YEAR II
SEMESTER - III

ENGINEERING MATHEMATICS III
BEG201 SH

Semester: III **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 purpose of this course is to round out the student's preparation more sophisticated applications with an introduction of linear algebra, a continuous of the study of ordinary differential equations and an introduction to vector algebra.

S.N.	Chapter	Lecturer Hours	No. of questions	Marks
1	Matrix and determinant. Vector Spaces. Linear transformations System of linear equations, Gauss elimination. Rank, matrix inversion. Eigen values, Eigen vectors.	15	4	40-10
2	Laplace Transforms. Standard Transforms. Inverse of Laplace Transforms. Application to differential equations.	9	3	30-10
3	Definition of Line Integration Evaluation of Line Integration Double Integration Transformation of double integrals into integrals rails beta gamma fun. Diritchet integral	6	1	10
4	Surfaces Tangent planes, first fundamental form and area Surface Integrals Volume integrals, Diritehet integrals	8	2	20
5	Green theorem in the plane, Triple integrals and divergence theorem of Gauss Divergent ,sequences and applications of the divergence theorems ,Stoker's theorem, Consequences and applications of Stoker's Theorem, Time Integrals and independence of path	7	1	10
	Total	**45**	**11**	**110-30=80**

BIO-ENGINEERING MATERIALS AND COMPONENTS
BEG 2B1 BM

Semester III **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 properties and selection of different materials relevant to their use as biomaterials.

1.0 Properties of Materials: **(6 hours)**

1.1. Introduction.
- 1.1.1. Solids
  - 1.1.1.1 Ionic bonding
  - 1.1.1.2 Covalent bonding
  - 1.1.1.3 Metallic bonding
- 1.1.2. Mechanical properties: tension and compression, shear, elasticity, stress and strain, stiffness, fatigue

1.2. Properties of materials
- 1.2.1. Bulk properties of materials.
- 1.2.2. Surface properties of materials.
  - 1.2.2.1 Various parameters to be measured

1.3. Measurement techniques.
- 1.3.1. Contact angle methods
  - 1.3.1.1 Static or sessile drop method
  - 1.3.1.2 Wilhemly plate method
  - 1.3.1.3 Captive air bubble method
  - 1.3.1.4 Capillary rise method
  - 1.3.1.5 Tilted-drop method
- 1.3.2. Electron Spectroscopy for Chemical Analysis (ESCA) or X-ray Photoelectron Spectroscopy (XPS)
- 1.3.3. Secondary Ion Mass Spectroscopy (SIMS)
- 1.3.4. Scanning Electron Microscopy (SEM)
- 1.3.5. Attenuated Total Reflection Infrared Spectroscopy (ATR) and Infrared Reflection Absorption Spectroscopy (IRRAS)

2.0 **Introduction to Bio-materials:** **(1 hour)**

2.1. Biomaterial science: An interdisciplinary course.
- 2.1.1. Biomaterial: introduction
- 2.1.2. Biocompatibility: introduction
- 2.1.3. Biomaterial science: introduction
- 2.1.4. The current state of affairs in biomaterial science

2.2. Classes of materials used in medicine.

3.0 **Metals:** **(3 hours)**

3.1. Introduction

3.2. Structure, chemistry, mechanical properties and applications of various metals relating to biomaterials.

3.3. Steps in fabrication of implants.
- 3.3.1. Ore
- 3.3.2. Raw material

3.3.3. Shaping
3.3.4. Preliminary implant device
3.3.5. Final implant device
3.3.6. market

3.4. Different metals and alloys used in implants.
3.4.1. Stainless steel
3.4.2. Titanium
3.4.3. Cobalt alloys

4.0 **Polymers:** **(5 hours)**

4.1. Types of polymers used in medicine
4.2. Molecular weight and synthesis.
4.2.1. Number average molecular weight
4.2.2. Weight average molecular weight
4.2.3. Addition polymerization
4.2.4. Condensation polymerization
4.3. Solid state polymers and copolymers.
4.3.1. PTFE
4.3.2. PMMA
4.3.3. PU
4.3.4. Ploysiloxanes (Silicone)
4.4. Hydrogel
4.4.1. Classification
4.4.2. Preparation
4.4.3. Swelling
4.4.3.1.Importance of degree of swelling
4.4.3.2.Quantification of swelling
4.4.4. PHEMA
4.4.5. Applications
4.5. Other polymers and their applications

5.0 Bioresorbable and Bioerodible Materials: **(5 hours)**

5.1. Definitions: bioresorption, biodegradation, bioerosion, biodeterioration
5.2. Need, requirement and uses of biodegradable materials
5.3. Types of degradable implants.
5.3.1. Temporary scaffold
5.3.2. Temporary barrier
5.3.3. Drug delivery device
5.3.4. Multifunctional device
5.4. Currently available degradable polymers.
5.4.1. Polyester
5.4.2. Polyhydroxybutyrate (PHB), Polyhydroxyvalerate (PHV) and copolymer
5.4.3. Polycaprolactone
5.4.4. Polyanhydrides
5.4.5. Polyorthoesters
5.4.6. Polyaminoacids
5.4.7. Polycyanocrylates
5.4.8. Polyphosphazenes
5.4.9. PLA, PGA and copolymer
5.5. Physical mechanisms of bio-erosion.
5.5.1. Bulk erosion
5.5.2. Surface erosion
5.6. Mechanism of chemical degradation.
5.7. Factors influencing the rate of bio-erosion.

