CURRICULUM

DIPLOMA

Biomedical Equipment Engineering

Council for Technical Education and Vocational Training

Curriculum Development Division

Sanothimi, Bhaktapur

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Table of Content

1. Introduction

Biomedical Engineering is an emerging field in the engineering and technology sector. Many people in the developed countries, developing countries and under developed countries have given emphasis the broader application of Biomedical Engineering. This field has been helping the world for overall development and it has been creating wage and self-employment opportunities both in public and private sectors. This curriculum is designed with the purpose of producing middle level technical workforce equipped with knowledge and skills related to the areas of Biomedical Equipment Engineering so as to meet the demand of such workforce in the country to contribute in the quality of health services in Nepal. The knowledge and skills incorporated in this curriculum will be helpful to deliver thenational needs in the field of Biomedical Equipment Engineering.

2. Course title

Diploma in Biomedical Equipment Engineering (DBEE)

3. Program Aim

The aim of this program is to produce diploma level biomedical equipment technician to provide technical service in different level of health facilities in the country.

4. Program objectives

Theobjectives of the course is to;

- produce middle level technically competent workforce/human resourcesto work as biomedical technician in different level of health facilities,
- reduce the dependency on employing such technicians from foreign countries,
- able to understand relationship between human anatomy physiology and biomedical engineering and
- carry out the overall planning and management of medical devices in the health facilities of Nepal

5. Programme description

This course is based on the job required to perform by the Biomedical Equipment Technicians at different levels of hospitals and nursing homes in Nepal. Therefore, this curriculum is designed to provide knowledge and skills focusing on Biomedical Equipment Engineering related to the occupation. There are three semesters in total within the period of one and half years. The courses are focused on basic disciplinary subjects of Biomedical Equipment Engineeringincluding provision of electivesubjects. Moreover, the third semester insists on the application of learned skills and knowledge through the project as infusion model of subjects.

It makes provision of projects as well as elective subjects in the specific areas of Electronics and Biomedical Equipment Engineering. The course structure and the subject wise content that reflect the details of this curriculum. In brief, this curriculum will guide to its implementers to produce competent and highly employable middle level technical workforces in the field of biomedical equipment engineering.

The contents of individual subjects prescribed in the curriculum are incorporated in the light of "must know and must do" principle of knowledge and skills for this level.

6. Duration

The total duration of the program is 18 months (3 semesters). Each semester consists of six months period of time. Moreover, one semester consist of 20 academic weeks including evaluation period. Actual teaching learning hours will be not less than 16 weeks in each semester.

7. Target group

The target group for this programme will be all interested individuals who passed 10+2 or equivalent to the science stream.

8. Group size

The group size will be maximum of 48(Forty eight) in a batch.

9. Target location

The target location will be all over Nepal.

10. Entry qualification

Entry qualification of applicants for diploma in biomedical equipment engineering programme should be 10+2 or equivalent to the science stream or as per provisions mentioned on the CTEVT admission guidelines.

11. Entry criteria

- Should submit 10+2 or equivalentto thescience stream.
- Should pass entrance examination as administered by CTEVT

12. Selection

Applicants fulfilling the entry criteria will be selected for the admission on the basis of merit.

13. Medium of instruction

The medium of instruction will be in English and/or Nepali.

14. Pattern of attendance

Minimum of 80% attendance in theory and 90% attendance in practical is required to appear in the respective final examination.

15. Teacher and student ratio

- For theory: As per the nature of the course
- For practical / demonstration: 1:10
- For workshop practice: 1:8

16. Teachers and demonstrators

- The disciplinary subjects' related teachersshould be a bachelor's degree holder in the related area with three years' experience in the related field.
- The demonstrators should be a bachelor's degree holder in the related area with two years' experiences in training activities.

17. Instructional media and materials

The following instructional media and materials are suggested for the effective instruction and demonstration.

- ***Printed Media Materials***(Assignment sheets, Case studies, Handouts, Information sheets, Individual training packets, Procedure sheets, Performance Check lists, Textbooks etc.).
- ***Non-projected Media Materials***(Display, Models, Flip chart, Poster, Writing board etc.).
- ***Projected Media Materials***(Opaque projections, Overhead transparencies, Slides etc.).
- ***Audio-Visual Materials***(Audiotapes, Films, Slide-tape programs, Videodiscs, Videotapes etc.).
- ***Computer-Based Instructional Materials***(Computer-based training, Interactive video etc.).

18. Teaching learning methodologies

The methods of teaching learningwill be a combination of several approaches,such as illustrated lecture, tutorial, group discussion, demonstration, simulation, guided practice, practical experiences, fieldwork, report writing, hospital visit, term paper presentation, case analysis, tutoring, role-playing, heuristic, project work and other independent learning.

- Theory: lecture, discussion, seminar, interaction, assignment.
- Practical: demonstration, observation, guided practice, self-practice, project work, industries practice.

19. Examination and marking scheme

- The subject teacher will internally assess the students' achievement in each subject during the course followed by a final examination at the end of each semester.
- A weightage of 20% for the internal assessment and 80% for the semester wise final examination will be allocated for theoretical components of a subject.
- The final semester examinations of all theory components will be administered through written tests.
- Generally the method of continuous assessment will be adopted for practical components.
- Semester final examinations are also conducted for practical components as per needs.
- Students who fail in the internal assessment will not be allowed to sit in the semester final examination.

20. Provision of back paper

There will be the provision of back paper but a student must pass all the subjects of all three semesters within three years from the date of enrolment.

21. Disciplinary and ethical requirements:

- Intoxication, insubordination or rudeness to peers will result in immediate suspension followed by review by the disciplinary review committee of the institute.

- Dishonesty in academic or practice activities will result in immediate suspension followed by administrative review, with possible expulsion.
- Illicit drug use, bearing arms at institute, threats or assaults to peers, faculty or staff will result in immediate suspension, followed by administrative review with possible expulsion.

22. Pass marks:

The students must secure minimum of 40% marks in theory and 50% marks in practical (Lab).Moreover, the students must secure minimum pass marks in the internal assessment as well as in the final semester examination of each subject to pass all subjects offered in each semester.

23. Grading system:

The overall achievement of each student will be measured by a final aggregate percentage of all final semester examinations and graded as follow:

Marks division:

- Distinction : > or =80 %
- First division : 65 % to <80 %
- Second division : 50 % to <65 %
- Pass division : Pass aggregate to < 50 %

24. Certification and degree awards:

- Students who havepassed all the components of all subjects of all three semesters are considered to have successfully completed the course.
- Students who have successfully completed the course will be awarded with a degree of "**Diploma in Biomedical Equipment Engineering"**.

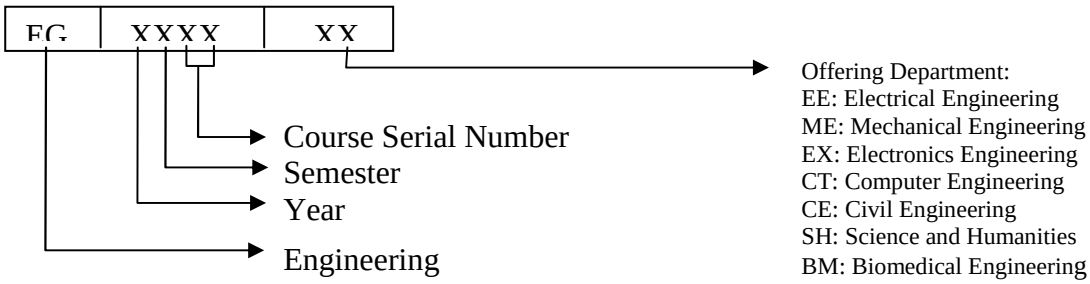
25. Career path:

The graduates will be eligible for the position equivalent to Non-gazetted 1st class (technical) as Biomedical Equipment Technician or as prescribed by the Public Service Commission of Nepal. The graduate will be eligible for registration with the related Council in the grade as provisioned in the related Council Act (if any).

