Wildlife Forensic Investigation:Principles and Practice,John E. Cooper Margaret E. Cooper,CRC Press,*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-(Z)-304**	**Semester**	**III (Zoology)**
Animal Biotechnology			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(Z)-304 Animal Biotechnology

UNIT-I

1.1 Introduction: Historical background, Application of animal biotechnology, Advantages and limitation of animal tissue culture.
1.2 Types of tissue culture – Adherent culture, Suspension culture, Short term culture and Long term culture primary
1.3 Culture environment, Cell adhesion, Cell proliferation and plating efficiency, Differentiation.
1.4 Primary culture, Subculture and cell lines, cell viability, maintenance of cell line and characterization

Ref:

1. *Ian Freshney, Culture of Animal Cells (Fifth Edition), Wiley-Leiss*
2. *Doyle and B. Griffith, Cell and Tissue Culture: Laboratory Procedures in Biotechnology,Wiley publications.*
3. *D. Helgason and C. L. Miller, Basic Cell Culture Protocols, Humana press.*

UNIT-II

2.1 Cryopreservation of cell lines, Vitrification, Design and Control of Stocks, Cytotoxicity and Genotoxicity.
2.2 Transformation and Immortalization; genetic instability, chromosomal aberration, variation in DNA content, control of senescence, immortalization with viral genes, immortalization of human fibroblast, telomerase induced immortalization
2.3 Immortalization:Anchorage Independence, contact inhibition, serum dependence, oncogenes
2.4 Quantitation; cell counting, electronic counting, stained monolayers, cell weight, DNA content, protein content. Cell proliferation; cell growth cycle, analysis of monolayer and growth curve, medium volume, cell density, cell concentration, phases of growth cycle, plating efficiency, growth fraction

Ref:

1. *Ian Freshney, Culture of Animal Cells (Fifth Edition), Wiley-Leiss*
2. *Doyle and B. Griffith, Cell and Tissue Culture: Laboratory Procedures in Biotechnology,Wiley publications.*
3. *D. Helgason and C. L. Miller, Basic Cell Culture Protocols, Humana press.*

UNIT-III

3.1 Animal tissue culture lab design & layout, equipments, Aseptic techniques, safety and bioethics and validation

3.2 Culture vessels & Substrates; Attachment and growth, substrate material, choice of culture vessels, Suspension culture, venting, specialized systems, treated surface

3.3 Defined Media & Supplements; Physicochemical parameters, Balanced salt solutions, complete media, selection of media and serum, other suplements

3.4 Serum free media; Advantages and disadvantages, selection of serum free media, development of serum free media, sterilization of media

Ref:

1. *Ian Freshney, Culture of Animal Cells (Fifth Edition), Wiley-Leiss*
2. *Doyle and B. Griffith, Cell and Tissue Culture: Laboratory Procedures in Biotechnology,Wiley publications.*
3. *D. Helgason and C. L. Miller, Basic Cell Culture Protocols, Humana press.*

UNIT-IV

4.1 Organotypic culture; cell interaction and phenotypic expression. Histotypic and organotypic culture; structural integrity, limitations of organ culture, histotypic culture; Gel and sponge technique , hollow fibres, spheroids. Rotating chamber system, filter well insert,Overview of types of scaffolds and matrices used in tissue engineering constructs.

4.2 Cloning; The main steps of differentiation,Cloning by nuclear transfer The goals of gene therapy,The tools of gene therapy,The applications of gene therapy,

4.3 Techniques of animal transgenesis; The aims and the concept of animal transgenesis, Gene transfer into gametes,Gene transfer into embryos, Gene transfer via cells, Vectors for gene addition, Vectors for gene replacement, Vectors for the rearrangement of targeted genes, Targeted integration of foreign genes, Non-classical vectors for the recombination of targeted genes, Vectors for gene trap, Vectors for the expression of transgenes

4.4 Applications of animal cloning; Basic research Transgenesis, Animal reproduction, Human reproduction, Therapeutic cloning Applications of 0animal transgenesis; Basic research, Study of human diseases, Pharmaceutical production, Xenografting, Breeding

Ref:

1. *Animal Transgenesis and cloning Louis-Marie Houdebine, Wiley*
2. *Culture of Animal cell A manual of basic techniques,Wiley*
3. *Animal cloning, A science of nuclear transfer*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-(Z)-305**	**Semester**	**I**
Practical Based on BIOS-(Z)-301 to 304			
Course type	**Practical**	**Total Credit**	**08**
Teaching time	**Examination Marking Scheme**		
Practical (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
16/week	**60**	**140**	**200**