5.8. Storage stability, sterilization and packaging.

6.0 **Ceramics, Glasses and Glass ceramics:** **(5 hours)**

6.1. Structure, chemistry and properties of ceramics and glasses used in medical devices.
6.2. Types of bio-ceramics.
6.3. Characteristics and processing of bio-ceramics.
6.4. Nearly inert crystalline ceramics.
- 6.4.1. Alumina
  - 6.4.1.1 Single crystal alumina
  - 6.4.1.2 Polycrystal alumina
  - 6.4.1.3 Uses of alumina
- 6.4.2. Zircona
  - 6.4.2.1 Properties
  - 6.4.2.2 uses of zirconia
- 6.4.3. Pyrolytic carbons
  - 6.4.3.1 Properties of pyrolytic carbons
  - 6.4.3.2 uses of pyrolytic carbons

6.5. Bioactive glasses and glass ceramics.
- 6.5.1. Introduction and properties
- 6.5.2. Bonding to bone
- 6.5.3. Surface reactions on bioactive glasses and glass-ceramics

7.0 Natural Materials: **(5 hours)**

7.1. Different types of natural polymers
- 7.1.1. Advantage and disadvantage
- 7.1.2. Proteins
  - 7.1.2.1 Primary structure
  - 7.1.2.2 secondary structure
  - 7.1.2.3 tertiary structure
  - 7.1.2.4 quaternary structure

7.2. Collagen
- 7.2.1. Structure of native collagen.
- 7.2.2. Physical modification of the native structure of collagen.
- 7.2.3. Chemical modification of collagen.
- 7.2.4. Molecules to microfibrils
- 7.2.5. Microfibrils to fibrils
- 7.2.6. Mechanical properties
- 7.2.7. Physiochemical properties
  - 7.2.7.1 Electrostatic properties
  - 7.2.7.2 Fibre forming properties
  - 7.2.7.3 Biological properties
  - 7.2.7.4 Immunologic properties
- 7.2.8. Isolation and purification of collagen
- 7.2.9. Fabrication of devices
  - 7.2.9.1 Collagen matrix
  - 7.2.9.2 Collagen membrane
  - 7.2.9.3 Collagen gel
  - 7.2.9.4 Collagen Solution

7.3. Elastin
- 7.3.1. Extraction
- 7.3.2. Mechanical properties
- 7.3.3. Properties and uses

7.4. Proteoglycans and glycosaminoglycans.

8.0 Composites: **(4 hours)**

8.1. Introduction and definition of composites.
- 8.1.1. Advantages of composites
- 8.1.2. Disadvantages of composites
- 8.1.3. Classification and application
- 8.1.4. Limitation on properties
- 8.1.5. Voigt and Reuss structures

8.2. Reinforcing systems.
- 8.2.1. Particulate composite
  - 8.2.1.1.Uses of particulate composite
- 8.2.2. Fibrous composite
  - 8.2.2.1.Carbon fiber reinforcement
  - 8.2.2.2.Polymer fiber reinforcement
  - 8.2.2.3.Aramid fiber reinforcement
  - 8.2.2.4.Ceramics

8.3. Polymer composites

9.0 Thin films, Grafts and Coatings: **(2 hours)**

9.1. General Principles
9.2. Methods for modifying the surfaces of materials for enhancing biological interactions.
9.3. The nature and production of plasma environment.
9.4. High energy and high temperature plasma treatments.

10.0 Fabrics: **(3 hour)**

10.1. Types of fabrics and their construction.
10.2. Processing and characteristics of major constructions.
10.3. Characterization, testing, and evolution.
10.4. Major biomedical applications.

11. Biologically Functional Materials: **(2 hour)**

10.5. Some typical words and phrases: enzymes, antibodies, antigens, saccharides, polysaccharides, lipids, peptides, ligands, affinity, conjugation
10.6. Biologically active molecules.
10.7. Immobilization of biologically active molecules.
- 10.7.1. Solid support for biomolecules
- 10.7.2. Biomolecules immobilization
- 10.7.3. Applications
- 10.7.4. Immobilization methods
  - 10.7.4.1.Physical adsorption
  - 10.7.4.2.Physical entrapment
  - 10.7.4.3.Covalent attachment
    - 10.7.4.3.1 Pre-activation of support
    - 10.7.4.3.2 Pre-activation of biomolecule
    - 10.7.4.3.3 Conjugation followed by co-polymerization
    - 10.7.4.3.4 Direct attachment to pre-activated polymer, gel or graft polymer

12.0 Natural Tissues: **(3 hours)**

12.1 Types of natural tissues, connective tissues, blood vessel, ligaments, and tendon.
12.2 Properties of natural tissues.

