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**VEER NARMAD SOUTH GUJARAT UNIVERSITY**

University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.

**વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી**

યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.

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## **-: પરિપત્ર :-**

વિજ્ઞાન વિદ્યાશાખા હેઠળની પ્રાણીશાસ્ત્ર વિષય ચલાવતી સંલગ્ન સ્નાતક આચાર્યશ્રીઓને જણાવવાનું કે, શૈક્ષણિક વર્ષ : ૨૦૨૧-૨૨ થી અમલમાં આવનાર T.Y.B.Sc.(Zoology)ના સિલેબસ બનાવવા બાબતે ઝૂઓલોજી વિષયની અભ્યાસસમિતિની તા.૨૨/૦૩/૨૦૨૧ની સભાનાં ઠરાવ ક્રમાંક: ૨ અન્વયે નીચે મુજબ કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાની તા.૧૭/૦૬/૨૦૨૧ની સભાનાં ઠરાવ ક્રમાંક:૩ અન્વયે મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલે તેની તા.૨૫-૨૬/૦૬/૨૦૨૧ ની સભાના ઠરાવ ક્રમાંક: ૨૦ અન્વયે સ્વીકારી મંજૂર કરેલ છે. તેની જાણ સંબંધકર્તા શિક્ષકો અને વિદ્યાર્થીઓને કરવી, તદ્દુપરાંત તેનો અમલ કરવો.

**ઝૂઓલોજી વિષયની અભ્યાસસમિતિની તા.૨૨/૦૩/૨૦૨૧ની સભાનાં ભલામણ ક્રમાંક: ૨**

:: આથી સર્વાનુમતે ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૧-૨૨ થી અમલમાં આવનાર T.Y.B.Sc. Sem-5 & 6 નો પ્રાણીશાસ્ત્ર વિષયનો અભ્યાસક્રમ મંજૂર કરી તે મંજૂર કરવા વિજ્ઞાન વિદ્યાશાખાને ભલામણ કરવામાં આવે છે.

**વિજ્ઞાન વિદ્યાશાખાની તા.૧૭/૦૬/૨૦૨૧ની સભાનાં ઠરાવ ક્રમાંક:૩**

:: આથી ઠરાવવામાં આવે છે કે, ઝૂઓલોજી વિષયની અભ્યાસસમિતિ તા.૨૨/૩/૨૦૨૧ની સભાનાં ઠરાવ ક્રમાંક: ૨ અન્વયે મંજૂર કરેલ શૈક્ષણિક વર્ષ ૨૦૨૧-૨૨ થી અમલમાં આવનાર T.Y.B.Sc. Sem-5 & 6 નો પ્રાણીશાસ્ત્ર વિષયનો અભ્યાસક્રમ સ્વીકારી મંજૂર કરવામાં આવે છે. અને તે મંજૂર કરવા એકેડેમિક કાઉન્સિલને ભલામણ કરવામાં આવે છે.

**એકેડેમિક કાઉન્સિલની તા.૨૫-૨૬/૦૬/૨૦૨૧ ની સભાનાં ઠરાવ ક્રમાંક: ૨૦**

:: આથી ઠરાવવામાં આવે છે કે, પ્રાણીશાસ્ત્ર વિષયની અભ્યાસસમિતિએ તેની તા.૨૨/૦૩/૨૦૨૧ ની સભાના ઠરાવ ક્રમાંક : ૨ અન્વયે ભલામણ કરેલ અને વિજ્ઞાન વિદ્યાશાખાએ તેની તા. ૧૭/૦૬/૨૦૨૧ ની સભાનાં ઠરાવ ક્રમાંક : ૩ અન્વયે સ્વીકારેલ શૈક્ષણિક વર્ષ ૨૦૨૧-૨૨ થી અમલમાં આવનાર T.Y.B.Sc. Sem-5 & 6 નો પ્રાણીશાસ્ત્ર વિષયનો અભ્યાસક્રમ સ્વીકારી મંજૂર કરવામાં આવે છે.

બિડાણ: ઉપર મુજબ

ક્રમાંક : એકે./પરિપત્ર/૯૨૬૭/૨૧

તા.૦૧-૦૭-૨૦૨૧

ઈ.ચા. કુલસચિવ

પ્રતિ,

- ૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની પ્રાણીશાસ્ત્ર વિષય ચલાવતી સંલગ્ન કોલેજોના આચાર્યશ્રીઓ.
- ૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા
- ૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.

.....તરફ જાણ તેમજ અમલ સારૂ.

**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T.Y.B. Sc. Semester-V**

**Zoology Paper – Z - 501**

**(Non chordates Taxonomy, Animal type)**

**(Effective from June-2021)**

**Unit - 1:** Taxonomy of non-chordates phyla to be studied up to order. **(07 Hours)**

Structural organization of different classes of non-chordates.

(Protozoa to Annelida)

**Unit - 2:** Study of the following animal types with reference to the **(08 Hours)**

Structure and functions of various organs of all systems:

**Leech**

**Unit - 3:** Amplification of non-chordate phyla **(08 Hours)**

- Protozoa: Nutrition, Economic Importance
- Porifera: Skeletal system, Reproduction
- Cnidaria: Coral and coral reefs, Mesenteries
- Helminthes: Ascariasis
- Annelida: Asexual Reproduction in Polychaeta, Coelomoducts and nephridia

**Unit - 4:** Phyllogenetic relationships of the following minor phyla and

General organization:

**(07 Hours)**

- Ctenophora
  - Chaetognatha
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**T.Y.B. Sc. Semester-V**

**Zoology Practicals (Based on paper Z - 501)**

**(Effective from June-2021)**

**1 – Classification of following animals upto order.**

Volvox, Ceratium, Entamoeba, Polystomella, Plasmodium, Opalina, Balantidium, Leucosolenia, Pheronema, Euspongia, Obelia, Millipora, Physalia, Vaella, Rhizostoma, Tubipora, Alcyonium, Cerianthus, Pennatula, Virgularia, Adamsia, Zoanthus, Favia, Fungia, Astrea, Opisthorchis, Trichinella, Sabella, Serpula, Arenicola, Polynoe, Acanthobdella, Sagitta and Pleurobranchia

2 – Study of some aquatic invertebrates like Euglena, Paramecium, Vorticella, Hydra, Daphnia and Cyclops from the culture.

