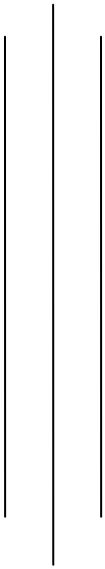
SYLLABUS

FOR
BACHELOR IN BIOMEDICAL ENGINEERING
BE (BM)



PURBANCHAL UNIVERSITY

(FACULTY OF SCIENCE AND TECHNOLOGY)
BIRATNAGAR, NEPAL
2006

PURBANCHAL UNIVERSITY

FACULTY OF SCIENCE AND TECHNOLOGY

CURRICULUM

ON

BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING

1.0 Introduction:

Purbanchal University is offering the bachelor's degree course in Biomedical Engineering through its own as well as affiliated colleges with the objective of producing high-level technical manpower as per the nation's need and with a capacity to undertake any kinds of Biomedical Engineering works using new technologies.

2.0 Details of the Course:

The following are the details of the course.

2.1 Title of Course:

Bachelor in Biomedical Engineering

2.2 Objectives of the Course:

The objective of the course is to train students with appropriate technical & analytical knowledge and skills required to enable them to function and practice as professional Biomedical Engineers on all aspects of Biomedical Engineering works.

2.3 Duration of the Course:

The total duration of the course is 4 years. Each year consists of two semesters and each semester has duration of 90 days.

3.0 Admission Procedure:

3.1 Eligibility:

3.1.1 The candidate must have passed I. Sc. Examination or 10+2 (Science) or Diploma in Engineering (Electrical and Electronics) from recognized Universities minimum in second division.

3.1.2 The candidate must have passed entrance examination conducted by the University.

3.1.3 The successful candidates in the entrance examination will be admitted in the merit basis in the University affiliate colleges.

4.0 Course Structure:

4.1 Contents:

The teaching course is divided in eight semesters (half yearly). The first two semesters are general and are of prerequisite nature.

4.2 Subject Codes:

Each subject is coded with specific letters and numbers. The code of all subjects that are offered in engineering programme begins with three letters: **"BEG"** which denotes Bachelors in Engineering which is followed by three numbers; for Biomedical department, at first a digit then letter **B** and then a digit for course code, denoting subject offered in the particular half yearly semester. The first digit denotes the year for example 1, 2, 3 & 4 for first, second, third and fourth year

respectively. The second digit/alphabet-**B** and third digits 0 to 99/B0-B9 are used to represent specific subject i.e. subject code. The last two letters denote the department, which offer the subject (e.g. BM-Biomedical; SH-Science & Humanities; ME-Mechanical Engineering; EL-Electrical Engineering; EC Electrical Communication Engineering; AR-Architecture etc). The subject code is provided as per the departments offering the subject. The total departments that are offering the subjects and subject code provided for them as are below.

	Departments	**Subject Code**
1	Science & Humanities in short **"SH"**	01 to 09
2	Architecture in short **"AR"**	10 to 19
3	Electrical in short **"EL"**	20 to 29
4	Electronics & Communication in short **"EC"**	30 to 39
5	Mechanical in short **"ME"**	40 to 49
6	Civil in short **"CI"**	50 to 69
7	Computer in short **"CO"**	70 to 89
8	Management Science in short **"MS"**	90 to 99
9	Biomedical in Short **"BM"**	B0-B9, C0-C9

Note:

The subject code of particular subject offering in particular year can remain the same for another subject which is being offered in another year. For example: the subject code of Bio-Engineering Materials and Components is B1. This subject is being offered in 2nd year, first part with the code **BEG2B1BM.** Similarly, the subject code of Engineering Geology is 58; this subject is being offered in 2nd year, first semester with the code **BEG258CI** and similarly, the subject code of Soil Mechanics is also 58 but this subject is being offered in 3rd year 1st semester with the code **BEG358CI**.

Example

BEG104 SH is the code for subject **Chemistry** (the subject code of chemistry is 04) that is offered in first year by the department of Science & Humanities.

4.3 Teaching Methods:

The teaching methods applied are lecture, tutorial, practical and course work or work project. Tutorials are used to develop and enlarge the concepts stated in lecture. Practical classes in form of laboratory works and drawing practice are used to verify the concept and develop required technical and analytical skills. Similarly, course works and course projects are aimed at creating necessary knowledge and skill to implement and present the acquired technical and analytical skills in the form of projects. The medium of instruction, test and examination of the bachelor's degree course in Biomedical Engineering is conducted in English.

Evaluation and Grading System:

The evaluation of the student's knowledge is done through internal assessments during the course and followed by final semester examination. For the theoretical components of a subject weight of 20% for the internal assessment and 80% for semester examination are allocated while for practical component, the method of continuous assessment is adopted except for limited particular subjects in which semester examination are also conducted.

The student must obtain at least 40% mark in internal assessment in each subject to be eligible to sit in the final semester examination. The student should get 40% mark to pass in semester examination. The students who have passed all the subjects in all semester are considered to have successfully completed the course.

Course Structure-Biomedical Engineering

Year 1/Semester I

S.N	Course Code	Course Description	Credits	Lecture	Tutorial	Laboratory	Total
1	BEG101SH	Engineering Mathmatics I	3	3	1	-	4
2	BEG103SH	Physics	4	4	1	2	7
3	BEG105SH	Communicative English	3	3	1	-	4
4	BEG180CO	Introduction to Computer and Programming	3	3	1	3	7
5	BEG145ME	Engineering Drawing	3	1	-	3	4
6	BEG129EL	Basic Electrical Engineering	3	3	1	3	7
Total			**19**	**17**	**5**	**11**	**33**

Year 1/Semester II

S.N	Course Code	Course Description	Credits	Lecture	Tutorial	Laboratory	Total
1	BEG102SH	Engineering Mathmatics II	3	3	1	-	4
2	BEG104SH	Chemistry	3	3	1	2	6
3	BEG143ME	Basic Mechanical Engineering	3	3	1	3	7
4	BEG122EL	Electro-Engineering Materials	3	3	1	-	4
5	BEG170CO	Computational System & Database Concept	3	3	1	2	6
6	BEG139EC	Digital Logic	3	3	1	2	6
Total			**18**	**18**	**6**	**9**	**33**

Year 2/Semester III

S.N.	Course Code	Course Description	Credits	Lecture	Tutorial	Laboratory	Total
1	BEG201SH	Engineering Mathmatics III	3	3	1	-	4
2	BEG2B1BM	Bio-Engineering Materials and Components	4	3	1	-	4
3	BEG2B2BM	Human Anatomy and Physiology I	4	3	1	3	7
4	BEG2C5BM	Fluid Mechanics	3	3	1	3	7
5	BEG2B3BM	Cell Biology and Immunology	3	3	1	3	7
6	BEG237EC	Microprocessors	3	3	1	2	6
		Total	**20**	**18**	**6**	**11**	**35**

Year 2/Semester IV

S.N.	Course Code	Course Description	Credits	Lecture	Tutorial	Laboratory	Total
1	BEG204SH	Applied Maths	3	3	1	-	4
2	BEG239EC	Electronic Devices and Circuits	3	3	1	2	6
3	BEG299MS	Sociology	3	3	1	-	4
4	BEG2C1BM	Biomechanics	4	3	1	-	4
5	RM2C8BM	Research Methodology	2	2	1	-	3
6	BEG2B4BM	Human Anatomy and Physiology II	4	3	1	3	7
		Total	**19**	**17**	**6**	**5**	**28**

Year 3/Semester V

S.N.	Course Code	Course Description	Credits	Lecture	Tutorial	Laboratory	Total
1	BEG304SH	Probability and Statistics	3	3	1	-	4
2	BEG389CO	Numerical Methods	3	3	1	2	6
3	BEG3C3BM	Measurement and Instrumentation	3	3	1	2	6
4	BEG329EL	Control Systems	3	3	1	3	7
5	BEG3C2BM	Biomedical Embedded System Design	3	3	1	2	6
6	BEG3B6BM	Communication Systems	4	4	1	2	7
		Total	**19**	**19**	**6**	**11**	**36**

Year 3/Semester VI

S.N.	Course Code	Course Description	Credits	Lecture	Tutorial	Laboratory	Total
1	BEG399MS	Engineering Economics	3	3	1	-	4
2	BEG3B2BM	Tissue Device Interactions	3	3	1	-	4
3	BEG3B3BM	Medical Imaging I	3	3	1	2	6
4	BEG3B4BM	Biomedical Instrumentation I	4	4	1	2	7
5	BEG3B1BM	Medical Electronics	3	3	1	2	6
6	BEG3B5BM	Biomedical Digital Signal Processing	3	3	1	2	6
		Total	**19**	**19**	**6**	**8**	**33**

Year 4/Semester VII

S.N.	Course Code	Course Description	Credits	Lecture	Tutorial	Laboratory	Total
1	BEG4B7BM	Organisation and Project Management	3	3	1	-	4
2	BEG4B1BM	Biomedical Instrumentation II	4	4	1	2	7
3	BEG4B2BM	Medical Imaging II	3	3	1	2	6
4	BEG4B3BM	Implantable Devices	3	3	1	-	4
5	BEG4C9BM	Project I	3	3	-	3	6
6	-	Elective I	3	3	1	-	4
		Total	**19**	**19**	**5**	**7**	**31**

Year 4/Semester VIII

S.N.	Course Code	Course Description	Credits	Lecture	Tutorial	Laboratory	Total
1	BEG4B4BM	Medical Industry Management	3	3	1	-	4
2	BEG4B5BM	Engineering Professional Practice	2	2	1	-	3
3	-	Elective II	3	3	1	-	4
4	-	Elective III	3	3	1	-	4
5	BEG4B8BM	Project II	6	6	-	6	12
		Total	**17**	**17**	**4**	**6**	**27**

Total **150**

Elective I

S.N.	Course Code	Course Description	Credits	Lecture	Tutorial	Laboratory	Total
1	BEG4B9BM	Structural Biomaterials	3	3	1	-	4
2	BEG4C8BM	Biomedical Equipment Maintenance	3	-	1	5	6

Elective II

S.N.	Course Code	Course Description	Credits	Lecture	Tutorial	Laboratory	Total
1	BEG4C2BM	Minimally Invasive Medical Technology	3	3	2	-	5
2	BEG4B6BM	Medical Image Processing	3	3	1	2	6
3	BEG4C5BM	Theory of Medical Robotics	3	3	2	-	5

Elective III

S.N.	Course Code	Course Description	Credits	Lecture	Tutorial	Laboratory	Total
1	BEG4C7BM	Neural Network	3	3	1	2	6
2	BEG4C3BM	Medical Informatics	3	3	1	2	6
3	BEG4C1BM	Telemedicine and Telehealth	3	3	1	-	4

YEAR I

SEMESTER I & II

ENGINEERING MATHEMATICS I
BEG101 SH

Semester I **Year I**

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

COURSE OBJECTIVES: The basic objective of the course is to provide a sound knowledge of calculus and other related topics.

1.0 Limits and Continuity of a Function: Limit of a function with examples, infinity as a limit, continuity of a function, and simple properties of a continuous function **(3 hours)**

2.0 Derivatives: Review of derivatives (Derivatives of Implicit, Parametric equation, hyperbolic and inverse hyperbolic function), Higher order derivatives, successive derivatives and Leibnitz theorem, Functions of two or more variables, Partial derivatives, total differential coefficients. **(6 hours)**

3.0 Applications of Derivatives: Extrema of function of two or three variables, mean value theorems, Taylor and Maclaurin's infinite series, Indeterminate forms and L'Hospital's rule, Tangent and normal, curvature, Asymptotes and curve tracing. **(8 hours)**

4.0 Integration: Basic integration formulas, Integration methods, Standard Integrals, Definite Integral and its properties, Definite integral as the limit of a sum, Fundamental theorem of integral calculus, Improper integrals, Reduction formulae for integrals, Beta and Gamma functions. **(8 hours)**

5.0 Applications of Integral Calculus: Determination of area, Length, Volumes and surface areas of solid of revolution, multiple integrals, change of order of integration. **(5 hours)**

6.0 Plane Analytic Geometry: Translation and rotation of axes, circles, conic sections, parabolas, ellipses, hyperbolas and central conics. **(8 hours)**

7.0 Vector Algebra: Vector components, zero vector, unit vector, addition, equality, Direction cosines, space coordinates (Cartesian, cylindrical and spherical

coordinates), equation relating these coordinates, scalar and vector, product of two vectors, product of three vectors or more vectors, lines and planes.

(7 hours)

Recommended Books:

1.0 Differential Calculus, MB Singh and BC Bajracharya, S ukunda Pustak Bhawan, Kathmandu

2.0 Calculus and Analytic Geometry, Thomas and Finnney, Narosa Publishing House, India

3.0 Basic Mathematics (Vol I and II), DR Bajracharya, National Book Centre, Kathmandu

4.0 A Text Book of Vector Analysis, MB Singh and BC Bajracharya, Sukunda Pustak Bhawan, Kathmandu

5.0 Integral Calculus and Differential Equations, GD Pant & GS Shrestha, Sunila Prakashan, Kathmandu

6.0 Higher Coordinate Geometry, Lalji Prasad, Paramount Pubilications, Patna, India

7.0 Two-Dimensional Geometry-MR Joshi

PHYSICS
BEG103 SH

Semester I **Year I**

Teaching Schedule (Hours/Week)			Examination Schedule						Total Marks	Remarks
			Final				Internal Assessment			
			Theory		Practical		Theory	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
4	1	2	3 hrs	80	3	30	20	20	150	

COURSE OBJECTIVES: To provide the concept and knowledge of physics with the emphasis of present day applications. The background of physics corresponding to Proficiency Certificate Level/+2 is assumed.

Course Details

1.0 Simple Harmonic Motion:

1.1. Introduction, Hooks Law, elastic restoring force, equation of SHM
1.2. Examples of SHM: suspended mass spring system and physical pendulum (bar pendulum).
1.3. Angular harmonic motion: Torsional pendulum
1.4. Introduction to damped ,free and forced oscillation (1 /2hour)

2.0 Wave in Elastic Media:

2.1. Introduction: waves and particles, types of waves; traveling wave, mechanical wave.
2.2. Equation of wave process, particle velocity and particle acceleration.
2.3. Wave Speed on a Stretched String (using Newton's second law).
2.4. Energy and power in traveling waves, intensity in wave motion.
2.5. Principle of superposition, interference of waves.
2.6. Standing waves and resonance. (1/2 hour)

3.0 Acoustics:

3.1. Sound waves, review on Sound propagation in gases, liquids and solid; The speed of sound.
3.2. Pressure variation due to waves and pressure amplitude.
3.3. Beat phenomena
3.4. The Doppler effect.
3.5. Energy considerations, intensity level and loudness.
3.6. Ultrasound, production of ultrasound by magnetostriction and piezoelectric (Introduction) and its application in medical , distances measurement, imaging, signaling, cleaning, and neating (2 ½ hours)

4.0 Electrostatics:

4.1. Electric charge, Interaction between electric charges.

4.2. Electric field, lines of force, calculation of electric field due to dipole and quadrupole

4.3. Electric flux,Gauss' law, Application of Gauss Law to spherical, linear and planer symmetric distribution of charges.

4.4. Electric potential, potential difference, potential due to a point charge, potential gradient.

4.5. Potential due to dipole and quadrupole, electrostatic potential energy.

4.6. Capacitors. Parallel plate capacitor, spherical capacitor, permittivity, conductors and dielectric in electric field. E and D fields, energy stored in electric field and energy density.

4.7. Electrostatic induction, lightning conductors, industrial uses and hazards.

(½ hour)

5.0 Direct Current:

5.1. Review on Current flow in solid, liquid and gases. Ohm's law. Resistances in series and in parallel.

5.2. Current and current density, atomic view of resistivity, effect of temperature on resistance

5.3. Semiconductors: Intrinsic and extrinsic semiconductor, Introduction of PN Junction, NPN & PNP transistor.

5.4. Energy loss, heat production, statement of joule's law

5.5. Kirchhoft's Laws. (½ hour)

6.0 Magnetism and Magnetic Fields:

6.1. Source of Magnetic fields: Current and permanent magnets, earth's magnetic field, lines of force flux of magnetic field and permeability.

6.2. Biot and Savart's law and its application to long straight conductor carrying current. Amperes theorem and its application to long straight conductor carrying current and solenoid carrying current.

6.3. Magnetic scalar potential and potential gradient.

6.4. Force on conductor in magnetic fileds, force per unit length between parallel conductors carrying current

6.5. Faraday's law of electromagnetic induction. Flux linkage. Lenz's law. Self induction. Calculation of the coefficient of self-induction for solenoid.

6.6. LR circuit. Energy stored in magnetic field. Energy density of magnetic field.

6.7. Magnetic properties of matter, Domain Theory, Ferromagnetism, Saturation and Hysteresis. (2 hours)

7.0 Electromagnetic Oscillations:

7.1. LC oscillations. Analogy to SHM

7.2. Electromagnetic oscillation of LCR circuit (quantitative) forced oscillation on LCR circuit and resonance (2 hours)

8.0 Electromagnetic Waves:

8.1. Introduction to gradient,divergence and curl; Induced magnetic field ;Displacement current and its significance

8.2. Maxwell's equation – Differential and integral form

8.3. Application of Maxwell equation: wave equations in free space and medium.
8.4. Speed of electromagnetic wave. Energy of electromagnetic wave. Poynting vector (1 hour)

9.0 Optics:

9.1. Nature and source of light, different theories of light, different types of sources.
9.2. Review of optics of lenses, refraction in spherical surfaces; refraction through prism.
9.3. Combination of lenses in contact and at a separation, cardinal points, Achromatic combination of two lenses, separated by distance
9.4. Monochromatic aberration of lenses. Spherical aberration, astigmatism, coma, curvature of field and distortion. Causes and their minimization.
9.5. Fiber optics: Introduction to optical fiber. Types of optical fibers. Application in Illumination and Image transmission, optical communication optical fiber sensors, medical and military application
9.6. Lasers: principle of the generation of laser light, Uses of laser: industrial and entertainment electronics , medical .communication and information processing (1 ½ hours)

10.0 Physical Optics:

10.1. Interference: coherent sources, path difference and phase difference, Interference of light waves,
10.2. Young's experiment ,condition for constructive and destructive interference, interference in thin films and wedge shape, Newton's ring and determination of wave length, determination of refractive index of a liquid .
10.3. Diffraction: Introduction to Fresnel's and Fraunhoffer, Fraunhoffer diffraction at a single slit. Diffraction grating, wave length measurement by diffraction gratings; intensity variation in order.
10.4. Polarization: Introduction, polarization by reflection, Malu's law, double refraction, Nicol prism, plane, circular, elliptical polarization of light waves, double refraction ,quarter and half wave plate Optical activity and uses, polarimeter.
10.5. Use of light: holography, LCD, signal transmission, optical stress analysis, spectrometric analysis of gases. (1 hour)

Laboratory: (Minimum 9 Experiments)

1.0 Physical Pendulum, Torsional Pendulum
2.0 Resonance tube
3.0 Newton's Ring, Diffraction grating, prism
4.0 Carey Foster's Bridge, Low resistance, resistivity, LC Circuits
5.0 Polarimeter, Junction transistor

Recommended Books:

1.0 Physics by Resnick, Haliday, 2nd and 4th Edition.
2.0 A.S. Vasudeva, "Concept of Modern Engineering Physics", S. Chand & Co 1998, Delhi.
3.0 Subramanyam and Brij Lal, "Optics", S. Chand & Co. 1994, 1995, Delhi.
4.0 Practical Physics by CL Arora

COMMUNICATIVE ENGLISH
BEG105 SH

Semester I **Year I**

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

COURSE DESCRIPTION: This course is designed for the students of B.E. level, first year, first semester of Purbanchal University, who have completed either diploma level in Engineering or ISC or +2 from any institution recognized by this university. It intends to develop and strengthen in students the basic and communicative skills in the English language with emphasis of speaking, reading and writing

COURSE OBJECTIVES: This course intends to develop:

- Skills needed for group discussion, meeting conduction and technical talk.
- Intensive and extensive reading skills in technical and non-technical reading materials
- Skills in writing description, official letters and letters of application, proposals and formal technical reports

COURSE IN DETAIL:

1.0 Oral Communication: (16 hours)

A. Fundamentals of effective speaking: posture, gesture, facial expression, voice, eye contact, space distancing etc.
B. Group discussion on subjects of general and technical interest
C. Meetings
    a. Notice preparation
    b. Agenda preparation
    c. Minutes preparation
    d. Meeting conduction

D. Technical talk
    a. Writing complete manuscript for technical talk
    b. Presenting technical talk based on manuscript
    c. Preparing note for technical talk
    d. Presenting talks based on notes

2.0 Reading: Intensive and Extensive: **(14 hours)**

A. Intensive reading:
   a. How to tackle intensive reading materials
   b. Practicing comprehension on prescribed texts
   c. Note making and summary writing
   d. Practice on contextual grammar

B. Extensive Reading:
   a. How to tackle extensive reading materials
   b. Practicing extensive reading

3.0 Writing: **(26 hours)**

A. Fundamentals of effective writing; unity, coherence, conciseness, clarity
B. Description writing; mechanical, electrical or electronic objects, tables, graphs, charts, landscape, technical process
C. Letters
   a. Official Letters
      i. Standard letter formats
      ii. Writing letters for asking and giving information giving instruction, letters of request, apology and explanation, complaint and order
   b. Letters of Application
      i. Standard Format
      ii. Preparing Bio-data resume
      iii. Writing letters of application
D. Proposal Writing
   a. Format for technical proposals
   b. Writing technical proposals
E. Technical Report Writing
   a. Format for technical reports
   b. Writing technical reports

Prescribed Books:

1.0 English for Engineers and Technologist 2, Orient Longman, Anna University, Chennai 1990, (Reading and Language focus all and oral and writing as mentioned in the syllabus)

Reference Books:

1.0 Adhikari Usha, et, al. Communicative Skills in English, Research training unit, Department of Science and Humanities, Institute of Engineering, Pulchowk Campus 2002
2.0 Anne Eisenberg, "Effective Technical Communication", McGraw-Hill, 1982.
3.0 K.W. Hope and T.E. Pearsall, "Reporting Technical Information", 5th Edition. Macmillan Publishing Company, New York, 1984.
4.0 "A Communicative Grammar of English", Leech, G, Savartvik, ELBS 1975
5.0 "English Dictionary", Collings Cobuild, New Edition, Harper Collins Publishers 1995

INTRODUCTION TO COMPUTER AND PROGRAMMING
BEG180 CO

Semester I **Year I**

Teaching Schedule (Hours/Week)			Examination Schedule						Total Marks	Remarks
			Final				Internal Assessment			
			Theory		Practical		Theory	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
3	1	3	3 hrs	60	-	-	20	20	100	

COURSE OBJECTIVE: To give the basic knowledge of computer system and problem solving skills using structured programming methodology.