13.0 **Biology, Biochemistry and Medicine:** **(4 hours)**

13.1 Biocompatibility and haemocompatibility: definitions
13.2 Types of medical devices for blood contacting applications
- 13.2.1 Short term implantation
- 13.2.2 Long term implantation

13.2.3 Extracorporeal devices
13.3 Problems associated with material-blood contact
13.4 Tissue-material interactions
13.5 Molecular and cellular attachment
13.6 Protein systems
13.7 Protein adsorption
13.8 Implants and proteins
13.9 Arrival of cells
13.10 Structure of proteins
13.11 Some major plasma proteins
13.11.1 Albumin
13.11.2 Immunoglobulins
13.11.3 Fibrinogen
13.12 Protein properties which affects interaction with surfaces
13.13 Surface properties which affects interaction with proteins
13.14 Vroman effect
13.15 The importance of adsorbed proteins in biomaterials.
13.16 Desorption of proteins

14.0 Testing of Biomaterials: (6 hours)

14.1 Introduction.
14.2 In vitro assessment of tissue compatibility
14.2.1 Background concepts
14.2.1.1 Cytotoxicity
14.2.1.2 Cell culture
14.2.1.3 Toxicity
14.2.1.4 Exposure dose
14.2.1.5 Safety factors
14.2.1.6 Solubility of materials
14.2.1.7 Solubility in vitro
14.2.2 Assay methods.
14.2.2.1 Direct contact assay
14.2.2.2 Agar diffusion assay
14.2.2.3 Extract dilution assay (elution method)
14.2.2.4 Advantage and disadvantage of different methods
14.2.3 Standardization of tests
14.2.4 Cells for tests
14.2.5 Result interpretations
14.2.6 Why cytotoxicity testing?
14.2.6.1 Clinical uses
14.2.7 Which products should be tested? / Steps in the testing of products.
14.3 In vivo assessment of tissue compatibility.
14.3.1 General effects of implants
14.3.2 Tissue response
14.3.3 Animal models
14.3.4 In vivo tests classification
14.3.4.1 Non functional tests
14.3.4.2 Ex vivo tests
14.3.4.3 Functional tests
14.3.5 Implant sites.
14.3.5.1 Vascularity and parenchymal cells
14.3.5.1.1 Macrophages
14.3.5.1.2 Mechanical stress
14.3.5.2 Bone and musculoskeletal soft tissue
14.3.5.3 Subcutaneous and cutaneous tissue

14.3.5.4 Muscle
14.3.5.5 Epithelia
14.3.5.6 Nerve
14.3.6 Surgical protocol and form of implants, controls.
14.3.7 Evaluation of tissue reaction.
14.3.8 Criteria for assessing acceptability of the tissue response.

15.0 Degradation of Materials in Biological Environment:: (5 hours)

15.1 Introduction
15.2 Introduction to chemical and biochemical degradation of polymers.
15.3 Degradation effects of biological environment on metals and ceramics.
15.4 Corrosion.
15.5 Mechanical breakdown in the biological environment.
15.6 Pathologic calcification of biomaterials, prevention of calcification.
15.6.1 Introduction
15.6.2 Types of calcification
15.6.2.1 Dystrophic
15.6.2.2 Metastatic
15.6.3 Effects of calcification
15.6.4 Mineralization
15.6.5 Extrinsic and intrinsic calcification
15.6.6 Examples
15.6.6.1 Heart valve calcification
15.6.6.2 Calcification of polymeric bladders in blood pumps
15.6.6.3 Calcification of contraceptive uterine devices
15.6.6.4 Calcification of soft contact lenses
15.6.7 Assessment of calcific deposits
15.6.8 Prevention of calcification

16.0 Perspectives and Possibilities in Biomaterials Science: (1 hour)

16.1 Biomimetics
16.2 Biomimetic materials
16.3 Methods of biomolecular recognition
16.4 Surface modifications already in use
16.5 Modern concept
16.6 Advantages of short peptide sequences
16.7 Disadvantages of surface modification
16.8 Bulk modification of biomaterials
16.9 Injectable material
16.10 Effectiveness evaluation
16.11 Applications in tissue engineering
16.11.1 Bone tissue and bone tissue engineering
16.11.2 Neural tissue and neural tissue engineering
16.11.3 Cardiovascular tissue and cardiovascular tissue engineering
16.11.3.1 Human blood vessel
16.11.3.2 Current problem with vascular grafts
16.11.3.3 Ideal graft
16.11.3.4 EC lining

Text Books:
1.0 Hand-outs will be given to students.

Reference Books:
1.0 “Biomaterials Science”, Ed by Buddy Ratner et. al, Academic Press, 1996

Evaluation Scheme:

Chapter No.	Chapter Name	Marks allocated
1	Properties of Materials	5 to 10
2	Introduction to Bio-materials	5 to 10
3	Metals	5 to 10
4	Polymers	5 to 10
5	Bioresorbable and Bioerodible Materials	5 to 10
6	Ceramics, Glasses and Composites	5 to 10
7	Natural Materials	5 to 10
8	Composites	5 to 10
9	Thin films, Grafts and Coatings	5 to 10
10	Biologically Functional Materials	5 to 10
11	Biology, Biochemistry and Medicine	5 to 10
12	Testing of Biomaterials	5 to 10
13	Degradation of Materials in Biological Environment	5 to 10
14	Perspectives and Possibilities in Biomaterials Science	5 to 10

CELL BIOLOGY AND IMMUNOLOGY

BEG 2B3 BM

Semester III **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	3	80	3	15	20	10	125	

COURSE OBJECTIVE: To give the basics of cell biology & immunology required for biomedical Engineers.

