# YEAR II
## SEMESTER - IV

# APPLIED MATHEMATICS
# BEG 204 HS

| | | **Semester IV** | | | | | | | **Year II** | |
|---|---|---|---|---|---|---|---|---|---|---|

| Teaching Schedule Hours/Week | | | Examination Schedule | | | | | | Total Marks | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Final | | | | Internal Assessment | | | |
| | | | Theory | | Practical | | Theory Marks | Practical Marks | | |
| L | T | P | Duration | Marks | Duration | Marks | | | | |
| 3 | 1 | - | 3 | 80 | | | 20 | | 100 | |

**COURSE OBJECTIVES:** The aim of this course is to expose students to theory of complex variables, Fourier and Z-transforms applied to signal processing. The course also imparts the fundamental knowledge on Wave and Diffusion equations with coordinate systems.

| S.N. | Chapter | Lecturer Hours | No. of questions | Marks |
|---|---|---|---|---|
| 1 | **Complex variables:** Function of complex variables, Properties of complex variables, Geometrical interpretation of complex number, Geometrical interpretation of $Z_1+Z_2$, Geometrical interpretation of $Z_1-Z_2$, Geometrical interpretation of $Z_1Z_2$, Geometrical interpretation of $Z_1/Z_2$, Triangle inequality, Powers and roots of complex numbers, Complex analytics functions, Functions and sets in the complex plane, Limits, Continuity and Derivatives, Theorem on limits, Limits involving point at infinity, Continuity, Uniform continuity, Derivatives and related theorem, Analytic functions, The necessary conditions for the analytic functions, Sufficient condition for the analytic functions ( CR Equation), Polar form of CR equations, exponential and circular functions of complex variables, Hyperbolic functions of complex variables, Relation between complex trigonometric and hyperbolic functions, Harmonics functions and related theorem, Orthogonal system, Methods of constructing and analytic functions, Simple method, Mini Thomson's methods, Another methods by using CR equation. Conformal mapping, Some standers transformations, Conformal mapping and special liner transformations, Liner fractional transformation, Fixed points of liner transformation, Constructing conformal mapping | 6 | 1 | 14 |

| | | | | |
|---|---|---|---|---|
| | between given domain, Complex integral, Cauchy Integral, Simple connected region, Multiple curve, Extension of Cauchy Integral Theorem, Cauchy Integral formula, Converse of Cauchy Integral Theorem, Cauchy Inequality, Liouville's Inequality, State and prove Taylor's Theorem, Taylor's series of some special theorem, State and Prove Laurent's Theorem, Definition and uses of Singularities, , Definition and uses of Zeroes and Poles, Zeros of analytic function, Complex integration, Residues of Complex functions, Residues of a simple pole, Cauchy's Residues theorem, Evaluation of real integral, | | | |
| 2 | **Z-Transforms:** Introduction, Discrete time signals and sequences, Definition theorem of Z-transforms, Region of converges, Properties of Z- Transforms, Linearity, Multiplication by $a^k$ , Multiplication by k, Division by k, Multiplications by constant a, Real translation theorem (shifting theorem), Shifting to Left and Shifting to Right theorem, Complex Translation Theorem, Initial value theorem, Final Value Theorem, Unit Step Function, Unit Ramp Function, Polynomial Function, Exponential Function, Sinusoidal Function, Unit Impulse Function, Real Convolution Theorem, Z- Transforms of some Slandered Functions, Inverse of Z- Transforms, Direct division Function, Partial Fraction Expansion Method, Inversion Integral method, Application of Z- Transforms and initial value Problem. | 12 | 2 | 28 |
| 3 | **The Fourier Transform:** Introduction, The Fourier Integral, The Fourier Integral Odd and Even Functions, Fourier Sine and Cosine Integral, Fourier Complex Integral, Fourier Transform, Derivation of Fourier Cosine Transform, Derivation of Fourier Sine Transform, State and Prove Convolution Theorem of Fourier Transform, Parseval's Identity for Fourier Transform, Parseval's Identity for Cosine Transform, Parseval's Identity for Sine Transform, Relation between Fourier and laplace Transform. | 15 | 2 | 28 |
| 4 | **Partial Differential Equation:** Applications of Partial Differential Equation, One Dimensional Wave Equation, One Dimensional Heat Equation, Two Dimensional Laplace | 8 | 2 | 28 |

| | | | | |
|---|---|---|---|---|
| | Equation, Two Dimensional Poisson Equation, Three Dimensional Laplace Equation, Derivational of One Dimensional Wave Equation (Vibration of a string), Derivational of Solution of One Dimensional Wave Equation, Solution of Wave Equation with Given Boundary and Initial Condition, Heat Equation, Diffusion Equation, Solution of Heat Equation, Solution of Heat Equation with Given Boundary and Initial Condition, Solution of Heat Equation with Ends of the Bar are Insulated, Laplace equation in Two and Three Dimension, Solution of Laplace Equation, Laplace Equation in Polar Coordinates, Solution of General Laplace Equation, Cylindrical Coordinates, Change of Laplace Equations in to Spherical coordinates, Solution of Three Dimensional Laplace Equations, Cartesian Form , Spherical Form, Cylindrical Form. | | | |
| 5 | **Linear Programming**: Introduction, Solution of L.P.P., Formulation the Problem of L.P.P., Graphical Method, Surplus Variables, Slack Variables, Basic Feasible Solution, Basic and Non Basic Variables, Degenerate and Non Degenerate Solution, Feasible Solution, Optimal Solution, Main Steps of Simplex Method, Formulation of Duel Method, Formulation of Duel Problem, Minimization Using Duel Problem. | 4 | 1 | 10 |
| 6 | **Total** | 45 | 8 | 80 |

*Note*: *Chose any six questions but **S.N.5 is compulsory.***

## BIOMECHANICS
## BEG 2C1 BM

**Semester IV**                                                                                                      **Year II**

| Teaching Schedule Hours/Week | | | Examination Schedule | | | | | Total Marks | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | | Final | | | Internal Assessment | | | |
| | | | Theory | | Practical | | | | |
| | | | | | | Theory Marks | Practical Marks | | |
| L | T | P | Duration | Marks | Duration | Marks | | | |
| 3 | 1 | - | 3 | 80 | - | - | 20 | 25 | 125 | |

## COURSE OBJECTIVE:
- To provide basic mechanical features of human body and tissues.
- To provide basic idea on application of mechanics to study human body- different joints, hard and soft tissues as well as body fluids.