26. Curriculum and credits:

In this curriculum each subject has its code; full marks; and credit hours divided into lecture hours, tutorial hours, and practical hours.

27. Subjects Codes



28. Provision of specialization:

There will be no provision of specialization but some subjects are offered here with the provision of elective; such as ENT, Dental & Ophthalmic Equipment, Medical Imaging Equipment, Tele medicine and Hospital Equipment Management.

29. Internship

After completing the final exam of 3rd semester, 3 months (12 weeks) internship will be placed in different health facilities. Internship implementation and evaluation guidelines will be prepared by the related training institute with the collaboration of CTEVT. Every student must complete the internship and submit internship completion report to receive the final certificate.

Course Structure ofDiploma in Biomedical Equipment Engineering

First Semester

Teaching Schedule			Mode				DISTRIBUTION OF MARKS						Total Marks	Remark
							Theory			Practical				
SN	Course Code	Course Title	L/W	T/W	P/W	Total Hours	Int. Marks	Final Marks	Time Hours	Int. Marks	Final Mark	Time Hours		
1	EG1121BM	Human Anatomy and Physiology	3		1	4	20	60	3	10	10	2	100	
2	EG1122BM	Electrical Engineering Drawing			4	4				60	40	4	100	
3	EG1123BM	Electrical Circuit and Machine	4	1	3	8	20	80	3	60	40	4	200	
4	EG1124BM	Bio Medical Chemistry	3		1	4	20	60	3	10	10	2	100	
5	EG1125BM	Logic Circuits	3		3	6	20	80	3	30	20	3	150	
6	EG 1126BM	Engineering Mathematics	3	1		4	20	80	3				100	
7	EG1127BM	Workshop Technology	1		3	4				60	40	4	100	
8	EG1128BM	Computer and Programming	3		3	6	20	80	3	30	20	3	150	
		Total	**20**	**2**	**18**	**40**	**120**	**440**		**260**	**180**		**1000**	

Second Semester

Teaching Schedule			Mode				DISTRIBUTION OF MARKS						Total Marks	Remark
							Theory			Practical				
SN	Course Code	Course Title	L/W	T/W	P/W	Total Hours	Int. Marks	Final Marks	Time Hours	Int. Marks	Final Mark	Time Hours		
1	EG1221BM	Bio-Medical Instrumentation I	3		2	5	20	60	3	10	10	2	100	Continuous Assessment
2	EG1222BM	Electronic Devices and Circuits	4		4	8	20	80	3	60	40	3	200	
3	EG1223BM	Electrical Measurements & Instrumentation	3		1	4	20	60	3	10	10	2	100	
4	EG1224BM	Microprocessors and Micro Controller	3		2	5	20	60	3	10	10	2	100	
5	EG1225BM	Data Communication and Networking	3		3	6	20	80	3	30	20	3	150	
6	EG1226BM	Medical Electronics	3		3	6	20	80	3	30	20	3	150	
7	EG1227BM	Bio-Medical Equipment Maintenance I	2		4	6	10	40	1.5	60	40	3	150	
		Total	**21**		**19**	**40**	**130**	**500**		**250**	**170**		**950**	

Third Semester

Teaching Schedule			Mode				DISTRIBUTION OF MARKS						Total Marks	Remark
							Theory			Practical				
SN	Course Code	Course Title	L/W	T/W	P/W	Total Hours	Int. Marks	Final Marks	Time Hours	Int. Marks	Final Mark	Time Hours		
1	EG2121BM	Bio-Medical Instrumentation II	3		4	7	20	80	3	60	40	4	200	
2	EG2122BM	Bio-Medical Equipment Maintenance II	4	1	8	13	20	80	3	120	80	4	300	
3	EG2123BM	Project work			8	8				120	80	4	200	
4	EG2124BM	Elective	3	1	3	7	20	80	3	30	20	3	150	
a		ENT, Dental and Ophthalmic Equipment												continuous assessment
b		Medical Imaging Equipment												
c		Tele medicine												
d		Hospital Equipment Management												
5	EG3201SH	Entrepreneurship Development	3		2	5	20	60	3	10	10	3	100	
		Total	**13**	**2**	**25**	**40**	**80**	**300**		**340**	**230**		**950**	
		Internship (12 weeks)												

Note:
L/W = Lecture hours per week
T/W = Tutorial hours per week
P/W = Practical hours per week
Total Hours = Total hours per week

Detail Curriculum

First Semester

Human Anatomy and Physiology

EG 1121 BM

Total: 4 hours/week
Year: I **Lecture: 3 hours/week**
Semester: I **Tutorial: 0 hours/week**
Practical: 1 hours/week

Course description:
This course is designed to provide knowledge of Human Anatomy & Physiology required for Biomedical Field. This provides knowledge about the cells, the chemical composition of cells, the buildup of human body from cellular to organ-system level. It includes the various systems of biological environment that are continuously interacting with each other and regulating their functions to an optimized level. This course covers all the anatomical and physiological descriptions of the human body.

Course objectives:
After the completion of this course, students will be able to:

1. Understand the organization of the human body.
2. Describe the various types of systems governing the human body.
3. Explain about the anatomy of various organs and systems.
4. Understand the physiology or the functions of different organs and systems.

Course Contents:

Theory

1.0 Introduction to Human Body: (2hrs)

1.1 Body design at structure-function level
1.2 Pathological Changes of disease

2.0 Introduction to the Chemistry of Life: Atoms, Molecules & Compounds. Biological, Molecules & Body Fluids: (2 hrs)

1.0 Ionic structures of different atoms, biological molecules in relation to body Structure
1.1 Outline: salt-water balance of body
1.2 pH mechanism of body fluids. Acidosis & Alkalosis
1.3 Body fluids & their control

3.0 The Cells, Tissues &Structure of the Body: (2 hrs)

3.1 Structure & function of different types of cells & tissues
3.2. Tissue repair & regeneration

4.0 The Skin. Structure, Function & Disorder of Skin: (3 hrs)

4.1. Microscopic anatomy of skin
4.2. Functional roles of skin

4.3. Skin diseases
4.4. Method of wound repair

5.0. The Skeleton, Axial Skeleton & Appendicular Skeleton Bones: (5 hrs)

5.1 Outline: Human Skeleton axial & appendicular views
5.2 Study of different types of bone
5.3 Histology of bone components
5.4 Learning of bone development or ossification of bone
5.5 Function of Bone
5.6 Skull bones
5.7 Structure, & function of vertebral, thoracic limb & pelvic bone

6.0. The joint. Types of Joints: (2hrs)

6.1 Basic structure of joints
6.2 Differentiate the types of joints, fibrous, fixed & in relation to their movement

7.0. The Muscular System: (2 hrs)

7.1.Introduction to different types of muscle
7.2 Outline of muscle functions

8.0. The Special Senses. Hearing & Balance of Ear, Sight & Eye: (4 hrs)

8.1. Structural details of human ear- external ear, middle ear & internal ear
8.2. Outline the functions of ear
8.3. Hearing & balancing functions of the ear
8.4. Brief introduction to diseases of ear
8.5. Structural details of Human eye
8.6. Function of eye
8.7. Physiology ofEyesight

9.0 Blood Component. Hemostasis& Thrombosis. Disorders of Blood Coagulation (2 hrs)

1.1. Composition of Blood
1.2. Revision of blood functions
1.3. Learning of hemostatic mechanisms
1.4. Effect of thrombus formation on blood vessels
1.5. Review of blood coagulation & disorders

10.0 The Cardiovascular System. Blood Vessels, Blood Pressure, Pulse & Circulation of The Blood: (4hrs)

10.1. Anatomy & function of heart & blood vessels.
10.2. Blood supply of heart or coronary circulation
10.3. Blood circulation from different organs to the heart
10.4. Cardiac cycle, cardiac output & blood pressure
10.5. Learning of conduction system of heart
10.6. Brief understanding of heart diseases
10.7. Study of the disorders of blood vessels