1. CELL BIOLOGY 6 Hours

1.1. Cell Structure, Function and Biosynthesis of Cell membrane and Organelles.

1.1.1 Cell, Definition, Types of Cells.

1.1.2 Prokaryotic and Eukaryotic Organization

1.1.3 Cell Size, Cell shape and Cell Organelle

1.1.4 General Idea of Viruses, Mycoplasma, Viriods and Prions.

1.2. Cell Growth, Apoptosis and Oncogenic Transformation.

1.2.1. Cell growth, Generation time, Growth in Multicellular Organisms.

1.2.2. Cell Cycle and Cell Division.

1.2.3. Apoptosis, Definition, Caspases, Adaptor Protein, TNF Family, BCl2 Family, Necrosis Vs Apoptosis and Importance of Apoptosis.

1.2.4. Oncogenic Transformation, Oncogene, Cancer, Types of Tumor, Molecular Basis of Cancer, Anti-Oncogene, growth factors. Viral and Cellular Oncogene, Tumor Suppressor gene.

1.3. Transport, Receptor and Cell Signaling.

1.3.1. Transport, Plasma Membranes, Molecular Models of Plasma membranes.

1.3.2. Membrane Transport:Passive Transport, Diffusion down concentration gradient, Diffusion down the electric gradient, Osmosis, Faciliated Transport, Active Transport .

1.3.3. Receptors,Types of receptors (Enzyme linked receptors, Ion Channel receptors, G- Protein Coupled receptors.

1.3.4. Cell Signaling (Signal Transduction), Importance and its implication. Second Messenger Hypothesis, Sensory Responses, Antigen Mediated responses. Humoral and Cell mediated responses.

1.4. Cytoskeleton, Extracellular matrix and Cell movement.

1.4.1. Cytoskeleton, Microtubules, Biochemical Composition, Function of microtubeles, microtubular organelles, centriolar apparatus, Ciliary apparatus, microfilaments, Chemical composition, microtubular system.

1.4.2. Cell Movement amoeboid motion, cytoplasmic streaming, microvilli, Ciliary and flagellar motion, kinesis – mediated movement, flagellar movement in bacteria.

1.5. Chromatin Structure.

1.5.1. Nucleolus, chromatin, chemistry of Chromatin, Histone and non-Histone proteins.

2. BIOMOLECULES 6 Hours

2.1. Carbohydrate.

2.1.1. Definition, Types of carbohydrates, General Structure and examples of Monosaccharide, Disaccharides and Polysaccharides.