Contents:

1.0 INTRODUCTION TO COMPUTER: **(4 hours)**

1.1. Generation of Computer.
1.2. Block diagram of Computer.
1.2.1. Discussion on Input Device/ Output Device
1.2.2. CPU. Memory and its types.
1.2.3. Uses of Computer, Computer network
1.2.4. Managing data and Information

2.0 INTRODUCION OF PROGRAMMING: **(4 hours)**

2.1. History of C
2.2. Introduction to C
2.3. Importance of C
2.4. Desirable program characteristic

3.0 DATA TYPES, OPERATORS AND SOME STATEMENT: **(5 hours)**

3.1. Identifiers & Keywords
3.2. Constant
3.2.1. String Constant
3.2.2. Numeric Constant
3.2.3. Character Constant
3.3. C Operators
7.3.1. Arithmetic Operators
7.3.2. Assignment Operators
7.3.3. Logical & Comparison Operators
7.3.4. Bitwise Operators
3.4. Special Operators

4.0 VARIABLES ,INPUTAND OUTPUT: (5 hours)

- 4.1. Variable Declaration
- 4.2. The Scope of Variable
  - 4.2.1. Register Variable
  - 4.2.2. Static Variable
  - 4.2.3. External Variable
  - 4.2.4. Automatic Variable
- 4.3. Statements
- 4.4. Simple C programs
- 4.5. Input Statement
- 4.6. Output Statement
- 4.7. Feature of stdio.h

5.0 CONTROL STRUCTURE: (4 hours)

- 5.1. Conditional Statements
  - 5.2.1. if statement
  - 5.2.2. if-else statement
  - 5.2.3. switch statement
- 5.2. Loop Statements
  - 5.2.1. for loop
  - 5.2.2. while loop
  - 5.2.3. do-while loop
- 5.3. Breaking Control Statements
  - 5.2.1. break statement
  - 5.2.2. continue statement
  - 5.2.3. go-to statement

6.0 ARRAY: (4 hours)

- 6.1. Array Notation
- 6.2. Array Declaration
- 6.3. Multidimensional Array
- 6.4. Array Initialization
- 6.5. Processing with Array

7.0 FUNCTION: (4 hours)

- 7.1. Defining Function
- 7.2. Use of Function
- 7.3. Types of Function
- 7.4. Return Statement
- 7.5. Recursive Function

8.0 POINTER (5 hours)

- 8.1. Pointer Declaration
- 8.2. Pointer Arithmetic
- 8.3. Pointer Function
- 8.4. Pointer & Array
- 8.5. Pointers to pointers

9.0 Structure and Unions (5 hours)

- 9.1. Defining a structure, Arrays of Structures, Structures with in Structures
  - 9.1.1. Processing a Structure

9.1.2. Structures Pointers
9.1.3. Passing Structures to Functions
9.1.4. Union and its importance

10.0 Data Files **(4 hours)**

10.1. Opening and Closing a Data File
10.2. Creating a Data File
10.3. Processing a Data File

11.0 Graphics **(4 hours)**

11.1. Initialization
11.2. Graphical mode
11.3. Simple program using built in graphical function

Reference Book:

1.0 "Let USC",;Yashavant Kanetker.
2.0 Programming with C; Gottfried
3.0 E.Balaguruswamy,"Programming in C",Tata McGraw –Hill.
4.0 E.Balaguruswamy "Graphic under C"

ENGINEERING DRAWING
BEG145 ME

Semester I **Year I**

Teaching Schedule (Hours/Week)			Examination Schedule						Total Marks	Remarks
			Final				Internal Assessment			
			Theory		Practical		Theory	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
1	-	3	-	-	3 hrs	80	20	50	150	

COURSE OBJECTIVE:
To develop basic projection concepts and to develop sketching, drafting working drawings to facilitate communication.

1.0 Instrumental Drawing, Practices and Techniques: (1 hour)
- 1.1. Description of drawing instruments and drawing techniques/
- 1.2. Techniques of Instrumental Drawing e.g. pencil sharpening, securing paper, proper use of T-squares, triangles, erasing shields, French curves.

2.0 Freehand Technical Lettering: (3 hours)
- 2.1. Lettering strokes, letter proportions, use of pencils, inclined and vertical letters and numerals, upper and lower cases.

3.0 Dimensioning: **(2 hours)**
- 3.1. Fundamentals of dimensioning, size and location dimensioning, use of scales, measurement units, reducing and enlarging scales.
- 3.2. Placement of dimensions, aligned and unidirectional dimensioning, chain and parallel dimensioning.

4.0 Plane Geometrical Construction: (9 hours)
- 4.1. Bisecting and trisecting lines and angles, proportional division of lines, construction of pentagon, hexagon and any other polygons circumscribing or inscribing a circle, methods for drawing tangents and circular arcs.
- 4.2. Methods for drawing ellipses, parabolas, hyperbolas.

5.0 Basic Descriptive Geometry: **(6 hours)**
- 5.1. Projection rays, source, Projection planes, Positioning of objects in three dimensional spaces.
- 5.2. Projection of points, lines and planes in space.
- 5.3. Auxiliary views of lines and planes.

5.4. True length and angle of inclination of a line using revolution and auxiliary projection plane method.
5.5. Parallel lines, Perpendicular lines.
5.6. Shortest distance from a point to a line.
5.7. True shape of an oblique plane and angle of inclination with projection plane.

6.0 Multiview Drawings (Orthographic Projection): (6 hours)

6.1. Orthographic Projection
6.2. Problems of Orthographic projection of objects without curved surfaces.
6.3. Problems of orthographic projection of objects with curved surfaces and holes.

7.0 Pictorial Drawing: (4 hours)

7.1. Methods to draw Isometric Drawing
7.2. Methods to draw Oblique Drawing.

8.0 Introduction to AutoCad: (4 hours)

8.1. CAD, CAM, CAD-CAM software.
8.2. AutoCad commands, Drawing, Dimensioning, Modifying.
8.3. 3-D surface and solids.

Drawing Practicals: (3 hrs/Week)

1.0 Freehand technical lettering and use of drawing instruments.
2.0 Dimensioning.
3.0 Plane geometrical construction.
4.0 Basic descriptive geometry.
5.0 Basic descriptive geometry (contd.)
6.0 Orthographic projection.
7.0 Orthographic projection (contd.)
8.0 Pictorial drawing.

Textbooks and Reference Books:

1.0 W.J. Luzadder, "Fundamentals of Engineering Drawing," Prentice Hall, 1981.
2.0 T.E. French, C.J. Vierck and R. J. Foster, "Engineering Drawing and Graphic Technology," Mcgraw Hill, 1981.

BASIC ELECTRICAL ENGINEERING
BEG129 EL

Semester: I **Year: I**

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

COURSE OBJECTIVES:

This course serves as the foundation course on Basic Electrical Engineering. After the completion of this course, students will be able to Analyse AC & DC Electric Circuits.

1.0 Basic Concept of DC Circuit: (8 hours)

1.1. Concept of electric charge and current. Ohm's law its application and limitation.
1.2. Electric circuit, circuit elements
1.3. Resistance inductance and capacitance, their functional behavior, constructional features, mathematical descriptions
1.4. Introduction to voltage source and current source
1.5. Series and parallel connection of resistors
1.6. Series and parallel connection of sources effect of their internal resistance on the circuit characteristics
1.7. Star/delta transformation
1.8. Power and energy in DC current

2.0 Circuit Analysis: (15 hours)

2.1. Kirchoff's laws-current law and voltage law, application, limitations
2.2. Superposition theorem, reciprocity theorem
2.3. Maxwell's loop current method
2.4. Nodal analysis of electric circuit
2.5. Thevenin's theorem
2.6. Norton' theorem
2.7. Maximum power transfer theorem

3.0 AC Circuit: (8 hours)

3.1. Faraday's law of Electromagnetic induction, Generation of sinusoidal alternating emf, terminologies used in AC Circuit
3.2. Sinusoidal AC, emf, phasor representation of AC, j-operator and its use in AC Circuit

3.3. R, L and C excited by AC source, R-L, R-C, R-L-C series circuits, Resonance phenomena, Power and power factor in AC circuit – Instantaneous and average power, reactive and apparent power

4.0 Three Phase AC Circuit: (6 hours)

4.1. Generation of three phase AC emf wave form representation, use of j-operator, star and delta connection of source and load, line voltage and line current, phase voltage and phase current, balanced three phase system, calculation of current and voltage, measurement of power, Introduction to three phase four wire system

5.0 Transformers: (8 hours)

5.1 Magnetically coupled circuits
5.2 Effects of secondary current in ideal transformer
5.3 Transformer reactance and equivalent circuits
5.4 Air core Vs iron core transformers
5.5 Losses in transformer, open circuit and short circuit tests
5.6 Instrument transformers
5.7 Introduction to three phase transformers

Laboratory:

1.0 Basic electrical measurements and verification of ohms law
2.0 Series and parallel connection of resistors, verification of Kirchoff's laws
3.0 Measurement of power in Dc. Circuit using Wattmeter
4.0 Measurement of power in single phase AC circuit using wattmeter
5.0 Measurement of rms value, amplitude value, power factor by using oscilloscope
6.0 Measurement of power in three phase AC circuit
7.0 Series, resonance and parallel resonance
8.0 Perform a open and short circuit test on single phase transformer

References:

1.0 SN Tiwarin and AS Gin Saroor, " A First Course in Electrical Engineering", AH Wheeler and Co. Ltd, Allahabad, India
2.0 BL Theraja and Ak Theraja, "A Text Book of Electrical Technology" S Chand and Company Ltd., New Delhi India
3.0 V Del Toro "Principles of Electrical Engineering", Prentice Hall of India Ltd. New Delhi
4.0 IJ Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, New Delhi
5.0 PS Bhimbra, Electric Machinery, Khanna Publishers, New Delhi

ENGINEERING MATHEMATICS II
BEG102 SH

Semester II **Year I**

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

COURSE OBJECTIVES: The basic objective of the course is to provide a sound knowledge of vectors, 3-D analytical geometry, Infinite series and ordinary differential equations.

1.0 **Analytic Geometry of 3-D:** Planes, Straight lines, and standard equation of sphere, cylinder and cone. **(14 hours)**

2.0 **Infinite Series:** Infinite series and sequences, convergence, ratio root and integral tests, absolute convergence, power series, radius of convergence. (**6 hours)**

3.0 **Plane Curves and Polar Coordinates:** Plane curves, parametric equations, polar coordinates, integral in the polar coordinates. **(4 hours)**

4.0 **Vector Calculus:** Differentiation and Integration of vectors, gradients, divergence and curl. **(8 hours)**

5.0 **Differential Equations:** First order differential equation, variable separation, homogeneous, linear and exact. Second order differential equations, linear equations with constant coefficient homogeneous equation with constant coefficients, general solutions, initial value problems, non-homogeneous equations, solutions in series, Legendre, Bessel equations. **(13 hours)**

Recommended Books:

1.0 Three-dimensional Geometry, YR Sthapit and BC Bajracharya
2.0 Algebra, GD Pant
3.0 A Text Book of Vector Analysis, MB Singh and BC Bajracharya
4.0 Integral Calculus and Differential Equations, GD Pant & GS Shrestha
5.0 Calculus and Analytic Geometry, Thomas and Finney, Narosa Publication House, India
6.0 Advanced Engineering Mathematics, E Kreyszig, 5th Edition, Wiley, New York

CHEMISTRY
BEG 104 SH

Semester II **Year I**

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

COURSE OBJECTIVES: This course will develop the basic concepts of Physical Chemistry, Inorganic Chemistry and Organic Chemistry relevant to problems in engineering.

GROUP A (Physical)

1.0 Review lectures of Bohr Theory and Summer Field Theory: (8 hours)

1.1. Debroglie eq.
1.2. Heisenberg's uncertainty principle
1.3. Wave mechanical model of atom
1.4. Quantum No.
1.5. Aufbou principle shapes of s, p, d orbitals
1.6. Pauli's exclusion principle, Hund's rule of maximum multiplicity electronic confn of elements using s, p, d and forbitals
1.7. Stability of half filled and completely filled orbitals

2.0 Chemical Bonding: (6 hours)

2.1. Electrovalent, covalent and coordinate covalent bond
2.2. Hybridization, Metallic bone, hydrogen bonding, VSEPR
2.3. Theory, vander waals force trus, covalent Net Working
2.4. Crystal lattice, types of crystal

3.0 Electrochemistry: (10 hours)

3.1. Strong and weak electrolysis.
3.2. Ostwald's dilution law and its limitation.
3.3. pH and pH scale.
3.4. Common ion effect in ionic equilibria.
3.5. Buffer and pH of buffer.
3.6. Electrolytic cells and Galvanic cells.
3.7. Single electrode potentials and normal hydrogen electrode, electro-chemical series.

3.8. Nernst's equation and determination of electrode potential and cell potential under non-standard conditions.
3.9. Corrosions of metals and its prevention.

4.0 Introductory Thermodynamics: (8 hours)

4.1. Internal energy enthalpy and law of thermodynamics.
4.2. Relation between enthalpy change and change in eternal energy
4.3. Enthalpy of a reaction
4.4. Exothermic and endothermic rxn
4.5. Hess's law of constant heat summation
4.6. Enthalpy change from bond energy
4.7. Molar heat capacities, relation between Cp and Cv.
4.8. Variation of heat of reaction with temperature (Kirchhoff's equations)
4.9. Calorific values of fuels and food.

GROUP B (Inorganic)

1.0 Co-ordination Complexes: (5 hours)

1.1. Double Salt and Complex Salt
1.2. Werner's Co-ordination theory.
1.3. Nomenclature of Co-ordination complexes.
1.4. Electronic interpretation in co-ordination.
1.5. Bonding in co-ordination compounds – only valence bond theory.
1.6. Applications of valence bond theory – Octahedral complexes, tetrahedral complexes and Square planer complexes.
1.7. Application of co-ordination complexes

2.0 Transition Element: (6 hours)

2.1. Transition elements and their position in periodic table
  2.1.1 Characteristics properties of third transition metals with reference to
  2.1.2 Electronic Configuration, Metallic character, Variable Valency, Complex Formation, Magnetic properties, Alloy Formation, Catalytic Activity, Colour

3.0 Silicones – Properties and Uses: (1 hour)

4.0 Environmental Chemistry: (4 hours)

4.1. Introduction to Environment
4.2. Types of pollution-Air, water, soil and noise and their possible remedies

GROUP C (Organic)

1.0 Types of Organic Reaction: (4 hours)

1.1. Substitution Reaction (SN1 and SN2 type)
1.2. Addition Reaction
1.3. Elimination Reaction (E1 and E2 Reaction)
1.4. Rearrangement Reaction

2.0 Stereochemistry: (3 hours)

2.1. Types of Stereoisomerism.
2.2. Optical and Geometrical isomerism

3.0 Organometallic Compounds: (1 hour)

3.1. Preparation Props and uses of Grignard's reagent

4.0 Explosives: (1 hour)

4.1. Simple idea about low and high explosives.
4.2. TNT, TNG and nitrocellulose preparation and uses.

5.0 Polymers & Polymerization: (3 hours)

5.1. Types of Polymerization reaction.
5.2. Types of Polymers.
5.3. Synthetic fibers Polystyrene, Teflon, terylene or Dacron.

Recommended Books:

1.0 Selected topics in physical chemistry, Motikaji Sthapit
2.0 Principles of physical chemistry, Marron & Prutto
3.0 Essentials of physical chemistry, Bahl & Tuli
4.0 Advanced inorganic chemistry, Satyaprakash, RD Madan, GD Tuli
5.0 Concise Chemistry, JD Lee
6.0 Organic Chemistry, Morrison & Boyd
7.0 Organic Chemistry, BS Bahl

Practical Works in Chemistry:

1.0 To determine the alkalinity of the given sample of water (Two practical)
2.0 To determine the hardness of water sample
3.0 To determine the pH of different aqueous solutions using pH meter and preparation standard buffer solution acidic
4.0 To determine the amount of free chlorine in the given sample of water
5.0 To determine the condition in which corrosion takes place
6.0 To measure the quantity of charge required to deposit one mole of copper

BASIC MECHANICAL ENGINEERING
BEG 143 ME

Semester II **Year I**

Teaching Schedule (Hours/Week)			Examination Schedule						Total Marks	Remarks
			Final				Internal Assessment			
			Theory		Practical		Theory	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
3	1	3	3 hrs	80	-	-	20	50	150	

COURSE OBJECTIVE:
To make the students familiar with theoretical and applied field of mechanical engineering.

1.0.0 WORKSHOP TECHNOLOGY

1.1.0 Basic Tools, Hand operating operations and Measuring **(8 hours)**
1.1.1 Basic Tools:
Hammer, screw drivers, punches, chisels, files, pliers, wrenches, hacksaws, bench vises, hand drills, taps.
1.1.2: Basic Hand Working Operations:
Sawing techniques, Filling to obtain required finishing surfaces, Tapping holes and threading rods, Sheet metal works, Safety.

1.2.0 Machine Tools: **(8 hours)**
1.2.1 Introduction:
1.2.2 Lathes, Drilling & Milling Machine
Physical Construction, Working Principle, Tool Selection and Feed Rates, Lathe operations, Accessories, Safety.

1.3.0 Metal Joining: **(4 hours)**
Soldering, Brazing, Gas welding, Arc welding, Safety

1.4.0 Measuring and Gagging:
Rulers, Scales, Depth gages, Micrometer, Vernier calipers, Dial indicators.
(3 hours)

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2.0.0 Applied Mechanics: **(12 hours)**
2.1.1 Introduction
2.1.2 Concept of a particle, Rigid body, Principles of forces, Free body diagram, Equilibrium in two dimensions.
2.1.3 Distributed forces, Centre of gravity, Centroid of lines, areas and volumes.
2.1.4 Friction and Laws of Friction

2.1.5 Rectilinear and curvilinear motion of particles; position, velocity and acceleration.
2.1.6 Dynamics: Kinetics & Kinematics.

3.0. Mechanics and Properties of Solids: (10 hours)

3.1 Stress, Strain, Stress-Strain diagram, Hooke's Law
3.2 Thermal stress
3.3 Principal Stress
3.4 Torsion
3.5 Bending of beams, Pure bending, Bending Stress, Shearing force& bending moment diagrams.

Laboratories (3 hrs/week)

1.0 Bench tools and hand working operations
2.0 Lathe machine: facing, turning, drilling and boring
3.0 Sheet metal work
4.0 Gas and arc welding
5.0 Tension test
6.0 Refrigerator/ Heat Pump experiment

Textbooks and Reference Books:

1.0 B. S. Raghuwanshi, "A Course in Workshop Technology, Vol. I & II, " Dhanpat Rai & Co.(P) Ltd., 2002
2.0 J.R. Howell & R. O. Buckius, "Fundamentals of Engineering Thermodynamics," McGraw Hill Publishers, 1987
3.0 J.P. Holman, "Heat Transfer," McGraw Hill, 1981
4.0 E.P. Popov, "Engineering Mechanics of Solids," Prentice Hall Inc., Englewood Cliffs, N. J.,1990
5.0 F.P. Beer & E.R. Johnson, " Mechanics of Materials," McGraw Hill, 1981

ELECTRO-ENGINEERING MATERIALS
BEG122 EL

Semester II **Year I**

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

COURSE OBJECTIVES: The objectives of this course to understand the properties of dielectric materials in static and alternating fields, to understand the properties of insulating and magnetic materials, and to understand the properties of conductors and semiconductors.