1. **Forces in Joint:**                                                                          **(8 hour)**
    **1.1** Joint movement terminology
    **1.2** Classification of joints- based on movement and axes
    **1.3** Elbow
        1.3.1    Introduction
        **1.3.2**    Loads on elbow
        **1.3.3**    Derivation for  joint reaction force
        **1.3.4**    Problems
    1.4 Shoulder
        1.4.1     Introduction
        1.4.2     Shoulder joints
        1.4.3    Problems
    1.5 Hip
        1.5.1    Introduction
        1.5.2    Forces in hip joints
        1.5.3    Derivation for joint reaction force
        1.5.4    Problems
    1.6  Knee
        1.6.1    Introduction
        1.6.2    Forces in Patellofemoral joint
        1.6.3    Forces in Tibiofemoral joint
        1.6.4    Problems
    1.7 Spine
        1.7.1    Introduction
        1.7.2    Stress on man's back muscle
        1.7.3    Loads on Spine
        1.7.4    Problems
    1.8 Ankle
        1.8.1    Introduction
        1.8.2    Ankle joints
        1.8.3    Loads on the foot
        1.8.4    Ankle Injuries
        1.8.5    Problems
    1.9 Wrist
        1.9.1    Introduction
        1.9.2    Radiocarpal and Midcarpal joints
        1.9.3    Motion
        1.9.4    Wrist injury

3.2.3.4 Mechanical testing-difficulties

## 4. Mechanics of Soft Tissues: (4 hours)
4.1 Collagen
    4.1.1 Collagen fibrils and fibers
    4.1.3 Stress-strain relationship
    4.1.4 Stress relaxation
    4.1.5 Preconditioning
    4.1.6 Change in mechanical properties with life cycle
4.2 Elastin
    4.2.1 Introduction
    4.2.1 Functions
    4.2.2 Incomplete fixation in aldehyde
4.3 Resilin
4.4 Abductn
4.5 Elasticity due to Entropy& Internal energy changes
4.6 Thermodynamics of elastic deformation
4.7 Quasi-Linear Viscoelasticity
4.8 Concept of Pseudo-elasticity

## 5. Synovial Joint Mechanics: (4 hours)
5.1 Introduction
5.2 Functions
5.3 Mechanical properties of cartilage
    5.3.1 Permeability
    5.3.2 Indentation testing
    5.3.3 Tensile tests
    5.3.4 Confined compression creep test
    5.3.5 Confined compression relaxation test
    5.3.6 Effect of strain rate- tension test& compression test
5.4 Lubrication of Joints
    5.4.1 Introduction
    5.4.2 Wear
    5.4.3 Types of Lubrication
- Boundary Lubrication
- Squeeze film Lubrication
- Hydrodynamic Lubrication
- Elastohydrodynamic Lubrication
- Weeping Lubrication
- Boosted Lubrication

    5.4.4 Use of Reynold's equation & feasibility of hydrodynamic lubrication

## 6. Muscle Mechanics: (4 hours)
6.1 Introduction
    6.1.1 Skeletal muscle
    6.1.2 Heart Muscle
    6.1.3 Smooth muscle
6.2 Functional arrangement of Muscles
6.3 Comparison of force transmission in parallel and in pinnate arrangement
6.4 Structure of skeletal muscles
6.5 Sliding element theory of muscle action
6.6 Cross-bridge theory
6.7 Hill's equation for tetanized skeketal muscle

6.8 Cardiac Muscle
    6.8.1   Features
    6.8.2   Comparison with skeletal muscles
    6.8.3   Properties of an Unstimulated Heart Muscle
    6.8.4   Hill's Equation and its modification

## 7. Modalities of Elastic and Viscoelastic Solids, Constitutive Equations (8 hours)
7.1     Stress Traction and Tensor
7.2     Index notation
7.3     Kronecker delta
7.4     Strain tensor
    7.4.1   Derivation of Green's and Almansi's strain tensors
    7.4.2   Deduction of Cauchy's infinitesimal strain tensor from Almansi's
7.5     Constitutive Equation
    7.5.1   Newtonian Viscous Fluid
    7.5.2   Hookean Elastic Solid
7.6     Viscoelasticity
    7.6.1   Stress relaxation
    7.6.2   Creep
    7.6.3   Hysteresis
7.7     Mechanical models for viscoelastic solids
    7.7.1   Maxwell model
    7.7.2   Voigt model
    7.7.3   Kelvin (Linear Standard Solid) model
    7.7.4   Derivation of creep and stress relaxation functions

## 8. Introduction to Bio-Fluid Mechanics (7 hours)
8.1     Introduction to Bio-fluid        (1 hr)
    8.1.1   Blood
    8.1.2   CSF
    8.1.3   Lymph
    8.1.4   Mucus
    8.1.5   Saliva
    8.1.6   Synovial Fluid

8.2     Basics of Blood Rheology        (4 hrs)
    8.2.1   Rheology
    8.2.2   Viscosity
           8.2.2.1 Factors affecting viscosity
           8.2.2.2 Apparent and relative viscosity
           8.2.2.3 Viscometers
    8.2.3   Characterization of liquids
           8.2.2.5 Newtonian and non-newtonian liquids
           8.2.2.6 Shear thinning and thickening liquids
           8.2.2.7 Bingham Plastic
           8.2.2.8 Rheograms
    8.2.4   Blood
           8.2.4.1 Composition
           8.2.4.2 Properties
    8.2.5   Blood flow
           8.2.5.1 Laminar flow of blood in a tube
           8.2.5.2 Derivation for mean velocity and flow rate
    8.2.6   Blood viscosity
           8.2.6.1 Variation of blood viscosity with temperature, hematocrit &
                     protein concentration