2.1.2. Starch, cellulose, Glycogen, Chitin, Dextrin, Insulin.

2.1.3. Isomers (Anomers, Epimers) D & L form, Racemic mixtures.

2.2. Lipids

2.2.1. Definition, Classification and Function of Lipids.

2.2.2. Importance and General structure of fatty acids and glycerol.

2.2.3. Essential fatty acids, Phospholipids and its types.

2.2.4. Glycolipids, Lipoprotein, Steroids and Cholesterol.

2.3. Proteins

2.3.1. Types and Function of Proteins.

2.3.2. Amino acids, general structure and Classification of amino acids. Isoelectric PH, Zwitterion.

2.3.3. Polypeptide and Peptide Bond. Primary, secondary, Tertiary and Quaternary Structure of Proteins.

2.4. Nucleic Acids.

2.4.1. DNA and RNA, Function of Nucleic acids (NA), Components of NA.

2.4.2. Nucleotides (Nitrogenous Base, Pentose Sugar and Phosphate)

2.4.3. Structure of DNA and RNA.

2.4.4. Different forms of DNA-double helix.

2.4.5. Types of RNA

3. MOLECULAR BIOLOGY AND GENETICS 8 Hours

3.1. Central dogma: DNA, RNA and Protein Synthesis.

3.1.1. Replication of DNA (in Prokaryotic and Eukaryotic)

3.1.2. Transcription,

3.1.3. Post-Transcriptional modifications, Reverse transcription.

3.1.4. Translation. Chaperone and Protein folding.

3.2. Mutation and Repair.

3.2.1. Genetic Mutation (Point and Frame shift Mutation).

3.2.2. Consequences of point and Frame shift mutation.

3.2.3. Types of DNA damages and its repair.

3.3. Genetic Engineering.

3.3.1. Application and Importance of Genetic engineering.

3.3.2. Target DNA, restriction Endonucleases, Cloning Vectors, gene manipulation.

3.3.3. Plasmids as vector, Plasmid Cloning.

3.3.4. Bacteriophage as vectors.

3.3.5. Cloning Techniques, Ligation of DNA.

3.3.6. Industrial Application.

4. IMMUNOLOGY **18 Hours**

4.1. Introduction of Immunology.

4.1.1. Elie Metchnikoff, Louis Pasteur, Paul Ehrlich, Robert Koch etc.

4.1.2. Specific and Non-Specific Immune responses.

4.1.3. Natural Barriers, Mucus secretion, phagocytosis.

4.1.4. Pattern recognition, Ingestion, Killing by NO etc.

4.2. Antigen and Antibody.

4.2.1. Introduction, structure, type, function and importance of Ag and Ab.

4.2.2. Immunoglobulins.

4.3. Antigen and antibody Reactions and its effect.

4.3.1. Precipitation, Agglutination, Complement fixation.

4.3.2. Immuno-assay using labeled reagents (RIA, ELISA).

4.3.3. Immunohistochemistry, Cytokine Immunoassay.

4.3.4. DNA immunoassay (Western Blot).

4.4. Complement System.

4.4.1. Complement and its component, activators of complement.

4.4.2. Classical and Alternate Pathway.

4.4.3. Control mechanism of the complement system. Biological Consequences of complement activation.

4.5. Development structure and function of Immune response.

4.5.1. Stem Cells, The polymorph nuclear neutrophil, Mononuclear Phagocyte, Eosinophils.

4.5.2. Lymphoid Organs, Lymphocytes & Lymphocyte traffic.

4.5.3. Primary Lymphoid Organs (The thymus).Secondary Lymphoid Organs (Lymph Node & Spleen).

4.6. Cell Mediated Immunity and Humoral Immunity.

4.6.1. Hypersensitivity and its type

4.6.2. Autoimmunity

5. BLOOD 3 hours

5.1. Composition of Blood

5.1.1. Plasma, constituents of plasma and their functions

5.1.2. Erythrocytes (RBCs), leukocytes (WBCs) and platelets and their functions

5.1.3. Clotting factors

5.2. Haematopoesis

5.2.1 Haematopoetic stem cell

5.2.2 Differentiation and maturation of haematoblast into RBCs, WBCs and Plateletes

5.3. Identification of different blood cells

5.3.1 RBCs

5.3.2 WBCs: Granulocytes; Neutrophils, Eosinophils and Basophils

Agranulocytes; Monocytes and Lymphocytes

5.3.3 Plateletes: Megakaryrocytes and cell fragments

5.4. Hemostasis

5.3.1 Components of coagulation cascades

5.3.2 Extrinsic, intrinsic and common pathway of coagulation cascades

4. **EUKARYOTES AND PROKARYOTES 4 hours**

6.1. Microorganism: structure, growth and reproduction, eg. Bacteria

6.2. Parasitology: structure, growth and reproduction, eg. *E. histolytica, Giardia lamblia, T. solium, Plasmodium*

6.3. Virology: structure, growth and reproduction, eg. Hepatitis viruses, HIV, Herpes, Rhabdo

6.4. Mycology: structure, growth and reproduction, eg. *Candida albicans, Saccharomyces cerevesiae*.

Evaluation Scheme:

Chapter	Lecture Hour	Questions	Marks
CELL BIOLOGY			
Cell Structure, Function and Biosynthesis of Cell membrane and Organelles.	1	1 –long 2-short	8 10
Cell Growth, Apoptosis and Oncogenic Transformation	2		
Transport, Receptor and Cell Signaling.	2		
Cytoskeleton, Extracellular matrix and Cell movement.	2		
Chromatin Structure	1		
BIOMOLECULES			
Carbohydrates	1	1 long	8
Lipids	1		
Proteins	1		
Nucleic acids	2		
MOLECULAR BIOLOGY AND GENETICS			
Central dogma: DNA, RNA and Protein Synthesis	3	1 long 1 short	8 5
Mutation and Repair	2		
Genetic Engineering	2		
IMMUNOLOGY			
Overview of immunity	2	2 long 2 short	16 10
Antigen and Antibody	2		
Complement System	2		
Antigen and antibody Reactions and its effect	2		
Development structure and function of Immune cells and organs	3		
Cell Mediated Immunity and Humoral Immunity.	3		
BLOOD			
Composition and types of blood cells	1	1 long	6
Haematopoesis and identification of blood cells	1		
Homeostasis	1		
EUKARYOTES AND PROKARYOTES			
Microorganisms	1	1 long	6
Parasitology	1		
Mycology	1		
Virology	1		

FLUID MECHANICS
BEG 2C5 BM

Semester III **Year II**

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

COURSE OBJECTIVE: To provide fundamental knowledge on fluid mechanics and give an idea on difference between blood and water flow.

1.0 Introduction: **(5 Hrs)**

1.1. Fluid Mechanics,
- 1.1.1. Definition & Basic Concepts

1.2. Fluids,
- 1.2.1. classification
  - 1.2.1.1.1. Newtonian and Non-Newtonian fluid
  - 1.2.1.1.2. Ideal and Real fluid
- 1.2.2. Properties
  - 1.1.1.1 Extensive and Intensive properties
  - 2.1.1.1 Specific weight, Mass Density and Specific Gravity
  - 3.1.1.1 Compressibility and bulk modulus
  - 4.1.1.1 Viscosity
  - 5.1.1.1 Numerical problems

2.0 **Fluid Pressure & Forces:** **(9 Hrs)**

2.1. Pressure and hydrostatic force
- 2.1.1.Pascal's Law
- 2.1.2.Pressure at a point in fluid
- 2.1.3.General Equation for variation of pressure in a static Fluid
- 2.1.4.Variation of pressure vertically in a fluid under gravity
- 2.1.5.Equality of pressure at the same level in a static fluid
- 2.1.6.Pressure and head
- 2.1.7.Numerical problems

2.2. Atmospheric Pressure, gauze pressure and absolute pressure

2.3. Pressure Measurement Devices
- 2.3.1.Manometer
  - 2.3.1.1.1. The Piezometer tube manometer
  - 2.3.1.1.2. The "U"- tube manometer
  - 2.3.1.1.3. Measurement of pressure difference using a "U" tube manometer
  - 2.3.1.1.4. Selection of Manometer
  - 2.3.1.1.5. Numerical problems

2.4. Forces on submerged surfaces:
- 2.4.1. Plane horizontal surface,
- 2.4.2. plane vertical surface
- 2.4.3. Inclined surfaces.
- 2.4.4. Force in regular curved surface
- 2.4.5.Center of Pressure & Pressure Diagrams
- 2.4.6.Numerical problems