11.0 The Respiratory System, Nose, Nasal Cavity, Pharynx, Larynx, Trachea, Bronchi, Lungs and Respiration: (3hrs)

11.1. Anatomy-physiological relationship of upper respiratory tract
11.2. Structure & functions of Bronchial tree
11.3. Lungs & its topography. Pleura & pleural cavity
11.4. Learning of lung functions
11.5. Mechanism of breathing, types of breathing & control of respiration
11.6. Ventilation & Lung volumes
11.7. Gas transfer & diffusion

12.0. The Digestive System, Oral Cavity. Digestion, Absorption & Metabolism: (5 hours)

12.1. Structure of oral cavity & glands
12.2. Functions & abnormalities of teeth
12.3. Structure of alimentary canal
12.4. Functions of stomach, intestine & role of smooth muscle of gut
12.5. Digestion, secretion & absorption capacity of gut
12.6. Structure &function of liver, biliary tract & gall bladder
12.7. Structure &function of Pancreas

13.0. The Urinary System. Kidney, Ureters, Urinary Bladder, Urethra: (2 hours)

13.1. Topography of Kidneys
13.2. Structure &function of ureter, bladder & urethra
13.3. Function of bladder

14.0. The Endocrine System. Pituitary, Thyroid, Adrenal, Pancreas, Thymus Gland: (5 hrs)

14.1. Structures &function of Hypothalamus & Pituitary gland
14.2. Thyroid gland & its role in metabolic & electrolyte control of body
14.3. Function & structure of Parathyroid gland
14.4. Structure & function of Adrenal glands
14.5. Introduction to Thymus gland

15.0. Reproductive System. Male & Female Reproductive Organs: (5hrs)

15.1. Structure of female reproductive organs
15.2. Structure &function of Vagina, Uterus and Fallopian Tubes
15.3. Outline the anatomy of ovaries and its functions
15.4. Structure & Function of breast
15.5. Structure of male reproductive organs
15.6. Glandular function of male reproductive system
15.7. Prostate gland and its function

Practical (Laboratory)

Total Duration: 16Hours

1. Study of Systematic relationship of human body
2. Study of structures of Skeletal, cardiac, & smooth muscle cells
3. Study of structures of sense organs
4. Study of Systematic relationship of heart and Cardiovascular System, ECG
5. Study of Systematic relationship of respiratory system, Spirometer
6. Study of Systematic relationship of digestive system
7. Study of Systematic relationship of urinary system
8. Study of Systematic relationship of endocrine system
9. Study of Systematic relationship of reproductive system

References:

1. Anatomy & Physiology in Health & Illness –Anne Waugh & Allison Grant, Ninth Edition
2. Textbook of Physiology, C. Guyton, 6th Edition
3. Atlas of Anatomy, Anne MR Agur, Ninth Edition

Electrical Engineering Drawing

EG 1122 BM

Total: 4 hours/week
Year: I **Lecture: hours/week**
Semester: I **Tutorial: 0 hours/week**
Practical: 4 hours/week

Course Objectives: After completion of this course the student will

i) Know, understand describe and apply electrical symbols.
ii) Read and interpret wiring diagrams.
iii) Prepare schematic diagrams from wiring diagrams.

1. Introduction to subjects, preparation of drawing sheet, type of diagrams, drawing symbols.

2. Draw simple two way switch and intermediate switches connection for lighting.

3. Design control circuits for lighting using impulse relay and timer.

4. Design connection diagram for ammeter:
   (a) Direct on line (b) Using shunts (c) Using currenttransformer

5. Design connection diagrams for voltmeter
   (a) Direct on line (b) Using multipliers (c) Using potential transformer

6. Draw a connection and layout diagram for single-phase consumer “Intake” equipment, including 8-way distribution board.

7. Draw connection diagram for room heater with fan motor, fire protection circuit and thermostat.

8. Draw connection diagrams of DC motors.
   a) Series b) Shunt c) Compound wound

9. Draw connection diagrams of 220V/ 6V AC to DC conversion adopter with half wave and full wave rectification providing necessary filter.

10. Draw wiring and connection diagram for a refrigerator compressor motor circuit using single phase capacitor motor, starting relay, thermostat and series over load relay.

11. Draw connection diagram for 3-phase, 3 hp 380 V star connected squirrel cage induction motor controlled by manual controlled triple pole switch fuse device.

12. Draw connection diagram for 3-phase, 5 hp 380 V delta connected squirrel cage induction motor controlled by a star/delta rotary switch and fuses.

13. Draw connection diagram of a 3-phase, 10 hp, 380V delta connected squirrel case induction motor with automatic star/delta starter, overload trips, a limit switch and electromagnetic brake.

14 Drawing of the electrical circuits of different types of air conditioning systems on the basis of the information about the components in use.

References:-

1. Electrical circuits and Machines- E.C Lister
2. Basic principles of Electrical Craftsman- H.R. Martin
3. Electrical Engineering Design Manual- M.G. Say
4. Electrical Installation Design-J.B Gupta.

Electric Circuit and Machines

EG 1123 BM

Total: 8 hours/week
Year: I **Lecture: 4 hours/week**
Semester: I **Tutorial: 1hours/week**
Practical: 3 hours/week

Course Objectives: After completion of this course the student will understand the
i) Fundamental concept of DC, AC & 3-phase electrical circuits.
ii) Fundamental concept of AC and DC machine

Course Contents:

Theory

1. General Electric System **(4 hours)**
- 1.1. Drift of electrons in metals, current flow in a circuit, EMF and potential difference
- 1.2. Good conductors, bad conductors and semiconductors-definition and their atomic structure.
- 1.3. Ohm's law:-definition ,explanation and verification
- 1.4. Resistors,Resistance andResistivity
- 1.5.

2. Cells and Batteries **(6 hours)**
- 2.1. Simple voltaic cell - Construction and working principle
- 2.2. Principle and secondary cells - definition and explanation with examples, internal resistance, capacity of cells
- 2.3. Lead acid accumulator -construction and working principle
- 2.4. Grouping of cells

3. Network Theorems **(8 hours)**
- 3.1. Kirchoff'slaws, Kirchoff's laws in network solution
- 3.2. Superposition theorem
- 3.3. Theveninn's theorem
- 3.4. Nortan's theorem
- 3.5. Maximum power transfer theorem
- 3.6. Reciprocity theorem

4. Fundamentals of single-phase AC circuit **(8 hours)**
- 4.1. Comparison between A.C. and D.C. voltage and current.
- 4.2. Generation of A.C. emf, sine wave
- 4.3. Wave form, terms & definitions
- 4.4. Average and rms values of current & voltage
- 4.5. AC in resistive circuits
- 4.6. Current & voltage in an inductive circuits
- 4.7. Current and voltage in an capacitive circuits
- 4.8. Concept of complex impedance and admittance
- 4.9. AC series and parallel circuit

5. Three-Phase Circuit Analysis (6 hours)

5.1. Basic concept & advantage of Three-phase circuit
5.2. Phasor representation of star & delta connection
5.3. Phase and line quantities
5.4. Voltage, current and power computation in 3-phase circuits

6. Transformer (10 hours)

6.1 Construction, principle of operation, emf equation and transformation ratio.
6.2 Basic constructional details, magnetic circuit, electric circuits, core type and shell type construction.
6.3 No load operation of transformer, no-load equivalent circuit, operation of transformer with load, phasor diagram with resistive, inductive and capacitive loads.
6.4 Types of losses and efficiency, transformation of impedance, equivalent circuit.
6.5 Transformer tests:-polarity test, open circuit tests and short circuit test.
6.6 Parallel operation of single phase transformers.
6.7 Voltage regulation, percentage impedance, condition of maximum efficiency
6.8 Three phase transformer, different types of three phase transformer, parallel operation of three phase transformer.
6.9 Various parts of a power transformer-tank, conservator, breather, explosion vent, Bucholz'srelay, transformer oil, bushingsand arcing horns.