8.2.6.2 Model: Casson's plot
8.2.6.3 Fahraeus-Lindqvist effect
8.2.6.4 Fahraeus effect
8.2.7 Medical applications of blood rheology

8.3 Blood Flow in Vessels & its Measurement (2 hrs)
8.3.1 Cardiac output and stroke volume
8.3.2 Regulation of blood flow
8.3.3 Factors affecting blood flow
8.3.4 Regulation in blood pressure
8.3.4.1 Renin-Angiotensin System
8.3.5 Measurement of heart activity
8.3.6 Measurement of blood pressure
8.3.6.1 Non-invasive method
8.3.6.1 Invasive method
8.3.7 Measurement of blood flow
8.3.7.1 Indicator Dilution Method
8.3.7.2 Electromagnetic Flow Meters
8.3.7.3 Ultrasonic Flow Meters

**Textbook/s:**
1. Biomechanics-Mechanical Properties of Living Tissues, Y.C. Fung
2. Skeletal Tissue Mechanics, Martin, Burr & Shatkey
3. Basic Biomechanics, Susan J Hall

Marks Distribution:

| Chapter | Lecture Hours | No. of Questions | Marks |
|---|---|---|---|
| Forces in Joint | 8 | 2 | 16 |
| Skeletal Biology | 4 | 1 | 8 |
| Mechanical Properties of Tissues | 6 | 1.5 (1-2) | 8-16 |
| Mechanics of Soft Tissues | 4 | 1 | 8 |
| Synovial Joint Mechanics | 4 | 1 | 8 |
| Muscle Mechanics | 4 | 1 | 8 |
| Modalities of Elastic and Viscoelastic Solids, Constitutive Equations | 8 | 2 | 16 |
| Introduction to Bio-Fluid Mechanics | 7 | 1.5 (1-2) | 8-16 |
| **Total** | **45** | **10** *(one choice)* | **80** |

# ELECTRONIC DEVICES AND CIRCUITS
## (BEG 239 EC)

**Semester IV**                                                                 **Year II**

| Teaching Schedule Hours/Week | | | Examination Schedule | | | | Internal Assessment | | Total Marks | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Final | | | | Theory Marks | Practical Marks | | |
| | | | Theory | | Practical | | | | | |
| L | T | P | Duration | Marks | Duration | Marks | | | | |
| 3 | 1 | 2 | 3 | 80 | | | 20 | 25 | 125 | |

**COURSE OBJECTIVES:** To familiarize students with common semiconductor devices and integrated circuits so that they will be able to analyze, maintain and build basic electronic circuits.

## 1.0 Semiconductor Devices
    1.1 Introduction to semiconductor materials. (p-type, n-type, p-n junction)
    1.2 Ideal Diode
        1.2.1 Diode circuit symbol
        1.2.2 Current voltage characteristics of the ideal diode
        1.2.3 Equivalent circuit in the forward and reverse direction
        1.2.4 Simple application of ideal diode
    1.3 Semiconductor Diode and equivalent circuit
        1.3.1 Thermal characteristics of junction diodes
            1.3.1.1 Forward bias region(Diode current voltage relationship and problems)
            1.3.1.2 Reverse bias region
            1.3.1.3 Breakdown region
        1.3.2 Current voltage characteristic of junction diodes
    1.4 Modeling the diode forward characteristics
        1.4.1 The ideal diode model
        1.4.2 The constant voltage drop model
        1.4.3 The piecewise linear model
        1.4.4 Small signal model of diode
        1.4.5 Problems in diode modeling
    1.5 Reverse Recovery time
    1.6 Load line analysis
    1.7 Zener Diode
        1.7.1 Zener breakdown
        1.7.2 Zener diode introduction and modeling

## 2.0 Bipolar Junction Transistor
    2.2 Construction and operation
        2.2.1 A simplified structure of the npn transistor
        2.2.2 A simplified structure of the pnp transistor
        2.2.3 Current flow in an npn transistor biased to operate in the active mode
        2.2.4 Current flow in a pnp transistor biased to operate in the active mode.
        2.2.5 Circuit symbols and conventions.

    2.3 Transistor configuration:
        2.3.1 CB configuration: Input output family curve
        2.3.2 CE configuration: Input output family curve
        2.3.3 CC configuration: Input output family curve

2.4 DC Biasing
    2.4.1   Fixed Bias circuits
    2.4.2   Emitter Stabilized Biased Circuits
    2.4.3   Voltage divider biasing
    2.4.4   DC bias with voltage feedback
    2.4.5   Problems in each topics
2.5 Transistor Switching Network
    2.5.1   BJT as an inverter.
    2.5.2   Problems

# 3.0 Field effect transistor
3.2 Junction field effect transistor
    3.2.1   Construction
    3.2.2   Operation
3.3 Metal oxide field effect transistor(MOSFET)
    3.3.1   Depletion type MOSFET
        3.3.1.1 Construction
        3.3.1.2 Operation
    3.3.2   Enhancement type MOSFET
        3.3.2.1 Construction
        3.3.2.2 Operation
3.4 FET Biasing
    3.4.1   Self Bias Configuration
    3.4.2   Voltage divider bias Configuration
        Problems

# 4.0 Operational amplifier circuits
4.2 Ideal op-amps basic circuits
    4.2.1   Characteristics of ideal op-amps
    4.2.2   Inverting and Non-inverting amplifier and voltage follower
    4.2.3   Op- amps circuits for adder, subtractor, integrator and differentiator
    4.2.4   Problems
4.3 Bias circuits suitable for IC design
    4.3.1   Diode connected transistor
    4.3.2   Current mirror circuits
    4.3.3   Current steering Circuits
4.4 The Widlar current source
4.5 The differential amplifier
    4.5.1   BJT differential pair: basic operation only
4.6 Active loads: Basic concept

# 5.0 Operational amplifier characterization
5.2 Input offset voltage
5.3 Input bias and input offset currents
5.4 Output impedance
    5.4.1   Circuit diagram
    5.4.2   Mathematical derivation
5.5 Differential and common mode  input impedances
5.6 DC gain, bandwidth, gain-bandwidth product
    5.6.1   Gain versus frequency plot analysis
    5.6.2   Op-amp specifications- frequency parameters
5.7 Common mode and power supply rejection ratios.