BIOS-(Z)-305- Practicals based on topics covered in Bios 301 to 304

NOTE: Changes can be done depending upon the departmental need and availability of the resources

Wildlife and conservation Biology

1. Preparation of Ethogram
2. To study the modification of beak
3. To study the modification of feet
4. To study the antelope and antlers
5. Diversity study by transects
6. Study of pugmark / foot print of various domestics/ wild animals
7. Identification of butterfly
8. Identification of birds
9. Hair identification of animals
10. Scat analysis animals
11. Field trip
12. Visit of Zoo and national park
13. Online resources and databases of wild life
14. Demonstration of preservation of specimens

Structure and Function in Invertebrates and Vertebrates

1. Earthworm – nervous system, reproductive system (through charts/ model/ images)
2. Cockroach- nervous sysem, digestive system, reproductive system (through charts/model/images)
3. Prawn –Appendages, Statocyst.
4. Protozoans- rhizopods , flagellates , ciliates etc. (fresh water forms).
5. Crustaceans and rotifers - Planktonic copepodes, cladoceran, ostracoderm and rotifers.
6. Larval forms of the free living invertebrates.
7. Larval forms of parasitic invertebrates.
8. Comparative Digestive system in vertebrates (through charts/model/ images)
9. Comparative female reproductive system (ovary, oviduct, uterus, cervix) in vertebrates (through charts)
10. Comparative male reproductive system (testes, intratesticular ducts, vasa deferentia, urethra) in vertebrates (through charts /model/images)
11. Comparative aortic arteries in vertebrates (through charts/model/ images)
12. Comparative hearts in vertebrates (through charts/model/images)
13. Skull types (through charts/model)

14. To study Permanent slides of endocrine glands
15. Comparative anatomy of above mentioned systems in chordates.
16. Note: Student should prepare and submit at least 10 permanent stained micropreparation.

Cell culture

1. To perform primary cell culture from Splenocyte / Hepatocyte / Chick fibroblast.
   Cell Culture: Cell revival, Subculture, Viability and Cell maintenance.
   Genotoxic assay: Micronucleus assay.
2. Isolation of Peripheral Blood Mononuclear Cells (PBMC).
3. Cytotoxic assay: MTT assay.
4. Study of effect of cytotoxic chemicals on cell lines by different marker paramenters (Sulforhodamine-B, Super oxide Dismutase, Catalase, etc.)
5. Study of effect of genotoxiccehmicals on cells lines by different marker parameters (G2 assay, DNA fragmentation, Comet, etc.).
6. Characterization of cell line by isozyme analysis.
7. To estimate Lactate Dehydrogenase Activity from cell lines.
8. **T**o study morphological differentiation from primordial cells using appropriate differentiation medium.
9. To study Transfection in Animal Cell Culture.
10. Preparation and sterilization of Media by appropriate; autoclave and filtration techniques.

Histology

1. To study histological aspects of digestive system by using permanent slides.
2. To study histological aspects of circulatory system by using permanent slides.
3. To study histological aspects of respiratory system by using permanentslides.
4. To study histological aspects of Excretory system by using permanent slides.
5. To study histological aspects of reproductive system by using permanent slides.
6. To prepare chemical requirements for microtomy and demonstration of microtomy.
7. To prepare permanent histological slides of fish tissues (gills/liver/kidney/intestine/ brain).
8. To prepare permanent histological slides of chicken tissues (Heart/liver/kidney/ intestine/ brain/lungs).
9. To prepare permanent histological slides of goat tissues (liver/kidney/intestine/brain).
10. To localize carbohydrate moieties in the given histological slides.
11. To localize protein moieties in the given histological slides.
12. To localize lipid moieties in the given histological slides.
13. To localize enzymes (ACP/ALP) in the given histological slides.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-(Z)-401**	**Semester**	**III (Zoology)**
Applied Reproductive biology			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(Z)-401 Applied Reproductive biology

UNIT-I

1.1 Structure and functions of Female reproductive organs. Folliculogenesis, Ovulation, Corpus luteum, atrecia,

1.2 Implantation, Placenta, Pregnancy and its control Foetoplacental unit as an endocrine entity

1.3 Menopause, reproductive cycles, non-steroidal regulators of ovarian function.

1.4 Gamete and zygote transport; Semen Release, Contents of Seminal Plasma, Sperm Number and Structure, Sperm Transport and Maturation in the Female Reproductive Tract, Transport of the Sperm and Ovum in the Oviduct, sperm Capacitation and Activation, Sperm Passage through the Cumulus Oophorus, Sperm Passage through the Zona Pellucida, The Cortical Reaction, Completion of the Second Meiotic Division, Formation and Fusion of Sperm and Egg Pronuclei, Mammary glands, Lactation and its hormonal control.