**3 – Study of permanent slides :**

- Sponge spicules and gemmules
- Life cycle of Ascaris

4- The following practicals of **Leech** to be studied/taught **only** with the help of charts, models, videos, photographs, permanent slides, working models, simulators etc.

- **Systems:** Digestive system, Nervous system and Reproductive system
  - **Mountings:** Jaws, Salivary glands, Ovaries and Testicular nephridia
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**T.Y.B. Sc. Semester-VI**

**Zoology Paper – Z - 601**

**(Non chordates Taxonomy, Animal type)**

**(Effective from June-2021)**

**Unit - 1:** Taxonomy of non-chordates phyla to be studied up to order. **(07 Hours)**

Structural organization of different classes of non-chordates.

(Arthropoda, Mollusca, Echinodermata, Hemichordata)

**Unit - 2:** Study of the following animal types with reference to the **(08 Hours)**

structure and functions of various organs of all systems : **Sepia**

**Unit - 3:** Amplification of non-chordate phyla. **(08 Hours)**

- Arthropoda: Respiration, Excretion, Crustacean larvae
- Mollusca: Torsion and detorsion in Gastropods, Economic Importance
- Echinodermata: Autotomy and regeneration, larval forms and evolutionary significance
- Hemichordata: Reproduction

**Unit - 4:** Phylogenetic relationships of the following minor phyla and General organization:

- Endoprocta **(07 hours)**
  - Ectoprocta
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**T.Y.B. Sc. Semester-VI**

**Zoology Practicals (Based on paper Z - 601)**

**(Effective from June-2021)**

**1 - Classification of following animals upto order.**

Apus, Daphnia, Cyclops, Cypris, Squilla, Hippa, Sacculina, Mantis, Dragon fly, Ear-wig, Mosquito, Ant, Bettle, Tick, Mite, Heliotis, Patella, Nautilus, Oyster, Mytilus, Doris, Cyprea, Teredo, Solen, Octopus, Loligo, Astropecten, Strongylocentrotus, Synapta, Sand-dollar, Holothuria, Pedicellina and Bugula avicularia

**2-** The following practicals of **Sepia** to be studied/taught **only** with the help of charts, models, videos, photographs, permanent slides, working models, simulators etc.

- **Systems:** Digestive system, Nervous system
- **Mountings:** Jaws, Radula, Chromatophores and Spermatophores

**3 - Study of permanent slides :**

Crustacean larvae, Echinoderm larvae and Hemichordata larva

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## **Reference books: Z-501 and Z-601**

- (1) Invertebrate Zoology- E. L. Jordan and P.S.Verma.
  - (2) A Text book of Invertebrate Zoology - S. N. Prasad.
  - (3) A Text book of Invertebrate Zoology - R. L. Kotpal.
  - (4) Invertebrates Zoology - R. W. Hegner.
  - (5) A manual of Zoology vol. I - E. Ayer.
  - (6) The Invertebrates (only) - Bora dale & Potts.
  - (7) Invertebrate Zoology - Arumugum.
  - (8) A Text book of Zoology - Arumugum & Narayanan.
  - (9) A Text book of Zoology Vol. I - Parker & Haswell.
  - (10) Invertebrate Structure & Function - E. J. W. Barrington.
  - (11) A Textbook of Practical Zoology Invertebrate -S.S.Lal
  - (12) A Textbook of Practical Zoology- Ghosh & Manna.
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**T.Y.B. Sc. Semester-V**

**Zoology Paper – Z - 502**

**(Chordates Taxonomy, Animal type and Comparative Anatomy)**

**(Effective from JUNE-2021)**

**Unit – 1:** Taxonomy of chordate to be studied up to order, including Protochordata, Cyclostomata, Pisces and Amphibia. **(07 Hours)**

**Unit – 2:** Study of the following animal types with reference to the Structure and functions of various organs of all systems: **Scoliodon** **(08 Hours)**

**Unit – 3: Amplifications** **(08 Hours)**

- Geological time scale
- Origin of chordates
- Pisces: Dipnoi, Types of scales and Parental care in fishes
- Amphibia: Origin and evolution, Neoteny and Apoda (Gymnophiona)

**Unit – 4: Comparative Anatomy** **(07 Hours)**

- Aortic arches
  - Vertebral column
  - Skull
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**T.Y.B. Sc. Semester-V**

**Zoology Practicals (Based on Paper- Z - 502)**

**(Effective from June-2021)**

1. Classification of following animals up to order.

Amphioxus, Ascidian, Doliolum, Lamprey, Myxine, Tiger shark, Raja (Skates), Anabas, Harpodon, Clarius, Syngnathus, Ichthyophis, Necturus, Ambystoma, Alytes and Pipa

2. The following practicals of **Scoliodon** to be taught/studied **only** with the help of

Charts/models/videos/photographs/permanent slides, working models, simulators etc.