7. DC Machine (10 hours)

7.1 Construction and working principle of D.C. generator.
7.2 Types of D.C generators: separately excited, self-excited, shunt, series, compound generator, circuit diagram of different types,emf generated and load terminal voltage.
7.3 Characteristics of different types D.C generator, Voltage build up process in self-excited D.C generator, critical resistance and critical speed.
7.4 Introduction and working principle of operation DC motor
7.5 Torque developed by the motor -mathematical expression, characteristics and application
7.6 Losses and efficiency, Speed control of D.C. motor, testing of motor

8. Motors (12 hours)

8.1 Construction and working principle of Single phase Induction motor
8.2 Construction and working principle of three phase Induction motor
8.3 Construction and working principle of stepper motor.
8.4 Construction and working principle of servo motor.
8.5 Construction and working principle of Schrage motor.
8.6 Selection of motors.

Practical

Laboratory works: **Total duration: 48 hours**

1. Measurement of Voltage, current& power in DC circuit
   Verification of Ohm's Law
   Temperature effects in Resistance
2. Measurement amplitude, frequency and time with oscilloscope
   Calculate & verify average and rms value
   Examine phase relation in RL & RC circuit
3. Measurements of alternating quantities
   AC power, power factor, VARs, phasor diagrams
4. Three-phase AC circuits
   Measurement of Voltage, current& power in a three-phase circuit
   Two-wattmeter method of power measurement in R, RL and RC three phase circuits
5. Two Winding Transformers
   To perform turn ratio test
   To perform open circuit (OC) and short circuit (SC) test to determine equivalent circuit parameter of a transformer and hence to determine the regulation and efficiency at full load
6. DC Generator
   To draw open circuit characteristic (OCC) of a DC shunt generator and to calculate:
   (a) Maximum voltage built up (b)Critical resistance and critical speed of the machine
7. Motor
   Speed control of Single phase induction motor
   Speed Control of three phase induction motor
   Effect of capacitor on starting of single phase motor.

References:

1. J.R Cogdell, " Foundations of Electrical Engineering", printice Hall, Englewood Chiffs, New Jersy, 1990.
2. I.M Smith," Haughes Electrical Technology", Addison-Wesley, ISR Rprint,2000
3. Electric Machine by J.B Gupta
4. Electric Machine by Nagrath and Kothari
5. Electric Machine and Electric Technology by B.L. Theraja

Biomedical Chemistry

EG 1124 BM

Year: I
Semester: I

Total: 4 hours/week
Lecture: 3 hours/week
Tutorial: 0hours/week
Practical: 1 hours/week

Course description:

This subject consists of five units related to Oxidation and Reduction; Electrochemistry; Organic compounds and synthetic materials; Instrumental methods used to analyze substance and Acid-Base Chemistry to develop background in Bio medical chemistry that supports for the understanding and practicing related bio medical engineering works.

Course objectives:

After the completion of this subject, students will be able to explain the basic concepts related to the followings and apply them in the field of related engineering works:

1. Instrumental methods used to analyze substance
2. Electrochemistry
3. Organic compounds and synthetic materials

Course Contents:

Theory

Unit 1. Oxidation and Reduction (6hrs)

1.1 High energy or energy rich components
1.2 Free energy
1.3 ATP as an energy carrier
1.4 Electron transport chain
1.5 biological oxidation and oxidative phosphorylation
1.6 Oxidation – Reduction potentials

Unit 2 Electrochemistry (11hrs)

2.1 Introduction
2.2 Biological interest in electrochemistry

2.3 Electrochemistry and energy transudation
2.4 The range of electrochemical techniques
2.5 Principles of electrochemical techniques
2.6 Electrochemical cells and reactions
2.7 Schematic representation of electrochemical techniques
2.8 Introduction to potentiometry
2.9 Introduction to voltammetry

Unit: 3: Organic compounds and synthetic materials: (10hrs)

3.1. Organic compounds

- Organic compounds:
  - Historical background, classification, and nomenclature
  - Functional groups and homologous series
- Comparison of aliphatic and aromatic compounds
- Saturated hydrocarbon: Properties of Methane
- Unsaturated hydrocarbon: Properties of Ethylene and Acetylene
- Aromatic compounds: Properties of Benzene

3.2. **Synthetic materials:**

- Polymer and polymerization
  - Definition
  - Types of polymer
- Rubber:
  - Types (Natural and Synthetic)
  - Preparation and uses.
- Polyvinyl chloride (PVC):
  - Preparation and uses
- Polythene:
  - Preparation and uses

Unit 4 Instrumental methods Used to Analyze Substance of Biological Importance (16 hrs)

1.1 Electrophoresis Techniques
1.2 Chromatographic Techniques
1.3 Spectroscopic Techniques
1.4 Mass Spectrometric Techniques
1.5 Immunochemical Techniques
1.6 Radioisotope Techniques
1.7 Centrifugation Techniques
1.8 Filtration Techniques
1.9 Colorimetric Techniques

Unit 5 Acid – Base Chemistry **(5 hrs)**

5.1 pH

5.2 Buffer and buffer system
5.3 Organic acid
5.4 Electrolytes Water dissociation

Practical

Total duration: 16 hours

1. Orientation of different types of analytical lab equipment used in Hospital

Textbooks:

1. Foundations of chemistry, Vol-2, M.K. Sthapit and R.R. Pradhananga
2. A text Book of chemistry, Jha&Guglani
3. A text Book of Organic Chemistry, B.S. Bahl&ArunBahl
4. Elementary qualitative analysis, M.K.Sthapit and C.B.Tuladhar
5. Elementary practical chemistry, MK.Sthapit

References:

1. Inorganic chemistry, Bahl&Tuli
2. Elementary Organic Chemistry, P.N. Bargava
3. Fundamentals of chemistry, K.R. Palak
4. A text Book of Inorganic Chemistry, L.M. Mitra

Logic Circuits
EG 1125 BM

Total: 6 hours/week
Year: I **Lecture: 3 hours/week**
Semester: I **Tutorial: hours/week**
Practical: 3 hours/week

Course description:

This course focuses on the study, design and application of electronic devices/equipment that are based on digital techniques.

Course objectives:

After the completion of this course, students will be able:

1. To learn design methods for combinational logic circuit,
2. To verify truth tables of basic and universal gates
3. To learn design concepts of sequential logic circuits
4. To design problem based / predefined logic based circuits

Course Contents:

Theory

Unit 1. Introduction **[3 hrs]**

1.1 Analog and Digital Signals
1.2 Advantages of Digital over Analog Signals
1.3 Representation of Digital Signal
1.4 Applications of Digital Signal

Unit 2. Number Systems and Codes **[4hrs]**

2.1 Two State Devices
2.2 Decimal Number System
2.3 Binary Number System
2.4 Octal Number System
2.5 Hexadecimal Number System
2.6 Conversions among Different Number Systems
2.7 Fractions Conversion
2.8 BCD Code
2.9 Gray Code
2.10 Alphanumeric Code
- ASCII Code
- EBCDIC Code

Unit 3. Arithmetic Logic Operations [4 hrs]

3.1 Binary Arithmetic
- Binary Addition
- Binary Subtraction
- Binary Multiplication
- Binary Division

3.2 9's and 10's Complement Method
- 9's Complement Subtraction
- 10's Complement Subtraction

3.3 1's Complement and 2's Complement Method
- 1's Complement Subtraction
- 2's Complement Subtraction

Unit 4. Logic Gates [4 hrs]

4.1 Basic Gates: AND, OR, NOT
4.2 Universal Gates: NAND, NOR
4.3 Exclusive Gates: XOR, XNOR
4.4 Logic Equations
4.5 Truth Tables
4.6 The Universal Properties of the NAND Gates
4.7 The Universal Properties of the NOR Gates
4.8 Pulse Operation in Logic Gates
4.9 Combination of Logic Gates
4.10 Building Logic Circuits from Logic Equations
4.11 Forming Logic Equations from Logic Circuits

Unit 5. Boolean Functions and Logic Simplification [8 hrs]