5.8  Higher frequency poles, setting time
5.9  Slew rate
        5.9.1    Definition and formula
        5.9.2    Problems
5.10  Noise in operational amplifier circuits

## 6.0 Power supplies and voltage regulator

6.2  Half-wave and full-wave rectifiers.
        6.2.1    Simple half wave rectifier
        6.2.2    Centre taped full wave rectifier
        6.2.3    Bridge rectifier
        6.2.4    PIV calculation for each.
6.3  Capacitive filtering and problems
6.4  Zener diode as voltage regulator and problems
6.5  Series Regulator
        6.5.1    Transistor-zener diode voltage regulator
        6.5.2    Transistor Op-amp voltage regulator
6.6  Shunt regulator
        6.6.1    Transistor-zener diode voltage regulator
        6.6.2    Transistor Op-amp voltage regulator
6.7  IC voltage regulator

## 7.0 Filter circuits

7.2  LC filters: circuits and transform functions
7.3  RC filters: circuits and transform functions
7.4  Active filters: Introduction

## 8.0 Untuned and Tuned power Amplifiers

8.1 Amplifier classification
        8.1.1 Class A amplifier
        8.1.2 Class B amplifier
        8.1.3 Class AB amplifier
        8.1.4 Class C amplifier
        8.1.5 Push pull amplifier
8.2 Direct-coupled push-pull stages
        8.2.1 Amplifier input and output signal variation
        8.2.2 Load line for class A transformer-coupled amplifier
        8.2.3 Quiescent operating point
8.3 Transformer-coupled push-pull stages
        8.3.1 Transformer action
        8.3.2 Voltage transformation
        8.3.3 Current transformation
        8.3.4 Impedance transformation
        8.3.5 Problems

8.4 Tuned power amplifiers
        8.4.1 Device characteristics
        8.4.2 DC and AC load lines
8.5 Power dissipation considerations

| Chapters | Hours | Marks | No. of questions |
|---|---|---|---|
| Semiconductor diodes | 5 | 10 | 1 |
| Bipolar junction transistor | 6 | 10-15 | 1-2 |
| Field effect transistor | 5 | 5-10 | 1 |
| Operational amplifier circuits | 6 | 10-15 | 1-2 |
| Operational amplifier characterization | 8 | 10-15 | 1-2 |
| Power supplies and voltage regulators | 6 | 5-10 | 1 |
| Untuned and tuned power amplifiers | 7 | 10-15 | 1-2 |
| Filter Circuits | 2 | 5 | 1 |

**Refrences:**
1.0 W. Stanely, "Operational amplifiers with linear integrated circuits", Charles E. Merrill publishing company, Toronto, 1984.
2.0 J.G. Graeme, "Application of operational amplifiers: third generation techniques", the burr-Brown Electronic series", McGraw-Hill, New York, 1973.
3.0 P.E. Allen and D.R. Holberg, "CMOS Analog Circuit Design", Holt, Rinehart and Winston, Inc., New York, 1987.
4.0 A.S. Sedra and K.C. Smith, "Microelectronic Circuits", 2nd Edition, Holt, Rinehart and Winston, Inc., New York.
5.0 Theodore F. Bogart, Jeffrey S. Beasley and Gullermo Rico "Electronics devices and circuits" 6th edition,
6.0 Robert Boylestad and Louis Nashelsky " Electronics devices and circuit theory" 7th edition

# HUMAN ANATOMY AND PHYSIOLOGY II
## BEG 2B4 BM

**Semester IV**                                                                                                    **Year II**

| Teaching Schedule Hours/Week | | | Examination Schedule | | | | | | | Total Marks | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Final | | | | Internal Assessment | | | | |
| | | | Theory | | Practical | | Theory Marks | Practical Marks | | | |
| L | T | P | Duration | Marks | Duration | Marks | | | | | |
| 3 | - | 2 | 3 | 80 | | | 20 | 25 | | 125 | |

**COURSE OBJECTIVES:** To provide knowledge of Human Anatomy & Physiology required for Biomedical Engineering.

## CARDIOVASCULAR SYSTEM, BLOOD VESSELS, BLOOD PRESSURE, PULSE & CIRCULATION OF THE BLOOD                                                                                          10hrs

***Introduction of Cardiovascular System (CVS)***
a. Types of circulation *
b. Organs of CVS **

***Heart***
i. Gross features of Heart **
ii. Coverings of Heart *
iii. Chambers and valves of Heart *
iv. Blood and nerve supply of Heart **

***General heart functions***
a. Action potential of cardiac muscle. **
b. Ionic mechanism during depolarization & repolarization of cardiac muscle **
c. Long refractory periods in cardiac muscle cells **
d. Heart as a pump**

***Conducting system of the heart***
a. SA node as Natural pacemaker *
b. Phases of Cardiac cycle**
c. Heart rate *

***Arterial Circulation***
a. Parts, extent & branches of Aorta *
b. Major arteries of circulation *

***Venous circulation***
a. Vena-cava, extent formation and tributaries of Superior &Inferior vena-cava *
b. Major veins of circulation *
c. Portal circulation *