- **Systems:** Digestive system, Urinogenital system, Arterial system, Venous system and Brain
- **Mounting:** Eye muscles, Membranous labyrinth and Ampulla of Lorenzini

3. Parental care in fishes

4. Types of scales

5. Comparative study of Vertebral column and Skulls (Scoliodon, Frog, Varanus, Pigeon and Rabbit)

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**T.Y.B. Sc. Semester-VI**

**Zoology Paper – Z - 602**

**(Chordates Taxonomy, Animal type and Histology)**

**(Effective from June-2021)**

**Unit – 1:** Taxonomy of chordate to be studied up to order, including Reptilia, Aves and Mammalia **(07 Hours)**

**Unit – 2:** Study of the following animal types with reference to the Structure and functions of various organs of all systems: **Pigeon** **(08 Hours)**

**Unit – 3: Amplifications** **(08 Hours)**

- Reptilia: Mesozoic reptiles, Rhyncocephalia and its phylogenetic importance, Temporal fossae and Arcades, Carapace and Plastron
- Aves: Bird migration, Flight adaptations in birds, Ratitae
- Mammals: Dentition, Prototheria, Metatheria, Cetacea and Primates

**UNIT – 4: Mammalian Histology:** **(07 Hours)**

- Pituitary
  - Thyroid
  - Parathyroid
  - Adrenal
  - Thymus
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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T.Y.B. Sc. Semester-VI**

**Zoology Practicals (Based on Paper- Z - 602)**

**(Effective from June-2021)**

1. Classification of following animals up to order:

Trionyx, Sphenodon, Varanus, Dhaman, Russel's viper, Sea snake, Great Indian Bustard, Horned owl, Kiwi, Flamingo, Ornithorhynchus, Koala, Erinaceas, Seal, Leopard and Rhesus monkey

2. The following practicals of **Pigeon** to be taught/studied **only** with the help of

Charts/models/videos/photographs/permanent slides, working models, simulators etc.

- **Systems:** Digestive system, Urinogenital system, Circulatory system and Brain
- **Mountings:** Pecten and Hyoid apparatus

3. Study of Mesozoic reptiles (by Models/charts/photographs etc.) like Brontosaurus, Stegosaurus, Ichthyosaurus, Dimetrodon, Allosaurus and Rhamphorhynchus

4. Types of feathers

5. Dentition in Dog, Cat, Horse, Rabbit, Rat and Man

6. Mammalian histology: Pituitary, Thyroid, Thymus, Parathyroid, Adrenal

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## Reference books: Z-502 and Z-602

- (1) Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.
- (2) Pough H. *Vertebrate life*, VIII Edition, Pearson International.
- (3) Hall B.K. and Hallgrímsson B. (2008). *Strickberger's Evolution*. IV Edition. Jones and Bartlett Publishers Inc.
- (4) Outline of comparative anatomy of vertebrate Kingsley J.S. Central book depot. Allahabad
- (5) Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution*. IV Edition. McGraw-Hill Higher Education.
- (6) Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*. IX Edition. The McGraw-Hill Companies.
- (7) Hilderbrand, M and Gaslow G.E. *Analysis of Vertebrate Structure*, John Wiley and Sons.
- (8) Walter, H.E. and Sayles, L.P; *Biology of Vertebrates*, Khosla Publishing House.
- (9) JUNQEIRA'S Basic Histology Text & Atlas by Anthony L. Mescher
- (10) Histology: Arthiur W. Ham, M. B.
- (11) Vertebrate Zoology: An Experimental Field Approach-Nelson G. Hairston. Cambridge University Press, 1994
- (12) Chordate Zoology E.L Jordan & P. S. Verma. S.Chand
- (13) Vertebrate Zoology: An Experimental Field Approach-Nelson G. Hairston. Cambridge University Press, 1994
- (14) Text Book of Zoology - Dalela and Verma. JayPrash Nath & co. Meerut
- (15) Text Book of Zoology - S.N. Prasad. Vikas Publishing House pvt.ltd. Delhi
- (16) Chordate Zoology - Agrawal and Dalela. JayPrash Nath & co. Meerut
- (17) Text book of Zoology - R. D. Vidyarthi. S.Chand
- (18) Jiv Vignan-2 (Gujarati) - Nirav Prakashan.
- (19) A Text Book of General Biology - Tomer & Singh. Rastogi Publication, Meerut
- (20) Text Book of Chordates - A. Thangamani, S. Prasanna Kumar
- (21) Prushthvanshi Praniyo ane Garbhvidya - A.B.Vyas. Guj.Granth nirman Board.
- (22) Utkrushtha Aprushthvanshi Praniyo - U.M.Rawal. Guj.Granth nirman Board.
- (23) Chordate Zoology - Majupuria.
- (24) A Manual of Zoology Vol. I & II - Ekambernath Ayar. S. Vishwanathan Chennai.

- (25) Histology by Majumadar
  - (26) Histology by Shivaji Deshmukh
  - (27) Text book of Human histology with colour atlas and practical guide by Inderbir Singh.
  - (28) Prani Autikee . Gujarat granth nirman board
  - (29) Practical zoology Vertebrate By S. S. Lal., Rastogi publications Meerut.
  - (30) A manual zoology Practical zoology Chordates By Dr. P. S. Verma., S. Chand publications
  - (31) Practical Vertebrate zoology By Agrawal & Jindal., Pragati Prakashan
  - (32) Manual of prac. zoology vol.- I,II,III - P.K.G.Nair, Himalaya Publishing House.
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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T. Y. B. Sc. Semester-V**

**Zoology Paper – Z - 503**

**(Enzymology and Biochemistry)**

**(Effective from June-2021)**

**Unit - 1: Enzymology**

**(08 Hours)**

- Definition and chemical nature
- Properties
- Holoenzyme
- Nomenclature and classification
- Enzyme activation: Activation energy
- Mechanism of enzyme action
- Factors affecting on enzyme action
- Enzyme inhibition
- Enzyme kinetics
- Derivation of Michaelis-Menten equation
- Lineweaver-Burk plot
- Enzyme regulation

**Unit - 2: Biophysical Chemistry**

**(07 Hours)**

- pH
- Buffer
- Reaction kinetics
- Thermodynamics
- Solution and Colligative properties

**Unit - 3: Nucleic acid and Vitamins**

**(07 Hours)**

- **Nucleic acid** : Composition, types, Structure and function of DNA, Composition, types, Structure and function of RNA
- **Vitamins** : Composition, Structure and Formation

## **Unit - 4: Metabolism:**

**(08 Hours)**

**(With structures)**

- Glycolysis
  - TCA and oxidative phosphorylation (ETS or Biological oxidation)
  - Gluconeogenesis
  - Glycogenesis
  - Glycogenolysis
  - Deamination
  - Transamination
  - Ornithine cycle
  - $\beta$ -oxidation and synthesis of long chain fatty acids
  - Glycerol metabolism
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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T.Y.B. Sc. Semester-V**