5.1 Boolean Algebra and its Properties/Laws
5.2 Boolean Expression in Logic Gates
5.3 Simplification of Boolean Expressions
5.4 DeMorgan's Theorems
5.5 Karnaugh Map
- K-Map Simplification for Two Input Variables
- K-Map Simplification for Three Input Variables
- K-Map Simplification for Four Input Variables

5.6 Sum of Product (SOP) Simplification
5.7 Product of Sums (POS) Simplification
5.8 Maps with *Don't Care* Conditions

Unit 6. Combinational Logic Circuits [10 hrs]

6.1 Adders
- Half Adder
- Full Adder
- Parallel n-Bit Adders

6.2 Subtractors
- Half Subtractors

- Full Subtractors
- Parallel n-Bit Subtractors

6.3 Encoders
- Decimal to Binary Encoder
- Decimal to BCD Encoder
- ASCII Encoder
- Encoder IC Packages

6.4 Decoders
- Binary to Decimal Decoder
- Four Bit Binary Decoder
- BCD to Decimal Decoder
- Seven Segment Display Decoder
- Decoder IC Packages

6.5 Multiplexers
- Data Transmissions
- 4-to-1 Multiplexer
- 8-to-1 Multiplexer
- Multiplexer IC Packages

6.6 Demultiplexers
- Demultiplexer and Decoder Relations
- 1-to-4 Demultiplexer
- 1-to- 16 Demultiplexer
- Demultiplexer in IC Packages

Unit 7. Sequential Logic Circuits [12 hrs]

7.1 Latch and Flip-Flops
- RS Flip-Flop and its Truth Table
- D Flip-Flop and its Truth Table
- JK Flip-Flop and its Truth Table
- T Flip-Flop and its Truth Table
- Master-Slave Flip-Flops
- Applications of Flip-Flop

7.2 Shift-Registers
- Flip-flop as a One-bit Memory Device
- Right/Left Shift Registers
- Serial-in Serial-out (SISO) Shift Register
- Serial-in Parallel-out (SIPO)Shift Register
- Parallel-in Serial-out (PISO)Shift Register
- Parallel-in Parallel-out (PIPO)Shift Register
- Applications of Shift Registers

7.3 Counters
- Synchronous Counters
- Ripple Counters
- M- Modulus Counters

- Decade Counters
- Ring Counters
- Applications of Counters

Unit 8. Digital Displays [3hrs]

8.1 LED Display
8.2 LCD Display
8.3 Gas Display
8.4 7-Segment Display
8.5 Alphanumerical Display
8.6 Digital Clock Display Design

Practical

Total duration: 48 hours

1. Experiments on logic operation and verify with truth tables of basic gates: AND, OR, NOT, NAND, NOR
2. Verify the universal properties of the NAND gate and NOR gate.
3. Experiments on logic operation and verify with truth tables of basic gates: XOR, XNOR Gates.
4. Building logic circuits from logic equations
5. Realize the pulse operation in different logic gates
6. Realize and verify truth tables applying DeMorgan's Theorems
7. Realize and verify truth tables of binary half adder/Subtractor and full adder/Subtractor
8. Realizing the function of decimal to 3-4 bit binary encoder
9. Realizing the function of 4 bit binary decoder
10. Realizing the function of 4-to-1 multiplexer and 1-to-4 demultiplexer circuits.
11. Realizing the function of latches and flip-flops, RS,D,JK,T flip-flops
12. Realizing the function shift-registers: SISO,SIPO,PISO and PIPO
13. Realizing the function ripple counters
14. Realizing the function synchronous counters
15. Realizing and designing of seven-segment display-decoder logic circuit

References:

1. Principle of Digital Electronics- P. Malvino
2. Digital Fundamentals- T. Flyod
3. Digital Design- M.Mano

Engineering Mathematics
EG 1126 BM

Total: 4 hours/week
Year: I **Lecture: 3 hours/week**
Semester: I **Tutorial: 1hours/week**
Practical: hours/week

Course Description:

This subject consists of five units related to trigonometry; algebra; calculus and partial differential equation necessary to develop mathematical background helpful for the understanding and practicing the related engineering works.

Course Objectives:

After the completion of this course, students will be able to explain the concepts of the followings and apply them in the field of related engineering area

1. Trigonometric ratios and equations, inverse circular functions and properties of triangles
2. explain the concepts of the complex numbers, linear inequalities and programming apply them in the field of the related engineering area
3. explain the concepts of determinants and matrices and apply them in the field of the related engineering area
4. explain the concepts of determinants and matrices and apply them in the field of the related engineering area
5. Sets, limit and continuity, derivatives, integration and integrals.
6. explain the concepts of partial differential equations and apply them in the field of the related engineering area

Course Contents:

Theory

Unit 1. Trigonometry: [12hrs]

1.1. Review of trigonometric ratios:
- Basic trigonometric formulae
- Identities and conditional identities.

1.2. Trigonometric equations:
- Periodicity of trigonometric functions
- General solutions of the following equations:
  - Sin x = k, cos x = k and Tan x = k and using trigonometric equations.

1.3. Inverse circular functions:

- Domain and their graphs
- Formulae involving inverse circular functions
- Simple identities and equations involving circular functions

1.4. Properties of triangles:
- The sin law
- The cosine law
- The projection law
- The half angle formulae
- The area of a triangle
- The encircles and ex-circles of a triangle

Unit 2. Algebra: [10hrs]

2.1. Complex number in the from A+ ib.
2.2. Algebra of complex numbers.
2.3. Polar representation of complex numbers.
2.4. De Moivre's theorem and its applications
2.5. Linear inequalities and their graphs.
2.6. System of linear inequalities in two variables,
2.7. System of linear inequalities in two variables,
2.8. Linear programming: Problems involving two variables under given linear constraints
2.9. Determinants and matrices,
2.10 Algebra of matrices,
2.11 Properties of determinants,
2.12. Ad joint and inverse of matrices.
2.13. Solution of linear equations using cramers' rule
2.14. Row equivalent matrices
2.15. Idea of polynomial equations

Unit 3. Calculus: [12hrs]

3.1 Idea of set, set notations, set operations,
3.2. Venn diagram,
3.3. The set of real members and its subsets.
3.4. The absolute value of a real number.
3.5. Functions- algebraic and transcendental.
3.6. Graphs of simple function.
3.7. Limit of community.
3.8. Derivatives from definition of simple functions like:
- x^n, $(ax+b)^n$, sin (ax +b), e^{ax}, ax , and log x.

3.9. Derivatives of sum, difference, product and quotient of functions, chain rule, parametric and implicit functions
3.10. Integration, Rules for finding integrals.

3.11. Standard integrals and their uses.
3.12. Definite integrals- definition and evaluation.
3.13. Definite integral as limit of sum.

Unit 4. Partial Differential Equations: [10hrs]

4.1 Review of Ordinary Differential Equations,

4.2 Analysis of P.D.E of 1^{st} and 2^{nd} order,

4.3 Linear equations of the 1^{st} order and the general solutions,

4.4 P.D.E of 2^{nd} order, its derivation and basic concepts,

4.5 Solution of general P.D.E with constant coefficients, complimentary solution and integral solution,

4.6 Waveequations

Unit 5. Decibel [4hrs]

5.1. Gain Calculation
5.2. Current, Voltage and power gain
5.3. Physical Interpretation of dB calculation
5.4. Application of dB

Reference books:

1. Thomas and Finney, *Calculus and Analytical Geometry*, Narosa Publishing House, New Delhi, 1990.
2. E. Kreyszig, *Advanced Engineering Mathematics*, Wiley-Easter Publication, New Delhi, 1990.
3. Chandrika Prasad, *Mathematics for Engineer*, Prasad Mudranalaya, Allahabad, 1996.
4. E. Kreyszig, *Advanced Engineering Mathematics*, Wiley-Easter Publication, New Delhi, 1990.

Workshop Technology
EG 1127 BM

Total: 4 hours/week
Year: I **Lecture: 1 hours/week**
Semester: I **Tutorial: hours/week**
Practical: 3 hours/week

Course Description: This course is designed for Bio-medical students after graduation to carryout minor repair and maintain on their area of work in instruments and equipment for human health related activities. They would appreciate the mechanical engineering knowledge mainly in workshop related activities.