1.0 Theory of Metal: (10 hours)

1.1. Elementary Quantum Mechanical Ideas. De Broglie's Equation, Einstein's Equation, Heisenberg's Uncertainty Principle
1.2. Free Electron Theory, Energy Well Model of a Metal
1.3. Band Theory of Solids, Electron Effective Mass, Energy Bands, Density of States
1.4. Collection of Particles, Boltzmann Classified Statistics, Fermi-Dirac Distribution Function
1.5. Fermi Energy, Metal-Metal Contact, The Seeback Effect and The Thermocouple
1.6. Thermionic Emission, Richardson—Dushman Equation, Field Assisted Emission, The Schottky Effect, Work Function

2.0 Free Electron Theory of Conduction in Metals: (8 hours)

2.1. Thermal Velocity of Electron
2.2. Electron Mobility, Conductivity, Resistivity
2.3. Diffusion of Electron, Diffusion Coefficient, Einstein's Relationship between Mobility and Diffusion Coefficient
2.4. Chemical and Physical Properties of Common Conducting Materials (Ag, Cu, Al, Mn, Ni, etc)

3.0 Conduction in Liquid and Gases: (3 hours)

3.1. Ionic Conduction in Electrolytes
3.2. Electrical Conduction in Gases, Electric Break Down

4.0 Magnetic Materials and Superconductivity: (11 hours)

4.1. Magnetisation of Matter, Magnetic Dipole Moment, Atomic Magnetic Moment Magnetisation Vector M, Magnetic Permeability and Susceptibility, Magnetising Field or Magnetic Field Intensity, H

4.2. Magnetic Material Classification, Diamagnetism, Paramagnetism, Ferromagnetism, Ferrimagnetism , Antiferromagnetism
4.3. Magnetic Domain Structure, Magnetic Domain, Domains Walls, Domain Wall Motion
4.4. Soft and Hard Magnetic Materials: Their Examples and Application
4.5. Superconductivity: Zero Resistance and Meissner Effect, Type I, Type II Superconductors, Critical Current Density

5.0 Dielectric Materials: (8 hours)

5.1. Matter Polarisation and Relative Permittivity: Relative Permittivity Dipole Moment and Electronic Polarisation, Polarisation Vector P Local Field EIOC and Clausius—Mossotti Equation
5.2. Polarisation Mechanism: Electronic Polarisation, Ionic Polarisation, Orientational Polarisation, Interfacial Polarisation, Total Polarisation
5.3. Dielectric Contract and Dielectric Losses Frequency and Temperature Effects
5.4. Dielectric Strength and Breakdown: Dielectric Strength Dielectric Breakdown and Partial Discharge in Gases Dielectric Breakdown and Partial Discharge in Gases Dielectric Breakdown in Solids
5.5. Ferro-Electricity and Piezoelectricity
5.6. Properties of Common Dielectric Materials like Glass, Porcelain, Polythene, PVC, Nylon, Bakelite, Mica, Transformer Oil, Paper etc

6.0 Semi-Conducting Materials: (5 hours)

6.1. Electrons and Holes Conduction in Semiconductor, Electron and Hole Concentration
6.2. Extrinsic Semiconductor: N-Type Semiconductor, P-Type Semiconductor, Compensation Doping, Energy Band Diagram for Uniformly Doped and Graded P and N Type Materials
6.3. Generation and Recombination of Electrons and Holes, Concept of Lifetime
6.4. Diffusion and Conduction Equations Mobility and Diffusion Coefficients or Electron and Holes, Steady State Diffusion and Continuity Equations
6.5. Ideal PN Junction: No Bias, Forward Bias, Reverse Bias, PN Junction Band Diagram, Open Circuit (No Bias) Forward and Reverse Bias Metal Semiconductor Contract

Reference Books:

1.0 R.A. Colcaser and S. Diehl-Nagle, “Materials and Devices for Electrical Engineers and Physicists”, McGraw-Hill, New York, 1985
2.0 R.C. Jaeger, “Introduction to Microelectronic Fabrication—Volume IV”, Addison—Wesley Publishing Company, Inc, 1988
3.0 S.O. Karsap, “Principle of Electrical Engineering Device”, McGraw Hill, 2000

COMPUTATIONAL SYSTEM & DATABASE CONCEPT.
BEG170 CO

Semester II **Year I**

Teaching Schedule (Hours/Week)			Examination Schedule						Total Marks	Remarks
			Final				Internal Assessment			
			Theory		Practical		Theory	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
3	1	2	3 hrs	80	-	-	20	50	150	

COURSE OBJECTIVES: After finishing this course student will be able to design database systems ,SQL language and other matlab computational operation.

1.0 Introduction to Matlab: **(4 hours)**
- 1.1. Matlab as {best} calculator
- 1.2. Standard Matlab windows
- 1.3 Operations with variables
  - 1.3.1 .Naming
  - 1.3.2. Checking existence
  - 1.3.3 .Clearing Operations Application & Benefits of using OOP

2.0 Arrays **(5 hours)**
- 2.1 .Columns and rows: creation and indexing
- 2.2 .Size & length
- 2.3. Multiplication, division, power
- 2.4. Operations

3.0 Writing script files and Functions : **(5 hours)**
- 3.1 Logical variables and operators
- 3.2 Flow control
- 3.3 Loop operators
- 3.4 Input/output arguments
- 3.5 Function visibility, path.
- 3.6 Example: Matlab startup

4.0 Simple graphics : **(4 hours)**
- 4.1. D plots
- 4.2. Figures and subplots

5.0 Data and data flow in Matlab: **(5 hours)**
- 5.1. Data types
  - 5.1.1 Matrix, string
  - 5.1.2. Creating, accessing elements manipulating of data of different types

5.2. File Input-Output
- 5.2.1 Matlab files
- 5.2.2 Text files
- 5.2.3 Binary files
- 5.2.4 Mixed text-binary files

5.3.Communication with external devices
- 5.3.1 Serial port
- 5.3.2 Parallel port

6.0 Handle graphics and user interface: (6 hours)

6.1 . Pre-defined dialogs
6.2 Handle graphics
6.3 Graphics objects
6.4 Menu-driven programs
6.5 .Controls&Interactive graphics
6.6 . Large program logic flow

7.0 Introduction to DBMS: (3 hours)

7.1. Definition of database &database system
7.2. Characteristics of database approach
7.3.Advantage using DBMS

8.0 Concepts of Database systems: (5 hours)

8.1. Schemes and Instances
8.2. .Database language and interfaces
8.3. E-R model
8..4 Entity types Attributes, Keys, Relationship types

9.0 SQL& Normalization Steps (10 hours)

9.1. Introduction to SQL
9.2 Set operation
9.3 Null values
9.4. Queries, views
9.5. Join relation
9.6 Pitfalls of relational model
9.7.Functional dependencies(1FNF,2NF,3NF)

Reference Books:

1.0 Rudra pradap, "getting started with matlab".
2.0 David Kuncicky, "MATLAB Programming ".
3.0 H.F.Korth and A.Sllberscratz , "Database System Concept
4.0 C.J.Date, "An Introduction to Database System"
5.0 STEPHANE FAROULD, "Art of SQL"

DIGITAL LOGIC
BEG139 EC

Semester II **Year I**

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

COURSE OBJECTIVES: To provide fundamental of Digital electronics digital computer design and application of digital devices

1.0 Numbering Systems: **(5 hours)**
- 1.1. Introduction
- 1.2. Comparison between Analog and Digital System
- 1.3. Number Conversion
- 1.4. Binary Arithmetic

2.0 Boolean Algebra and Logic Gates: **(6 hours)**
- 2.1. Boolean algebra basic theory and properties
- 2.2. Boolean functions
- 2.3. Logical operations
- 2.4. Logical functions and gates
- 2.5. Application of gates

3.0 Simplification of Boolean Functions: **(6 hours)**
- 3.1. K-map
- 3.2. Two, three and four variable maps
- 3.3. Product of sums, sum of product simplification
- 3.4. NAND and NOR Implementation

4.0 Combinational Logic: **(12 hours)**
- 4.1. Design Procedure
- 4.2. Adders
- 4.3. Subtractors
- 4.4. Binary Parallel adder
- 4.5. Decimal adder
- 4.6. Magnitude comparator
- 4.7. Decoders and encoders
- 4.8. Multiplexers and De Multiplexers
- 4.9. Read only memory
- 4.10. Programmable logic array (PLA)

5.0 Sequential Logic: **(8 hours)**

5.1. Flip-Flops
5.2. Triggering of Flip-flops
5.3. Timing diagram

6.0 Registers, Counters and the Memory Unit: **(8 hours)**

6.1. Registers
6.2. Shift Registers
6.3. Ripple counters
6.4. Synchronous counters
6.5. Memory unit

Laboratory:

1.0 Familiarisation with Logic Gates
2.0 Encodes and Decodes
3.0 Multiplexer and De Multiplexer
4.0 Design of simple combination circuits
5.0 Design of adder/subtractor
6.0 Design of Flip-Flop
7.0 Clock Driven sequential circuits
8.0 Conversion of parallel data into serial format
9.0 Generation of timing signal for sequential system

References:

1.0 M Morris Mano, "Digital Logic and Computer Design" Pearson Education
2.0 Mano, Logic and computer design fundamentals
3.0 AP Malvino, Jerald A Brown, "Brown, "Digital Computer Electronics", 1995

YEAR II

SEMESTER III & IV

ENGINEERING MATHEMATICS III
BEG201 SH

Semester III **Year II**

Teaching Schedule (Hours/Week)			Examination Schedule						Total Marks	Remarks
			Final				Internal Assessment			
			Theory		Practical		Theory	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
3	1	-	3 hrs	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.

1.0 Matrices and Determinant: **(15 hours)**

1.1. Matrix and determinant.
1.2. Vector Spaces.
1.3. Linear transformations
1.4. System of linear equations, Gauss elimination.
1.5. Rank, matrix inversion.
1.6. Eigen values, eigen vectors.

2.0 Laplace Transformation: **(9 hours)**

2.1. Laplace Transorms.
2.2. Standard Transforms.
2.3. Inverse Laplace Transforms.
2.4. Application to differential equations.

3.0 Line Integration: **(6 hours)**

3.1. Definition of Line Integration
3.2. Evaluation of Line Integration
3.3. Double Integration
3.4. Transformation of double integrals into integrals rails beta gamma fun. Diritchet integral

4.0 Surface Integrals and Volume Integrals: **(8 hours)**

4.1. Surfaces
4.2. Tangent planes, first fundamental form and area
4.3. Surface Integrals
4.4. Volume integrals, Diritehet integrals

5.0 Integral Theorems: **(7 hours)**

5.1. Green theorem in the plane
5.2. Triple integrals and divergence theorem of Gauss
5.3. Cpm sequences and applications of the divergence theorems
5.4. Stoke's theorem
5.5. Consequences and applications of Stoke's Theorem
5.6. Time Integrals and independence of path

Recommended Books:

1.0 Kreyszig, Advanced Engineering Mathematics, 5the Edition, Wiley, New York
2.0 MN Guterman and ZN NIteeki, Differential Equations a First Course, 2nd Edition, Saunders, New York

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	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
4	-	-	3 hrs	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.
- 1.2. Bulk properties of materials.
- 1.3. Surface properties of materials.
- 1.4. Measurement techniques.

2.0 Introduction to Bio-materials: **(1 hour)**
- 2.1. Biomaterial science: An interdisciplinary course.
- 2.2. Classes of materials used in medicine.

3.0 Metals: **(3 hours)**
- 3.1. Structure, chemistry, mechanical properties and applications of various metals relating to biomaterials.
- 3.2. Steps in fabrication of implants.
- 3.3. Different metals and alloys used in implants.

4.0 Polymers: **(5 hours)**
- 4.1. Types of polymers used in medicine
- 4.2. Molecular weight and synthesis.
- 4.3. Solid state polymers and copolymers.
- 4.4. Characterization techniques.
- 4.5. Hydrogel.

5.0 Bioresorbable and Bioerodible Materials: **(5 hours)**
- 5.1. Types of degradable implants.
- 5.2. Currently available degradable implants.
- 5.3. Physical mechanisms of bio-erosion.
- 5.4. Mechanism of chemical degradation.
- 5.5. Factors influencing the rate of bio-erosion.
- 5.6. Storage stability, sterilization and packaging.

6.0 Ceramics, Glasses and Composites: (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.
6.5. Porous ceramics.
6.6. Bioactive glasses and glass ceramics.
6.7. Calcium phosphate ceramics, resolvable calcium phosphates.

7.0 Natural Materials: (5 hours)

7.1. Different types of natural materials.
7.2. Structure of native collagen.
7.3. Physical modification of the native structure of collagen.
7.4. Chemical modification of collagen.
7.5. Proteoglycans and glycosaminoglycans.
7.6. Elastin, Graft copolymers of collagen and glycosaminoglycans.

8.0 Composites: (4 hours)

8.1. Definition of composites.
8.2. Reinforcing systems.
8.3. Matrix systems.
8.4. Fabrication of fiber-reinforced composites.
8.5. Mechanical and physical properties of composites.
8.6. Absorbable matrix composites.
8.7. Non-absorbable matrix composites.

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

9.1. General Principals.
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 hours)**

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.

11.0 Biologically Functional Materials: **(2 hours)**

11.1. Biologically active molecules.
11.2. Immobilization of biologically active molecules.

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. Properties, their structure, properties and adsorption to surfaces.
13.2. Structure and properties of proteins relevant to adsorption.
13.3. Adsorption behavior of proteins as solid-liquid interfaces.
13.4. The importance of adsorbed proteins in biomaterials.

14.0 Testing of Biomaterials: **(6 hours)**

14.1. Introduction.
14.2. In vitro assessment of tissue compatibility, background concepts.
  14.2.1. Assay methods.
  14.2.2. Clinical use and new research directions.
14.3. In vivo assessment of tissue compatibility.
  14.3.1. Implant sites.
  14.3.2. Surgical protocol and form of implants, controls.
  14.3.3. Evaluation of tissue reaction.
  14.3.4. 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.

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

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

HUMAN ANATOMY AND PHYSIOLOGY I
BEG 2B2 BM

Semester III **Year II**

Teaching Schedule (Hours/Week)			Examination Schedule						Total Marks	Remarks
			Final				Internal Assessment			
			Theory		Practical		Theory	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
4	-	-	3 hrs	80	-	-	20	-	100	

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

1.0 Introduction to Human Body: (3 hours)

1.1. Understanding of body design at structure-function level.
1.2. Interpretation of the molecular cell biology to the development of body organs & system.
1.3. Appreciation of the Control & regulation of body function.
1.4. Understanding of disease mechanism.

2.0 Introduction to the Chemistry of Life: Atoms, Molecules & Compounds. Biological Molecules & Body Fluids: (4 hours)

2.1. Understanding of ionic structures of different atoms, biological molecules in relation to body building
2.2. Outline salt-water balance of. Body
2.3. pH mechanism of body fluids. Acidosis & Alkalosis
2.4. Body fluids & their control

3.0 The Cells, Tissues & Organization of the Body, Disorder of the Cells & Tissues: (4 hours)

3.1. Understanding of structure & function of different types of cells & tissues
3.2. Cell to cell transport mechanisms
3.3. Cell division
3.4. Development of organ-system
3.5. Abnormal development of cells & tissues
3.6. Tissue repair & regeneration

4.0 **The Skin. Structure, Function & Disorder of Skin: (5 hours)**

4.1. General remarking of microscopic anatomy of skin
4.2. Histological study of Epidermis, dermis, hairs & glands
4.3. Pigmentation of skin
4.4. Functional roles of skin
4.5. Skin diseases

4.6. Burns & complications
4.7. Mechanism of wound repair

5.0 The Skeleton, Axial Skeleton & Appendicular Skeleton Bones. Diseases Related to Bones. Healing of Bones: (8 hours)

5.1. Outline Human Skeleton axial & appendicular views
5.2. Study of different Bone types
5.3. Understanding of bone components & histology of bone
5.4. Learning of Bone development or ossification of bone
5.5. Bone function
5.6. Anatomy of major Skull bones
5.7. Structure, arrangement & function of vertebral, thoracic limb & pelvic bone
5.8. Disorder of bone development. Bone tumors
5.9. Deficiency disease of bone. Bone infections
5.10. Healing of bone defects

6.0 **The joint. Types of Joints. Main synovial Joints of the Limbs. Disorders of Joints: (8 hours)**

6.1. Understanding the basic structure of joints
6.2. Differentiate the types of joints, fibrous, fixed & in relation to their movement
6.3. Characterize Synovial joints in relation to different parts of body
6.4. Joint diseases
6.5. Infectious, inflammatory diseases & metabolic joint diseases
6.6. Understanding joint repair

7.0 The Muscular System. Muscles of Face, Neck, Back, Abdominal Wall & Pelvic Floor. Diseases of muscles. Healing of muscle, Repair of Nerves Supplying Muscles: (10 hours)

7.1. Introduction to different types of muscle
7.2. Learning forms muscles at different parts of body
7.3. Microanatomy of skeletal muscle
7.4. Outline muscle functions
7.5. Understanding control of muscle contraction & relaxation
7.6. Assessment of muscle action
7.7. Diseases of muscular system. Trophic disorders of muscles
7.8. Repair of muscle trauma

8.0 The Nervous System. Neurons, CNS, Brain, Spinal Cord, Peripheral Nervous system. Autonomic Nervous System. Disorders of Brain, Spinal Cord & Peripheral Nervous System. Responses of Nervous Tissue to Injury: (10 hours)

8.1. Understanding the microanatomy of Nerve cell (neurons)
8.2. Arrangement of neurons. Types of neurons & their connections
8.3. Functions of nerve cell. Impulse generation. Neuromuscular transmission
8.4. List the types of nerves
8.5. Structure of Central Nervous system (CNS)
8.6. Identification of underlying areas of Brain
8.7. Structural details of Peripheral Nervous system (PNS)
8.8. Outline the anatomical relationship of Autonomic Nervous system (ANS) to different parts of body. Types of ANS

8.9. Understanding of the function of CNS, PNS & ANS in relation to a computer function
8.10. Circulatory disorder of brain
8.11. Injury to nervous tissue & repair

9.0 The Special Senses. Hearing & Balance of Ear, Sight & Eye, Sense of Smell, Sense of Taste, Disease of Ear & Eye: (8 hours)

9.1. Structural details of Human ear, external ear, middle ear & internal ear
9.2. Outline the functions of ear
9.3. Understanding the hearing & balancing functions of the ear
9.4. Brief introduction of diseases of ear
9.5. Structural details of Human eye
9.6. Function details of eye
9.7. Eyesight physiology
9.8. General introduction of ocular diseases
9.9. Brief study of sense of smell
9.10. Structure-function relationship of sense of taste

Laboratories:

1.0 Study of Systematic relationship of Human body
2.0 Study of Histological structures of Skin
3.0 Study of structures of Skeletal, cardiac, & smooth muscle cells
4.0 Study of Histological structures of Spinal cord
5.0 Study of structures of Nerve cell
6.0 Study of structures of sense organs

Textbooks:

1.0 Anatomy & Physiology in Health & Illness –Anne Waugh & Allison Grant, Ninth Edition

Reference Books:

1.0 Textbook of Physiology, C. Guyton, 6th Edition
2.0 Atlas of Anatomy, Anne MR Agur, Ninth Edition

FLUID MECHANICS
BEG 2C5 BM

Semester III **Year II**

Teaching Schedule (Hours/Week)			Examination Schedule						Total Marks	Remarks
			Final				Internal Assessment			
			Theory		Practical		Theory	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
3	1	3	3 hrs	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 hours)**
- 1.1. Fluid Mechanics, Definition & Basic Concepts
- 1.2. Fluids, classification & properties

2.0 Fluid Pressure & Forces: **(9 hours)**
- 2.1. Pressure at a point in fluid
- 2.2. Equation of Fluid Statics
- 2.3. Pascal's Law
- 2.4. Atmospheric Pressure
- 2.5. Pressure Measurement Devices
- 2.6. Forces on submerged surfaces: Plane horizontal surface, plane vertical surface and inclined surfaces.
- 2.7. Center of Pressure & Pressure Diagrams

3.0 Buoyancy & Floatation: **(5 hours)**
- 3.1. Archimedes Principle
- 3.2. Principle of floatation, Meta center, Metacentric height determination
- 3.3. Conditions of Equilibrium
- 3.4. Fluid Mass Subjected to Acceleration (Translational & Rotational)

4.0 Fluid Kinematics: **(8 hours)**
- 4.1. Description of Motion: Lagarangian & Eulerain Methods, Lines of Flow
- 4.2. Types of Flow: Steady Flow-Unsteady Flow, Uniform Flow-Non Uniform Flow, Laminar Flow-Turbulent Flow, Compressible Flow- Incompressible Flow, Rotational Flow-Irrotational Flow
- 4.3. Discharge & Mean Velocity of Flow
- 4.4. One/Two/Three Dimensional Flows
- 4.5. Rotation & Vorticity
- 4.6. Equation of Continuity of Flow for One Dimensional Steady Flow

5.0 Dynamics of Flow: (8 hours)

5.1. Various Forces on Fluid
5.2. Euler's Equation of Motion, Bernoulli's theorem and Navier Stoke Equation
5.3. Energy of Steady Fluid Flow
5.4. Flow past submerged bodies, drag and lift forces
5.5. Concept of Boundary Layer
5.6. Flow Through orifices
5.7. Venturimeter and Orificemeter

6.0 Introductions on to Thermodynamics and Heat Transfer: (10 hours)

6.1. Introduction, System, Substances, Properties.
6.2. First Law of Thermodynamics.
6.3. Second Law of Thermodynamics (Kelvin-Planck Statement, Clausis statement, Entropy, Enthalpy, Heat Engine, Refrigerator, Coefficient of Performance.
6.4. Refrigerants: Classification and Properties.
6.5. Modes of Heat Transfer: Conduction, convection and Radiation.
6.6. One-dimensional steady state Heat Conduction, Parallel and Series Heat Conduction.
6.7. Free and Forced Convection.
6.8. Concept of Black Body Radiation, Emissivity, Absorptivity and Reflectivity.

Laboratory:

Six laboratory exercises will be performed in this course. These are:

1.0 Newton's law of viscosity
2.0 Verification of Bernoulli's theorem
3.0 Impact of flow jet
4.0 Flow through edged orifice

Tutorial:

1.0 Six assignments and two quizzes

Textbooks:

1.0 Dr. J. Lal, "Fluid Mechanics and Hydraulics", Metropolitan Books Co. Pvt Ltd., Delhi, 1987
2.0 R.J. Grade, "Fluid Mechanics"
Webster.f.P. Beer and E.R. Johnston, Jr., "Fluid Mechanics", 4th Edition, McGraw-Hill, 1987

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	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
3	-	3	3 hrs	80	-	-	20	25	125	

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

1.0 CELL BIOLOGY: (6 hours)

1.1. Cell structure, function and biosynthesis of cell membrane and organelles
1.2. Cell growth, apoptosis and oncogenic transformation
1.3. Transport, receptors and cell signaling..
1.4. Cytoskeleton, extracellular matrix and cell movements
1.5. Chromatin structure

2.0 BIO MOLECULES: (6 hours)

2.1. Carbohydrates: Importance, general structure and examples of monosaccharides, disaccarides and polysaccharides, isomers
2.2. Lipid: Importance and general structure, glycerol, fatty acids, types of phospholipids
2.3. Proteins: Amino acids, peptide bonds, polypeptides: primary, secondary, tertiary and quaternary structures of proteins; kinds of proteins; functions of proteins
2.4. Nucleic acids: Building components of nucleic acids, bases, sugars, phosphates, types of nucleic acids, structure of nucleic acids.

3.0 MOLECULAR BIOLOGY AND GENETICS: (8 hours)

3.1. Central Dogma: DNA, RNA and Protein synthesis
3.2. Mutation and Repair
3.3. Techniques of genetic engineering, Introduction, gene manipulation, gene cloning

4.0 IMMUNOLOGY: (18 hours)

4.1. An Introduction to Immunology
4.2. Antigen and antibody: Introduction, structure, type, function and its importance
4.3. Types of Antigen-Antibody reactions and its effect

4.4. Complement system: Complement and its component, Activation of complement system, Classical and alternate pathways
4.5. Development structure and function of immune system: Stem cells, central lymphoid organ
4.6. CMI and Humeral Immunity, Hypersensitivity, auto immunity

5.0 BLOOD: (3 hours)

5.1. Composition and Function
5.2. Identification and differentiation of different cells
5.3. Hemostasis

6.0 EUKARYOTES AND PROKARYOTES: (4hours)

6.1. Microorganisms: Structure, growth and reproduction
6.2. Parasitology: Structure, growth and reproduction
6.3. Virology: Structure, growth and reproduction
6.4. Mycology: Structure, growth and reproduction

Laboratories:

1.0 Types of Microscope.
2.0 Microscopy for Prokaryotic and Eucariotic Cells.
3.0 Blood Cell Count.
4.0 Antingen/Antibody Reaction.
5.0 Microscopy for Bacterial Cells.