***Electrocardiography (ECG), importance of the P wave, QRS complex, T wave ****

***Cardiac output***
a. Blood pressure & peripheral resistance**
b. Flow-pressure relationship**

***Control of Heart function***
a. Baroreceptors*
b. Chemoreceptors *
***Heart sounds ****

***Disorders of blood vessel, causes symptoms, diagnostic & treatment measures****

**Ischemic heart disease or myocardial infarction causes symptoms, diagnostic & treatment measures \*\***

*Abnormal heart rates*
a. Tachycardia *
b. Brady cardia *
c. Arrythmia *


**LYMPHATIC SYSTEM. LYMPH, LYMPH VESSELS, LYMPHATIC ORGANS & TISSUE           2hrs.**

*Introduction to lymphatic system*
a. Structure & important groups of Lymph nodes**
b. Major lymphatic duct as Thoracic duct & Right lymphatic duct *
c. Physiology of Lymph node & lymphatic ducts *
d. Components of lymph *

*Spleen*
a. Gross & microscopic features of Spleen **
b. Functions of Spleen *

*Thymus*
a.Gross & microscopic features of Thymus gland **
b Role of Thymus as an immune organ *

*Lymphoid organs*
a. Tonsil, Appendix, Gut associated lymphoid tissue( GALT) & Mucosa associated lymphoid tissue (MALT) as lymphoid organs **
b. Physiological importance of the lymphoid organs *

*Abnormal lymphoid disease*
a. Elephantiasis*


**RESPIRATORY SYSTEM, NOSE, NASAL CAVITY, PHARYNX, LARYNX, TRACHEA, BRONCHI, LUNGS, RESPIRATION DISORDERS OF UPPER RESPIRATORY TRACT, BRONCHI & LUNGS                         8 hours**

*Introduction to Respiratory system*
a. Structure-function relationship of the respiratory system **

*Nose*
a.External nose, nasal cavity its features & boundaries **
b .Blood and nerve supply of Nose *
c. Physiology of nasal cavity *

*Pharynx*
a. Definition, parts, extent and structure of Pharynx **
b .Blood, nerve supply & lymphatic drainage of Pharynx *
c. Physiology of Pharynx *

*Larynx*
a. Structure, extent, cartilages, joints and muscles of Larynx **
b. Interior of larynx *
c. Blood supply, innervations & lymphatic drainage of Larynx *
d. Functions of Larynx *

*Trachea and bronchi*
a. Structure & extent of Trachea & Bronchi **
b. Structure-function relationship of bronchial tree **
c. Physiology of Bronchi *

### Pleura
a. Layers of Pleura *
b. Functions of Pleura in respiration *

### Accessory muscles for breathing
a.Intercostal muscles *
b. Diaphargm *

### Lungs
a. Structure, parts and coverings of Lungs **
b. Hila and root of lung *
c. *Physiology of respiratory mucosa ** 
d. *Functions of bronchial tree ** 
e. *Functions of Lungs*** 
f. External & internal respiration *
g. Inspiration & expiration *
h. Mechanism of breathing *
i. Mechanics of breathing *
j. Mechanism of gas transport in the body **
k. Oxygen & Carbondioxide are transport in the body **
l. Oxygen-hemoglobin dissociation curve *
m. Mechanism of gas exchange **
n. Composition of air *
o. Roles of partial pressures of gases **
p. Diffusion of gases *
q. Lung compliance **
r. Surface tension of lung *
s. Pulmonary surfactant *

### Control of respiration
a. Chemoreceptors & their functions *

### Lung function tests
a. Pulmonary ventilation **
b. Spirometry - measurement of lung volumes **
c. Abnormal lung functions *

### Diseases of respiratory tract, causes symptoms, diagnostic & treatment measures
a. Bronchial asthma **
b Bronchitis **
c. Sinusitis *
d. Pneumonitis **


## DIGESTIVE SYSTEM, ORAL CAVITY. DIGESTION, ABSORPTION & METABOLISM. DISEASES RELATED TO DIGESTIVE SYSTEM                                    8 hours

### Introduction to Gastrointestinal Tract (GIT)
a. Organs of Alimentary canal **
b. Accessory glands *
c. General structure of Alimentary canal
d. Functions of Gastrointestinal tract **
i. Digestion of carbohydrate, protein & fat *
ii. Secretion of enzymes for digestion*
iii. Absorption of nutrients *

### Mouth
a.Parts & boundaries of Mouth *
b.Functions of Mouth *

### Teeth
a. Types of Teeth*
b. Structure, blood and nerve supply of Teeth *
c. Functions of Teeth *

### Tongue
a. Structure, attachment, blood and nerve supply of Tongue **
b. Types of taste buds in the Tongue *
c. Physiology taste sense *

### Salivary glands
a. Names of Salivary gland *
b. Structure & opening of salivary gland *
c. Blood and nerve supply of the gland *

### Functions of teeth system
a. Abnormalities of teeth *

### Oesophagus
a. Structure, parts & extent of Oesophagus*
b. Functions of Oesophagus*

### Stomach
a. Structure & parts of stomach **
b. Blood supply, nerve supply & lymphatic drainage of stomach **
c. Mechanisms of protein digestion *
d. Phases of gastric acid secretion **
e. Types of gastric glands & their secretions *
f. Control & regulation (neural & hormonal) of gastrointestinal processes **

### Structure-function relationship of Liver, billiary tract & gall bladder
a. Gross and histologic feature Liver and gall bladder **
b. Size, shape, location and blood supply of Liver *
c. Components & communications of Billiary system **
d. Functions of liver **
e. Liver function tests *
f. Role of gall bladder *

### Anatomy of Pancreas
a. Structure of Pancreas, different parts & its location **
b. Blood supply to pancreas *
a. Exocrine role of exocrine pancreas *

### Small intestine
a. Structure & parts of Small intestine **
b. Blood and nerve supply of small intestine *
c. Digestion of food materials in small intestine**
d. Secretion of enzymes involved during digestion of different food materials *
e. Absorption in small intestine. *
f. Absorptive surface & food materials absorbed *

### Large intestine
a. Structure, peculiarity of Large intestine *
b. Blood supply, nerve supply & lymphatic drainage of Large intestine *
c. Position, structure and location of Appendix *
d. Secretion & absorption in large intestine *