3.0 **Buoyancy & Floatation:** **(5 Hrs)**

3.1. Archimedes Principle
- 3.1.1.Definition
- 3.1.2.Uses
- 3.1.3.Concept of buoyancy

3.2. Principle of floatation,

3.2.1. Definition of flotation
3.2.2. Conditions for Equilibrium of floating body
3.2.3. Meta center and stability
3.2.4. Metacentric height determination
3.2.5. Numerical problems

3.3. Fluid Mass Subjected to Acceleration
3.3.1. Fluid in a container subjected in a constant acceleration in horizontal plane and pressure diagram
3.3.2. Fluid in a container subjected in a constant acceleration in inclined plane(upward and downward) and pressure diagram
3.3.3. Numerical problems

4.0 **Fluid Kinematics:** **(8 Hrs)**

4.1. Description of Motion:
4.1.1. Lagrangian & Eulerian Methods of fluid flow
4.1.2. Lines of Flow

5.0 ***Methods of Visualizing Fluid Flows***
5.1.1. Stream line flow
5.1.2. Stake line flow
5.1.3. path line flow

5.2. Types of Flow:
5.2.1. Steady Flow-Unsteady Flow,
5.2.2. Uniform Flow-Non Uniform Flow,
5.2.3. Laminar Flow-Turbulent Flow,
5.2.4. Compressible Flow- Incompressible Flow,
5.2.5. Rotational Flow-Irrotational Flow
5.2.6. Reynolds Number

5.3. One/Two/Three Dimensional Flows
5.3.1. Equation of fluid flow in three dimension/ two dimension and one dimension
5.3.1.1.1. Derivation and interpretation

5.4. Quantitative description of flow
5.4.1. Velocity of flow
5.4.2. Acceleration of flow
5.4.3. Mass flow rate of fluid
5.4.4. Discharge & Mean Velocity of Flow
5.4.5. Continuity of flow
5.4.6. Equation of Continuity of Flow for One Dimensional Steady Flow
5.4.7. Numerical problems

5.5. Velocity potential function and stream function
5.5.1. Derivation of relation
5.5.2. Numerical problems

5.6. Rotation & Vorticity
5.6.1. Introduction and concept

6.0 **Dynamics of Flow:** **(8 Hrs)**

6.1. Various Forces on Fluid
6.1.1. Force due to atmospheric pressure
6.1.2. Force due to friction
6.1.3. Force due to viscosity
6.1.4. Hydrostatic force
6.1.5. Force due to self weight

6.2. Equation of motion

6.2.1.Euler's Equation of Motion,

6.3. Bernoulli's theorem

6.3.1.Assumptions

6.3.2.Bernoulli's equation from Euler's equation

6.3.3. work and energy

6.3.4.Applications of the Bernoulli Equation

6.3.4.1.1. Pitot Tube

6.3.4.1.2. Venturi Meter

6.3.4.1.3. Flow Through Orifice

6.3.4.1.4. Venturi-meter and Orifice-meter

6.3.4.1.5. Flow from reservoir

6.3.4.1.6. Numerical problems

6.4. Energy of Steady Fluid Flow

6.5. Force exerted by flowing fluid on a stationary body

6.5.1. Drag forces

6.5.2. Lift forces

6.6. Concept of Boundary Layer

6.6.1.Laminar boundary layer

6.6.2.Turbulent boundary layer

6.6.3.Boundary layer thickness

6.6.4. Displacement thickness

6.6.5.Energy thickness

6.6.6.Drag force on a flat plate due to boundary plate

7.0 Introductions on to Thermodynamics and Heat Transfer: (10Hrs)

7.1. Introduction to thermodynamics

7.1.1. System,

7.1.2.Surrounding and boundary

7.1.3. Substances

7.1.4. Properties.

7.1.5.Work and energy

7.1.6.Numerical problems

7.2. Thermodynamic process

7.2.1. Isothermal

7.2.2.Isobaric

7.2.3.Isochoric

7.2.4.Adiabatic

7.2.5.Isotropic

7.2.6.isenthalpic

7.2.7.Work done in different thermodynamic process

7.3. First Law of Thermodynamics.

7.3.1.Control mass system

7.3.1.1.1. Derivation and interpretation

7.3.1.1.2. Problems

7.3.2.Control volume system

7.3.2.1.1. Derivation and interpretation

7.3.2.1.2. Problems

7.4. Second Law of Thermodynamics

7.4.1.Kelvin-Planck Statement,

7.4.2.Clausis statement,

7.4.3.Relation between Clausis and Kelvin-Planck

7.4.4. Entropy,

7.4.5.Enthalpy,

7.4.6.Heat Engine,

7.4.7. Refrigerator, Coefficient of Performance.

7.4.7.1.1. Refrigerants: Classification and Properties.

7.5. Modes of Heat Transfer:

7.5.1.Definition and concept of heat transfer

7.5.2.Conduction,

7.5.2.1.1. heat transfer through plane wall

7.5.2.1.2. Heat transfer through a composite wall

7.5.2.1.3. Heat transfer through cylindrical surface (composite surface)

7.5.3.Convection

7.5.3.1.1. Newton's law of cooling

7.5.3.1.2. Free convection

7.5.3.1.3. Forced convection

7.5.4.Radiation.