**Zoology Practicals (Based on Paper- Z - 503)**

**(Enzymology and Biochemistry)**

**(Effective from June-2021)**

- (1) Activation of salivary amylase under optimum condition
- (2) Factors affecting enzymes activity (temperature and pH)
- (3) To study the digestive enzymes from Human Saliva
- (4) Preparation of pH, buffer or different solution as per theory
- (5) Study of vitamins structure through model or chart
- (6) Structure of DNA with the help of model / chart
- (7) Structure of RNA with the help of model / chart
- (8) Preparation of A\_\_\_, T\_\_\_, G\_\_\_, C\_\_\_ by models
- (9) Preparation of water soluble vitamins and fat soluble vitamins

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**Reference books: Z-503**

- (1) J.L. Jain – Biochemistry
  - (2) Lehninger - Biochemistry
  - (3) Stryer-Biochemistry
  - (4) Granner and Rodwell - Harper's Illustrated Biochemistry
  - (5) J H Wet - General Biochemistry
  - (6) Rangnatha Rao K-Text Book of Biochemistry
  - (7) C. B. Powar - Biochemistry
  - (8) Das.-Biochemistry
  - (9) Fundamentals of Biochemistry - Dr. A. C. Deb
  - (10) Fundamentals of Biochemistry - David T. Plummer
  - (11) Biochemistry - N. Arumugum
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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T.Y.B. Sc. Semester-VI**

**Zoology Paper – Z - 603**

**(Animal Physiology and Endocrinology)**

**(Effective from June-2021)**

**Unit - 1: Respiration**

**(08 Hours)**

- Aquatic & terrestrial respiratory mechanism
- Hypoxia
- O<sub>2</sub> dissociation Curve
- Respiratory quotients
- BMR
- Transport of gases
- Exchange of gases
- Respiratory pigments
- Neural and chemical regulation of respiration.

**Unit - 2: Circulation**

**(08 Hours)**

- Structure of mammalian heart
- Properties of cardiac muscles
- Internal circulation (systemic, pulmonary and coronary) Cardiac-cycle and cardiac output Stroke volume
- Blood pressure
- ECG
- Blood coagulation
- Hormonal, Ionic and Nervous regulation of heart beat.

**Unit - 3: Mammalian Endocrinology**

**(07 Hours)**

Hormones:

- Pineal Gland
- Hypothalamus
- Pituitary Gland

- Thyroid Gland
- Parathyroid Gland
- Thymus
- Pancreas
- Adrenal Gland
- Ovary and Testes

**Unit - 4: Chemical coordination of Hormone**

**(07 Hours)**

- Chemical nature of hormones
  - Mechanism of hormonal action
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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T.Y.B. Sc. Semester-VI**

**Zoology Practicals (Based on Paper- Z - 603)**

**(Animal Physiology and Endocrinology)**

**(Effective from June-2021)**

1. Study of analytical instrument principle and applications.
    - pH meter
    - Sphygmomanometer
    - Stethoscope
    - Thoma pipette of haemocytometer
  2. Study of total RBC count in human blood
  3. Study of WBC differential count
  4. Measurement of systolic blood pressure, diastolic pressure, pulse pressure, mean pressure of an individual with the help of sphygmomanometer and stethoscope
  5. Study of Electrocardiogram (ECG)
  6. Study of hormonal control and regulation of glands:
    - Pituitary Gland
    - Thyroid Gland
    - Parathyroid Gland
    - Pancreas
    - Adrenal Gland
    - Ovary and Testes
-

## Reference books: Z-603

- |   |                  |
|---|------------------|
| (1) General and Comparative Endocrinology | - Barrington,    |
| (2) Textbook of Endocrinology             | - R.H. Williams  |
| (3) A Text book of Biochemistry           | - A. K. Berry.   |
| (4) Text book of medical Physiology       | - Guyton.        |
| (5) A Text of Animal Physiology           | - Nagabhusanam.  |
| (6) A Text of Animal Physiology           | - A. K. Berry.   |
| (7) Comparative animal Physiology         | - Proser& Brown. |
| (8) Animal Physiology                     | -M. P. Arora     |
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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T. Y. B. Sc. Semester–V**

**Zoology Paper – Z – 504**

**(Embryology and Wild life Biology)**

**Unit – 1: Introduction to Embryology and Gametogenesis (07 Hours)**

- Introduction
- The Programme of Development
- Scope and Branches of embryology
- Spermatogenesis: Formation of spermatids, Spermiogenesis, Factors controlling spermatogenesis, Structure of a typical sperm and Significance of spermatogenesis
- Oogenesis: Formation of egg (ovum) - Multiplication phase, growth phase (Previtellogenesis and Vitellogenesis) and Maturation phase

**Unit – 2: Fertilization and Sexual cycles (07 Hours)**

- Fertilization : External and internal fertilization - mechanism of Fertilization - capacitation and contact – acrosomal reaction and penetration – activation of ovum migration of pronuclei and amphimixis - theories of fertilization - significance of fertilization
- Estrous and Menstruous cycles, Pregnancy, Parturition, Placenta and placentation

**Unit – 3: Chick Embryology (07 Hours)**

- Sperm, Egg, Fertilization, cleavage, blastulation, gastrulation, formation of germ layers and primitive streak
- Development of chick embryo of 8, 16, 21, 24, 33, 48 and 72 hours

**Unit – 4: Wild life Biology (07 Hours)**

- Introduction to wild life Endangered, vulnerable, threatened species National parks and Sanctuaries
  - Causes of depletion, conservation and management
  - Wild life in Gujarat
  - Wild life trades and its legal provisions
  - CITES (Convention on International Trade in Endangered Species)
  - Conservation projects: Wild ass, Tiger, Crocodile and Black buck
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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T. Y. B. Sc. Semester–V**