### Metabolic functions of body **

*Elimination or defecation of undigested food products* *

*Digestive system disorders, causes symptoms, diagnostic & treatment measures*
a. Gastritis *
b. Pancreatitis *
c. Hepatitis *
d. Cholecystitis *

**URINARY SYSTEM. KIDNEY, URETERS, URINARY BLADDER, BLADDER, URETHRA. DISEASE RELATED TO SYSTEM                    6 hours**

*1.* **Introduction to the system and organs**
a. Gross features of Kidney *
b. Microscopic features of Kidney **
c. Structure of Nephron **

*2. Physiology of kidney*
a. Glomerular filtration & its rate (GFR) *
b. Tubular Reabsorption*
c. Tubular Secretion *
d. Excretion of waste products *

*3. Role of Nephrone*
*a.* Functions of Proximal convoluted tubule *
b. Distal convoluted tubule & its functions *
c. Role of Loop of Henle in concentration & dilution of urine **
d. Collecting tubule & its role *

*4. Regulation of Salt-water balance*
a. Role of Proximal convoluted tubule, Loop of Henle & Distal convoluted tubule in fluid balance **
b. Role of Anti-diuretic hormone in extracellular volume control*
c. Control of sodium, potassium, hydrogen ion & calcium **
d. Role of Aldosterone in sodium control *
e. Renin-angiotensin-aldosterone system in salt balance **

*5. Regulation of Acid-base balance*
a. Renal control of hydrogen ion *

6*. Abnormal Acid Base levels in the body*
a. Metabolic Acidosis *
b  Metabolic Alkalosis *
c. Respiratory Acidosis *
d. Respiratory Alkalosis *

*7. Structure-function relationship of ureter, bladder & urethra*
a. Extent and parts of Ureter *
b. Structure of Ureter & its Constrictions *
c. Structure of Urinary bladder, parts and openings *
d. Blood supply, nerve supply &lymphatic drainage to Urinary bladder *
e. Control of bladder function *
f. Micturition or urination *
g. Structure of Urethra *
h. Parts of male urethra & their roles **

**8. Abnormalities of kidney functions\*\***
 a. Kidney function tests *
 b. Nephritis causes symptoms, diagnostic & treatment measures **
 c. Kidney failure *


# THE ENDOCRINE SYSTEM. PITUITARY, THYROID, ADRENAL, PANCREAS, PINEAL & THYMUS GLAND: 5 hours

### 1. Introduction to endocrine system
  a. Name of different endocrine glands *

### 2. Principles of endocrine communications\*\*
  a. Roles of hormones in homeostasis *

### 3. Hypothalamus as Neuro-endocrine gland
  a. Releasing Hormones of Hypothalamus *
  b. Hypothalamus as a Neuro-endocrine organ *

### 4. Pituitary gland
  a. Size, structure and location of Pituitary gland **
  b. Stimulating actions of anterior pituitary hormones on the target organs**
  c. Pituitary as a Master gland *
  d. Effects of of Antidiuretic hormone & Oxytocin from posterior pituitary in target
     organs *

### 5. Thyroid gland
   a. Size, structure and location of Thyroid gland **
   b. General functions of the thyroid hormones (thyroxine, T4 & triiodothyronine, T3) *
   c. Role of iodine in the formation of thyroid hormones *
   d. Abnormal thyroid functions hyper& hypo functions *
   e. Hypothyroidism causes symptoms, diagnostic & treatment measures   **

### 6. Parathyroid gland
  a. Size, structure and location of Parathyroid gland **
  b. Role of parathyroid gland in the control of calcium in the body   *

### 7. Pancreas as an Endocrine organ
   a. Size, structure and location of Endocrine pancreas **
   b. List of hormones of alpha, beta &   delta cells of pancreas *
   c. Beta cells dysfunctions of pancreas *
   d. Diabetes mellitus types, causes symptoms, diagnostic & treatment
      measures **

### 8. Adrenal Gland
  a. Size, structure and location of Adrenal gland **
  b. Endocrine control of Adrenal glands – 10
  c. Hormones of adrenal cortex & their actions *
  d. Actions of glucocorticoids as anti-inflammatory & in immune rejection in organ
     transplant *
  e. Role of adrenal medulla  *

### 9. Thymus gland

a. Size, structure and location of Thymus gland **
b. Hormone produced in the thymus & its role *

**10. Pineal gland**
a. Size, structure and location of Pineal gland **
b. Pineal gland in reproduction *

**REPRODUCTIVE SYSTEM. MALE & FEMALE REPRODUCTIVE ORGANS.
DISEASES RELATED TO SEX ORGANS.** **5 hours**

A. Introduction to Reproductive system **

B. Female reproductive organs
a. Structure and gross features of ovaries, uterus, fallopian tubes and vagina **
b. General feature of external genitalia *
c. Pelvic floor muscles and their importance *

C. **Female reproductive physiology**
a. Role of ovaries in female *
b. Understanding of Puberty, Menarche, Menstrual cycle & Menopause **
c. Follicle development, ovulation & corpus luteum formation *
d. Female sex hormones *
e. Functions of uterus *
f. Role of fallopian tubes in reproduction *
g. Breasts as milk source for infant *

D. **Male reproductive system**
a. Structure and gross features of testis, epididymis, vas deferens, seminal vesicles and penis **
b. Spermatic cord, contents & embryological basis of its formation **

E. **Male reproductive physiology**
a. Puberty, erection & ejaculatory function in male **
b. Hormonal control of male reproductive system *
 c. Role of androgens (testosterone) in male fertility regulation *
d. Semen production & transport *
e. Prostate gland and its function *

F. **Contraception in male & female ****
G. **Male & female infertility ****
H. **Diseases of female reproductive system ****
 I. **Diseases of male reproductive system ****

*Symbols*
*\*: Students may expect a short question of 5 marks from this topic.*
*\*\*: Students may expect a long question of 10 marks from this topic.*