7.5.4.1.1. Stefan Boltzmann law of radiation

7.5.4.1.2. Reflectivity

7.5.4.1.3. Absorptivity

7.5.4.1.4. Transitivity

7.5.4.1.5. Black body

7.5.4.1.6. Opaque body

7.5.4.1.7. White body

7.5.4.1.8. Emissivity

Textbooks:

1.0 Dr. J. Lal, "Fluid Mechanics and Hydraulics", Metropolitan Books Co. Pvt Ltd., Delhi, 1987

2.0 R.J. Grade, "Fluid Mechanics"

3.0 Webster.f.P. Beer and E.R. Johnston, Jr., "Fluid Mechanics", 4th Edition, McGraw-Hill, 1987

4.0 Dr. D.S. Kumar "Fluid mechanics and fluid power engineering" sixth edition 1998

5.0 Dr. R.K. Bansal " Fluid mechanics and Hydraulics Machines" ninth edition 2005

MICROPROCESSORS

BEG237 EC

Semester III **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	2	3	80			20	50	150	

COURSE OBJECTIVES: The objective of this course is to provide fundamental knowledge to understand the operation, programming and application of microprocessor.

1. INTRODUCTION

[6Hr]

1.1 Introduction topics on:
- 1.1.1 Microprocessor
- 1.1.2 Microcontroller
- 1.1.3 Microcomputer

1.2 Evolution of Microprocessor
- 1.2.1 Historical Prospective of Microprocessor

1.3 Calculator and Stored program Concept
- 1.3.1 Features of Automated Calculator
- 1.3.2 Definition of stored program concept

1.4 Von Neumann and Harvard Architecture
- 1.4.1 Von Neumann Architecture
  - 1.4.1.1 Block Diagram
  - 1.4.1.2 Features
- 1.4.2 Harvard Architecture
  - 1.4.2.1 Block Diagram
  - 1.4.2.2 Features

1.5 Simple stored Program computer Architecture
- 1.5.1 Internal Architecture of 8 bit microprocessor
  - 1.5.1.1 Accumulator
  - 1.5.1.2 Registers B,C,D,E,H,L
  - 1.5.1.3 Temporary Registers
  - 1.5.1.4 Stack Pointer
  - 1.5.1.5 Program Counter
  - 1.5.1.6 Arithmetic Logic Unit
  - 1.5.1.7 Flags

2 Microprocessor Instruction

[8Hr]

2.1 Instruction and Machine Cycle
- 2.1.1 Instruction of a computer
  - 2.1.1.1 Operation Code
  - 2.1.1.2 Address Field
- 2.1.2 Instruction Format
  - 2.1.2.1 One Byte Instruction
  - 2.1.2.2 Two Byte Instruction

2.1.2.3 Three Byte Instruction

2.1.3 Classification of instruction(For 8085)

2.1.3.1 Description of Data Transfer Instruction

2.1.3.1.1 Load Registers Immediate

2.1.3.1.2 Load memory Immediate

2.1.3.1.3 Load Register pairs Immediate

2.1.3.1.4 Load Accumulator Direct

2.1.3.1.5 Load Accumulator indirect

2.1.3.1.6 Move register Instruction

2.1.3.1.7 Move to Memory from Register

2.1.3.1.8 Move to register from Memory

2.1.3.1.9 Store Accumulator Content

2.1.3.1.10 Exchange contents of H&L with D&E

2.1.3.1.11 Load H&L directly

2.1.3.1.12 Store Content of H&L directly

2.1.3.2 Description Arithmetic Group Instruction

2.1.3.2.1 Addition operation in 8085 microprocessor(8 bit and 16 bit)

2.1.3.2.2 Subtraction operation in 8085 microprocessor(8 bit and 16 bit)

2.1.3.2.3 Increment operation

2.1.3.2.4 Decrement operation

2.1.3.2.5 Flag operation

2.1.3.3 Description of Logical group instruction

2.1.3.3.1 Logical AND operation

2.1.3.3.2 Logical OR operation

2.1.3.3.3 Logical Ex- OR operation

2.1.3.3.4 Rotate operation

2.1.3.3.5 Compare operation

2.1.3.4 Description of miscellaneous group instruction

2.1.3.4.1 Instruction related to stack operation

2.1.3.4.2 Instruction related to IO ports

2.1.3.4.3 Instruction related to interrupt

2.1.4 Instruction Cycle

2.1.4.1 Fetch and Decode cycle

2.1.4.2 Execute Cycle

2.2 Addressing Modes

2.2.1 Direct Addressing

2.2.2 Indirect Addressing

2.2.3 Register Direct

2.2.4 Immediate Addressing

2.2.5 Implied Addressing

2.3 Register Transfer Language(for MOV,MVI,LDA, STA,IN, OUT)

2.3.1 Op-code fetch machine cycle

2.3.2 Memory read machine cycle

2.3.3 Memory write machine cycle

2.3.4 IO read machine cycle

2.3.5 IO write machine cycle

3 Assembly language Programming [10Hr]

3.1 Introduction to 16 bit microprocessor
- 3.1.1 Bus Interface Unit
- 3.1.2 Execution Unit

3.2 Assembler syntax labels, instructions, directives and comments

3.3 Types of Assembler and Assembler operation
- 3.3.1 One pass assembler
- 3.3.2 Two pass assembler
- 3.3.3 Assembler directives
- 3.3.4 Sample Assembly Language Program
- 3.3.5 Macro Assemblers