Textbooks and Reference Books:

1.0 Biochemistry by Albert Leningher
2.0 Textbook of Immunology by Ivan Roitl (Vol IV)
3.0 Textbook of Biotechnologyy by R.C. Dubey.
4.0 Transmission and Distribution by JB Gupta
5.0 Anatomy and Physiology by Ross and Wilson

MICROPROCESSORS
BEG237 EC

Semester III **Year II**

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

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

1.0 INTRODUCTION: (6 hours)

1.1. Evolution of microprocessor
1.2. Calculator and stored program computer
1.3. Von Neuman and Harvard architecture
1.4. Simple stored program computer architecture

2.0 MICROPROCESSOR INSTRUCTION: (8 hours)

2.1. Register Transfer Language (RTL)
2.2. Instruction and machine cycle
2.3. Addressing modes: Direct, indirect, immediate, absolute, relative, indexed, register, stack and implied
2.4. RTL descriptions of data transfer instructions, arithmetic instructions, logical instructions, branch instructions, and miscellaneous instructions
2.5. Fetch and execution cycle, fetch-execution overlap
2.6. Timing diagram for register move, indirect read, indirect write and out instruction

3.0 ASSEMBLY LANGUAGE PROGRAMMING: (10 hours)

3.1. Assembler instruction format: Opcodes, mnemonics and operands
3.2. Assembler operation: Sample assembly language program and code generation, one pass and two pass assembly
3.3. Macro assemblers, linking assembler directives

4.0 BUS STRUCTURE AND MEMORY DEVICES: (4 hours)

4.1. Bus structure, synchronous and asynchronous data bus, address bus, bus timing
4.2. Static and dynamic RAM, ROM
4.3. Programmable read only memory (PROM), ultraviolet electrically programmable memory
4.4. (UVEPROM) and electrically erasable programmable memory (EEPROM)
4.5. SRAM and ROM interface requirements

5.0 INPUT/OUTPUT INTERFACES: (7 hours)

5.1. Serial Communication
- 5.1.1. Asynchronous interface: ASCII code, baud rate, start bit, stop bit, parity bit
- 5.1.2. Synchronous interface
- 5.1.3. Physical communication standard
- 5.1.4. 8251A programmable communication interface
- 5.1.5. Parallel communication
- 5.1.6. Data Transfer wait interface
- 5.1.7. RS-232 and IEEE 488-1978 general purpose interface standard
- 5.1.8. Keyboard and display controller

6.0 INTERRUPT: (4 hours)

6.1. Introduction, interrupt vector and descriptor table
6.2. Interrupt service routine requirements
6.3. Interrupt priority: Maskable and Non-maskable interrupts, software interrupts, traps and exceptions
6.4. Vectored, chained and polled interrupt structures
6.5. Interrupts in parallel and serial interfaces

7.0 MULTIPROGRAMMING: (4 hours)

7.1. Microprogramming, uniprogramming and multiprogramming
7.2. Process Management and semaphore
7.3. Common procedure sharing
7.4. Memory management and virtual memory

8.0 INTRODUCTION TO ADVANCED MICROPROCESSOR ARCHITECTURE: (2 hours)

Laboratory:

1.0 Laboratories exercises using the microprocessor trainer kit and assembler

References:

1.0 Ghosh, P.K., Sridhar PR, "0000 to 8085: Introduction to Microprocessors for Engineers and Scientists", 2nd Edition, Prentice Hall of India Pvt. Ltd., 1997
2.0 Lance, A. Leventhal., "Introduction to Microprocessors: Software, Hardware and Programming", Eastern Economy Edition, Prentice Hall of India Private Limited 1995
3.0 Malvino, AP, "An Introduction to Microcomputers", Prentice Hall of India Ltd., 1995

APPLIED MATHEMATICS
BEG 204 SH

Semester III **Year II**

Teaching Schedule (Hours/Week)			Examination Schedule						Total Marks	Remarks
			Final				Internal Assessment			
			Theory		Practical		Theory	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
3	1	-	3 hrs	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.

1.0 Complex variables: **(6 hours)**

1.1. Function of complex variables
1.2. Taylor series, Laurent series
1.3. Singularities, Zeroes and Poles
1.4. Complex integration
1.5. Residues

2.0 Transforms: **(12 hours)**

2.1. Diffusion of Z-transforms
2.2. One sided and two sided transforms
2.3. Linear Time Invariant systems, response to the unit spike
2.4. Properties of Z-transforms
2.5. Region of Convergence Relationship to Casualty
2.6. Difference equation and solutions of difference equations, Representation of system transfer function in Z-domain
2.7. Inverse Z-transform
2.8. Parseval's Theorem

3.0 The Fourier series, Integral and Transform: **(15 hours)**

3.1. Periodic functions, even and odd functions
3.2. Fourier series for arbitrary range and for complex function
3.3. Magnitude and Phase Spectra
3.4. The Fourier integral, the inverse Fourier integral
3.5. Fourier and cosine Transforms
3.6. Magnitude, energy and Phase spectrum

4.0 Partial Differential Equation: **(8 hours)**

4.1. Wave equation
4.2. Diffusion equation
4.3. Laplace equation and Spherical coordinates

5.0 Linear Programming: **(4 hours)**

5.1. Simplex method
5.2. Canonical forms of solutions
5.3. Optimal values

References:

1.0 E. Keryszig. “Advanced Engineering Mathematics”, Wiley, US
2.0 JG Prakis and DG Manolakis, “Digital Signal Processing”, Prentice Hall-India

ELECTRONIC DEVICES AND CIRCUITS
BEG 239 EC

Semester III **Year II**

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

COURSE OBJECTIVES: To build on the material presented in SEMI CONDUCTOR DEVICES to include the fundamentals of analog integrated. circuit (IC) operation. Particular attention will be directed toward useful frequency range. Regulated power supplies, power amplifiers and relaxation and sinusoidal oscillators will be discussed

1.0 Semiconductor Diodes: **(4 hours)**

- 1.1 Ideal Diode.
- 1.2 Semiconductor Diode and Equivalent Circuit.
- 1.3 Reverse Recovery Time.
- 1.4 Load line Analysis.
- 1.5 Zener Diode

2.0 Bipolar Junction Transistor: **(6 hours)**

- 2.1 Construction and Operations.
- 2.2 Transistor Configurations.
- 2.3 Dc-Biasing.
- 2.4 Transistor Switching Network.

3.0 Field Effect Transistor: **(5 hours)**

- 3.1 Junction Field Effect Transistor (JFET)
  - 3.1.1 Construction and Characteristics.
  - 3.1.2 Transfer Characterization.
- 3.2 Metal Oxide Field Effect Transistor (MOSFET)
  - 3.2.1 Depletion Type MOSFET.
  - 3.2.2 Enhancement Type MOSFET.
- 3.3 FET Biasing

4.0 Operational Amplifier Circuits: **(6 hours)**

- 4.1. Bias circuits suitable for IC design.
- 4.2. The widlar current source.
- 4.3. The differential amplifier.
- 4.4. Active loads.
- 4.5. Output stages.

6.0 Operational Amplifier Characterization: (8 hours)

6.1. Input offset voltage.
6.2. Input bias and input offset currents.
6.3. Output impedance.
6.4. Differential and common-mode input impedances.
6.5. DC gain, bandwidth, gain-bandwidth product.
6.6. Common-mode and power supply rejection ratios.
6.7. Higher frequency poles, setting time.
6.8. Slew rate.
6.9. Noise in operational amplifier circuits.

7.0 Power Supplies and Voltage Regulators: (6 hours)

7.1. Half-wave and full-wave rectifiers.
7.2. Capacitive filtering.
7.3. Zener diode voltage regulators.
7.4. Series transistor-zener diode voltage regulators.
7.5. Series transistor-zener diode-constant current diode voltage regulators.
7.6. Voltage regulators with feedback.
7.7. IC voltage regulations.

8.0 Untuned and Tuned Power Amplifiers: (8 hours)

8.1. Amplifier classification.
8.2. Direct-coupled push-pull stages.
8.3. Transformer-coupled push-pull stages.
8.4. Tuned power amplifiers.
8.5. Power dissipation considerations.

9.0 Filter Circuits: (2 hours)

9.1. LC Filters
9.2. RC Filters
9.3. Active Filters

Laboratory:

1.0 I-V characteristics of semiconductor and Zenor diode.
2.0 Input/output characteristics of BJT (NPN and PNP).
3.0 Study of a discrete component operational amplifier realization.
4.0 Commercial operational amplifier characterization.
5.0 Power amplifiers.
6.0 Regulated power supplies.

References:

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.

BIOMECHANICS
BEG 2C1 BM

Semester IV **Year II**

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

COURSE OBJECTIVE: To provide basic mechanical features of Human Body and Tissues.

1. **Force in Joint:** **(12 hour)**
   Classification of Joints
   Forces in Elbow, Shoulder, Hip, Knee, Spine, Ankle and Wrist

2. **Skeletal Biology:** **(6 hours)**
   Introduction
   Composition of bone, Quantitative representation
   Mechanical Significance and organization of Articular Cartilage
   Longitudinal growth of bone
   Modeling and Remodeling of bone
   Fracture healing

3. **Mechanical Properties of Tissues:** **(8 hours)**
   Bone
   Ligament
   Tendon

4. **Mechanics of Soft Tissues:** **(6 hours)**
   Collagen
   Elastin
   Thermodynamics of elastic deformation
   Quasi-Linear Viscoelasticity
   Concept of pseudo-elasticity

5. **Synovial Joint Mechanics:** **(6 hours)**
   Introduction
   Mechanical Properties of Cartilage
   Lubrication of joint

6. **Muscle Mechanics:** **(6 hours)**
   Skeletal muscle
   Cardiac muscle

7. **Modalities of Elastic and Viscoelastic Solids, Constitutive Equations** **(8 hours)**
   Stress, Strain Tensors
   Constitutive Equation for Viscous fluid& Hookean elastic soild
   Viscoelasticity and Mechanical models

8. **Introduction to Bio-Fluid Mechanics** **(8 hours)**
   Introduction to Bio-fluid
   Basics of Blood Rheology
   Blood Flow in Vessels & its Measurement

Textbook:

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

SOCIOLOGY
BEG299 MS

Semester IV **Year II**

Teaching Schedule (Hours/Week)			Examination Schedule						Total Marks	Remarks
			Final				Internal Assessment			
			Theory		Practical		Theory	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
4	1	-	3 hrs	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
- 1.3. Relationship of Sociology with other Social Sciences
- 1.4. Application of Sociology in addressing contemporary issues

2.0 LANGUAGE OF SOCIOLOGY: **(14 hours)**
- 2.1. Society and Culture
- 2.2. Tribe, Caste and Ethnicity
- 2.3. Community and Institutions
- 2.4. Homogenous & Heterogeneous
- 2.5. Norms and Values
- 2.6. Cooperation and Conflict
- 2.7. Status & Roles
- 2.8. Competition & Conflict
- 2.9. Association and Group

3.0 FUNDAMENTAL CONCEPTS IN SOCIOLOGY: **(14 hour)**
- 3.1. Social System
- 3.2. Social Structure: family, caste and ethnic group, religious festivals
- 3.3. Social Process
- 3.4. Socialisation
- 3.5. Social and Cultural Change
- 3.6. Social Stratification
- 3.7. Social Problem and Social Control

4.0 NEPALESE CULTURE AND SOCIETY: **(12 hour)**
- 4.1. Historical ideological and political dimension of Nepalese culture and society
- 4.2. Caste System in Nepal
- 4.3. Ethnic groups and interrelationship among them

4.4. Religions and festivals in Nepal
4.5. Social stratification in Nepalese Societies on the basis of Caste, gender, ethnicity and age

5.0 COMMUNITY AND DEVELOPMENT: (16 hours)

5.1. Meaning
5.2. Nature and History
5.3. Development Approaches
5.4. Community organising for people's empowerment
5.5. Communications and community Education
5.6. Community mobilization
5.7. Indigenous and appropriate Technology
5.8. Ecology and Environment
5.9. Community Participation in Development Activities
5.10. Gender indifferences and role of Women in energy conservation and development, social cycle, modernisation and globalization
5.11. 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

RESEARCH METHODOLOGY
RM 2C8 BM

Semester IV **Year II**

Teaching Schedule (Hours/Week)			Examination Schedule						Total Marks	Remarks
			Final				Internal Assessment			
			Theory		Practical		Theory	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
2	1	-	1.5 hrs	40	-	-	10	-	50	

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

1.0 INTRODUCTION: Scientific research process, steps, research protocol and ethics of medical research **(3 hours)**

2.0 RESEARCH METHODOLOGY: **(6 hours)**

2.1 Introduction and Definitions

2.2 Types of Research :Applied Vs Fundamental, Quantitavive Vs Quantitative, Conceptual Vs Empirical .

2.3 Validity and Reliability

3.0 RESEARCH DESIGN: **(3 hours)**

3.1 Introduction, Purpose and characteristics of a good research design

3.2 Types of Research design; Conventional, Historical, Descriptive, Developmental, Action, Field study,
True experimental, Evaluation, Ex-Post facto, Correlation, Casual comparative, Case study,
Assessment study research.

4.0 SAMPLING, DATA COLLECTION AND DATA ANALYSIS: **(6hours)**

4.1 Objective and principle of sampling.

4.2 Techniques of data collection.

4.3 Source and quality of data .

4.4 Types of measurement.

4.5 Processing and Classification of data.

5.0 MEAN, MEDIAN AND STANDARD DEVIATION: **(6 hours)**

5.1 Definition.

5.2 Different method of calculation of mean, median and standard deviation.

5.3 T-test & Z-test

6.0 RESEARCH, PRAPOSAL AND REPORT WRITING: (6 hours)

- 6.1 Topic selection.
- 6.2 Research problem.
- 6.3 Research hypothesis.
- 6.4 Submitting research proposal.
- 6.5 Introduction to report writing.
- 6.6 Types of research.
- 6.7 Format of the research report.
- 6.8 Bibliography.

Textbooks and References:

1.0 Research Methodology by P.R. Joshi.

2.0 Basic Methods of Medical Research by A.Indrayan.

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	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
4	-	3	3 hrs	80	-	-	20	25	125	

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

1.0 BRIEF REVISION OF BLOOD COMPONENT. HAEMOSTASIS & THROMBOSIS. DISORDERS OF BLOOD COAGULATION. BLOOD CELLS DISORDERS: (3 hours)

1.1. Brief revision of blood components.
1.2. Revision of blood functions
1.3. Learning of haemostatic mechanisms
1.4. Effect of thrombus formation on blood vessels
1.5. Review of Blood coagulation & disorders
1.6. Outline blood cell disorders

2.0 THE CARDIOVASCULAR SYSTEM. BLOOD VESSELS, BLOOD PRESSURE, PULSE & CIRCULATION OF THE BLOOD: (12 hours)

2.1. Understanding of Anatomy of heart & blood vessels.
2.2. Study of blood supply of heart or coronary circulation
2.3. Blood circulation from different organs to the heart & from the heart to different organs.
2.4. Pulmonary circulation
2.5. Portal circulation
2.6. Introduction of capillary circulation, internal respiration & cell metabolism
2.7. Outline the heart functions
2.8. Understanding of cardiac cycle, cardiac output & blood pressure
2.9. Learning of conduction system of heart
2.10. Brief understanding of heart diseases
2.11. Study of the disorders of blood vessels
2.12. Understanding of disorders of blood pressure

3.0 THE LYMPHATIC SYSTEM. LYMPH, LYMPH VESSELS, LYMPHATIC ORGANS & TISSUE: (3 hours)

3.1. Understanding of the component of lymph

3.2. Structure of lymph vessels
3.3. Structure-function relationship of spleen
3.4. Thymus gland & its role
3.5. Brief understanding of lymphatic, spleen & thymus gland diseases

4.0 THE RESPIRATORY SYSTEM, NOSE, NASAL CAVITY, PHARYNX, LARYNX, TRACHEA, BRONCHI, LUNGS. RESPIRATION. DISORDER OF UPPER RESPIRATORY TRACT, BRONCHI & LUNGS: (8 hours)

4.1. Understanding of Anatomy-physiological relationship of upper respiratory tract
4.2. Structure & functions of Bronchial tree
4.3. Lungs & its topography. Pleura & pleural cavity
4.4. Learning of lung functions
4.5. Mechanism of breathing, types of breathing & control of respiration
4.6. Composition of air
4.7. Understanding of Ventilation & Lung volumes
4.8. Gas transfer & diffusion
4.9. Bronchial disorders
4.10. Abnormal lung functions

5.0 **THE DIGESTIVE SYSTEM, ORAL CAVITY. DIGESTION, ABSORPTION & METABOLISM. DISEASES RELATED TO DIGESTIVE SYSTEM: (10 hours)**

5.1. Structure of oral cavity & underlying glands
5.2. Teeth systems, functions & abnormalities of teeth
5.3. Structure of alimentary system
5.4. Functions of stomach, intestine & role of smooth muscle of gut
5.5. Understanding of digestion, secretion & absorption capacity of gut
5.6. Structure-function relationship of liver, billiary tract & gall bladder
5.7. Pancreas & its functions
5.8. Revision of Metabolic functions of body
5.9. Digestive system disorders
5.10. Pancreatic & hepatic disorders

6.0 THE URINARY SYSTEM. KIDNEY, URETERS, URINARY BLADDER, BLADDER, URETHRA. DISEASE RELATED TO SYSTEM: (8 hours)

6.1. Topography of Kidneys
6.2. Microanatomy of kidney
6.3. Role of kidney in salt-water balance
6.4. Structure-function relationship of ureter, bladder & urethra
6.5. Control of bladder function
6.6. Abnormalities of kidney functions
6.7. Renal & urinary diseases

7.0 THE ENDOCRINE SYSTEM. PITUITARY, THYROID, ADRENAL, PANCREAS, PINEAL & THYMUS GLAND: (8hours)

7.1. Structures-function relationship of Hypothalamus & Pituitary gland
7.2. Thyroid gland & its role in metabolic & electrolyte control of body
7.3. Parathyroid gland & its role in body function
7.4. Pancreas as an Endocrine organ
7.5. Structure of Adrenal glands & their control in the body

7.6. Pineal gland as a biological clock
7.7. Introduction to Thymus gland
7.8. Diseases related to Pituitary, thyroid, parathyroid, pancreas & adrenal glands

8.0 REPRODUCTIVE SYSTEM. MALE & FEMALE REPRODUCTIVE ORGANS. DISEASES RELATED TO SEX ORGANS. (8 hours)

8.1. Structure of female reproductive tract
8.2. Structure-function relationship of Vagina, Uterus and Fallopian Tubes
8.3. Outline the anatomy of ovaries and its functions
8.4. Understanding of Puberty, Menstrual cycle and Menopause in female
8.5. Learning of breast structure and functions
8.6. Structure of male reproductive tract
8.7. Glandular function of male reproductive system
8.8. Topographical relationship of Spermatogenesis and circulation
8.9. Prostate gland and its function
8.10. Puberty and Ejaculatory function in male
8.11. Abnormalities of female reproductive system
8.12. Fertility disorders
8.13. Diseases of male reproductive system
8.14. Male infertility

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 nephrone
9.0 Study of Systematic relationship of endocrine system
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:

1.0 Anatomy & Physiology in Health & Illness –Anne Waugh & Allison Grant, Ninth Edition

YEAR III

SEMESTER V & VI

PROBABILITY AND STATISTICS
BEG 304 SH

Semester V **Year III**

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

1.0 Introduction and Descriptive Statistics: **(4 hours)**

1.1. An overview of probability and statistics.
1.2. Pictorial and Tabular methods in descriptive statistics.
1.3. Measures of location: mean, median, quartiles, percentiles etc
1.4. Measures of variability

2.0 Probability: **(4 hours)**

2.1. Sample spaces and events
2.2. Axioms, interpretations and properties of probability
2.3. Counting techniques
2.4. Conditional probability

3.0 Discrete Random Variables and Probability Distribution: **(6 hours)**

3.1. Random Variables
3.2. Probability distributions for random variables
3.3. Expected values of discrete random variables
3.4. The binomial probability distribution
3.5. Hypothesis testing using the binominal distribution
3.6. The hyper geometric and negative binomial distributions
3.7. The Poisson probability distribution

4.0 Continuous Random Variables and Probability Distributions: **(6 hours)**

4.1 Continuous random variables and probability density functions
4.2 Cumulative distribution functions and expected values for continuous random variables
4.3 The normal distribution
4.4 The Gamma distribution
4.5 Chi-Squared Distribution

5.0 Joint Probability Distributions and Random Samples: **(4 hours)**

5.1. Jointly distributed random variables

5.2. Expected values, covariance and correlation
5.3. Sums and averages of random variables
5.4. The central limit theorem

6.0 Point Estimation: (2 hours)
6.1. Some General concepts of point estimation
6.2. Methods of Point Estimation

7.0 Hypothesis Testing Procedures Based on a Single Sample: (5 hours)
7.1 Tests about the mean of a normal population
7.2 Large-sample test for population mean.
7.3 Large-sample test for a population proportion
7.4 The t-test
7.5 Test procedures for a population variance
7.6 Some comments on selecting a test procedure.