**Zoology Practicals (Based on paper Z - 504)**

**(Embryology and Wild life Biology)**

1. Different types of mammalian placenta
  2. **Chick embryology**: Unfertilized egg, different stages cleavage, morula, blastula, gastrula, development of Structure of 8, 16, 21, 24, 33,48 and 72 hrs
  3. **Study of projects** – Wild ass, Tiger, Crocodile and Black buck-their locations in map of India, present status and significance
  4. Wild life Illegal trades, practices and its control measures of following
    - Tiger (Claws, Bones, Skins and Whiskers)
    - Rhino (Horns)
    - Elephant (Tusks)
    - Musk Deer (musk)
    - Turtle (Shells)
  5. The students are supposed to attend all the Industrial Workshops/Laboratory Workshops/ Training Programme/Symposia/Seminar/Field visit/Educational Excursion organized by the department/college. The students shall attend these programmes at their own cost.
-

## Reference books: Z-504

- (1) Austin, C.R. and Short, R.V. reproduction in Mammals. Cambridge University Press.
  - (2) Degroot, L.J. and Jameson, J.L. (eds). Endocrinology. W.B. Saunders and Company.
  - (3) Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.
  - (4) Hatcher, R.A. et al. The Essentials of Contraceptive Technology. Population Information Programme.
  - (5) Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
  - (6) Carlson, Bruce M (1996). Patten's Foundations of Embryology, McGraw Hill, Inc.
  - (7) Chordate Embryology - P S Verma S.Chand Delhi.
  - (8) Embryology - N. Arumugam , Saras Publication, KanyaKumari
  - (9) Embryology A. K. Berry
  - (10) A Textbook of Embryology By G. S. Sandhu, Sharad Srivastava and C. K. Arora
  - (11) Wild life Protection Act(1972) - Publish by Wildlife Trust of India
  - (12) Remote Sensing – Schowengerdt
  - (13) The Wild Life of India By E. P. Gee An imprint of Harper Collins publishers india
  - (14) Call of the wild by B. Seshadri
  - (15) The wild animals of India by B. N. H. S.
  - (16) Vanya jeev vigyan by Gujarat Granth nirman board, Gujarat
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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T.Y. B. Sc. Semester-VI**

**Zoology Paper – Z - 604**

**(Entomology)**

**(Effective from June-2021)**

**Unit – 1: Introduction to Entomology (08 Hours)**

- History, Development, Scope and Applications of Entomology
- Branches of Entomology
- General characteristics of class Insecta

**Unit – 2: Agricultural Entomology (08 Hours)**

- ❖ Pests of field crops and their management:
  - **Sugarcane** – Stem borer, Leaf aphids and Shoot borer
  - **Cotton** – Spotted ball worm, Leaf roller, Red cotton bug and Jassids
- ❖ Pests of Horticultural crops and their management:
  - **Vegetables:** Brinjal (Shoot and Fruit borer, Leaf eating beetles, Jassids, Leaf roller), Cabbage (moth and maggot fly)
  - Insect pests of stored grains and their management (Rice weevil, Saw Toothed Grain beetle, Khapra beetle, Rice moth and lesser grain borer)

**Unit – 3: Medical Entomology (07 Hours)**

- Morphology, Vectorship, Pathogenicity and Control of:  
Mosquito, Housefly, Rat fleas and Head louse
- Morphology, Vectorship, Pathogenicity and Control of:  
Pests of domestic animals - Dogs, Cats and Cattles

**Unit – 4: Economic Entomology (07 Hours)**

- **Beneficial Insects** (Economic importance of Honey bee, Silkworm, Lac insect, Pollinators, Scavengers, Insect as a source of drugs and dyes)
- **Household pests:** Morphology, Damage caused and Control measure of: Cockroach, Ants and Termites and Bed bugs

- **Insect pest control methods:** Bio control, Integrated pest management, Insecticides and Pesticides
  - Appliances used for pest management (Hydraulic Sprayers: Hand, Knapsack and Foot., Pneumatic Sprayers: Hand and Knapsack)
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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T.Y. B.Sc. Semester-VI**

**Zoology Practicals (Based on paper Z - 604)**

**(Entomology)**

**(Effective from June-2021)**

**To study the following practicals with the help of charts/models/photographs/specimens/slides etc.**

- 1. Branches of Entomology, Its scope, Applications, Development**
  - 2. Identification, Pathogenicity and Control of pests**
    - Cereals - Khapra beetle (*Trogoderma granarium*), Locust
    - Cotton - Spotted ball worm
    - Sugarcane (*Saccharum officinarum*) – Stem (node-internode) borer
    - Vegetables - *Hellula undalis*
  - 3. Morphology, Vectorship, pathogenicity and control of – Anopheles (male – female), Culex (male-female) and Aedes (male-female)**
  - 4. Pests of domestic animals: Dogs- Dog flea (*Ctenocephalidies canis*), *Trichodectes canis*, Cats- Cat flea (*Ctenocephalidies felis*), Cattles – Cattle tick (*Boophilus microplus*), *Haemaphysalis cuspidate*, *H.minuta***
  - 5. Economic importance of arthropods /insects – Silk worm, Lac insects, Honey bees and Butterflies as **Pollinators**; Lady bug and Dermestid beetle as **Scavengers**; Cochinal insects and Kermes insects(of oak tree) as **Dyes**; Honey bees, Blow fly maggots, Centipedes and Cantharis fly (*Canth vesictoria*) as **Drugs /Medicines**; Ants, Termites, Dermestid beetles and Bed bugs as **Harmful insects****
  - 6. Pests management appliances- Insect repellents, Hydraulic Sprayers: Hand, Knapsack and Foot; Pneumatic Sprayers: Hand and Knapsack), Traps (electric and chemical). Biological pests controller- Spiders, Lizards, Frogs, Green bee-eater, Lady bug beetle and Bats**
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## **Reference books: Z-604**