3.4 Description of Assembly process in Macro assembler(MASM)
- 3.4.1 Assembling(Compiling)
- 3.4.2 Linking
- 3.4.3 Sample program

3.5 16 Bit Microprocessor Addressing Modes
- 3.5.1 Register and immediate addressing (direct) modes
- 3.5.2 Memory Addressing(Register Indirect) mode
- 3.5.3 Memory Direct
- 3.5.4 Register Indirect Address
- 3.5.5 Based Address
- 3.5.6 Indexed Address
- 3.5.7 Based Indexed Address
- 3.5.8 String Address

3.6 Some common Instructions & operators of Intel 8086

3.7 Some common DOS functions and Interrupts
- 3.7.1 INT 21H
- 3.7.2 INT 10H

4 Bus Structure and Memory Devices: [4 Hrs]

4.1 Bus Structure: Definition
- 4.1.1 Address Bus
- 4.1.2 Data Bus
- 4.1.3 Control Bus
- 4.1.4 Synchronous Bus
- 4.1.5 Asynchronous Bus

4.2 Memory Devices
- 4.2.1 Processor Memory
  - 4.2.1.1 Register
  - 4.2.1.2 Cache
- 4.2.2 Primary memory
  - 4.2.2.1 Random Access Memory
    - 4.2.2.1.1 Static RAM
    - 4.2.2.1.2 Dynamic RAM

4.2.2.2 Read Only Memory
4.2.2.2.1 Masked ROM
4.2.2.2.2 PROM
4.2.2.2.3 EPROM
4.2.2.2.4 EEPROM
4.2.2.2.5 UVPROM
4.2.2.2.6 ROM Design
4.2.2.3 Secondary Memory
4.2.2.4 Access time and Cycle time
4.2.3 Memory Interfacing
4.2.3.1 ROM Interfacing
4.2.3.2 RAM Interfacing
4.3 Bus Timing Diagram (For MOV, MVI, IN, OUT, LDA, STA etc.)

5 Input Output Interface [7 Hr]

5.1 Input Output interface
5.1.1 I/O Interface
5.1.2 Serial Interface
5.1.3 Parallel Interface
5.1.4 Address decoding
5.1.4.1 I/O mapped I/O
5.1.4.2 Memory mapped I/O
5.1.4.3 Unique Address decoding
5.1.4.4 Non- Unique Address Decoding
5.1.4.5 Examples of interfacing I/O ports
5.2 Synchronizing the computer with Peripherals
5.2.1 Data Transfer using simple wait interface
5.2.2 Hand Shaking
5.2.2.1 Single Handshaking
5.2.2.2 Double Handshaking
5.3 Serial communication
5.3.1 Synchronous Serial data transmission
5.3.2 Asynchronous serial data transmission
5.3.3 Baud Rate
5.3.4 ASCII character
5.3.5 RS232-C Standard
5.4 Keyboard and display interface
5.5 8251A Programmable Communication Interface
5.5.1 Block Diagram
5.6 Parallel Communication : Definition

6 Interrupt Operation [4Hr]

6.1 Introduction, interrupt vector and Descriptor Table
6.1.1 Definition
6.1.2 Interrupt Service Routine
6.1.3 Process of Interrupt Operation
6.2 Interrupt vector table
6.3 Interrupt Priority

- 6.3.1 External Interrupt
  - 6.3.1.1 Maskable Interrupt
  - 6.3.1.2 Non- Maskable Interrupt
- 6.3.2 Internal Interrupt
- 6.3.3 Trap and exceptions
- 6.3.4 Software Interrupt

6.4 Vectored (chained) and Polled Interrupt
- 6.4.1 Polled Interrupt
- 6.4.2 Vectored Interrupt

6.5 Peripheral devices using interrupts
- 6.5.1 Interrupts of 8085
  - 6.5.1.1 TRAP
  - 6.5.1.2 RST 7.5, 6.5, 5.5 (RIM and SIM instruction)
  - 6.5.1.3 INTR

6.6 Process of Handling Multiple Interrupt
- 6.6.1 Sequential approach
- 6.6.2 Nested Approach

6.7 8259 Programmable Interrupt Controller (PIC)

7 Multiprogramming

[4Hr]

7.1 Microprogramming, Multiprogramming and Uniprogramming
- 7.1.1 Microprogramming
- 7.1.2 Multiprogramming
- 7.1.3 Uniprogramming
- 7.1.4 Multitasking

7.2 Process Management and Semaphore

7.3 Common Procedure Sharing

7.4 Memory Management
- 7.4.1 Definition
- 7.4.2 Virtual memory

8 Introduction to Advanced Microprocessor Architecture

[2Hr]

8.1 RISC Machine
- 8.1.1 Introduction
- 8.1.2 Features

8.2 CISC Machine
- 8.2.1 Introduction
- 8.2.2 Features

8.3 Difference between RISC and CISC

Chapter	Lecture Hours	Marks
Introduction	6	5-10
Microprocessor Instruction	8	15-25
Assembly language Programming	10	20-25
Bus Structure and Memory Devices	4	10
Input Output Interface	7	10-15
Interrupt Operation	4	5-10
Multiprogramming	4	5-10
Introduction to Advanced Microprocessor Architecture	2	5
Total	**45**	**80**