8.0 Hypothesis Testing Based on Two Samples: (4 hours)
8.1. z-tests for differences between two population means.
8.2. The two-sample t-test.
8.3. Analysis of paired data.
8.4. Testing for differences between population proportions

9.0 Interval Estimation: (3 hours)
9.1. A confidence interval for the mean of a normal population
9.2. Large-sample intervals for population means
9.3. Confidence intervals for population proportions
9.4. Small-sample intervals for means of normal populations

10.0 Simple Linear Regression and Correlation: (4 hours)
10.1. The simple linear probabilistic model and principle of least square.
10.2. Correlation and the coefficient of determination.
10.3. Interfaces about the slope parameter beta 1
10.4. Interfaces concerning um sub x, y and the prediction of future values

11.0 The Analysis of Categorical Data: (3 hours)
11.1. Goodness of fit tests when category probabilities are completely specified
11.2. Goodness of fit for composite hypothesis
11.3. Two way contingency tables

Reference Book:

1.0 Jay L. Devore, "Probability and Statistics for Engineering and the Sciences", Books/Cole Publishing Company, Monterey, California, 1982.

NUMERICAL METHODS
BEG 389 CO

Semester V **Year III**

Teaching Schedule (Hours/Week)			Examination Schedule						Total Marks	Remarks
			Final				Internal Assessment			
			Theory		Practical		Theory	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
3	1	2	3 hrs	80	-	-	20	50	150	

COURSE OBJECTIVES: To solve the engineering problems by using the theory of numerical computational procedures.

1.0 Introduction: **(2 hours)**

1.1. Introduction to numerical method
1.2. Needs of numerical method
1.3. Number and their accuracy
1.4. Errors (Absolute, Relative, rounding off error, truncation error, general error formula)
1.5. Convergence

2.0 Solution of Nonlinear Equations: **(8 hours)**

2.1. Introduction
2.2. Graphical method
2.3. The iteration methods
2.4. The bisection method
2.5. Newton Raphson method
2.6. Secant method
2.7. Fixed point iteration
2.8. Zeros of polynomials by Horner's method

3.0 Interpolation: **(10 hours)**

3.1. Introduction
3.2. Polynomial forms
3.3. Linear interpolation
3.4. Lagrange's interpolation polynomial
3.5. Newton's interpolation and divided differences.
3.6. Spline interpolation
3.7. Chebyshev interpolation polynomial
3.8. Least squares method of fitting continuous and discrete data or functions

4.0 Numerical Differentiation and Integration: (5 hours)

4.1. Introduction
4.2. Numerical differentiation
4.3. Numerical integration
4.4. Numerical double integration

5.0 Matrices and Linear Systems of Equations: (10 hours)

5.1. Introduction
5.2. Review of the properties of matrices
5.3. Solution of linear systems direct methods
5.4. Solution of linear systems-interactive methods
5.5. The Eigenvalue problem
5.6. Singular value decomposition

6.0 Numerical Solution of Ordinary Differential Equations: (7 hours)

6.1. Introduction
6.2. Euler's method for solving ordinary differential equations of 1st order
6.3. Runga-Kutta methods
6.4. Prediction-Corrector methods
6.5. Simultaneous and higher order equations
6.6. Initial value problems
6.7. Boundary value problems

7.0 Numerical Solution of Partial Differential Equations: (3 hours)

7.1. Introduction
7.2. Finite-difference approximates to derivatives
7.3. Laplace's equation
7.4. Parabolic equations
7.5. Iterative methods for the solution of equations
7.6. Hyperbolic equation

Laboratories:

There shall be 12 laboratory exercises using high level programming language

References:

1.0 V Rajaraman, *"Computer Oriented Numerical Methods"*
2.0 *SS Sastry, "Introductory Methods of Numerical Analysis*
3.0 S. Yakwitz and F. Szidarovsky, "An introduction to Numerical Computations", 2nd edition, Macmillan Publishing Co., New York.

MEASUREMENT AND INSTRUMENTATION
BEG 3C3 BM

Semester V **Year III**

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

Course objective: Comprehensive Knowledge on Measurement Techniques and Instrument Design for Biomedical Applications.

1.0 Measurement and Error: (8 hours)

1.1 Accuracy and Precision
1.2 Significant Figures
1.3 Types of Error
1.4 Statistical Analysis
1.5 Probability of Errors
1.6 Limiting Errors

2.0 Measurements and Control by Analog and Digital System: (3 hours)

2.1 Physiological Variable Measurement and Control by Analog system
2.2 Physiological Variable Measurement and Control by Digital system
- 2.2.1 Supervisory Control
- 2.2.2 Direct Digital Control

3.0 Introduction to Human Instrument System: (1 hour)

4.0 Transducers and Sensors: (18 hours)

4.1 General Transducer/Sensors Characteristics
4.2 Transducer/Sensor Classification
4.3 Mechanical Sensors:
- 4.3.1 Resistive and Capacitive Sensors
- 4.3.2 Strain Sensors - strain Gauze
- 4.3.3 Variable Reluctance Sensor - Linear Variable Differential Transformer (LVDT)
- 4.3.4 Magnetic Sensors - Hall Effect Sensors
- 4.3.5 Flow Sensors
- 4.3.6 Measurement Techniques of Physiological Variables using Mechanical Sensors
- 4.3.7 Piezoelectric Sensors

4.4 Thermal Sensors:
- 4.4.1 Metal and Resistance vs. Temperature Devices
- 4.4.2 Thermistors
- 4.4.3 Thermocouples
- 4.4.4 Bimetal Strip
- 4.4.5 Solid State Temperature Sensors
- 4.4.6 Design Considerations
- 4.4.7 Measurement Techniques of Physiological Variables using Thermal Sensors
- 4.4.8 Concept of Biomedical Instrument Development using Thermal Sensors

4.5 Optical Sensors:
- 4.5.1 Fundamental of EM radiation
- 4.5.2 Photodetectors
- 4.5.3 Pyrometry
- 4.5.4 Optical Sources and their medical Applications
- 4.5.5 Measurement Techniques of Physiological Variables using Optical Sensors
- 4.5.6 Concept of Biomedical Instrument Development using Optical Sensors

4.6 Fiber Optic Sensors:
- 4.6.1 Fiber Optic Basics
- 4.6.2 Classification of Fiber Optic Sensors
- 4.6.3 Intensity-Modulated Sensors
- 4.6.4 Phase Modulated Sensors
- 4.6.5 Spectrally Modulated Sensors
- 4.6.6 Distributed Fiber Optic Sensors
- 4.6.7 Biomedical Application of Fiber optic Sensors
- 4.6.8 Measurement Techniques of Physiological Variables using Fiber Optic Sensors
- 4.6.9 Concept of Biomedical Instrument Development using Fiber Optic Sensors

5.0 Analog Signal Conditioning: (4 Hour)

5.1 Principle of Analog Signal Conditioning:
5.2 Signal Level Bias Changes
5.3 Linearization
5.4 Conversion
5.5 Filter and Impedance Matching
5.6 Concept of Loading
5.7 Op-Amp Circuits in Instrumentation
5.8 Guidelines for Analog Signal-Conditioning Design

6.0 Digital Signal Conditioning: (8 Hour)

6.1 Review of Digital Fundamentals
6.2 Digital to Analog Conversion Process and Networks (DACs):
- 6.2.1 Standard DAC Principle with Binary Input
- 6.2.2 Conversion Resolution, Reference Voltage and Step Size

6.2.3 DAC Circuit using Binary Weighted Resistor
6.2.4 R-2R Ladder Network for DAC

6.3 Analog to Digital Conversion Process and Networks (ADCs):
6.3.1 Standard ADC Principle with Analog Input
6.3.2 Conversion Resolution, Reference Voltage and Step Size
6.3.3 Counter Type ADC
6.3.4 Ramp ADC
6.3.5 ADC using Successive Approximation Technique
6.3.6 Flash Type ADC

6.4 Data Acquisition System

7.0 Output Devices, Display and Recording Systems: (3 Hour)

7.1 Indicators, Meters
7.2 Interfacing to Computers and Networks
7.3 Mimic Boards and Displays

Laboratory Experiments:

1. Instrumentation Amplifiers
   Performance measurements, sensitivity, accuracy, drift, noise, frequency response, input and output impedance

2. Transducers and Sensors
   Design and test a practical circuit to measure the variable like temperature, pressure, light intensity, displacement, and strain and other bio-physical variables using the appropriate sensors.

3. Analog/Digital Conversion
   Examination of A/D and D/A conversion systems.

Text Books:

1. Albert D. Helfrick and William D. Cooper, "Modern Electronic Instrumentation and Measurement Technique" PHI.
2. C.S. Rangan, G. R. Sarma, and V. S. V. Mani, "Instrumentation Devices and Systems" Tata McGraw Hill.

References:

1. D.M. Considine, "Process Instruments and Controls Handbook", 3rd Edition, McGraw-Hill, New York, 1985.
2. S. Wolf and R.F. M., Smith, "Students Reference Manual for Electronic Instrumentation Laboratories", Prentice Hall, Englewood Cliffs, New Jersey, 1990.

CONTROL SYSTEMS
BEG 329 EL

Semester V **Year III**

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

COURSE OBJECTIVES: To provide knowledge on feedback control principles and to apply these concepts to control processes.

1. Introduction **(4 hours)**

1.1. Definition of control systems
1.2. Examples of biomedical equipments control techniques
1.3. Concept of feedback
  1.3.1 Closed loop and open-loop systems
1.4. Types of sytems:
  1.4.1 Linear system
  1.4.2 time-invariant system
  1.4.3 Stable system

2. System Modeling: **(13 hours)**

2.1. Differential equation and transfer function
2.2. State-space formulation of differential equations, matrix notation
2.3. Mechanical components: mass, spring , damper
2.4. Electrical components:
  2.4.1. Inductance, capacitance, resistance, tachometers, transducers and operational amplifier
  2.4.2. DC Motors:
    2.4.2.1. Torque/speed characteristics of shunt, series and compound field motors
    2.4.2.2. Armature reaction and motor operation
    2.4.2.3. Starting and speed control of motors, armature voltage and shunt field control
  2.4.3. DC Generators:
    2.4.3.1. Voltage/speed/load characteristics
    2.4.3.2. Shunt, series and compound field machines
    2.4.3.3. Automatic voltage regulation
  2.4.4. Synchronous and induction machines

2.4.4.1. Introduction of Synchronous and induction Machines
2.4.4.2. Generator voltage regulation with real and reactive power loads
2.4.4.3. Generator synchronization, load and power factor control, torque angle

2.5. Fluid and fluidic components, Thermal system components
2.6. Mixed systems
2.7. Linearized approximations

3. Transfer Functions and Responses: (8 hours)

3.1. Components to physical systems
3.2. Block diagram and system reduction
3.3. Mason's loop rules
3.4. Laplace transform analysis of systems with standard input functions – stpes, ramps, impulses, sinusoids
3.5. Initial and final steady-state
3.6. Effects of feedback on steady-state gain, bandwidth, error magnitude, dynamic responses

4. Stability: (4 hours)

4.1. Heuristic interpretation for stability of a feedback system
4.2. Characteristic equation, complex plane interpretation of stability, root locations and stability
4.3. Routh-Hurwitz criterion, Eigenvalue criterion.
4.4. Setting loop gain using the R-H criterion.
4.5. Relative stability from complex plane axis shifting.

5. Root Locus Method: (6 hours)

5.1. Relationship between root loci and time responses of systems.
5.2. Rules for manual calculation and construction of root loci diagrams
5.3. Computer programmes for root loci plotting, polynomial root
5.4. Derivative feedback compensation design with root locus
5.5. Setting controller parameters using root locus, Parameter change sensitivity analysis by root locus

6. Frequency Response Methods: (4 hours)

6.1. Frequency domain characterization of systems
6.2. Bode amplitude and phase plots, Effects of gain and time constants on Bode diagrams, Stability from the Bode diagram
6.3. Nyquist plots, Correlation between Nyquist diagrams and real time response of systems: stability, relative stability, gain and phase margin, damping ratio

7. Computer Simulation of Control Systems: (4 hours)

7.1. Role of simulation studies
7.2. Linear and non-linear simulations

8. Performance Specifications for Control Systems: (2 hours)

8.1. Time domain specifications: steady-state errors, response rates, error criteria, hard and soft limits on responses, damping ratio, log decrement.
8.2. Frequency domain specifications: bandwidth, response amplitude ratio.

Laboratories:

1.0 Identification of Control System Components
2.0 Study of reversible DC motor drive system
3.0 Open and Closed Loop Performance of Servo Position Control System
4.0 Simulation Study of Feedback System Using TUSTIM or MATLAB
5.0 Design of a PID Controller
6.0 Non-Electrical Control System

Textbook:

1.0 K. Ogata, "Modern Control Engineering", 2nd Edition, Prentice Hall, Englewood Cliffs, New Jersey, 1990.
2.0 E. Fitgerald, C Kinsley, and S Dumans, "Electric Machinery", Tata McGraw-Hill India Limited, 1984

BIOMEDICAL EMBEDDED SYSTEM DESIGN
BEG 3C2 BM

Semester VI **Year III**

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

COURSE OBJECTIVES:

- To provide Design Concepts of Embedded Systems.
- To provide Interfacing Concepts with Micro Controllers.
- To provide Design Concepts of Biomedical Instruments.

1. BACKGROUND (3 hours)

1.1 Introduction to Embedded Systems
1.2 Introduction to Real Time Systems
1.3 Architecture and Design of an Embedded System
1.4 Example of an Embedded System

2. HARDWARE FUNDAMENTALS (3 hours)

2.1 Terminology
2.2 Gates and its implementation in practical considerations
2.3 Other Basic Considerations
2.4 Memory

3. ADVANCED HARDWARE FUNDAMENTALS (5 hours)

3.1 Microprocessors
3.2 Buses
3.3 DMA
3.4 Interrupts
3.5 Timer
3.6 Other Common parts.

4. ASSEMBLY LANGUAGE PROGRAMMING (6 h hours)

4.1 Basic Concepts of MASM and NASM
4.2 Optimization
4.3 Construction of Graphics Routine
4.4 Device Driver Concepts
4.5 Examples
4.6 Recent Software Tools for ALP

5. MICROCONTROLLERS (6 hours)

- 5.1 Introduction
- 5.2 Architecture of Microcontroller
- 5.3 AT89c51/52/55 Architecture
- 5.4 8255 PPI
- 5.5 Microcontroller Based Medical Instruments

6. EMBEDDED SOFTWARE DEVELOPMENT TOOLS (2 hours)

- 6.1 Cross Assemblers
- 6.2 Cross Compilers
- 6.3 Debuggers
- 6.4 Downloaders

7. SYSTEM DESIGN WITH MICROCONTROLLERS (10 hours)

- 7.1 Design and build a bioelectric amplifier
- 7.2 Activity and posture recorder
- 7.3 Doppler Ultrasound

8. EMERGING CONCEPTS (10 hours)

- 8.1 VLSI
- 8.2 VLSI application in medicine
- 8.3 VLSI sensors for biomedical signals
- 8.4 VLSI design with VHDl/Verilog

Laboratory:

1. Interfacing Standard Parallel and Serial Port
2. Real Life Projects with Microcontrollers
   a. Simple Flashing LED
   b. Flashing LED with Push Buttons
   c. Seven Segment Display Interfacing
   d. Keypad Interfacing
   e. Keypad with Seven Segment Display
   f. Stepper Motor Control
3. LCD Display Using Microcontroller
   a. Introduction to LCD and its Programming Protocols
   b. LCD with Microcontroller
   c. LCD Programming with Keypad
4. System Interfacing with Microcontroller
   a. Serial Data Communication
   b. Interrupts and Interrupt Service Routine
   c. ADC with Microcontrollers
   d. Activity and Posture Recorder
5. Interfacing on PIC Microcontrollers
6. Simple Projects on VHDL in FPGA Board

Project:

Students have to prepare one project using FPGA or Microcontroller related to Biomedical Instruments.

Text books:

1. Embedded System Primer, Simon
2. The 8051 Microcontroller Architecture, Programming and Application, Kenneth J. Ayala
3. IBM PC Assembly Language and Programming, Peter Abel
4. The 8051 Microcontroller and Embedded System, Muhammad Ali Mazidi & Janice Gillispie Mazidi

Reference book:

1. Biomedical Digital Signal Processing, Willis J. Tompking

COMMUNICATION SYSTEMS
BEG 3B6 BM

Semester VI **Year III**

Teaching Schedule (Hours/Week)			Examination Schedule						Total Marks	Remarks
			Final				Internal Assessment			
			Theory		Practical		Theory	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
4	1	2	3 hrs	80	-	-	20	25	125	

COURSE OBJECTIVES: To introduce the student to analog, digital and data communications systems.

1.0 Analog and Digital Communication Systems: (6 hours)

1.1. Analog and digital communication sources, transmitters, transmission channels and receivers.
1.2. Fundamental limitations due to noise, distortion, and interference and the relationships between noise, bandwidth and information.
1.3. Frequency domain concepts
1.4. Relationship between data rate and bandwidth
1.5. Types and reasons for modulation.

2.0 Continuous Wave Linear Modulators: (10 hours)

2.1. Amplitude modulation (AM), time domain expressions and modulation index, frequency domain (spectra).
2.2. AM modulation for a single tone message, phasor diagram of an AM signal, illustration of the carrier and sideband components.
2.3. Transmission requirements for AM, normalized power and its use in communication, carrier power and sideband power.
2.4. Double sideband suppressed carrier (DSB) modulation, time and frequency domain expressions.
2.5. Transmission requirements for DBS, bandwidth and transmission power for DSB.
2.6. Methods of generating AM and DSB, square modulators, balanced modulators, ring modulators.
2.7. Single sideband modulation (SSB), generation of SSB using a sideband filter, indirect generation of SSB.
2.8. Representation of SSB Signals.
2.9. Transmission requirements for SSB, transmit bandwidth and power, sideband filter examples.
2.10. Vestigial sideband modulation (VSB).

3.0 Frequency Modulation (FM) and Phase Modulation (PM): (10 hours)

3.1. Instantaneous frequency and instantaneous phase, time domain, representations for FM and PM, phasor diagrams for FM and PM.
3.2. FM and PM signals for a single tone message, the modulation index and phasor diagrams.
3.3. Spectral representation of FM and PM for a single tone message, Bessel' functions and the Fourier series.
3.4. Transmission bandwidth for FM, Carson's rule, narrow band and wide-band FM and PM signals.
3.5. Generation of FM using Armstrong's method, commercial FM requirements.
3.6. Demodulation of FM and PM signals, the limiter discriminator.
3.7. Commercial FM radio and stereo FM radio.
3.8. Demodulation of FM using a phase-locked loop.

4.0 Protocol Architecture: (4 hours)

4.1 Need for a protocol architecture
4.2 Simple protocol architecture
  4.2.1 OSI Model
  4.2.2 TCP/IP protocol suite
4.3 Addressing

5.0 Transmission Media: (5 hours)

5.1. Guided transmission media
5.2. Unguided transmission media
5.3. Wireless propagation
5.4. Line of sight transmission
5.5. Transmission impairments

6.0 Signal Encoding Techniques: (8 hours)

6.1. Digital data, digital signals
6.2. Digital data, Analog signals
6.3. Analog data, digital signals
6.4. Analog data, analog signals

7.0 Digital Data Communication Technique: (6 hours)

7.1. Asynchronous and synchronous transmission
7.2. Error detection and correction techniques

8.0 Data Link Control: (2 hours)

8.1. Line configuration
8.2. Flow control
8.3. Error control

9.0 Multiplexing: (5 hours)

8.1 Frequency division multiplexing
8.2 Synchronous time division multiplexing
8.3 Statistical time division multiplexing

10.0 General Concept of Wireless Communication System

Laboratory Experiments:

1. Examination of AM and FM system.
2. Synchronous and Asynchronous data transmission.
3. Examination of flow and error control techniques.
4. Field visit to communication networking.

Text Books:

1.0 S. Haykin, "An Introduction to Analog and Digital Communications", Wiley, New York, 1989.

2.0 William Stallings, "Data and Computer Communications"PHI.

Reference Books:

1.0 L.W. Couch II, "Digital and Analog Communication Systems", 2nd Edition, Macmillan Publishing Company, New York, 1987.

2.0 LW Couch II, "Digital and Analog Communication Systems" 6th Edition, Pearson Education, Asia 2001

3.0 BP Lathi, "Modern Digital and Analog Communication Systems", 3rd Edition, Oxford University Press, 1999

4.0 J. Proakis, M. Salehi, "Communication Systems Engineering", Prentice Hall, New Jersey, 1994

ENGINEERING ECONOMICS
BEG 399 MS

Semester VI **Year III**

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

COURSE OBJECTIVES: To provide knowledge of the basic tools and methodology of economic studies for evaluation engineering project in private industry, in the public sector and in the utilities area.

1.0 Introduction: (3 hours)

1.1 Essential business and accounting terminology.
1.2 Definition of cash flow.
1.3 Economic systems.

2.0 Cost Classification and Analysis: (5 hours)

2.1 The elements of cost.
2.2 Classification of cost: overhead, prime cost.
2.3 Cost variance analysis.
2.4 Job and process costing.

3.0 Interest and the Time Value of Money: (6 hours)

3.1 Simple interest, compound interest, interest tables, interest charts.
3.2 Present worth.
3.3 Nominal and effective interest rates.
3.4 Continuous compounding and compounding formula.
3.5 Interest calculations for uniform gradient.

4.0 Basic Methodologies of Engineering Economic Studies: (7 hours)

4.1 Present worth and annual worth methods.
4.2 Future worth method.
4.3 Internal rate of return method.
4.4 Drawbacks of the internal rate of return method.
4.5 External rate of return method.
4.6 Minimum attractive rate of return method.
4.7 The playback (payout) period method.

5.0 Cash/Benefit Analysis: (4 hours)

5.1 Conventional cost/benefit ratio.
5.2 Modified cost/benefit ratio.
5.3 Break-even analysis.

6.0 Investment Decisions: (8 hours)

6.1 Comparison of alternatives having some useful life.
6.2 Comparison of alternatives having different useful life.
6.3 Comparison of alternatives including of excluding the time value of money.
6.4 Comparison of alternatives using the capitalized worth method.
6.5 Definition of mutually exclusive investment alternatives in terms of combinations of projects.
6.6 Comparison of mutually exclusive alternatives.

7.0 Risk Analysis: (4 hours)

7.1 Projects operating under conditions of certainty.
7.2 Projects operating under conditions of uncertainty.
7.3 Decision tree.
7.4 Sensitivity analysis.