Course objectives:

1. Knowledge on safety, uses and application involved inmedical equipment activities in work area.
2. Knowledge on mechanical engineering workshop activities related to Bio-medical field.

Contents:

Theory

1. **Safety** **[2 hrs]**
   1.1 Brief description of relevant safety regulations and requirements; accident prevention measures.
   1.2 Precautions required in the use of machinery, equipment and hand tools.
   1.3 Safe use of electrical equipment and compressed air equipment.
   1.4 Precautions to be taken when cutting, joining, welding and cleaning sheet metals.
2. **Measurements** **[3 hrs]**
   In all the topics safe working and correct procedure explained
   2.1 Rule, calipers, scribers, square, dividers, straight edge and plane.
   2.2 The micrometer, Vernier caliper, bevel gauge and protractor.
   2.3 Marking out equipment such as surface plate, angle plate, surface gauge, Vee – block.
3. **Material removal process** **[3 hrs]**
   3.1 Use and cutting characteristics of hand tools: hack saw, chisel, files, taps.
   3.2 The important and limitations of hand process for metal working: filing, scraping.
   3.3 Working principal, procedure, cutting by multipoint cutting tools in grinding and drilling.
   3.4 Metal removal by machine tools: knowledge on cutting process by lathe, shaper, milling machines.
4. **Joining process – temporary joining** **[2 hrs]**
   4.1 Requirement of dowels, wedges and pins, securing joints by friction.
   4.2 Different types of threads, its application and tightening procedure.
   4.3 Types, selection and application of bolts and nuts.

5. **Joining process – permanent joining [2hrs]**
   5.1 Different methods of fastening sheet metal by soldering.
   5.2 Riveted joints for sheet metal working.
   5.3 Detailed introduction into gas welding.
   5.4 Detailed introduction into metal arc welding.
6. **Electrical Safety of Medical Equipment [4 hrs]**
   6.1 Basic concept of Electric Shock and safety rule.
   6.2 Care, uses, and application of industrial hygiene & safety. (special for gas safety & Device/appliances)
   6.3 Prevention of electrical accident with medical Equipment.
   6.4 Care, uses, handling and application of basic electrical tools.
   6.5 Safe use of electrical equipment and compressed air equipment. (with repair & maintenance schedule)
   6.6 Basic chemical safety
   6.7 Radiation hazards

PRACTICAL

Total duration: 48 hours

1. Communication and drawing - preparation of working sketches of simple components from assemble drawing.
2. Communication and drawing-preparation of assembly sketches showing location of components for its assembly procedure. Reading of Catalogue drawing
3. Fitting exercise - marking out, cutting out and filing to size. Squared, angled, curved and tangential surface
4. Fitting exercise - precision filing – male and female joints
5. Fitting exercise - filing, drilling, tapping and assembly of dowels, grinding for surface finish
6. Braze welding - braze welding of copper pipes, mild steel and cast iron
7. Soldering exercises - soft soldering, joining metal by soldering, electric connection by solder
8. Installation Work -Control one bulb by one way switch with light & power socket.
9. Safety- Repair &maintenance of gas regulator, gas stove, pipe and electrical hand tools with instruments. (with Maintenance schedule)

References:

1. Workshop technology- HajraChaudary.
2. Shop theory - ILO publication
3. Manufacturing technology - M. Adithan, A.B. Gupta
4. A textbook of Production Engineering- P.C.Sharma.
5. Basic Electrical Engineering – M L Anwani

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Computer and Programming

EG 1128 BM

Total: 6hours/week

Year: I **Lecture: 3 hours/week**

Semester: I **Tutorial: hours/week**

Practical: 3 hours/week

Course description:

This course deals with the fundamentals of Computer Programming. The students will learn the effective use of the C programming language syntax to develop special programs, and provide I/O control for special applications.

Course objectives:

After the completion of this course, students will be able:

1. To Know the basic skills needed in programming
2. To write, compile, debug and run a program in C
3. To understand the uses of all data types in C
4. To understand the use of functions and write functions in C
5. To use different control structures
1. To use Arrays, Strings and Pointers in their programs
2. To use input/output statements in a program.
3. T0 read/write/search in a file through a C program.

Course Contents:

Theory

Unit 1. Introduction to Computer Program [3hrs]

- 1.1 What is a program?
- 1.2 What is a programming language?
- 1.3 Steps in Programming
- 1.4 Fundamentals of a Programming Language
- 1.5 Different Programming Techniques
  - Procedural Programming
  - Modular Programming
  - Object Oriented Programming

Unit 2. Problem Solving Using Computer [3hrs]

- 2.1 Problem Analysis
- 2.2 Algorithm Development and Flowcharts
- 2.3 Coding
- 2.4 Compilation and Execution
- 2.5 Debugging and Testing
- 2.6 Program Documentation

Unit 3. Introduction to C [6hrs]

3.1 Words and Sentences in C language
3.2 Alphabets in C
3.3 Keywords in C
3.4 Rules of forming Words in C language
3.5 Data Variables, Data Types and Rules for naming and declaring data variables
3.6 Constants
3.7 Comments in C
3.8 Enumerated Data Types
3.9 Arithmetic Expressions
3.10 Concepts of Header files and Preprocessors

Unit 4. Input and Output [3hrs]

4.1 Formatted I/O
4.2 Character I/O
4.3 Programming Using I/O

Unit 5. Flow Control Instructions [4hrs]

5.1 Decision Control Instructions
- If
- If-else
- If-else-if
- Nested if-else
- Conditions

5.2 Loop Control Instructions
- For Loop
- While Loop
- Do While

5.3 Selection Instructions

Unit 6. Functions [5hrs]

6.1 Why use Functions?
6.2 Components of Function
- Name of a function
- Body of a function
- Local variables of a function
- Parameters or Arguments to a function
- Return Values
- Prototype of a function

6.3 Rules of using a function

Unit 7. Array **[5hrs]**

7.1 What is an array?
7.2 Array Declaration
7.3 Array Initialization
7.4 Accessing individual elements of an array
7.5 Two Dimensional Arrays
7.6 Accessing the elements of a two dimensional array
7.7 Passing an array element to a function
7.8 Rules of using an array

Unit 8. Pointers **[5hrs]**

8.1 What is a pointer?
8.2 Declaring a Pointer variable
8.3 Initializing a pointer variable
8.4 Using a Pointer Variable
8.5 Pointer Arithmetic
8.6 Why use pointers
- As function arguments (By reference)
- Pointers and array
- Passing an entire array to a function
- Functions returning a Pointer Variable

Unit 9. Strings **[4hrs]**

9.1 What are strings?
9.2 String I/O
9.3 String Manipulation Functions

Unit 10. Structures **[4hrs]**

10.1 Declaring and Accessing Structure
10.2 Variables Uses of Structures

Unit 11. Filing **[4hrs]**

11.1 File Pointer
11.2 Opening a File
11.3 Closing a File
11.4 Seeking in a file

Unit 12. Some Examples of Different systems Applications **[2hrs]**

12.1 Various Applications of computer Program
- Applications in Banking
- Library Management System
- Graphics/Gaming

Practical

Total duration: 48 hours

1. Familiar with Turbo C

2. Input/output statement

3. Control Statement
   - 3.1. Familiar with if statement
   - 3.2. Familiar with if else, and if else ladder statement
   - 3.3. Familiar with switch, continue, and break statement
   - 3.4. Familiar with while loop
   - 3.5. Familiar with do while loop
   - 3.6. Familiar with for loop
   - 3.7. Familiar with nested loop

4. Familiar with function

5. Arrays & String
   - 5.1. Familiar with Arrays
   - 5.2. Familiar with Strings

6. Structures
   - 6.1. Familiar with Structures

7. Data files
   - 7.1. Familiar with Data files

8. Project

References:

1 Brian W. Keringhan and Dennis M. Ritchie, " The C Programming Language" PHI
2 V. Rajaraman, " Computer Programming in C " PHI
3 Byron S. Gottfried, " Programming with C " McGraw Hill
4 Stephen G. Kochan " Programming in C ", CBS Publishers and distributors
5 Kelly and Pohl, "A book on C " , Benjamin/Cummings

Second Semester

Bio-Medical Instrumentation I

EG 1221 BM

Total: 5 hours/week
Year: I **Lecture: 3 hours/week**
Semester: II **Tutorial: hours/week**
Practical: 2 hours/week

Course description:
This course is designed to present the basic concepts of medical instruments, design analysis of various types of medical instruments currently using in medical, clinical and hospital field. This course deals with study, design, uses and applications of advanced biomedical equipment.