Ref;

1. *Endocrine and reproductive physiology, Edited by Bruce a. white, PhD and Susan p. Porterfield, PhD, Elsevier*
2. *Human Reproductive Biology, Richard jones, Elsevier*
3. *Human reproduction and developmental biology, D. J. Begley, BSc, PhD, J. A. FIRTH, MA, PhD.*
4. *Preservation of human oocytes from cryobiological science to clinical application*

UNIT-II

2.1 Structure and function of the Male Reproductive Organs.

2.2 Spermatogenesis and its hormonal control. Functions of the Sertoli cells and Leydig Cells.

2.3 Semen formation and its biochemistry. Sperm structure and function.

2.4 Testis Anomalies, Senescence, Puberty.

Ref;

1. *Endocrine and reproductive physiology, Edited by Bruce a. white, PhD and Susan p. Porterfield, PhD, Elsevier*
2. *Human Reproductive Biology, Richard jones, Elsevier*
3. *Human reproduction and developmental biology, D. J. Begley, BSc, PhD, J. A. FIRTH, MA, PhD*
4. *Preservation of human oocytes from cryobiological science to clinical application*

UNIT-III

3.1 Principles of Fertility Regulation in males and females.

3.2 In-Vitro Fertilization, ET and AR technologies.

3.3 Collection and preservation of Gametes; Principles of Cryopreservation,fundamentals of vitrification, Expression of Functional Aquaporins

in Oocytes and Embryos and the Impact on Cryopreservation, Oocyte Storage at Different Developmental Stages, Cryopreservation and the Cytoskeleton of the Human Oocyte, Impact of Cryopreservation on Oocyte Physiology, Metabolism, and the Proteome,The Contribution of Embryo Cryopreservation to the Clinical Efficacy of ART and to a Reduction of ART Multiple Pregnancies,Factors Influencing the Clinical Efficiency of Oocyte Cryopreservation, impact of Oocyte Storage in Oocyte Donation Treatments

3.4 Research methodologies; RIA, PCR, EIA, IRMA, Radioreceptors, Chemiluminescence, Polyclonal and Monoclonal antibodies.

Ref;

1. *Endocrine and reproductive physiology, Edited by Bruce a. white, PhD and Susan p. Porterfield, PhD, Elsevier*
2. *Human Reproductive Biology, Richard jones, Elsevier*
3. *Human reproduction and developmental biology, D. J. BEGLEY, BSc, **PhD,** J. A. FIRTH, MA, **PhD,***
4. *Preservation of human oocytes from cryobiological science to clinical application*

UNIT-IV

4.1 Development, factors affecting sex determination, Genetic Control of sex determination, Endocrinology of the foetal gonads, Prenatal diagnostic techniques.

4.2 Reproduetivefanure and wastage; Introduction, Congenital abnormalities, Teratogenesis, Inbom errors of metabolism, Spontaneous abortion and fetallosses, Prenatal diagnosis of fetal abnormalities

4.3 Oocyte Storage in Domestic Species:

4.4 Life cycle of male and female reproductive system

Ref;

1. *Endocrine and reproductive physiology, Edited by Bruce a. white, PhD and Susan p. Porterfield, PhD, Elsevier*
2. *Human Reproductive Biology, Richard jones, Elsevier*
3. *Human reproduction and developmental biology, D. J. BEGLEY, BSc, **PhD,** J. A. FIRTH, MA, **PhD.***
4. *Preservation of human oocytes from cryobiological science to clinical application*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-(Z)-402**	**Semester**	**III (Zoology)**
Applied Zoology			

Course type	Core Compulsory	Total Credit	04
Teaching time	Examination Marking Scheme		
Theory (hrs)	Internal Marks	External Marks	Total Marks
4/week	30	70 (Paper of 3hrs)	100