**Laboratories:**
1.0 Study of Systematic relationship of Heart and Cardiovascular System
2.0 Histological studies of blood cells
3.0 Study of Systematic relationship of respiratory system
4.0 Histology of Lungs tissue
5.0 Study of Systematic relationship of digestive system

6.0 Histology of intestine

7.0 Study of Systematic relationship of urinary system

8.0 Histology of nephron

9.0 Study of Systematic relationship of endocrine system10

10.0    Histology of pancreas and adrenal gland

11.0    Study of Systematic relationship of reproductive system

12.0    Histology of ovaries and testes.

**Textbooks:**
1. Ross & Wilsons Anatomy & Physiology in Health & Illness –Anne Waugh & Allison Grant, Ninth Edition
2. Textbook of Medical Physiology
   A.C. Guyton & J.E. Hall
3. Hutchinson' Clinical Methods
   D. Hunter & R.R Bomford
4. Concise Medical Physiology S. K. Chaudhary

## Marking system

Total hours: 45            No. of Question: 16            F.M.: 80

| Systems | Hours | No. of Questions | Marks |
|---|---|---|---|
| CVS/lymphatics | 11 | 4 | 20 |
| Respiratory | 8 | 3 | 15 |
| GI | 8 | 3 | 15 |
| Urinary | 8 | 3 | 15 |
| Endocrine | 5 | 2 | 10 |
| Reproductive | 5 | 1 | 5 |
| **Total** | **45** | **16** | **80** |

# RESEARCH METHODOLOGY
## (RM 2C8 BM)

**Semester IV**                                                                                           **Year II**

| Teaching Schedule Hours/Week | | | Examination Schedule | | | | Total Marks | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | Final | | Internal Assessment | | | |
| | | | Theory | | Practical | Theory Marks | Practical Marks | |
| L | T | P | Duration | Marks | Duration | Marks | | |
| 2 | 1 | - | | 40 | | | 10 | | 50 | |

**COURSE OBJECTIVES:** To give basic concepts on research, proposal and report writing methods for biomedical engineers.

## Chapter 1: Introduction                                                3 hrs
- What is Research?
- Biomedical research (or experimental medicine)
- Concept of scientific Research
- Process or steps of scientific research
- Protocol review
- Guidelines for research on human subjects
- Ethical of Medical Research

## Chapter 2: Research Methodology                                    6 hrs

- Definition of research
- Types of research
- ✓ Quantitative v/s qualitative research
- ✓ Fundamental V/s applied research
- ✓ Empirical V/s conceptual research

- Reliability & Validity

- Types of validity
- ✓ Content validity
- ✓ Construct validity
- ✓ Criterion validity
- Concept of Reliability

## Chapter 3: Research Design                                          3 hrs
- Purpose of research design

- Characteristics of a good research design

- ✓ Objectivity
- ✓ Reliability
- ✓ Validity
- ✓ Generalizability

- Types of Research Design

1. Historical Research design: Processes of historical research, limitation, Essential Requirement of Research Design
2. Conventional Research Design: Limitations
3. Descriptive Research Design: Steps and limitation
4. Developmental Research design: Types of Developmental research: Longitudinal growth Study, Cross Sectional Growth Study, Trend Study, Cohort Study, Steps and Limitations
5. Action Research: Steps and Limitations
6. Field Study Research: Steps and Limitations
7. True Experimental Research Design: Types, Steps and Limitations
8. Evaluation Research Design: Steps and Limitations
9. Ex- Post Facto Research Design: Steps and Limitations
10. Correlation Research Design: Steps
11. Casual Comparative Research Design: Steps
12. Case Study Research Design: Steps, Assumptions and Limitations
13. Assessment Study Research Design: Steps and Limitations

## Chapter 4: Sampling, data collection and data analysis            6 hrs

- Objectives of sampling
- Principles of sampling theory
- Methods of data collection
- Primary sources of data
- ✓ Use of internet for data collection
- ✓ Observation
- Secondary sources of data
- Data quality
- Types of measurement
- ✓ Nominal
- ✓ Ordinal
- ✓ Interval
- ✓ Ratio measurement scales

- **Processing and classification of data**
- ✓ Types of data
- ✓ Data processing, editing and coding
- ✓ Concept of classification
- ✓ Objectives of classification
- ✓ Types of classification
  -Periodical and geographical basis
- ✓ Transcription
- ✓ Methods of transcription
- ✓ Tabulation
- ✓ General Rules for Tabulation

## Chapter 5: Mean, Median and Standard Deviation            6 hrs

- Mean: Meaning, Simple arithmetic mean, Weighted arithmetic mean
- Median: Individual series, Discrete Series, Continuous Series

- Standard Deviation: short cut method, step-deviation method, co-efficient of variation
- Z-test: Test of significance of a single mean, Difference between means, sample proportion, two sample proportion
- T-test: mean of a random sample, between two means, between means of two samples

## Chapter 6: Research proposal and report Writing                                    6 hrs

- Research topic selection
- Preliminary survey of literature for topic selection
- Research problems: Empirical problems, Analytical problems, Normative problems
- Components of a research problem
- Research questions
- Research hypothesis
- Characteristics of hypothesis
- Research proposal
- Research Proposal Types
- Structure of the research proposal
- Introduction to Report writing
- Types of Research
- Format of research report
- Bibliography

**Marks Distribution:**

| Chapter | Lecture Hours | No. of Questions | Marks |
|---|---|---|---|
| Introduction | 3 | 1 | 10 |
| Research Methodology | 6 | 2 | 2×5=10 |
| Research Design | 3 | 1 | 5 |
| Sampling, Data collection, and Data analysis | 6 | 1 | 5 |
| Mean, Median and Standard Deviation | 6 | 1 (a and b) | 2+8=10 |
| Research Proposal and Report Writing | 6 | 1 | 10 |
| **Total** | **30** | **7 *(one choice)*** | **40** |