- (1) General and Applied Entomology- Nayer, K.K. , T. Anant Krishnan and B.W. David
  - (2) Metcalf, G.L. and W.P. Fling : Destructive and Useful Insects
  - (3) Hemsingh Pruthi : A Text Book of Agricultural Entomology
  - (4) Wigglesworth : Principles of Insect Physiology
  - (5) ESSIG : College Entomology
  - (6) M.S. Mani : A Text Book of General Entomology
  - (7) Fradt, R.E. : Fundamentals of Applied Entomology
  - (8) Smith, K.G. V. : Insects and Other Arthropods of Medical Importance
  - (9) Ray, D.N. and A.W.A. Brown: Entomology Medical & Veterinary
  - (10) Shrivastava, K.P. : A Text Book of Applied Entomology (Vol.I-H)
  - (11) Ross, H.A. : Text Book of Entomology
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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T.Y. B. Sc. Semester-V**

**Zoology Paper – Z - 505**

**(Forensic science and Toxicology)**

**(Effective from June-2021)**

- Unit – 1:** Definition, Scope, History and Development of Forensic science,  
Basic principles, Forensic science in international perspectives  
including RFSL, CFSL and INTERPOL, Dactylography, Foot prints,  
Tattoo marks, Occupational marks, Speech and Voice **(07Hours)**
- Unit – 2:** Morphology and Structure of hair: Human and other animals  
(Dog, Cat, Cow, Buffalo, Horse, Goat), DNA Fingerprinting,  
Wildlife and forensic science **(08 Hours)**
- Unit – 3:** Concept and Scope of Toxicology: Introduction, History,  
Disciplines of toxicology, Toxicants and their classification, Toxicity **(07 Hours)**
- Unit – 4:** Food-Additives: General account, Incidental (indirect) additives,  
Intentional (direct) additives, Terms related to adverse reactions to food,  
Food-borne molds and Mycotoxins (food contaminants),  
Testing of food additives **(08 Hours)**
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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T.Y. B. Sc. Semester-V**

**Zoology Practicals (Based on paper – Z - 505)**

**(Forensic science and Toxicology)**

**(Effective from June-2021)**

To study the following practical with the help of charts/models/photographs/specimens/slides/simple methods without using live animals.

1. Study of different types of Finger prints and Tattoo marks
  2. Study the morphology of different hairs- Man, Dog, Cat, Cow, Buffalo, Horse, Goat
  3. Study of various samples of food additives/preservatives and their usages  
(Vinegar, Benzoic acid, Formic acid, Citric acid and Gelatin)
  4. Study of food contaminants on - Bread, Chapati, Curd and Fruits
  5. Tests (only two tests to be performed) of adulterated milk, black pepper, khoya (maava of milk), edible oil, coconut oil, ghee, rabdi
  6. To study DNA finger printing method
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## Reference books: Z-505

- (1) Fundamentals of Toxicology-K.Pandey,J.P.Shukla and S.P.Trivedi.
  - (2) Environmental Biology and Toxicology-P.D.Sharma.
  - (3) Aquatic Pollution and Toxicology-R.K. Trivedi.
  - (4) Toxicology-P.D. Sharma.
  - (5) Introduction to General Toxicology-E.J.Ariens, A.M.Simonis and  
J.Offermerier.
  - (6) Modern Toxicology, vol.I,II,III - P.K.Gupta and D.K.Salunkhe.
  - (7) Basic Toxicology- C.Lu Frank
  - (8) Toxicology, A Basic Science of Poisons,2<sup>nd</sup> edition- L.J.Casarett and J.Doull
  - (9)Text book of forensic science and toxicology- Narayan Reddy
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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T.Y. B. Sc. Semester-VI**

**Zoology Paper – Z - 605**

**(Cell Biology and Bioinstrumentation)**

**(Effective from June-2021)**

**Unit – 1: Microscopy (08 Hours)**

- Introduction
- Magnification, Resolution
- Light microscope (Simple and Compounding Microscope)
- Electron microscope
- Phase Contrast microscope

**Unit – 2: Cytological Techniques (08 Hours)**

- Examination of living cells (Teasing, Smear preparation, Squash preparation, Whole mount and Microtomy)
- Fixation
- Cytological staining

**Unit – 3: Biochemical techniques (07 Hours)**

- Paper chromatography
- Centrifugation
- Electrophoresis
- PCR
- Spectrophotometry

**Unit – 4: Cell cycle and Cellular transportation (07 Hours)**

- Cell Cycle
  - Interphase
  - Mitosis
  - Meiosis
  - Cell membrane structure and function: Structure of cell membrane, Lipid bilayer and membrane protein diffusion, Osmosis, Ion channels, Active transport, Ion pumps, Mechanism of sorting and regulation of intracellular transport
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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T.Y. B. Sc. Semester-VI**

**Zoology Practicals (Based on paper Z - 605)**

**(Cell Biology and Bio instrumentation)**

**(Effective from June-2021)**

1. Types of microscope
  2. Micro technique preparation of permanent slides of different organs
  3. To perform paper chromatography for separation of amino acids
  4. Permanent slides of mitosis and meiosis
  5. To prepare different stages of mitosis from onion root tip
  6. To study electrophoresis, Centrifuge machine, PCR and Spectrophotometry through charts/models
-

## Reference books: Z-605

- (1) Basic Separation Techniques in Biochemistry, 1998, Okotore R. O., New Age International, New Delhi.
  - (2) Cytological techniques: The Principles Underlying Routine Methods, 1963, Baker J.R, Methuen & Co, London
  - (3) Davenport H. A. : Histological and Histochemical techniques.
  - (4) Handbook of basic Microtechnique, 1958, 2nd Edn., Gray P., McGraw-Hill, USA
  - (5) The microscope and how to use it, 1970, George Stehli, Dover Publications Inc., New York.
  - (6) Histopathological technique and Practical Histochemistry, 1976, 4th Edn, Lillie R.D McGraw-Hill, USA
  - (7) Notes on Microscopical Techniques for Zoologist, 1964, Pantin C. F.A.: Cambridge University Press
  - (8) Elementary Microtechnique, 1973, 4th Edn., Peacock H.A., Edward Arnold Publ. Ltd., UK
  - (9) Histochemistry, 1968, Pearse A.G.E., Vol. I & II., W.B. Saunders Company (WBS) of Philadelphia
  - (10) Microscope and microscopic life, 1979, 2nd Edn., Peter Healey, Hamlyn, UK
  - (11) Biological Instrumentation and methodology, 2008, 2nd Revised Edition, P.K. Bajpai, S. Chand and Co. Ltd., New Delhi
  - (12) Cell and molecular biology By P. K. Gupta., Rastogipublication, Meerut, New Delhi
  - (13) Cell biology A laboratory handbook Volume 2., Edited by Julio E. Celis
  - (14) Fundamentals of Biochemistry By Dr. A. C. Deb.
  - (15) Biochemistry By. Geoffrey L. Zubay
  - (16) Text book of Biochemistry By A. K. Berry
  - (17) Cell biology Genetics Molecular Biology Evolution and Ecology By P. S. Verma and V. K. Agrawal., S. Chand publication Meerut.
  - (18) Handbook of Experimental Physiology and Biochemistry By Dr. P. V. Chadha., Jaypee publication
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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T. Y. B. Sc. Semester-V**