BIOS- (Z)-402 Applied Zoology

UNIT-I

1.1 Care and Use of Laboratory Animals; Animal Environment, Housing, and Management; Physical environment; Microenvironment and Macroenvironment, Housing, Space Recommendations, Temperature and Humidity, Ventilation, Illumination, Noise, Behavioral management; Structural Environment, Social Environment, Activity, Husbandry; Food, Water, Bedding, Sanitation, Bedding Change, Cleaning and Disinfection of Primary Enclosures, Cleaning and Disinfection of Secondary Enclosures, Assessing the Effectiveness of Sanitation, Waste Disposal, Pest Control, Emergency, Weekend, and Holiday Care

1.2 Animal models in toxicology; Mouse, rat, hamster, rabbit, zebrafish, daphnia, earthworm

1.3. Animal Genetics: Animal breeding, out breeding and inbreeding, open nucleusbreeding systems. Conservation of germplasm, breeding of laboratory animals, genetic health monitoring. Concept of production of specific pathogen free (SPF) and germ free laboratory animals. Development of various chimeras.

1.4 Animal nutrition: Introduction, Dairy Cattle Nutrition and Feeding, Sheep Nutrition and Feeding, Poultry Nutrition and Feeding, Fish Nutrition and Feeding, Diet Formulation and Common Feed Ingredients

Ref:

1. *Guide for the Care and Use of Laboratory Animals, Institute of Laboratory Animal Research, Commission on Life Sciences, National Research Council, NationaAcadamy of Science.*
2. *Handbook of Laboratory Animal Management and Welfare, Sarah Wolfensohn, Third eddition, Blackell publishing*
3. *Animal model in toxicology. Edited by Shayne C. Gad, Taylor & Francis*
4. *Design Standards for Small Animals (Rodents) Vivarium, The University of Texas, MD Anderson, Center*
5. *Animal nutrition Handbook, by Lee I. Chiba*

UNIT-II

2.1 Important marine organisms and their behavior; Introduction to marine environment; Marine flora - phytoplankton, seaweeds, sea grasses and mangroves - their characteristics and identification; Marine fauna–zooplankton; Major marine invertebrates (crustaceans &molluscs); Vertebrates (Pisces) and marine mammals (dolphin and whales) - characteristics and identification; Biology - food & feeding - age & growth - reproduction - life history of crustaceans, molluscs and fishes.

2.2 Oceanography: Physical; Temperature, salinity and density – horizontal, vertical and temporal variations; waves, tides and currents, upwelling. Chemical; nutrient cycle, metals, minerals and trace elements Biological-primary and secondary productivity, finfish and shellfish resources.

2.3 Culture systems and hatchery techniques: Importance of coastal aquaculture; Aquafarms: design and construction; Criteria for selecting cultivable species;Culture systems and management practices – extensive, semi-intensive andintensive culture practices. Seed production in controlled condition; Types; Design and management of hatchery –induced spawning; Mass production of seeds; Live feed culture technique and feed formulation; Artificial insemination - in vitro fertilization.

2.4 Manipulation and microbial techniques; Chromosome manipulation in aquaculture – hybridization; Ploidy induction; Gynogenesis, Androgenesis and sex reversal in commercially important fishes. Application of microbial biotechnology in culture ponds; Bioaugmentation; Bioremediation for soil and water quality improvement - nutrient cycling; bio-fertilization; Probiotics – Immunostimulants; Regulation of bacterial growth.

Ref:

1. Handbook of Marine Biotechnology, Kim, Springer

UNIT-III

3.1 Introduction to Epidemiology, Measuring disease frequency
3.2 Descriptive epidemiology, Outbreaks Investigations
3.3 Introduction: Conceptualizing and Partitioning the Emergence Process of Zoonotic Viruses from Wildlife to Humans
3.4 Overview of important zoonotic disease

Ref:

1. *Essential Epidemiology an Introduction for Students and Health Professionals, Penny Webb, Cambridge university press*
2. *Gordis Epidemiology, David D. Celentano, Elesevier*
3. *Epidemiology Kept Simple, An introduction to traditional and modern epidemiology, Gerstman, Wiley*
4 *Wildlife and Emerging Zoonotic Diseases: The Biology, Circumstances and Consequences of Cross-Species, James, Springer*
5. *Zoonotic Disease of Public health Importance, National Institute Of Communicable Diseases*
6. *Zoonoses Infectious Diseases Transmissible from Animals to Humans, Rolf, ASM*

UNIT-IV

4.1 Concept and application of host microbiome and hologenome
4.2 Overview of rumen microbiome
4.3 Overview of human and other Animal microbiome
4.4 Mirobiome engineering

Ref:

1. *Handbook of Molecular Microbial Ecology I, Metagenomics and Complementary Approaches*
2. *Edited by Frans J. de Bruijn, Wiley-Blackwell, A John Wiley & Sons, Inc., Publication*
3. *Handbook of Molecular Microbial Ecology I, Metagenomics in different habitats, by Frans J. de Bruijn, Wiley-Blackwell, A John Wiley & Sons, Inc., Publication*
4. *Rumen Microbiology: From Evolution to Revolution, edited by Anil Kumar, PuniyaRameshwar Singh, DevkiNandanKamra, Springer*
5. *Methods in Gut Microbial Ecology for Ruminants, Edited by Harinder P.S. Makkar, Springer*
6. *The Hologenome Concept: Human, Animal and Plant Microbiota, Eugene Rosenberg, IlanaZilber-Rosenberg, Springer*
7. *Understanding Host-Microbiome Interactions - An Omics Approach Omics of Host-Microbiome Association, Ravindra Pal Singh, Ramesh Kothari, Prakash G. Koringa, Satya Prakash Singh, Springer*
8. *Metagenomic Analysis of the Human Gut Microbiome, dos Santos, Marcelo BertalanQuintanilha; Nielsen, Henrik Bjørn; Sicheritz-Pontén, Thomas, Technical University of Denmark (DTU).*
9. *Encyclopedia of Metagenomics-Environmental Metagenomics, Edited by Sarah K. Highlander Francisco Rodriguez-Valera Bryan A. White, Springer*
10. *Encyclopedia of Metagenomics*
11. *Genes, Genomes and Metagenomes: Basics, Methods, Databases and Tools, Karen E. Nelson, Springer*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-(Z)-403**	**Semester**	**IV**
RESEARCH METHODOLOGY AND PROFESSIONAL SKILLS			
Course type	**Core Compulsory**	**Total Credit**	**04**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**30**	**70 (Paper of 3hrs)**	**100**

BIOS-(Z)-403-RESEARCH METHODOLOGY AND PROFESSIONAL SKILL

Learning Objective and Outcomes: *The course is design to train student for research activity and communication skill at the end of the course student will be*

- *Able to understand the research problem and design and research work*
- *Able to write, prepare poste and present oral presentation*
- *Able to prepare CV and face the interview .*

Unit I: Basic of Research Methodology

1.1 Philosophy of the natural sciences: Traditional philosophy of science, Hypotheticodeductive method, the empirical turn in philosophy of science,

1.2 Research Methodology: Objective, Motivation, Types approach, Significance, method, methodology, research process, good research, Researchers in India;

1**.3 Research problems and Design:**Research problems:Definition, selection of problems, Defining problems, technique; Research Design: Meaning, Need, features, concept, types, and Experimental design;

1.4 Sampling design: Survey, design, steps, criteria, characteristics, types, random sample and sampling

Reference Books

1. *C R Kothari Research Methodology 2nd Ed, New Age International Publication, 2004*
2. *Petter Laake, Haakon Breien Benestad and Bjørn Reino Olsen, Research methodology in the medical and biological sciences, Academic Press Elsevier, 2007*
3. *Yogesh Kumar Singh, Fundamental of Research methodology and statistics, New Age International (P) Limited, Publishers, 2006*
4. *Phyllis G. Supino and Jeffrey S. Borer, Principles of Research Methodology- A Guide for Clinical Investigators, Springer, 2012*

Unit II: Thesis Preparation

2.1 Preparing a dissertation: Formatting guidelines, sections, raw data, tips, requirement

2.2 Thesis writing: Title, Introduction, Review of literature, methodology, Result, Discussion, references, additional components

2.3 Strategies for writing thesis: Eleven steps strategies

2.4 Defense of the thesis or dissertation: Structure of the oral examination, Preparation for the examining committee session,Conduct of the oral examination, Decision making regarding the oral defense, Follow-up

Reference Books

1. *R Raveendran, B Gitanjali,S Manikandan, A practical Approach to PG dissertation, 2nd Eidtion, PharmaMed Press, 2012*
2. *Aysha Divan, Communication Skill for the Biosciences, Oxford University Press, 2009.*
3. *James E. Mauch and Namgi Park, 5th Edition, Guide to the Successful Thesis and Dissertation, Marcel Dekker, Inc, 2003.*

Unit III: Scientific Presentation and Management

3.1 Writing a research Proposal and research Paper: Research Proposal: Components, writing, funding sources for bioscience research, peer review; Research Paper: Structure, Strategy, aim and content of paper, submission, peer-review