8.0 Taxation System in Nepal: (3 hours)

8.1 Taxation law in Nepal.
8.2 Depreciation rates for buildings, equipment, furniture etc.
8.3 Recaptured depreciation.
8.4 Taxes on normal gains.
8.5 Taxes on capital gains.

9.0 Demand Analysis and Sales Forecasting: (5 hours)

9.1 Demand analysis.
9.2 Correlation of price and consumption rate.
9.3 Market research.
9.4 Sales forecasting.
9.5 Criteria for desirable sales forecasting procedures.
9.6 Factors affecting accuracy of forecasting.

Tutorials: 3 Assignments, 2 quizzes, 3 case studies.

Note:

The case studies will concentrate on economic analysis and selection of public projects, economic analysis and selection of private projects, risk analysis and demand analysis.

Recommended Books:

1.0 E.P. DeCramo, W.G. Sullivan and J.A. Bontadelli, 8th Edition, Macmillan Publishing Company, 1988.
2.0 N.N. Borish and S. Kaplan, "Economic analysis: For Engineering and Managerial Decision Making", McGraw-Hill.

TISSUE DEVICE INTERACTIONS
BEG 3B2 BM

Semester VI **Year III**

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

COURSE OBJECTIVE: To provide knowledge of interactions between biomaterials and surrounding tissues after implantation in human body.

1.0 Introduction to Tissue-Device Interactions and Their Importance: (1 hour)

2.0 Inflammation, Wound Healing and Foreign Body Respond: (10 hours)
- 2.1 Acute Inflammation
- 2.2 Chronic Inflammation
- 2.3 Granulation Tissue
- 2.4 Foreign body reaction
- 2.5 Fibrosis and fibrous encapsulation.
- 2.6 Inflammation and wound healing.

3.0 The Effect of Biomaterials on the Heat: (5 hours)
- 3.1 Biochemical response to biomaterials.
- 3.2 Cellular response to biomaterials.
- 3.3 Systemic Response to biomaterials

4.0 Blood-Biomaterials Interactions: (5 hours)
- 4.1 Blood protein general interactions.
- 4.2 Specific proteins: fibrinogen and albumin,
- 4.3 Platelets.
- 4.4 Coagulation factors.
- 4.5 Complement activation.

5.0 Endothelial Cells and Biomaterials: (4 hours)
- 5.1 Endothelial Cell Physiology
- 5.2 Techniques for endothelial cell Harvest and culture.
- 5.3 Endothelial cell reading studies.

6.0 The Extra cellular Matrix and Biomaterials: (5 hours)

6.1 ECM components
6.2 Acute responses in injury or implantation.
6.3 Chronic response.
6.4 Cellular interactions.
6.5 Future challenges.

7.0 Bacteria and Biomaterials: (7 hours)

7.1 Specialties of infections due to biomaterials.
7.2 Nature of microbial adhesion.
7.3 Tissue-centred or biomaterial-centred.
7.4 Clinical reviews.
7.5 Molecular mechanisms of microbial adhesion.
7.6 Failure of integration due to infection.
7.7 Surface modification of biomaterials for control of infection.

8.0 Integrins Adhesion Molecules and Biomaterials: (6 hours)

8.1 Integrins
8.2 Adhesion Molecules.
8.3 Integrins, adhesion molecules and biomaterials.

9.0 Controlling, manipulating the material/host interactions by changing material, Chemistry i.e. surface charge, physical properties eg. Shape, topography, porosity and others:

Reference Book:

1.0 Implantation Biology: The first response and Biomedical Devices, Ralph S Greco, CRC Press

MEDICAL IMAGING I
BEG 3B3 BM

Semester VI **Year III**

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

COURSE OBJECTIVE: To provide knowledge in different imaging techniques, their mechanism and equipment.

1. **Basic Principles of Medical Imaging:** **(2 hours)**
   Different types of medical imaging and their functions

2. **Radiation Physics:** **(7 hours)**
   Review of Electricity
   Transformer
   Thermionic emissions and rectifiers
   Atomic structure and electromagnetic radiation
   Radioactivity

3. **X-rays:** **(5 hours)**
   Introduction
   Interaction of radiation with matter
   Measurement of electromagnetic radiation and other particles
   Radiation protection
   Control of scattered radiation

4. **X-ray Equipment:** **(6 hours)**
   X-ray tubes
   X-ray control and indicating equipment
   Filters and grids
   Different types of X-ray equipment (portable, fluoroscopy, mammography etc.)

5. **Radiographic Imaging:** **(8 hours)**
   Photographic Principle
   Film Materials
   Intensifying Screen
   Radiographic Processing

Radiographic Image
Exposure factors
Image Quality Control

6. **Basics of Radioisotope Imaging:** **(7 hours)**
Types of radioactivity'
Radionuclide/Radiopharmaceuticals
Labeling Technique
$^{99}Mo/^{99m}$ Tc Generator
Principle of Gamma Camera
SPECT and PET

Textbooks:

1. Physics for Medical Imaging, FR Farr and PJ Allisy-Roberts
2. Thomes S. Curry, III James E. Dowdey&Kobert C.Murry Jr., "Christensen's Physics of Diagnostive.

BIOMEDICAL INSTRUMENTATION I
BEG 3B4 BM

Semester VI **Year III**

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

COURSE OBJECTIVE: To give basic knowledge in different types of instruments used in medical applications

1.0 Fundamental of Medical Instrumentation: (2 hours)

1.1 Anatomy and Physiology
1.2 Physiological System of the Body
1.3 Sources of Biomedical Signals
1.4 Basic Medical Instrumentation System
1.5 Performance Requirements of Medical Instrumentation Systems
1.6 Intelligent Medical Instrumentation Systems
1.7 General Constraints in Design of Medical Instrumentation Systems
1.8 Regulation of Medical Devices 28

2.0 Bioelectric Signals and Electrodes: (4 hours)

2.1 Origin of Bioelectric Signals
2.2 Recording Electrodes
2.3 Silver-silver Chloride Electrodes
2.4 Electrodes for ECG
2.5 Electrodes for EEG
2.6 Electrodes for EMG
2.7 Electrical Conductivity of Electrode Jellies and Creams
2.8 Microelectrodes

3.0 Physiological Transducers: (4 hours)

3.1 Introduction
3.2 Classification of Transducers
3.3 Performance Characteristics of Transducers
3.4 Displacement, Position and Motion Transducers
3.5 Pressure Transducers
3.6 Transducers for Body Temperature Measurement
3.7 Photoelectric Transducers

3.8 Optical Fibre Transducers
3.9 Optical Fibre Sensors
3.10 Biosensors
3.11 Smart Sensors

4.0 Recording System: (4 hours)

4.1 Basic Recording System
4.2 General Consideration for Signal Conditioners
4.3 Preamplifiers
4.4 Sources of Noise in Low Level Measurement
4.5 Biomedical Signal Analysis Techniques
4.6 Signal Processing Techniques
4.7 The Main Amplifier and Driver Stage
4.8 Writing Systems
4.9 Direct Writing Recorders
4.10 The Ink Jet Recorders
4.11 Potentiometric Recorders
4.12 Digital Recorders
4.13 Instrumentation Tape Recorders

5.0 Biomedical Recorders: (6 hours)

5.1 Electrocardiograph
5.2 Vectrocardiograph (VCG)
5.3 Phonocardiograph (PCG)
5.4 Electroencephalograph (EEG)
5.5 Electromyograph (EMG)
5.6 Other Biomedical Recorders
5.7 Biofeedback Instrumentation

6.0 Patient Monitoring Systems: (8 hours)

6.1 System Concept
6.2 Cardiac Monitor
6.3 Beside Patient Monitoring Systems
6.4 Central Monitors
6.5 Measurement of Heart Rate
6.6 Measurement of Pulse Rate
6.7 Blood Pressure Measurement
6.8 Measurement of Temperature
6.9 Measurement of Respiration Rate
6.10 Catheterisation Laboratory Instrumentation

7.0 Arrhythmia and Ambulatory Monitoring Instruments: (6 hours)

7.1 Cardiac Arrhythmias
7.2 Arrhythmia Monitor
7.3 QRS Detection Techniques
7.4 Exercise Stress Testing
7.5 Ambulatory Monitoring Instruments

8.0 Foetal Monitoring Instruments: (6 hours)

8.1 Cardiotocograph
8.2 Methods of Monitoring Foetal Heart Rate
8.3 Monitoring Labour Activity
8.4 Recording System

9.0 Biomedical Telemetry and Telemedicine: (4 hours)

9.1 Wireless Telemetry
9.2 Single Channel Telemetry Systems
9.3 Multi-patient Telemetry
9.4 Multi-channel Wireless Telemetry Systems
9.5 Implantable Telemetry System
9.6 Transmission of Analog Physiological Signals
9.7 Telemedicine

10.0 Oximeters: (2 hours)

10.1 Oximetry
10.2 Ear Oximeter
10.3 Pulse Oximeter
10.4 Skin Reflectance Oximeters
10.5 Intravascular Oximeter

11.0 Blood Flowmeters: (5 hours)

11.1 Electromagnetic Blood Flowmeter
11.2 Types of Electromagnetic Blood Flowmeter
11.3 Ultrasonic Blood Flowmeters
11.4 NMR Blood Flowmeters
11.5 Laser Doppler Blooe Flowmeter

12.0 Cardiac Output Measurement: (5 hours)

12.1 Indicator Dilution Method
12.2 Dye Dilution Method
12.3 Thermal Dilution Techniques
12.4 Measurement of Continuous Cardiac Output Derived from Aortic Pressure Waveform
12.5 Impedance Technique
12.6 Ultrasound Method

13.0 Pulmonary Function Analyzers: (4 hours)

13.1 Pulmonary Function Measurements
13.2 Spirometry
13.3 Pneumotachometers
13.4 Measurement of Volumes
13.5 Pulmonary Function Analyzers
13.6 Respiratory Gas Analysers

Laboratories:

1.0 Sensors
2.0 ECG
3.0 Oximetry

Textbook:

1. Handbook of Biomedical Instrumentation, RS Khandpur, Tata McGraw Hill
2. Biomedical Instrumentation and Measurements, Leslie Cromwell et. Al., Prentice Hall India

Reference Book:

1. Handbook of Biomedical Instrumentation, RS Khandpur, Tata McGraw-Hill (2nd Edition)

MEDICAL ELECTRONICS
BEG 3B1 BM

Semester VI **Year III**

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

Course Objective: Completion of this course will enhance the basic knowledge on electronics, characteristic of waveguide and nanotechnology so as to implement these in biomedical applications.

1.0 Thyristors and Other Devices: **(8 Hours)**

- 1.1 Basic 4 Layer Devices
- 1.2 Silicon-Controlled Rectifier (SCR)
- 1.3 SCR Characteristics and Ratings
- 1.4 SCR Construction and Terminals Identification
- 1.5 SCR Application
- 1.6 Light-Activated SCR
- 1.7 Silicon-Controlled Switch
- 1.8 Gate Turn off Thyristor (GTO)
- 1.9 DIAC and TRIAC
- 1.10 Unijunction Transistor
- 1.11 Programmable Unijunction Transistor
- 1.12 Insulated Gate Bipolar Transistor (IGBT)
- 1.13 Phototransistors
- 1.14 Opto-isolators

2.0 Stability and Oscillators: **(8 Hours)**

- 2.1 Stability
  - 2.1.1 Condition for Stability
  - 2.1.2 Nyquist Criteria
- 2.2 Oscillators
  - 2.2.1 Oscillator Principle
  - 2.2.2 Oscillator Types
  - 2.2.3 Oscillator Criteria
- 2.3 Operational Amplifiers Based Sinusoidal Oscillators
  - 2.3.1 Phase Shift Oscillator
  - 2.3.2 Wien Bridge Oscillator

2.3.3 Quadrature Oscillator
2.3.4 Colpitt Oscillator
2.3.5 Hartley Oscillator
2.4 Relaxation Oscillator
2.5 Voltage Controlled Oscillator
2.6 Crystal Oscillator
2.7 Amplitude and Frequency Stabilization
2.8 Integrated-Circuit Based Timers
2.8.1 Operating Modes of the 555 Timer
2.8.1.1 Monostable Multivibrator
2.8.1.2 Astable Multivibrator
2.9 Signal Generators
2.10 Use of Oscillators and Signal Generators in Biomedical Application

3.0 Waveguides and Components: (14 Hours)

3.1 Concept of Waveguide
3.2 Waveguide Components
3.3 Wave Propagation in the Guide
3.4 Rectangular and Circular Wave Guide
3.5 Modes in Waveguides
3.5.1 Transverse Electric (TE) Modes
3.5.2 Transverse Magnetic (TM) Modes
3.5.3 Higher Order Modes
3.6 Power Transmission and Attenuation in Waveguide
3.8 Waveguide Resonators
3.11 Tees and Magic Tees
3.12 Waveguide Corners, Bends, and Twists
3.13 Directional Couplers
3.14 Circulators and Isolators
3.15 Uses of Waveguides in Biomedical Application

5.0 Nanoelectronics: (15 Hours)

5.1 Definition and Background of Nanoscience and Nanotechnology
5.2 Nanomaterials Generations
5.2.1 Top Down vs. Bottom up Techniques
5.2.2 Lithographic Process and its Limitations
5.2.3 Non-lithographic Techniques
5.3 Nanomaterials Characterization Tools/Devices and Properties for Biomedical Application
5.4 Carbon Nanostructures
5.4.1 Fullerenes
5.4.2 Carbon Nanotubes
5.5 1-D Nanostructures
3.5.1 Nanowires
3.5.2 Nanotubes
5.6 2-D Nanostructures
5.6.1 Thin Films

5.7 Single Electron Transistor
5.8 Molecular Machine
5.9 Nanobiometrics
5.10 Current and Future Biomedical Application of Nanomaterials

Laboratory Experiments

Thyristors and Other Devices:
- Study of different type's thyristor circuit.
- Examination of opto-isolators.

Oscillators:
- Examination of different types of Sunusoidal oscillator's circuit.
- Study of Astable and Monostable multivibrator circuit using 555 timer.
- Examination of Signal generators using OP-AMP circuits.

Waveguide:
- Study of waveguide phenomena using a commercial kit.

Nanoelectronics:
- Study of characterization techniques.
- Synthesis and characterization of nonmaterial's thin film.

References

1. Rashid, "Power Electronics", PHI.
2. Samuel Y. Liao, "Microwave Devices and Circuits," PHI
3. C. S. S. R. Kumar, J. Hormes, C. Leuschner, Nanofabrication Towards Biomedical Applications, Techniques, Tools, Applications, and Impact. Wiley-Vch
4. Dennis Roddy & John Coolen, "Electronic Communications," 4/E – PHI/Pearson
5. A.S. Sedra and K.C. Smith, "Microelectronic Circuits", 2nd Edition, Holt, Rinehart and Winston, Inc., New York.

BIOMEDICAL DIGITAL SIGNAL PROCESSING
BEG 3B5 BM

Semester VI **Year III**

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

COURSE OBJECTIVES:
To introduce biomedical digital signal processing techniques and applications.

1.0 Introduction to Signal and System: (5 hours)

1.1 Signals – unit impulse, unit step, exponential, sinc, causal, noncausal and anticausal signal.
1.2 Types of signal: Analog discrete and digital
1.3 ECG signal characteristics
1.4 Basic sampling theorem
1.5 System:
- 1.5.1 Introduction
- 1.5.2 LTI System Characteristics
- 1.5.3 FIR and IIR System

1.6 Convolution summation biomedical discrete systems to discrete inputs.
1.7 Stability of biomedical system with reference to convergence of power series.

2.0 Difference Equations and Frequency Response: (5 hours)

2.1 Review of Z-transform
- 2.1.1 Introduction
- 2.1.2 Properties
- 2.1.3 Z-plane plot and region of convergence
- 2.1.4 Inverse Z-transform

2.2 General form of the linear, shift-invariant constant coefficient difference equation – signal flow graph representation.
2.3 Steady state and transient response to sinusoidal, periodic and ECG signals

3.0 Basic of Digital Filter: (5 hours)

3.1 Introduction
3.2 Elements of Digital filter

3.3 Types of Digital Filter
3.4 Structure of Digital filter
3.4.1 Cascaded and parallel
3.4.2 Direct form-I
3.4.3 Direct form-II
3.4.4 Lattice and Lattice-Ladder
3.5 Z-plane pole zero plot

4.0 FIR Filter Design: (7 hours)
4.1 Characteristics of FIR filters
4.2 Smoothing filter
4.3 Notch filter
4.4 Window design: rectangular, hanning, hamming, and Kaiser
4.5 Frequency sampling
4.6 FIR filter design using the Remez exchange algorithm.

5.0 IIR Filter Design: (5 hours)
5.1 Classical filter design using polynomial approximations-Butterworth, Chebychev, elliptic
5.2 IIR filter design by transformation – matched Z-transform, impulse-invariant transform and bilinear transformation.
5.3 Application of the bilinear transformation to IIR low pass discrete filter design.
5.4 Spectral transformations, high pass, band pass and notch filters.

6.0 The Discrete Fourier Transform: (6 hours)
6.1 Derivation
6.2 DFT as linear transform
6.3 Properties
6.3.1 Periodicity
6.3.2 Linearity
6.3.3 Multiplication, Circular convolution
6.4 Correlation
6.5 Fast Fourier transform
6.6 Properties of the DFT.
6.7 Power spectrum estimation

7.0 Signal Averaging: (2 hours)
7.1 Basic of signal averaging
7.2 Typical Signal averaging
7.3 Software for signal averaging
7.4 Limitations of signal averaging

8.0 Data Reduction Techniques (5 hours)
8.1 Turning point algorithm
8.2 Fan Algorithm
8.3 AZTEC algorithm
8.4 Huffman welding

9.0 Real Time Biomedical System: (5 hours)

- 9.1 Introduction and need
- 9.2 Real time ECG processing
  - 9.2.1 Power spectrum
  - 9.2.2 Differentiation Technique
  - 9.2.3 A QRS detection algorithm

Laboratory:

1.0 Introduction of signal – plot and analysis of different biomedical signals
2.0 Response of a recursive (IIR) digital filter – for ECG Analysis
3.0 Scaling, dynamic range and noise behaviour of a recursive digital filter, observation of nonlinear precision effects.
4.0 Response of a non-recursive (FIR) for Domain Analysis of ECG
5.0 Use of DFT and FFT transforms for ECG frequency
6.0 Signal Averaging: ECG Signal Averaging
7.0 Data Reduction Technique: ECG Data reduction Algorithm

Text Book:

1.0 Willis J Tompkins, Editor, "Biomedical Digital Signal Processing", Prentice Hall of India, 1995
2.0 John G. Proakis and Dimitris G. Manolakis, "Digital Signal Processing"

Reference:

A.V. Oppenheim, "Discrete-Time Signal Processing", Prentice Hall, 1990

YEAR IV

SEMESTER VII & VIII

ORGANISATION AND PROJECT MANAGEMENT
BEG 4B7 BM

Semester VII **Year IV**

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

COURSE OBJECTIVES: To provide students with fundamental principles of organisation management and also provide basic tools and methodology of initiating, planning, scheduling and controlling of project.

1.0 Introduction: **(4 hours)**

1.1 Organisation and Management
1.2 Organisation and Management
1.3 Functions and roles of management
1.4 Project Definition
1.5 Project Cycles, Project Phases
1.6 Setting of project Objectives and Goals

2.0 Organisation: **(3 hours)**

2.1 Organisation and its characteristics
2.2 Formal and informal organisation
2.3 Organisation chart and types or organisation

3.0 Leadership and Motivation: **(5 hours)**

3.1 Motivation and Incentives
3.2 Theories of motivation
3.3 Leadership styles
3.4 Management by objectives
3.5 Management by exception

4.0 Personnel Management: **(5 hours)**

4.1 Functions of personnel management
4.2 Job analysis and description
4.3 Recruitment and promotion
4.4 Performance appraisal
4.5 Wages and methods of wages payment
4.6 Upgrading and training

5.0 Project Planning: (18 hours)

5.1 Definition
5.2 Planning Function
5.3 Network models- CPM/PERT
5.4 Goal Oriented Project Planning (ZOPP Planning)
5.5 Project Scheduling with limited resources
5.6 Wiest's Algorithm
5.7 Manpower levelling
5.8 Materials Scheduling
5.9 Multi Project Scheduling
5.10 Mathematical Programming for minimum cost or maximum project return.
5.11 Plan of operation and its different forms of presentation.