**Zoology Paper – Z - 506**

**(Genetics and Molecular Biology)**

**(Effective from June-2021)**

**Unit – 1: Gene Structure and Functions (08 Hours)**

Gene concept, Location of and size of genes, Role of genes,  
Chemical composition and numbers of genes, Ultra structure of genes,  
Jumping genes, Split genes and Sex chromatin

**Unit – 2: Central Dogma and Biotechnology (08 Hours)**

Genetic code, DNA replication, Transcription and Protein synthesis,  
DNA Repair, Recombinant DNA technology

**Unit – 3: Human Cytogenetics and Mutation (07 Hours)**

Karyotyping, Chromosomal banding techniques – G, Q, C and R banding,  
Chromosomal aberrations and syndromes, Gene mutations

**Unit – 4: Oncology (07 Hours)**

Cancer: Overview of Tumour growth and development, Metastasis

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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T. Y. B. Sc. Semester–V**

**Zoology Practicals (Based on paper Z - 506)**

**(Genetics and Molecular Biology)**

**(Effective from June-2021)**

1. To study Barr body (dosage compensation) from cheek epithelial cells
2. Preparation of DNA, RNA by models
3. To study DNA replication using photographs or charts
4. Normal human karyotype and syndromes (Down syndrome, Patau, Edward, Cri du chat, Jacob's, Klinefelter, Turner, Super female, Philadelphia)
5. To study types of cancer – Blood cancer, Skin cancer with charts/photos
6. Study of Transgenic animal (Dolly sheep)

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**Reference books: Z-506**

- (1) Principles of Genetics- F.J. Gardner.
  - (2) Molecular cell biology- H.S. Bhamra and KavitaJuneja,
  - (3) Fundamental molecular biology- Lizabethallison.
  - (4) Thomas A. P (Editor), (2012). *Genetics and Biotechnology- The Fundamentals*. Green Leaf Publications, TIES, Kottayam.
  - (5) Vijayakumaran Nair K. (2012). *Genetics and Biotechnology*. Academica, Trivandrum.
  - (6) Robert A. – Biology of Cancer Weinberg. 2nd edition
  - (7) Weinberg R A. 2014. Biology of Cancer. 2nd edition. Garland Science, Taylor & Francis
-

**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T.Y.B. Sc. Semester-VI**

**Zoology Paper – Z - 606**

**(Ecology, Ethology and Evolution)**

**(Effective from June-2021)**

**Unit – 1: (A) Animal Inter relationship: (08 Hours)**

- Species interactions
- Types of interactions

**(B) Biogeography:**

- Zoogeography
- Zoogeographical Regions of world
- Diverse fauna of India

**Unit – 2: Social behaviour: (07 Hours)**

- Costs and Benefits of group living
- Evolutionary Advantages and disadvantages of group living
- Characteristics of Social Insect

**Unit – 3: Bioluminescence, Biological Clock and Insect Pheromones (08 Hours)**

**Unit – 4: Direct Evidences of Evolution: (07 Hours)**

❖ Fossils:

- Introduction
  - Branches of Palaeontology
  - Fossils formation
  - Conditions of Fossilisation
  - Determination of age of Fossils
  - Nature of Fossils
  - Types of Fossils
  - Significance of Fossils
  - Conclusions drawn From Fossil record
  - Imperfection of Fossil record
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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T.Y.B. Sc. Semester-VI**

**Zoology Practicals (Based on paper Z - 606)**

**(Ecology, Ethology and Evolution)**

**(Effective from June-2021)**

1. Estimation of Alkalinity and Hardness
2. Estimation of free CO<sub>2</sub> and dissolved O<sub>2</sub>
3. Study of Habituation of mosquito larva
4. Study of Antennal grooming behavior (Chemotaxis)
5. Study of alarming, attractant, aggression behavior
6. Types of Fossils by photo graphs/charts

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**Reference books: Z-606**

- (1) Ecology and Environment- P.D.Sharma
  - (2) Modern concepts of Ecology- H.D.Kumar
  - (3) Fundamentals of Ecology- E.P.Odum
  - (4) Animal Ecology- S.P.Singh
  - (5) Cytology, Genetics and Evolution-P.K.Gupta.
  - (6) Cell Biology, Genetics and Evolution-N.Arumugam.
  - (7) Cell biology, Genetics, Molecular Biology, Evolution and Ecology. – P.S. Verma, and V.K.Agarwal
  - (8) Animal Behaviour-M.P.Arora
  - (9) Animal Behaviour-E.G.Boulenger
  - (10) Animal Behaviour-Vinod Kumar
  - (11) A Textbook of Animal Behaviour-H.S.Gundevia &H.G.Singh
  - (12) Insect Behaviour-M.Prakash.
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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T. Y. B. Sc. Semester-V**