3.2 Delivering effective presentation: Oral presentation: Planning, Preparation, practicing, delivering, answering and evaluating presentation; Poster: Planning, Preparation and presentation

3.3 Management fundamental: Characteristics, nature, function, process, profession, role, level and evolution

3.4 Entrepreneurship fundamental: Concept, Evolution, Characteristics, Entrepreneur Intrapreneur, Ultrapreneur, role, barrier,

Reference Books

1. *Aysha Divan, Communication Skill for the Biosciences, Oxford University Press, 2009.*
2. *Jennifer Peat, Scientific Writing- Easy when you know how, BMJ Books. 2002*
3. *Janice R. Matthews and Robert W. Matthews, Successful Scientific Writing, 3rd Edition, Cambridge University Press, 2008*
4. *Veerabhadrappa Havinal, Management and entrepreneurship, New Age International publishers,2009*

Unit IV: Communication and Research Skills

4.1 Before Writing: Academic Writing, Writer's Mindset, Strategies to avoid procrastination

4.2 Elements of English Grammar: Basic Terms and Definitions, Similar meaning, different spelling, Similar spelling, different meaning, Proofreading, word uses, Active versus Passive Voice

4.3 Research information system: Computer and ICT in research, Ethics in communication

4.4 Networking: Networking, CV and interview preparation

Reference Books

1. *Marialuisa Aliotta, Mastering Academic Writing in the Sciences, CRC press, 2018*
2. *Janice R. Matthews and Robert W. Matthews, Successful Scientific Writing, 3rd Edition, Cambridge University Press, 2008*
3. *Aysha Divan, Communication Skill for the Biosciences, Oxford University Press, 2009.*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience (Botany)**
Course Code	**BIOS (Z)-404**	**Semester**	**IV**
Dissertation/ Training			
Course type	**Core Compulsory**	**Total Credit**	**06**
Teaching time	**Examination Marking Scheme**		
Practical / Lab (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
12/week	**45**	**105 (Paper of 3hrs)**	**150**

BIOS-(Z)-204: DISSERTATION/ TRAINING

Student shall take anyone option from Dissertation or Training as per following guideline

Dissertation

- Students have to take up a small research project under the supervision of a teacher from the department or may carry the work in an industry / NGO / private laboratory with required facility/other university or institution.
- If a student is doing project outside the university all other arrangements are to be made by the student.
- Student has to submit the dissertation before the last date for the submission as declared by the university.

Training

Students have to undergo for at least 30 days training in any Industry or other organization under the supervision of the any faculty of the department.

At the end of the training student has to submit the detailed training report including the scientific review on the relevant topic of his training

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT			
Programme Code		**Programme Name**	**M.Sc. Bioscience**
Course Code	**BIOS-(Z)-405**	**Semester**	**III (Zoology)**
Practical Based on Bios-(Z)-401 to 403			
Course type	**Core Compulsory**	**Total Credit**	**06**
Teaching time	**Examination Marking Scheme**		
Theory (hrs)	**Internal Marks**	**External Marks**	**Total Marks**
4/week	**45**	**105**	**150**

BIOS-(Z)-405-Practicals based on topics covered in Bios-(Z)-401 to 403

.NOTE: Changes can be done depending upon the departmental need and availability of the resources

Applied Reproductive Biology

1. Sperm profiling
2. Sperm wash and analysis
3. Cryopreservation of gamets
4. Detection of ovulation by rapid test kit
5. Pregnancy detection by rapid test kit
6. Demonstration and visit Artificial insemination in Animal facility
7. Demonstration and visit of IVF facilities

Applied Zoology

1. Microbial analysis of fishery products
2. Chemical analysis of fishery products
3. Study of Probiotics
4. Study and analysis of animal nutrient
5. Visit of Animal house facility
6. Study of zooplankton and phytoplankton
7. Visit of hatchery/Fish farm
8. Gut microbiome analysis

Research Methodology And Professional Skill

1. Searching of scientific literature
2. Digital research resources e-ShodhSindhu and Shodhgangaat INFLIBNET
3. Online grammar checking in scientific writing
4. References management by online tools
5. Plagiarisms checking
6. Preparation of graphs and tables to present the scientific data
7. Searching of approved and Index-Journal- UGC CARE, NAAS collection and Web of sciences/Scopus.
8. Searching of proper journals based on title and abstract of your research.

9. Preparation of scientific poster
10. Oral presentation on scientific topic
11. Preparation of curriculum vitae
12. Mock interview and group discussion skill