Course objectives:
After the completion of this course, students will be able to:

1. Describe the uses of various kinds of bio potential electrodes.
2. Explain the uses and applications of different physiological transducers
3. Perform checking, maintenance, diagnosis and testing of various medical instruments

Course Contents:

Theory

Unit 1. Biomedical Engineering **(3hrs)**

- 1.1 Introduction
- 1.2 Biometrics
- 1.3 Man-instrument system
- 1.4 Components of man-instrument system
  - Subject
  - Stimulus
  - Transducers
  - Signal conditioning equipment
  - Display
  - Recording and data transmission
  - Data storage
- 1.5 Physiological system of the human body

Unit 2. Biomedical system **(4 hrs)**

- 2.1 Bioelectric potential
- 2.2 Resting potential
- 2.3 Action potential
- 2.4 Propagation of action potential
- 2.5 Biological signals
- 2.6 Electrodes
- 2.7 Bio-potential electrodes
- 2.8 Microelectrodes
- 2.9 Sin surface electrodes

Unit 3. Physiological Transducers **(4 hrs)**

3.1 Active transducers

3.2 Passive transducers

- Passive transducers using resistive elements
- Passive transducers using inductive elements
- Passive transducers using capacitive elements

3.3 Transducers for biomedical applications

Unit 4. Measuring and monitoring system **(10hrs)**

4.1 Electrocardiograph (ECG)

- The electrocardiogram
- The electrocardiographic diagnosis
- ECG lead configurations
- Computer aided electrocardiograph analysis

4.2 Electroencephalograph (EEG)

- EEG electrode configurations
- EEG recording techniques
- Practical; details of EEG

4.3 Electromyograph (EMG)

- Electromyographic recording techniques
- Different muscle related diseases

Unit 5. Tissue Engineering **(5hrs)**

5.1 Introduction to Tissue Engineering

5.2 Technical goals of Tissue Engineering

5.3 Tissue culture

- Preparation
- Slide or cover slip cultures
- Flask cultures
- Test tube cultures

5.4 Artificial Skin

5.5 Artificial Cartilage

Unit 6. Patient monitoring system and biotelemetry **(10hrs)**

6.1 ECG Monitoring

6.2 B.P monitoring

6.3 ICU monitoring instruments

6.4 Biotelemetry for general use

6.5 The components of a biotelemetry system

6.6 Design of a system.

6.7 Multichannel system

6.8 Frequency modulation techniques in telemetry link

6.9 Real time processing

6.10 Telemetry in operating room

6.11 Sports physiology studies through telemetry

Unit 7. Therapeutic and prosthetic devices **(6hrs)**

7.1 Cardiac pacemakers and other electric stimulators

7.2 Defibrillators

7.3 Hemodialysis

7.4 Lithotripsy

7.5 Ventilators
7.6 Therapeutic applications of the laser

Unit 8. Blood flowmeters and Oximeters (6 hrs)

8.1 Electromagnetic Blood Flowmeter
8.2 Types of Electromagnetic Blood Flowmeter
8.3 Ultrasonic Blood Flowmeter
8.4 Blood Flow estimation by Radiographic method
8.5 Oximetry
8.6 Pulse Oximeter
8.7 Skin Reflectance Oximeter

Practical

Total duration: 32 hours

1. Study on anatomy and physiology system of the body along with simulation on Bio-pac system
   a. Study of operation different types of electrodes used in medical electronics.
   b. Different types of physiological transducers and design.
   c. Analysis of Heart Sounds and Blood Pressure.
   d. ECG analysis and their recording techniques.
   e. EEG analysis and their recording techniques.
   f. EMG analysis and their recording techniques.
   g. Pulmonary Function analysis and their recording techniques.

2. Operation, preventive maintenance, corrective maintenance, trouble shooting and calibration of following equipment; Sphygnometers, Stethoscope, Syringe pump, Infusion pump, Nebulizers, Oxygen cylinder, Oxygen concentrator, Weighing machine, Central gas delivery system, Baby warmer, Infant incubator, Fetal Doppler, Delivery table, Vacuum extractor, Patient monitor, Ventilator, Defibrillator, Autoclave, ECG and Dialysis equipment.

References:

1. John G. Webster, Medical Instrumentation, Application and Design: Third edition, John Wiley and sons, New York.
2. Leslie Cromwell, Bio medical Instrument and measurements, Prentice Hall, Inc, Englewood cliffs.
3. Onkar N. Pandey, Bio medical Electronics and Instrumentation, S.K. Kataria and sons, Publishers of Engineering and Computer books.

Electronic Devices and Circuits

EG 1222 BM

Total: 8 hours/week

Year: I **Lecture: 4hours/week**

Semester: II **Tutorial: 1 hours/week**

Practical: 3hours/week

Course Description:

This course deals with different electronic devices and circuits related to biomedical engineering.

Course Objectives:

On completion of this course the students will be able:

1 To differentiate between passive and active devices, understand their characteristics
2 To identify basic types of vacuum tubes, their characteristics and applications
3 To identify and explain the working principles of various semiconductor devices, relate their characteristics and applications
4 To explain the characteristics of CB, CE and CC configuration circuits

Course Contents:

Theory

Unit 1. Basic Passive Devices: R, C and L: [5hrs]

Construction, types, color coding and characteristics.

Unit 2. Introduction to electron vacuum tubes: Diode, Triode and Pentode:[5hrs]

Unit 3. Semiconductor Devices (Especially Si Devices): [10hrs]

i. Energy levels, valence and conduction bands, conduction of electrons and holes in solids.
ii. Intrinsic and extrinsic semiconductor devices (Si), impurities, doping, majority and minor charge carries in P – type and N – type materials. Definition is characteristic.
iii. Diffusion and drift currents – definition and characteristics.
iv. PN Junction and depletion layer and potential barrier – definition and characteristics.

v. Forward and reverse biasing of PN junction diode – IV characteristics, principles of operation, and effects of temperature and junction capacitance.

vi. Forward and reverse breakdown of PN junction diode – Zener and avalanche effects – Principles of operation and IV characteristics.

vii. Electrical analysis of PN junction diode with IV characteristics and mathematical expressions with equivalent model circuit diagrams.

Unit 4. Power Supplies: [6hrs]

4.1. Basic rectifying circuits – Types, working principles, characteristics and applications.

4.2. Analysis of simple DC voltage power supplies – Principles, characteristics and ripple (voltages) factors.

4.3. Simple voltage regulation using Zener diodes – Principles, circuits, characteristics and application.

Unit 5. Pripolar Junction Transistors (npn and pnp) – Types, construction, working principle as an amplifier and characteristics: [14hrs]

5.1. Classification of amplifiers: CB, CE and CC amplifier circuits – Working principles, basic circuits to investigate input and output IV characteristics and their results.

5.2. Other characteristics of BJT – Saturation and cutoff modes: Definition, circuits, principles and characteristics.

5.3. Types of amplifier circuits: Class A, class B and class C – Definition characteristics and applications.

5.4. Specifications and data book.

Unit 6. Field Effect Transistor (JFET and MOSFETS) – Types, construction, working principles as an amplifier and characteristics: [12hrs]

6.1. Basic circuits for investigating input and output IV characteristics – Working principles, characteristics and applications.