6.0 Project Monitoring and Evaluation (M&E) and Control: (6 hours)

6.1 Definition of M&E
6.2 Methods and technique in M&E
6.3 Technique in formulating monitoring indicator
6.4 Controlling System
6.5 Project control system
6.6 Feedback control system
6.7 Cost control
6.8 Work Breakdown structure
6.9 Project Management Information System

7.0 Capital Planning and Budgeting: (4 hours)

7.1 Capital Planning Procedure
7.2 Operating and capital budget
7.3 Fixed and flexible Budget

References:

1.0 Essentials of Management by Harold Koontz and Heinz Weihrich
2.0 Organisation and Management in Nepal by Govinda Ram Agrawal
3.0 Personnel Management by CB Mamoria
4.0 The Economics of Development and Planning by ML Jhingan
5.0 Modern Economic Theory by KK Dewett

BIOMEDICAL INSTRUMENTATION II
BEG 4B1 BM

Semester VII **Year IV**

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

COURSE OBJECTIVE: To give basic knowledge in different types of instruments used in medical applications

1.0 Clinical Laboratory Equipments: **(4 hours)**
- 1.1. Medical Diagnosis with Chemical Tests
- 1.2. Spectrophotometry
- 1.3. Spectrophotometer type Instruments
- 1.4. Colorimeters
- 1.5. Spectrophotometers
- 1.6. Automated Biochemical Analysis Systems
- 1.7. Clinical Flame Photometers
- 1.8. Selective ion Electrodes Based Electrolytes Analysers

2.0 Blood Gas Analysers: **(4 hours)**
- 2.1. Acid Base Balance
- 2.2. Blood pH Measurements
- 2.3. Measurement of Blood PCO_2
- 2.4. Blood pO_2 Measurement
- 2.5. Intra-Arterial Blood Gas Monitoring
- 2.6. A Complete Blood Gas Analyser

3.0 Blood Cell Counters: **(3 hours)**
- 3.1. Types of Blood Cells
- 3.2. Methods of Cell Counting
- 3.3. Coulter Counters
- 3.4. Automatic Recognition and Differential Counting of Cells

4.0 Audiometers and Hearing Aids: **(4 hours)**
- 4.1. Mechanism of Hearing
- 4.2. Measurement of Sound
- 4.3. Basic Audiometer
- 4.4. Pure Tone Audiometer
- 4.5. Speech Audiometer

4.6. Audiometer System Bekesy
4.7. Evoked Response Audiometry System
4.8. Calibration of Audiometers
4.9. Hearing Aids

5.0 Patient Safety : (2 hours)
5.1. Electric Shock Hazards
5.2. Leakage Currents
5.3. Safety Codes for Electromedical Equipment
5.4. Electrical Safety Analyser
5.5. Testing Biomedical Equipment

6.0 Cardiac Pacemakers: (6 hours)
6.1. Need for Cardiac Pacemaker
6.2. External Pacemaker
6.3. Implantable Pacemakers
6.4. Recent Development in Implantable Pacemakers
6.5. Pacing System Analyser

7.0 Cardiac Defibrillators: (4 hours)
7.1. Need for a Defibrillator
7.2. DC Defibrillator
7.3. Pacer – cardioveter-defibrillaror
7.4. Defibrillator Analysers

8.0 Instruments for Surgery (6 hours)
8.1. Principal of Surgical Diathermy
8.2. Surgical Diathermy Machine
8.3. Safety Aspects in Electro-surgical Units
8.4. Surgical Diathermy Analysers

9.0 Laser Applications in Biomedical Field (4 hours)
9.1. The Laser
9.2. Pulsed Ruby Laser
9.3. Nd-YAG Laser
9.4. Helium-Neon Laser
9.5. Argon Laser
9.6. CO_2 Laser
9.7. Excimer Lasers
9.8. Semiconductor Lasers
9.9. Laser Safety

10.0 Physiotherapy and Electrotherapy Equipment: (6 hours)
10.1. High Frequency Heat Therapy
10.2. Short-ware Diathermy
10.3. Microwave Diathermy
10.4. Ultrasonic Therapy Unit
10.5. Eletrodiagnostic/ Therapeutic Apparatus
10.6. Pain Relief Through Electrical Stimulation
10.7. Diaphragm Pacing by Radio-frequency for the Treatment of Chronic Ventilatory Insufficiency

10.8. Bladder Stimulators
10.9. Cerebellar Stimulators

11.0 Haemodialysis Machines **(3 hours)**
11.1. Function of the Kidneys
11.2. Artificial Kidney
11.3. Dialysers
11.4. Membrances for Haemodialysis
11.5. Haemodialysis machine
11.6. Portable Kidney Machines

12.0 Lithotripters: **(2 hours)**
12.1. The Stone Disease Problem
12.2. First Lithotripter Machine
12.3. Modern Lithotripter Systems
12.4. Extra-corporeal Shock-wave Therapy

13.0 Anaesthesia Machine: **(2 hour)**
13.1. Need for Anaesthesia
13.2. Anaesthesia Machine
13.3. Electronics in Anaesthesia Machine

14.0 Ventilators: **(4 hours)**
14.1. Mechanisms of Respiration
14.2. Artificial Ventilation
14.3. Ventilators
14.4. Types of Ventilators
14.5. Ventilator Terms
14.6. Classification of Ventilators
14.7. Pressure-volume-flow Diagrams
14.8. Modern Ventilators
14.9. High Frequency Ventilators
14.10. Humidifiers, Nebulizers and Aspirators

15.0 Radiotherapy Equipment **(3 hours)**
15.1. Use of High Voltage X-ray Machines
15.2. Development of Betatron
15.3. Cobalt-60 Machine
15.4. Medical Linear Accelerator Machine

16.0 Automated Drug Delivery Systems **(3 hours)**
16.1. Infusion Pumps
16.2. Components of Drug Infusion Systems
16.3. Implantable Infusion Systems
16.4. Closed-loop Control in Infusion Systems
16.5. Examples of Typical Infusion Pumps

Laboratories:

1.0 Spectrometry
2.0 Anaesthesia
3.0 Drug Delivery system
4.0 Audiometry

Textbooks:

1.0 Handbook of Biomedical Instrumentation, R.S.Khandpur, Tata McGraw Hill (Second Edition)

MEDICAL IMAGING II
BEG 4B2 BM

Semester VII **Year IV**

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

COURSE OBJECTIVE:
To provide knowledge in different imaging techniques, their mechanism and equipment.

1.0 Principle and Equipment for Diagnostic Imaging: (2 hours)

2.0 Digital Imaging:
- 2.1 Introduction
- 2.2 Digital Radiography
- 2.3 PACS (Picture Archiving and Communicating System)

3.0 Computer Tomography (CT): (10 hours)
- 3.1 Basic Principles of CT
- 3.2 Generation of CT
- 3.3 System Components
- 3.4 Recent Advances in CT

4.0 Magnetic Resonance Imaging (MRI): (15 hours)
- 4.1 Fundamental Concepts
- 4.2 Principles of Parameters or MRI
- 4.3 Basic Principles of MR Imaging and Related Parameters
- 4.4 Contrast Enhanced MRI
- 4.5 Artifacts in MRI
- 4.6 MR Scanners
- 4.7 Clinical Application

5.0 Ultrasonography (USG): (15 hours)
- 5.1 Physics of Ultrasound
- 5.2 Construction and Properties of Ultrasound Transducer
- 5.3 Ultrasonic Beam
- 5.4 Modes of Ultrasound Imaging
- 5.5 Doppler Ultrasound
- 5.6 Clinical Application
- 5.7 Contrast Media in Ultrasound Imaging
- 5.8 Recent Advances in Ultrasonic Equipment
- 5.9 Biological Effects of Ultrasound

Laboratories:
Various Lab works related to CT, USG, Scanner and MRI

Textbook:

1. Physics for Medical Imaging, FR Farr and PJ Allisy-Roberts

IMPLANTABLE DEVICES
BEG 4B3 BM

Semester VII **Year IV**

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

COURSE OBJECTIVE: To introduce various devices which are implanted into the human body during different abnormalities

1.0 Introduction to Implants and Their Necessity in Human Life: (1 hour)

2.0 Cardiovascular Implants: (5 hours)

- 2.1 Cardiopulmonary bypass
- 2.2 Heart valves
- 2.3 Vascular grafts
- 2.4 Drug administration systems and vascular access
- 2.5 Stents, catheters and cannulas
- 2.6 Pacemakers
- 2.7 Inferior venacava filters
- 2.8 Intraaortic balloon pump
- 2.9 Ventricular assist device and total artificial hearts
- 2.10 Blood substitutes

3.0 Non Thrombogenic Treatments and Strategies: (3 hours)

- 3.1 Overview for the design of nonthrombogenic surfaces.
- 3.2 Evaluation methods of blood compatibility.
- 3.3 Heparin coating

4.0 Dental Implants: (4 hours)

- 4.1 Designs of different dental implants.
- 4.2 Chemical environment.
- 4.3 Concepts of staging and osteointegration.
- 4.4 Dental implant systems.
- 4.5 Tissue interfaces.
- 4.6 Trends in research and development.

5.0 Plastic Surgery Implant: (4 hours)

- 5.1 Introduction and general principles.
- 5.2 Overview of biomaterials used in plastic surgery.
- 5.3 Cranio maxillofacial reconstruction.

5.4 Aesthetic surgery.
5.5 Breast surgery.
5.6 Burn and wound care.
5.7 Hand and micro surgery.

6.0 Orthopaedic Implants: (4 hours)
6.1 Structure and properties of calcified tissues.
6.2 Biomaterials used in orthopaedic implants.
6.3 Total hip arthroplasty.
6.4 Ligament reconstruction.

7.0 Catheters: (4 hours)
7.1 Catheter materials and biocompatibility.
7.2 Biomaterials and catheter complications.
7.3 Thrombophlebitis.
7.4 Intravascular catheter and thrombosis.

8.0 Biomaterials Used in Urology: (4 hours)
8.1 Introduction.
8.2 Urethral catheter and stents.
8.3 Prostatic stents.
8.4 Penile & testicular prosthesis.
8.5 Artificial urinary sphincter and bladder.

9.0 Prosthesis for Drug Delivery: (4 hours)
9.1 Introduction and rationale.
9.2 Evaluation of prosthesis – mediated drug delivery
9.3 Methods of drug binding.
9.4 Entrapment of drugs in polymers.
9.5 Covalent attachment of drugs.

10.0 Different Kinds of Artificial Organs: (8 hours)
10.1 Introduction.
10.2 Artificial Pancreas.
10.3 Artificial liver.
10.4 Artificial Heart and lung.
10.5 Artificial skin
10.6 Artificial reproductive organs.
10.7 Artificial vision
10.8 Artificial hearing implant.

11.0 Introduction to Tissue Engineering: (4 hours)
11.1 Introduction.
11.2 General principles.
11.3 Building blocks of artificial tissues.
11.4 Tissue and organ reconstruction.

12.0 Implants and Device Failure: (2 hours)

Reference Books:

1. Implantation Biology, Ed. Ralph Greco, CRC Press Inc.
2. Biomaterials Science, Ed. Ratner et. al., Academic Press, 1996

PROJECT
BEG 4C9 BM

Semester VII **Year IV**

Teaching Schedule (Hours/Week)			Examination Schedule						Total Marks	Remarks
			Final				Internal Assessment			
			Theory		Practical		Theory	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
3		3	-	-	-	80	-	120	200	

COURSE OBJECTIVE:

The objective of this project work is to give knowledge on project planning, researching, designing, reporting and presentation skill. Student should prepare project proposal for approval by the college, write an elaborate literature review, plan and partially complete an individual biomedical engineering design project under the supervision of teacher and prepare project report.

Procedures:

1.0 A detail project proposal not exceeding 10 double-spaced pages submitted to the concerned department within two weeks of the start of the project course. The department then will consult possible supervisor for approval of proposal. This proposal will be evaluated by the supervisor. This proposal carries the 10% of project final marks and this mark will be given by the project supervisor.

2.0 Literature review not exceeding 15 double-spaced pages should be submitted within three weeks after approval of the proposal.

3.0 A mid-term progress reports not exceeding 12 double-spaced pages shall be submitted before the 8th week of the term. An oral presentations will take place during the 9th week of term. This mid term written and oral reports will account for 25% of the final marks.

4.0 Final report minimum of 25 double-spaced pages will be submitted at the end of the 15th week of the term. This report will be evaluated by the project supervisor. This report carries 40% of final marks.

5.0 An oral presentation of the final report is to be conducted during the 16th week of the term by a panel of external examiner. The oral defence carries 25% of the final marks.

STRUCTURAL BIOMATERIALS
BEG 4B9 BM
ELECTIVE I

Semester VII **Year IV**

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

Course Objective: To provide basic knowledge in biological materials.

1. **Introduction** **[7 hours.]**
   - 1.1. Structure of soft and hard tissues
   - 1.2. Structure and surface of internal lining tissues
     - 1.2.1. Types of epithelia
     - 1.2.2. Connective Tissues
     - 1.2.3. Specialized organs
     - 1.2.4. Muscular Tissues
     - 1.2.5. Structure of hard tissues
   - 1.3. Properties of tissues
   - 1.4. Structure and properties of synthetic materials
   - 1.5. Structure and properties of cells

2. **Structure and properties of biological tissues** **[9 hours.]**
   - 2.1. Introduction to principles of stereochemistry
   - 2.2. Basic Building blocks
   - 2.3. Stereochemistry of polymer chains
     - 2.3.1. Stereochemistry of polypeptides
     - 2.3.2. Stereochemistry of polysachharides
     - 2.3.3. Stereochemistry of lipids
     - 2.3.4. Stereochemistry of nucleic acids
   - 2.4. Primary and secondary structure of biological macromolecules
     - 2.4.1. Primary and secondary structure of proteins
     - 2.4.2. Primary and secondary structure of DNA and RNA
   - 2.5. Higher order structures
   - 2.6. Structure of Extracellular matrix macromolecules
     - 2.6.1. Structure of fibrous collagens
     - 2.6.2. Structure of elastic fibres
     - 2.6.3. Structure of laminins and fibronectins
     - 2.6.4. Hyaluronan
   - 2.7. Cell membrane polymers

2.7.1. Syndecan and Glypican
2.7.2. Integrins

2.8. Other polymeric materials
2.8.1. Fibrinogen
2.8.2. Keratin
2.8.3. Actin and Myosin

3. **Microscopic and macroscopic structure of tissues [6 hours.]**
3.1. Introduction to methods of cellular and tissue analysis
3.2. Surface of Internal linings
3.3. Histology of Alveoli and bronchi, cornea, peritoneum and pleura, skin, uterus, oral histology
3.4. Conduit and holding structures
3.4.1. Structures of Blood vessels and lymphatics
3.4.2. Structure of stomach and intestines
3.4.3. Structure of bladder and ureter
3.4.4. Parenchymal and organ supporting structures
3.4.5. Skeletal structures

4. **Determination of physical structure and modeling [7 hours.]**
4.1. Introduction
4.2. Viscosity
4.3. Light scattering
4.4. Ultracentrifugation
4.5. Electron microscopy
4.6. Determination of physical parameters for biological macromolecules

5. **Assembly of biological macromolecules [7 hours.]**
5.1. Introduction
5.2. Methods for studying self assembly processes
5.3. Collagen self assembly
5.4. Assembly of cytoskeletal components
5.5. Actin-Myosin interaction
5.6. Fibrinogen

6. **Mechanical properties of tissues [5 hours.]**
6.1. Review of analysis of tissue mechanical properties
6.2. Mechanical properties of collagenous tissues
6.3. Mechanical properties of hard tissues
6.4. Cellular biomechanics

7. **Pathobiology and response to tissue injury [4 hours.]**
7.1. Introduction
7.2. Cellular components
7.3. Cell attachment, proliferation and differentiation
7.4. Cellular adaptation

TEXT BOOKS:

1. Biomaterials Science and Biocompatibility Frederick H. Silver and David L. Christianser

BIOMEDICAL EQUIPMENT MAINTENANCE
BEG 4C8 BM
ELECTIVE I

Semester VII **Year IV**

Teaching Schedule (Hours/Week)			Examination Schedule						Total Marks	Remarks
			Final				Internal Assessment			
			Theory		Practical		Theory	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
-	1	5	-	-	3 hrs	80	-	20	100	

COURSE OBJECTIVES:

- To provide basic practical knowledge in Maintenance of commonly used medical devices in district level hospitals of Nepal.

Procedures:

1. Students will works on various equipments like incubators, oven, ECG machine, oxygen concentrator, centrifuge machine, other laboratory equipments, ultrasound etc. with an emphasis on maintenance aspects of the devices.
2. Two practical assessments will be conducted during the semester. Each student will be given a faculty device for maintenance during these assessments.

MEDICAL INDUSTRY MANAGEMENT
BEG 4B4 BM

Semester VIII **Year IV**

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

COURSE OBJECTIVE: To give an overview of medical industries including hospitals and device industries and to introduce the standards and norms of the medical industries and their products.

1.0 **Introduction:** **(1 hour)**

2.0 **Types of Medical Devices:**
- 2.1. Different Types Of Medical Device Companies.

3.0 **Structure of Multinationals:** **(2 hours)**
- 3.1. Finance and investment
- 3.2. Board of Directors
- 3.3. Scientific Advisory Boards

4.0 **Roles of the Medical Device Industry:** **(3 hours)**
- 4.1. European, USA Procedures

5.0 **International Standards:**

6.0 **Risk Assessment and Management:** **(3 hours)**
- 6.1. Failure Modes and Effects Analysis

7.0 **Product Liability:** **(2 hours)**
- 7.1. Medical Device Litigation

8.0 **Clinical Requirements and Their Implication in Device Design:** **(3 hours)**

9.0 **Protection of Intellectual Property:** **(1 hour)**

10.0 **Introduction of Clinical Evaluation of Medical Devices:** **(3 hours)**
- 10.1. Control of Clinical Trials, Post Market Surveillance
- 10.2. Epidemiological Aspects of Device Performance

11.0 **Case Studies: Implantable Devices:** **(3 hours)**

12.0 **Case Studies: Tissue Engineering Products:** **(3 hours)**

13.0 **Case Studies: Other Devices:** **(3 hours)**

14.0 **Architectural Planning of Hospitals:** **(2 hours)**

15.0 **Basics of Hospital Management:** **(3 hours)**

16.0 **Selection and Purchase of Medical Equipment:** **(2 hours)**

17.0 **Peripheral Devices Used in Hospitals:** **(8 hours)**
- 17.1. Electro power System
- 17.2. Refrigeration
- 17.3. Air-conditioning
- 17.4. Heating

Laboratories:

1.0 Air-conditioning Principles
2.0 Refrigeration Principles
3.0 Electro-power Principles

Text Book:

1.0 Principles of Hospital Administration and Management, R Bindra Hands-out

ENGINEERING PROFESSIONAL PRACTICE
BEG 4B5 BM

Semester VIII **Year IV**

Teaching Schedule (Hours/Week)			Examination Schedule						Total Marks	Remarks
			Final				Internal Assessment			
			Theory		Practical		Theory	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
3	1	2	3	80	-	-	20	-	100	

COURSE OBJECTIVES: To introduce the ethical and legal environment in which engineering is practiced.

1.0 Background Perspective: (6 hours)

1.1 Impacts and consequences of technology on society: effects of major technological development such as printing, gunpowder, mechanization, computers, organic chemistry, communication satellites.

1.2 Cultural motivations and limitations, eastern Vs western philosophy of change and development.

1.3 Political and social limitations.

1.4 Individual freedoms Vs societal goals.

1.5 Exponential growth.

1.6 Alternative use of scarce resources and causes of international tensions.

1.7 Risk and overall cost/benefit ratio analysis in engineering decision making.

1.8 Education and training of technologists, scientists and engineers.

2.0 Ethics and Professionalism: (3 hours)

2.1 Perspective on morals, ethics and professionalism.

2.2 Codes of ethics and guidelines for professional engineering practice.

2.3 Relationship of the engineering profession to basic science and technology, relationship to other professions.

3.0 Roles of Professional Association: (1 hour)

3.1 Regulation of the practice of the profession, licensing, guidance for training, new entrants into the profession, advice and assistance to engineering colleges, upgrading and maintaining the professional and technical competence of member, providing technical expertise as requested for the guidance and assistance of legislators, seeing to the matter of safety and general welfare of the public in engineering works.

4.0 Legal Aspect of Professional Engineering in Nepal: (9 hours)

4.1 The Nepalese legal system as it affects the practice of engineering.
4.2 Provision for private practice and for employee engineers.
4.3 Contract law.
4.4 Tendering.
4.5 Contract documents.
4.6 Liability and negligence.
4.7 Business and labor laws.
4.8 Relationship to foreign firms working in Nepal.

5.0 The Roles and Practice of Professional Engineering in Other Countries: (2 hours)

5.1 Other Asian countries.
5.2 The USSR and Eastern Europe.
5.3 Western Europe.
5.4 North America.

6.0 Case Studies Involving Professional Ethical Issues Chosen From a Wide Range of Topics: (9 hours)

6.1 Intellectual property rights: copyrights and patent protection.
6.2 Personal privacy and large computerized data bases.
6.3 Industrialization Vs protection of the environment.
6.4 Risk/benefit considerations in public transportation.
6.5 Engineers and the military.
6.6 Science and technology for medicine.
6.7 Engineers in international development.

Reference Book:

1.0 Carson Morrison and Philip Hughes, "Professional Engineering Practice – Ethical Aspects", McGraw-Hill Ryerson Ltd., Toranto, 1982.

PROJECT
BEG 4B8 BM

Semester VIII **Year IV**

Teaching Schedule (Hours/Week)			Examination Schedule						Total Marks	Remarks
			Final				Internal Assessment			
			Theory		Practical		Theory	Practical		
L	T	P	Duration	Marks	Duration	Marks	Marks	Marks		
6	-	6	-	-	-	100	40	60	200	

COURSE OBJECTIVES:

The objective of this project work is to give knowledge on project planning, researching, designing, manufacturing, reporting and presentation skill . Student should plan and complete an individual biomedical engineering design and construct project under the supervision of teacher and prepare project final reports. Normally the project will be a continuation of VII semester project, where the student will deliver the final outcome of the research with required amendments.

Procedures:

1.0 Student will work on the project report submitted during the seventh semester. If any amendment is required, than the student will prepare amended proposal in consultation with the supervisor.

2.0 Two mid-term progress reports not exceeding 6 single-spaced pages shall be submitted during the 5th and 9th week of the term. Two oral presentations will take place after submission of these reports. This mid-term written and oral reports will account for internal assessment marks.

3.0 Final report minimum of 25 double-spaced pages will be submitted at the end of the 15th week of the term. This report will be evaluated by the project supervisor. This report carries 50% of final marks.

4.0 An oral presentation of the final report is to be conducted during the 16th week of the term by a panel of external examiner. The oral defence carries 50% of the final marks.

MINIMALLY INVASIVE MEDICAL TECHNOLOGY
BEG 4C2 BM
ELECTIVE II

Semester VIII **Year IV**

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

Course Objective: To provide the basic concepts of Computer Applications in various medical fields.