# SOCIOLOGY
## (BEG299 MS)

| Semester IV | | | | | | | | | Year II |
|---|---|---|---|---|---|---|---|---|---|
| Teaching Schedule Hours/Week | | | Examination Schedule | | | | | Total Marks | Remarks |
| | | | Final | | | | Internal Assessment | | |
| | | | Theory | | Practical | | Theory Marks | Practical Marks | |
| L | T | P | Duration | Marks | Duration | Marks | | | |
| 3 | 1 | | 3 | 80 | | | 20 | | 100 |

**COURSE OBJECTIVE:** To introduce the sociological aspects relevant to societies.

## 1.0 INTRODUCTION                                          (4 hours)

1.1. Definition of Sociology
1.2. Evolution of Sociology
    1.2.1 Four stages of development of sociology
1.3. Relationship of Sociology with other Social Sciences
    (history, economics, political science, psychology)
1.4. Application of Sociology in addressing contemporary issues
    1.4.1 Concept of G R Madan
    1.4.2 Concept of Duncan Mitchell

## 2.0 LANGUAGE OF SOCIOLOGY                                 (14 hours)

2.1. Society and Culture
    2.1.1 Introduction& definition
    2.1.2 Characteristic
    2.1.3 Types
    2.1.4 Functions
2.2. Tribe, Caste and Ethnicity
    2.2.1 Introduction& definition
    2.2.2Characteristic
    2.2.3 Types
    2.2.4 Differences
2.3. Community and Institutions
- Introduction
- Definition
- Characteristic
- Types
2.4. Homogenous & Heterogeneous
- Population dynamics
2.5. Norms and Values
- Introduction
- Definition
- Characteristic
- Types
- Function
2.6. Cooperation and Conflict
- Introduction
- Definition
- Characteristic
- Types
- Differences

2.7. Status & Roles

- Introduction
- Definition
- Characteristic
- Types
- Interrelationships

2.8. Competition & Conflict
- Introduction
- Definition
- Characteristic
- Types
- Differences

2.9. Association and Group
- Introduction
- Definition
- Characteristic
- Types

## 3.0 FUNDAMENTAL CONCEPTS IN SOCIOLOGY                    (14 hour)

3.1. Social System
3.2. Social Structure:
- Family
- Caste
- Ethnic group

3.3. Social Processes
- Acculturation
- Enculturation
- Accommodation
- Adaptation
- Amalgamation
- Assimilation
- Integration

3.4. Socialization
- Introduction
- Definition
- Characteristic
- Stages
- Agent

3.5. Social and Cultural Change
- Introduction
- Definition
- Characteristic
- Types
- Differences

3.6. Social Stratification
- Introduction
- Definition
- Characteristic
- Bases

3.7. Social Problem and Social Control
- Introduction
- Definition
- Characteristic
- Types
- Remedies

## 4.0 NEPALESE CULTURE AND SOCIETY (12 hour)

4.1. Historical ideological and political dimension of Nepalese culture and society
- Ancient
- Medieval
- Modern period

4.2. Caste System in Nepal
- Introduction
- Evolution
- Definition
- Merits and demerits

4.3. Ethnic groups and interrelationship among them

4.4. Religions in Nepal
- Introduction to and origin of religion
- *Hinduism:* Key features and sects: Shaivism, Vaishnavism and Shaktism
- *Buddhism:* Key features and sects: Vajrayan, Mahayan and Hinayan
- *Islam:* Key features and sects: Siya and Sunni
- *Christianity:* Key features and sects: Catholics and Protestants
- *Kirat:* Key features

4.5. Festivals in Nepal
- Dashain
- Tihar
- Holi
- Chhath
- Lhosar
- Eid
- Christmas

4.6. Social stratification in Nepalese Societies on the basis of
- Caste
- Gender
- Ethnicity
- Age

## 5.0 COMMUNITY AND DEVELOPMENT (16 hours)

5.6. Meaning

5.7. Nature and History

5.8. Development Approaches
- Concept of laissez faire by Adam Smith
- Top down and bottom up model

5.9. Community organising for people's empowerment

5.10. Communications and community Education
- Importance
- Implementation ways
- Effectiveness study

5.11. Community mobilization
- Methods
- Benefits

5.12. Indigenous and appropriate Technology
- Introduction
- Definition
- Characteristic
- Significance

5.13. Ecology and Environment
- Concept
- Terms

5.14. Community Participation in Development Activities

- Approach
- Methods
- Benefits

5.15. Gender indifferences and role of women in energy conservation and development

5.16. Social cycle

    5.16.1 Modernization
- Definition
- Nature
- Factors
- Modernization in Nepal

    5.16.2 Globalization
- Definition
- Nature
- Agents

5.17. Application of knowledge of sociology with special reference energy, policy, legal issues and practices, identification of issues and resolution

## Recommended Books

1.0 Inkels Alex, "What is Sociology? Introduction in the discipline and profession", Prentice Hall of India

2.0 Foster GM, "Traditional Culture and Impact of Technological Change"

3.0 Mair L, "Applied Sociology, Anthropology"

4.0 Gsanlender AW, "Applied Sociology and Opportunity Problems"

5.0 Regmi Rishikeshav Raj, "Dimension of Nepali Society and Culture"

6.0 Gurung Santa Bahadur, "Rural Development Approach in Nepal" Deva Publications Kathmandu

| Chapter | Lecture Hours | No. of Questions | Marks |
|---|---|---|---|
| INTRODUCTION | 4 | 1L or 1 S | 8 - 12 |
| LANGUAGE OF SOCIOLOGY | 14 | 1L and/or 3S | 12 - 24 |
| FUNDAMENTAL CONCEPTS IN SOCIOLOGY | 14 | 1L and/or 2S | 12 – 16 |
| NEPALESE CULTURE AND SOCIETY | 12 | 1 S | 8 |
| COMMUNITY AND DEVELOPMENT | 16 | 2L and/or 3S | 24 |
| Total | 60 | * 2L, 7S | 80 |

L= Long, S=Short.

*Students will have to answer 2 out of 3 Long questions & 7 out of 9 Short questions.*