**Zoology - Fisheries – E.G.**

**(Effective from June-2021)**

<b>Unit- 1:</b> Natural and cultivated ponds-construction, layout, Management and productivity	<b>(05 Hours)</b>
<b>Unit- 2:</b> Induced breeding methods in major carp	<b>(05 Hours)</b>
<b>Unit- 3:</b> Fish seed collection and transportation	<b>(05 Hours)</b>
<b>Unit- 4:</b> Study of aquarium fishes and its management	<b>(05 Hours)</b>
<b>Unit- 5:</b> Crafts and Gears used in fresh and marine water fisheries	<b>(05 Hours)</b>
<b>Unit- 6:</b> Larvivorous Fishes	<b>(05 Hours)</b>

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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T. Y. B. Sc. Semester-VI**

**Zoology – Fisheries – E.G.**

**(Effective from June-2021)**

<b>Unit -1:</b> Fish migration	<b>(05 Hours)</b>
<b>Unit- 2:</b> Schooling of fish	<b>(05 Hours)</b>
<b>Unit- 3:</b> Electric organs in fishes	<b>(05 Hours)</b>
<b>Unit- 4:</b> Preservation, processing and by-products of fishes	<b>(05 Hours)</b>
<b>Unit -5:</b> Fish pathology: bacterial, fungal, ectoparasitic and protozoan diseases of fishes	<b>(05 Hours)</b>
<b>Unit- 6:</b> Global warming and its effects on Fisheries	<b>(05 Hours)</b>

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## **Reference books: Fisheries – E. G. (Semester – 5 and 6)**

- (1) An Introduction to fishes-S.S.Khanna.
  - (2) Fish and Fisheries of India-V.G.Jhingran.
  - (3) Fish and Fisheries –A.R.Shukla
  - (4) Fish and Fisheries-B.N.Yadav.
  - (5) Ichthyology-Lagler,Bardach,Passino & Miller
  - (6) Fundamentals of Ichthyology-Gupta, Guhalwat, Yadav, Jain
  - (7) Fundamentals of Ichthyology-S.P.Biswas
  - (8) General and Applied Ichthyology-S.K.Gupta,P.C.Gupta.
  - (9) An Introduction to fishes-G.S.Sandhu.
  - (10) Fish Biology-C.B.L.Srivastava
  - (11) A Textbook of Fish Biology and Fisheries- S.S.Khanna and H.R.Singh
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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T. Y. B. Sc. Semester-V**

**Zoology- Food Hygiene and Sanitation – E.G.**

**(Effective from June-2021)**

**UNIT – 1: (08 Hours)**

- Definition of Public Health and Hygiene
- Social and preventive medicine
- Basic aspects of personal hygiene
- Epidemiology methods
- Introduction to Analytical
- Experimental and Descriptive methods
- Diseases transmission

**UNIT – 2: (08 Hours)**

- Food Borne Disorders:
  - Food borne infections-
  - Typhoid
  - Para typhoid,
  - Cholera
  - Infective hepatitis
  - Amoebiasis
- Food borne intoxications:
  - Disorders caused by-
  - Natural toxins
  - Chemical toxins
  - Microbiological toxins in food- Staphylococcal intoxication
  - Botulism
  - Clostridium
  - Perfringens
  - Mycotoxins.

**UNIT – 3: (08 Hours)**

- Food handling and Public Health:
  - Preventing food borne illness and the spread of communicable disease
  - Sanitation of food serving institution
  - Environmental sanitation
  - hygiene in food handling and personal hygiene of food handler
  - Water- sources, Impurities- Principles of water purification- commercial and domestic

**UNIT – 4:****(06 Hours)**

- Food adulteration:
    - Common, adulterants, and health hazards
  
  - Food standards and food laws - National and International;
    - PFA, FPO, FAO, MMPO, Agmark, Codex, FSSAI, HACCP, ISO Certification;
    - Consumer guidance society
    - Consumer rights
    - Consumer court
    - Central facilities for assessing food adulteration
    - Role of food inspectors
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**Reference Books: Food Hygiene and Sanitation – E.G.  
(Semester – V)**

- (1) Food hygiene & sanitation- Roday.S ,tataMcGraw hill publishing company ltd.
  - (2) Food science- B.Srilakshmi.
  - (3) MohiniSethi, catering management, New age international publishers.
  - (4) Sri Lakshmi.B – Food science, New Age International Publishers.
  - (5) Park K (2011). Park’s Textbook of Preventive and Social Medicine,  
21<sup>st</sup> EditionM/sBanarasidasBhanot Publishers, Jabalpur, India.
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**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**T. Y. B. Sc. Semester-VI**

**Zoology- Public Health – E.G.**

**(Effective from June-2021)**

**UNIT – 1: (08 Hours)**

- Health and Nutrition:
  - Education-definition
  - Components
  - Principles of health education
  
- Methodology:
  - Individual
  - Group and mass methods use of audio visual aids

**UNIT – 2: (08 Hours)**

- Medical entomology
  - Control of household pest with special reference to Mosquito and Housefly
  - Environmental, chemical, biological and generic control

**UNIT – 3: (07 Hours)**

- Immunity:
  - Classification, specific and non-specific immunity
  - Immunoglobulins
  - Cellular and hormonal, immune response
  - Immunization active and passive immunization schedule
  - Immunizing agents
  - Hazards of immunization

**UNIT – 4: (07 Hours)**

- Primary health care system with special reference to Maternal and Child Health care
  - Primary health system functioning in rural areas, health indicators mortality (Infant and Maternal), morbidity, disability and various health organizations
  - Malaria and AIDS Control-NHP, WHO, UNICEF
-

## **Reference Books: Public Health – E.G. (Sem – VI)**

- (1) Wadhwa A and Sharma S (2003). Nutrition in the Community-A Textbook. Elite Publishing House Pvt. Ltd. New Delhi.
  - (2) Park K (2011). Park's Textbook of Preventive and Social Medicine, 21st Edition. M/s Banarasidas Bhanot Publishers, Jabalpur, India.
  - (3) Mahtab S. Banji, Kamala Krishnaswamy and G.N. V. Brahmam, Human Nutrition 4<sup>th</sup> edition. Oxford and IBH Publishing Co., P. Ltd. New Delhi.
  - (4) McLaren D.S .Nutrition in the Community, John Wiley and Sons.
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