1. CHEMICAL SENSORS [7 hours]

1.1 Objects Of Measurement
- 1.1.1. Objects of measurement
- 1.1.2. Requirement of chemical measurement sensor
- 1.1.3. Placement of sensors

1.2 Electrochemical Sensors
- Electrode potential
- Potentiometric sensors
- Amperometric measurement
- Electrochemical gas censors

1.3 Fiber-Optic Chemical Sensor
- 1.3.1 Spectrophotometric analysis and beer's Law
- 1.3.2 Fiber-Optic chemical sensor
- 1.3.3 Optical oximetry

1.4 Other transducer
- 1.4.1 Acoustic bulk-wave device
- 1.4.2 Acoustic surface-wave device
- 1.4.3 Thermal measurement

1.5 Biosensors
- 1.4.2 Enzyme-based biosensors
- 1.4.2 Immunosensors
- 1.5.3 Microbial sensors

Problems

References

2. NEURO-ELECTRICAL SIGNAL RECORDING [3 hours]

2.1 Neuro-electrical signal

2.1.1 Resting potential
2.1.2 Action potential
2.2 Conventional electrodes
2.2.1 Metal microelectrode
2.2.2 Micropipette electrode
Problems
Reference

3. PRESSURE SENSORS [4 hours]

3.1 Pressure measurement
3.2 Indirect pressure measurement
3.3 Direct measurement
3.3.1 Diaphragm for pressure sensor
3.3.2 Strain-gage pressure sensor
3.3.3 Capacitive pressure sensor
3.3.4 Fiber-optic pressure sensor
3.4 Catheter-type pressure sensor
3.4.1 Catheter-sensor pressure sensor
3.4.2 Catheter-tip pressure sensor
Problems
References

4. GENERAL TECHNIQUES AND APPLICATIONS [5 hours]

4.1 Minimally invasive cardiovascular surgery
4.1.1 Minimally invasive direct coronary artery bypass
4.1.2 PTMR
4.1.3 Percutaneous transluminal coronary angioplasty
4.2 Minimally invasive brain surgery
4.2.1 Endoscopic neurosurgery and endoscope-assisted microneurosurgery
4.2.2 Image-guided stereotexic brain surgery
4.3 Minimally invasive ophthalmalic surgery
4.3.1 Laser glaucoma surgery
4.3.2 Laser corneal reshaping surgery
Problems
References

5. ENDOSCOPIC SURGERY [7 hours]

5.1 Endoscopes
5.1.1 Rigid endoscope
5.1.2 Flexible telescope
5.1.3 New developments and perspectives of endoscope technology
5.2 Mechanical surgerical tools for endoscope surgery
5.2.1 Endoscopic surgical tools for dissection, ligation and suturing
5.2.2 Haptic feedback for endoscopic surgery
5.3 Endoscopic electrosurgery, ultrasonic surgery and laser surgery
5.3.1 Electrosurgical technology in endoscopic surgery
5.3.2 Ultrasonic surgery and harmonic scalpel
5.3.3 Laser surgery

5.4 The basic procedure and equipment set-up for laparoscopic surgery
- 5.4.1 Basic procedures of laparoscopic surgery
- 5.4.2 Equipment set-up for laparoscopic surgery
- 5.4.3 Discriptions of some laparoscopic equipment and surgical tools
- 5.4.4 New trends and perspectives of laparoscopic technology

5.5 Arthroscopy
- 5.5.1 Instruments
- 5.5.2 Arthroscopic knee surgery

Problems
References

6. IMAGE-GUIDED SURGERY [7 hours]

6.1 Image registration
- 6.1.1 Rigid body transformation
- 6.1.2 Nonrigid body transformation
- 6.1.3 Extrinsic image registration
- 6.1.4 Intrinsic image registration
- 6.1.5 Image fusion

6.2 Surgical planning
- 6.2.1 Generic atlas model
- 6.2.2 Visualization

6.3 Stereotactic sugeries
- 6.3.1 Frame-based stereotactic systems
- 6.3.2 Frameless stereotactic systems

6.4 Intraoperative endosocopy and microscopy
- 6.4.1 Endoscopy
- 6.4.2 Microscopy

6.5 X-ray fluoroscopy
6.6 Inraoperative computed tomography
6.7 Intraoprerative ultrasound
6.8 Intraoperative magnetic resonance imaging
- 6.8.1 Scaner design
- 6.8.2 Instrumantation compatibility
- 6.8.3 Instrument tracking
- 6.8.4 Data acquisition and reconstruction

Problems
References

7. ABLATION [9 hours]

7.1 Significance and present application
- 7.2.1 Radio-frequency ablation
- 7.2.1 Background
- 7.2.2 Mechanism of RF energy-inducted injury
- 7.2.3 Designs of RF ablation system
- 7.2.4 Advantages and limitations
- 7.2.5 Application of radio-frequency ablation
- 7.2.6 Research

7.3 Laser ablation
- 7.3.1 Background

7.3.2 Laser-tissue interaction
7.3.3 Advantage and limitation
7.3.4 Applications
7.3.5 Current research

7.4 Ultrasound ablation
7.4.1 High-intensive focus ultrasound: background
7.4.2 Advantage and limitation
7.4.3 Applications
7.4.4 Research

7.5 Cry ablation
7.5.1 Background
7.5.2 Mechanism of tissue damage
7.5.3 Design of cry oblation system
7.5.4 Advantage and limitation
7.5.5 Application and limitation
7.5.6 Research

7.6 Microwave ablation
7.6.1 Background
7.6.2 Designs
7.6.3 Advantages and limitations
7.6.4 Applications
7.6.5 Research

7.7 Chemical ablation
7.7.1 Applications of chemical ablation

Problems
References

8. DRUG DELIVERY **[4 hours]**

8.1 Noninvasive drug delivery
8.1.1 Respiratory delivery
8.1.2 Transdermal delivery
8.1.3 Oral controlled release delivery
8.1.4 Other noninvasive routes of administration

8.2 Controlled -release drug delivery
8.2.1 Controlled-release delivery
8.2.2 Targeted-release delivery

8.3 Controlled-dose delivery
8.3.1 Implantable system and micropumps
8.3.1 Feedback system

Problems
References

TEXT BOOKS:

1."Minimally Invasive Medical Technology", John G. Webster

MEDICAL IMAGE PROCESSING
BEG 4B6 BM
ELECTIVE II

Semester VIII **Year IV**

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

Course Objectives:

To learn about mathematical foundations and practical techniques for digital manipulation of medical image acquisition, Preprocessing, Processing in spatial and frequency domain and image compression.

1. Introduction **[9 hours]**

1.1 Typical Measurement System
1.2 Transducers
1.3 Analog-to-Digital Conversion
1.4 Image Representation and image Analysis
1.5 Human Visual System and Image Model
1.6 Image Digitization
- 1.5.1 Sampling Theorem
- 1.5.2 Quantization

1.7Properties of Digital Images
- 1.7.1 Histogram
- 1.7.2 Entropy
- 1.7.3 Image Quality
- 1.7.4 Noise in Images

2. Fundamentals of Image Processing **[6 hours]**

2.1 Image Processing Basics
2.2 General Image Formats
2.3 Data Classes: Intensity Coding Schemes
2.4 Data Formats
2.5 Data Conversions

2.6 Image Display
2.7 Image Stores and Retrieval
2.8 Basic Arithmetic Operation
2.9 Neighborhood Operations
2.10 Basic Statistical Operations

3. Medical Image Processing [7 hours]

3.1 Medical Image Representation and Modeling
3.2 Medical Image Enhancement
3.3 Medical Image Filtering and Restoration
3.4 Medical Image Analysis and Computer Vision
3.5 Medical Image Formation Principal
- 3.5.1 X-Ray Imaging
- 3.1.2 Computer Tomography (CT)
- 3.5.3 Magnetic Resonance Imaging (MRI)
- 3.5.4 Positron emission tomography (PET)
- 3.5.5 Single Photon emission computed tomography (SPECT)

3.2 Medical Image Encoding for Transmission
- 3.2.1 Image Data Properties
- 3.2.2 Image Coding
- 3.2.3 Contour Representation
- 3.2.4 Quadtrees
- 3.2.5 Lossless and Lossy Compression

4. Medical Image Segmentation [6 hours]

4.1 Pixel-Based Methods
4.2 Continuity Based Methods
4.3 Morphological Operations
4.4 Edge-Based Segmentation

5. Expert System [7 hours]

5.1 Object Representation
- 5.1.1 Position-Dependent Brightness Correction
- 5.1.2 Gray-Scale Transformation

5.2 Geometric Transformations
- 5.2.1 Pixel Co-ordinate Transformations
- 5.2.2 Brightness Interpolation

5.3 Local Pre-Processing

5.3.1 Image Smoothing
5.3.2 Edge Detectors
5.3.3 Zero-Crossings of the Second Derivative
5.3.4 Scale in Image Processing (overview)
5.3.5 Canny Edge Detection (overview)
5.3.8 Local pre-processing in the frequency domain

5.4 Image Restoration
5.4.1 Degradations that are Easy to Restore
5.4.2 Inverse Filtration

6. Image Segmentation [7 hours]

6.1 Thresholding
6.1.1 Threshold Detection Methods
6.1.2 Optimal Thresholding

6.2 Edge-based Segmentation
6.2.1 Edge Image Thresholding
6.2.2 Edge Relaxation
6.2.3 Border Tracing
6.2.4 Border Detection as Graph Searching
6.2.5 Border Detection as Dynamic Programming
6.2.6 Hough Transform

6.3 Region-based Segmentation
6.3.1 Region Merging
6.3.2 Region Splitting
6.3.3 Splitting and Merging
6.3.4 Watershed Segmentation
6.3.5 Region Growing Post-Processing

6.4 Matching
6.4.1 Matching Criteria

6.5 Evaluation Issues in Segmentation
6.5.1 Supervised Evaluation
6.5.2 Unsupervised Evaluation

7. Image Data Compression [3 hours]

7.1 Image Data Properties
7.2 Discrete Image Transforms in Image Data Compression
7.3 Error-free compression

PRACTICAL

1. Introduction
   Introduction of Visual Basic or C++ builder programming.
2. **Medical** Image Histogram and Point Operations
   First- and second-order image histograms, contrast enhancement via point transformations, histogram equalization, and color transformations
3. Geometric Operations
   Medical Image resizing, interpolation and decimation, affine spatial transformations (rotation), and higher-order spatial transformations.
4. Linear Processing
   Convolution and correlation, linear filtering, FIR filters, blurring, sharpening, and edge detection
5. Selective Processing
   Block processing, region-of-interest processing, and line profiles.
6. Nonlinear Processing
   Nonlinear noise reducing filters (*e.g.*, median, outlier, and adaptive) and image morphology

Text Book

1. Sonka-Hlavac-Boyle: Image Processing, Analysis and Machine Vision, 3rd edition
2. Digital Image Processing, R. C. Gonzalez, R. E. Woods, Second Edition, Prentice Hall.
3. Digital Image Processing, William K.Pratt, 3rd edition

Reference Books

1. K.K. Shung, M.B. Smith, B. Tsui, Principles of Medical Imaging, Academic Press, 1992.
2. Z.H. Cho, J.P. Jones, M. Singh, Foundations of Medical Imaging, Wiley, New York, 1993.
3. A. Macowski, Medical Imaging Systems, Prentice-Hall, New Jersey, 1993.

THEORY OF MEDICAL ROBOTICS
BEG 4C5 BM
ELECTIVE II

Semester VIII **Year IV**

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

COURSE OBJECTIVE: To give an overview of robotic and their application in medical field

1. Introduction of Robotics: (5 hours)

- 1.1 Introduction
- 1.2 Uses of Robert in medical field
- 1.3 Types of Robots
  - 1.3.1 Workstation based Robots
  - 1.3.2 Wheel chair mounted Robots
  - 1.3.3 Body worn robots
  - 1.3.4 Mobile Robots
  - 1.3.5 Smart wheelchairs

2. Review of Technology (5 hours)

- 2.1 Devices
- 2.2 Arm design
- 2.3 Electronics: power supply, Central processor, Communication bus, Motor control and drive sensors
- 2.4 Sensors
- 2.5 Human Machine Interface
- 2.6 Gripper
- 2.7 Safety

3. Fuzzy Logic (7 hours)

- 4.1 Introduction
- 4.2 Application of Fuzzy Neural Network for medical diagnosis
- 4.3 Future application of fuzzy Neural Network

4. Medical Robotics in Surgery (12 hours)

- 4.1 Robotic surgical system
- 4.2 Image guided surgery: Computer and Robotic based
- 4.3 Future of Robotic surgery

5. Robotic Rehabilitation Therapy **(8 hours)**

- 5.1 Introduction
- 5.2 Technology Overview
- 5.3 Future application

6. Telesurgery **(8 hours)**

- 6.1 Introduction
- 6.2 Block diagram
- 6.3 Telerobotic System
- 6.4 Telemanipulation

Text Book:

1.0 Robotics for surgery R.D. Howe and Y Matsuoka

2.0 Medical Robotics. By Vanja Bozovic

NEURAL NETWORK
BEG 4C7 BM
ELECTIVE III

Semester VIII **Year IV**

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

Course objective

This subject provide

- Information and architecture of Neural Networks
- Modeling of Medical system using Neural Networks
- Application of Neural Network in medicine
- Idea of Genetic Algorithms and Fuzzy Logic

1. Introduction to Neural Networks **[4 hours]**

1.1 Introduction to Neural Network
1.2 Historical background
1.3 Applications of Neural Networks in Medicine
1.4 Neural networks versus conventional computers - a comparison

2. Neural Networks Architecture **[4 hours]**

2.1 Biological Neural Networks (structure, activation, lateral inhibition)
2.2 Learning mechanisms

3. Artificial Neural Networks (ANN) **[4 hours]**

3.1 History of ANNs (Mc Culloch and Pitts, Connectionist, XOR problem)
3.2 Feedback (autoassociative) networks
3.3 Perceptrons

3.4 Multi-Layered Perceptrons

4. The Learning Mechanisms **[8 hours]**
   - 4.1 Supervised learning methods
     - 4.1.1 Backpropagation
     - 4.1.2 Conjugate Gradient method
     - 4.1.3 Levenberg-Marquardt (LM) method
     - 4.1.4 Madalines
     - 4.1.5 Radial-Basis Networks
     - 4.1.6 Cascade-Correlation Networks
     - 4.1.6 Polynomial Networks
     - 4.1.7 Recurrent Networks
       - Time series
       - Backpropagation through time
       - Finite Impulse Response (FIR) MLP
       - Temporal Differences method (TD)
   - 4.2 Unsupervised learning methods (Kohonen Self-Organizing Maps (SOMs))

5. Associative models **[6 hours]**
   - 5.1. Linear Associative Memory (LAM)
   - 5.2. Hopfield Networks
   - 5.3. Brain-State-in-a-Box (BSB)
   - 5.4. Boltzmann Machines and Simulated Annealing
   - 5.5. Bi-Directional Associative Memory (BAM)

6. Applications of ANN **[4 hours]**
   - 6.1 Pattern Recognition
   - 6.2 Optimization problems

7. Neural networks in medicine **[8 hours]**
   - 7.1 Modelling and Diagnosing the Cardiovascular System
   - 7.2 Electronic noses - detection and reconstruction of odors by ANNs
   - 7.3 Instant Physician - a commercial neural net diagnostic program

8. Introduction to Genetic Algorithms and Fuzzy Logic **[6 hours]**
   - 8.1Genetic Algorithm
     - 8.1.1Basics of Genetic Algorithms,
     - 8.1.2 Design issues in Genetic Algorithm,

8.2 Genetic Modeling,

8.3 Hybrid Approach

8.3.1 GA based Fuzzy Model Identification.

8.3.2 Fuzzy Logic controlled Genetic Algorithm

8.3.3 Neuro- Genetic Hybrids & Fuzzy – Genetic Hybrids.

PRACTICAL:

1. Introduction and Key Features of Matlab
2. Working with Neural Network Toolbox and familiar with recognition, clustering and network training
3. Network Architectures
    a. Supervised Networks
        i. Feed forward
        ii. Radial basis
        iii. Dynamic networks
        iv. learning vector quantization
    b. Unsupervised Networks
4. Training and Learning Functions
    a. Backpropogation algorithm
5. Modeling and Diagnosing the Cardiovascular System
6. Electronic noses - detection and reconstruction of odors by ANNs

Text books

1. Neural Networks – A comprehensive introduction, Simon Hayin, 2nd edition
2. An Introduction to Neural Networks, James A. Anderson, PHI

Reference books

1. An introduction to neural computing. Aleksander, I. and Morton, H. 2nd edition
2. Neural Networks by Eric Davalo and Patrick Naim
3. Learning internal representations by error propagation by Rumelhart, Hinton and Williams (1986).

MEDICAL INFORMATICS
BEG 4C3 BM
ELECTIVE III

Semester VIII **Year IV**

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

COURSE OBJECTIVE: To provide the basic concepts of Computer Applications in various medical fields.

1. Database system **[14 hours]**

1.1 Purpose of database system, Data models, Database languages, Database administrator, Database users, System structure

1.2 Entity-Relationship Model, Basic concepts, Design issues, Mapping constraints, Keys, Entity – relationship diagram, Weak entity sets, Extended E-R features

1.3 Relational mode, the structure of relational database, the relational algebra

1.4 SQL, basic structure, set operation, data definition language, features of SQL

1.5 Integrity constraints, relational database design, introduction to normalization

2. Review of telecommunication and computer networks **[4 hours]**

2.1 Introduction and types of network

2.2 Centralized versus Distributed Processing

2.3 Communication channels

2.4 Network Topology

2.5 TCP/IP reference model

3. System analysis and design/System design and engineering [4 hours]

3.1 What is system?
3.2 Essential principle for successful system development
3.3 Types of system Need for system analysis. Role of system analyst
3.4 System Analysis: concept, system approach, system selection procedure
3.5 System design, concept, DD, DFD, Input, Output file design
3.6 SDLC: various stages, water fall, prototyping, spiral

4. Information security and privacy [4 hours]

4.1 Importance of security
4.2 Security and integrity constraints
4.3 Access control: Discretionary and mandatory authorization
4.4 Security and views
4.5 Encryption and decryption

5. Medical informatics application to health services [14 hours]

5.1 Medical data: their acquisition, storage and use
5.2 Standards in medical informatics
5.3 Medical decision making
5.4 Computer based patient record system
5.5 Patient care and monitoring system
5.6 Information retrieval system

6. Expert system and Clinical decision support system [4 hours]

6.1 Expert system
6.2 Architecture of expert system
6.3 Case study of expert system (clinical decision support system)

Lab Exercise:
There shall be at least 6 lab exercises based on RDMS covering theoretical studies involving medical data.
At the end of the course students shall be able to design medical database with report generation.

Project Work:
A project on medical informatics application.

Text Books:
1. Abraham Silberchatz, Henry F. Korth, S. Sudarshan; Database System Concepts
2. Edward H. Shortliffe, Leslie E. Perreault – Medical informatics, computer application in health care and biomedicine
3. Edward J. Cimino - Biomedical Informatics

TELEMEDICINE AND TELEHEALTH
BEG 4C1 BM
ELECTIVE III

Semester VIII **Year IV**

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

COURSE OBJECTIVES:

To give an introduction to telemedicine and telehealth and stress its importance in the present day world and in underdeveloped country like Nepal.

1. Introduction and history of remote management of diseases **[3 hours]**
   - 1.1. Definition of Telemedicine and telehealth
   - 1.2. History of Telehealth
   - 1.3. Use of Telephone in telemedicine
   - 1.4. Use of current telecommunications technology

2. Telehealth: A patient perspective **[3 hours]**
   - 2.1. Importance of patient focus for telehealth
   - 2.2. Influence of changing role of patient on telehealth
   - 2.3. Providing health information to consumers andn patients
   - 2.4. Future of patient participation in health care in telehealth

3. Telecommunication technologies in healthcare **[4 hours]**
   - 3.1. Synchronous and asynchronous communication
   - 3.2. Catagories of telecommunication technology
     - 3.2.1. Transmission channels
     - 3.2.2. Capture/ Reception equipment: videoconferencing
     - 3.2.3. Special applications: Radiology equipment
     - 3.2.4. General telemedicine equipment

3.2.5. Vendor considerations
3.2.6. Technical considerations

4. Clinical Applications **[6 hours]**
   4.1. Radiology
      4.1.1. Clinical Applications
      4.1.2. The importance of image resolution
      4.1.3. Utilization and cost effectiveness
      4.1.4. Behavioral health care
         4.1.4.1. Video Channel as preferred technology
         4.1.4.2. Video considerations in behavioral e-health
         4.1.4.3. Ethical concerns for behavioural e-health
         4.1.4.4. Practical conciderations
      4.1.5. Home care
         4.1.5.1. Clinical applications
         4.1.5.2. Cost effectiveness
         4.1.5.3. Disease management
      4.1.6 Telepathology
      4.1.7 Teledermatology
      4.1.8 Telesurgery

5. Special settings **[3 hours]**
   5.1. Correctional settings
   5.2. Military settings
   5.3. Tribal community
   5.4. School settings
   5.5. Projects
   5.6. Internet
6. Telehealth and relationship with physicians **[4 hours]**
   6.1. Changing role of professionals
   6.2. Traditional doctor-patient relationship
   6.3. Current challenges in doctor-patient relationship
   6.4. Objectives of doctor-patient relationship
   6.5. octor patient relationship in telehealth

7. Telehealth care transactions **[3 hours]**
   7.1. Suitable areas for telehealth care
   7.2. Telehealth transaction
   7.3. Operational management of Telehealth transactions

7.4. Future of telehealth transactions

8. Regulatory considerations, security and privacy **[3 hours]**
   - 8.1. Privacy
   - 8.2. Confidentiality
   - 8.3. Security
   - 8.4. Data integrity
   - 8.5. Legal issues

9. Market for telehealth services **[3 hours]**
   - 9.1. Market in primary and secondary care
   - 9.2. Market in academic centres
   - 9.3. Market in home care
   - 9.4. International market
   - 9.5. Rural health care market
   - 9.6. Market in military

10. Contracting for telehealth care **[2 hours]**

11. Starting Telemedicine **[3 hours]**
   - 11.1. Understanding missions and goals
   - 11.2. Identifying needs and services to be delivered
   - 11.3. Identifying target clients
   - 11.4. Identifying required resources

12. Choosing the right technology for telemedicine **[4 hours]**
   - 12.1. Investment on equipment
   - 12.2. Effect of data exchange performance rates on telemedicine programmes
   - 12.3. Buying bandwidth
   - 12.4. Equipment and communication standards
   - 12.5. Equipment requirement for specific telehealth applications

13. Telemedicine and Telehealth in Nepalese Context **[3 hours]**
   - 13.1. Economic considerations
   - 13.2. Geographical considerations
   - 13.3. Technological considerations
   - 13.4. Regulatory considerations

14. Future of Telehealth and Telemedicine **[2 hours]**
    - 14.1 Future health care trends
    - 14.2 Technological trends

COURSE BOOKS:

1. Marlene M. Maheu, Pamela Whitten, Ace Allen: E-Health, Telehealth and Telemedicine
2. Telemedicine and Telehealth, Adam William Darkins and Margaret Ann Cary.