6.2. Saturation, cut off breakdown and ohmic regions of operation – Investigation of IV characteristics curves.

6.3. Specifications and data book.

Unit 7. Special Semiconductor Devices – Working principles, functional circuits, characteristics and applications: [12hrs]

7.1. UJT, PUT, SCR, Diac and Triac.

7.2. Photo voltaic effects and solar cells.

7.3. Photodiode, phototransistor, LED, LDR, optocouplers and isolators.
7.4. Tunnel diode, schottyky diode, GaAs Transistors, MESFET.
7.5. Charge coupled devices, Hall effects, solid state relay ad thermister.

Practical

Total duration: 48 hours

1 Diode characteristics – PN diode and Zener diode
2 BJT characteristics – C.E. input and output characteristics
3 FET characteristics – C.S. input and output characteristics
4 HW and FW rectifier – waveforms and characteristics
5 UJT characteristics – IV characteristics
6 PUT characteristics – IV characteristics
7 SCR characteristics – IV characteristics
8 Tunnel diode characteristics – IV characteristics
9 Photo diode characteristics – IV characteristics

Reference books:

1. Basic Electronics Solid State - B.L. Theraja
2. Electronic Principles - Sanjay Sharma
3. Electronic Devices - Thomas L. Floyd
4. Principles of Electronics - Albert Paul Malvino
5. Electronics Vol 1 to Vol 7 - Harry Moleaf
6. Basic Radio Vol 1 to Vol 6 - Marvin Tepper

Electrical Measurements & Instrumentation

EG 1223 BM

Total: 4 hours/week
Year: I **Lecture: 3 hours/week**
Semester: II **Tutorial: hours/week**
Practical: 1 hours/week

Course Objectives:

After completion of this course the student will be able to

i) Describe construction and operation of various types of electrical instrument

ii) Describe the operation of different types of bridge for resistance, inductance and capacitance measurement

iii) Learn about digital measurement system

Course Contents:

Theory

1. Introduction: (6 hours)

- 1.1 Instrumentation and Components of instrumentation
- 1.2 Transduction, Signal Conditioning and Signal Transmission
- 1.3 Input and Output device
- 1.4 Type of signals
- 1.5 Error in measurement and error type
- 1.6 Types of measuring Instruments-Indicating ,recording, integrating,analog and digital
- 1.7 Essential features of indicating instrument- deflecting torque,
- 1.8 Balancing torque and damping torque.

2. Measuring Instrument (8 Hours)

- 2.1 Moving coil instrument-construction and working principle.
- 2.2 Moving iron instrument- construction and working principle
- 2.3 Electrodynamics instrument-construction and working principle
- 2.4 Measurement of low, high & medium resistances
- 2.5 AC bridge & measurement of inductance and capacitance

3. Transducer (6 Hours)

- 3.1 Introduction
- 3.2 Classification
- 3.3 Application
  - 3.3.1 Measurement of mechanical variables, displacement, strain, velocity, acceleration and vibration
  - 3.3.2 Measurement of process variables - temperature pressure, level, fluid flow, chemical constituents in gases or liquids, pH and humidity.

4. Electrical Signal Processing and transmission (6 Hours)

4.1 Basic Op-amp characteristics
4.2 Instrumentation amplifier
4.3 Signal amplification, attenuation, integration, differentiation, network isolation, wave shaping
4.4 Effect of noise, analog filtering, digital filtering
4.5 Optical communication, fiber optics

5. Analog - Digital and Digital - Analog Conversion (5 Hours)

5.1 Analog signal and digital signal
5.2 Digital to analog convertors - weighted resistor type, R-2R ladder type, DAC Errors
5.3 Analog to digital convertors - successive approximation type, ramp type, dual ramp type.

6. Digital Instrumentation (5 Hours)

6.1 Sample data system, sample and hold circuit
6.2 Components of data acquisition system
6.3 Interfacing to the computer

7. Bio medical equipment testing and calibration (12 Hours)

7.1 Safety analyzer
Introduction
Procedure

7.2 Defibrillator tester
Introduction
Testing Procedure

7.3 Patient simulator
Introduction
Testing Procedure

7.4 Pulse oximeter calibrator
Introduction
Testing Procedure

7.5 Oxygen analyzer
Introduction
Testing Procedure

7.6 Gas analyzer
Introduction
Testing Procedure

7.7 KVP, mA, Time, MAS, Dose meter

Introduction
Testing Procedure

7.8 Ultrasound phantom
Introduction
Testing Procedure

7.9 Insulation tester
Introduction
Testing Procedure

1.10 Earthing taste
Introduction
Testing Procedure

Practical

Total Duration: 16Hours

1. **Accuracy test in analog meters**
2. **Operational Amplifiers in Circuits**
   - Use of Op amp as a summer, inverter, integrator and differentiator
3. **Use resistive, inductive and capacitive transducers to measure displacement**
   - Use strain gauge transducers to measure force
4. **Study of Various transducers for measurement of Angular displacement, Angular Velocity, Pressure and Flow**
   - Use optical, Hall effect and inductive transducer to measure angular displacement
   - Use tacho - generator to measure angular velocity
   - Use RTD transducers to measure pressure and flow
5. **Digital to Analog Conversion**
   - Perform static testing of D/A converter
6. **Analog to Digital Conversion**
   - Perform static testing of A/D converter
7. Bio medical equipment testing procedure

References:

1. D.M Considine "Process Instruments and Controls Handbook" third edition McGraw Hill, 1985
2. E.O Deobelin "Measurement System, Application and Design" McGraw Hill, 1990
3. A.K Sawhney "A Course in Electronic Measurement and Instrumentation " DhanpatRai and Sons,1988
4. C.S. Rangan, G.R Sharma and V.S.V. Mani, "Instrumentation Devices and Systems" Tata McGraw Hill publishing Company Limited New Delhi,1992.
5. J.B. Gupta. "A Course in Electrical & Electronics Measurement & Instrumentation, thirteenth edition, 2008, Kataria& Sons.

Microprocessors and Microcontroller

EG 1224 BM

Total: 5 hours/week
Year: I **Lecture: 3 hours/week**
Semester: II **Tutorial: hours/week**
Practical: 2 hours/week

Course description:
This course deals with fundamentals of microprocessor, basic low level microprocessor programming, interfacing and microcontroller fundamentals and design.

Course objectives:
After the completion of this course, students will be able:

1. To understand the working principle of microprocessor
2. To understand the process of writing and executing low level language
3. To understand the processing unit, memory, interfacing and interrupt mechanism
4. To know microcontroller and its use in embedded systems

Course Contents:

Theory

Unit1. Introduction to Microprocessor [8hrs]

1.1. History of computer development
1.2. Analog and digital computer
1.3. Microprocessor, microcomputer, microcontroller
1.4. Stored program concept and von-Neumann's architecture
1.5. General architecture of a microcomputer system showing control buses
1.6. Block diagram of a typical microprocessor and microcontroller
1.7. Programming languages
1.8. Instruction set of microprocessors
1.9. Introduction to Simple as Possible (SAP1,SAP2,SAP3) computers

Unit2. Microprocessor architecture and the instruction set [8hrs]

2.1. Internal architecture of 8085 microprocessor
2.2. Instruction and data formats
2.3. Instruction classifications
2.4. Addressing modes in 8085
2.5. 8085 Instruction set

Unit3. Assembly language programming for 8085 [8 hrs]

3.1. Introduction to assembly language and assemblers
3.2. Simple assembly language programs
3.3. Programs using loops, counters, delays
3.4. Table processing
3.5. Subroutine and stack
3.6. Code conversion ASCII/BCD/Binary

Unit4. Interfacing I/O and memory devices [8 hrs]

4.1. 8085 machine cycles and bus timing
- Fetch and execute cycles
- Memory read/write machine cycle
- I/O read/write machine cycle

4.2. Address Decoding
- Unique and non-unique address decoding
- Address decoding for I/O and memory devices

4.3. Interfacing I/O devices
- Interfacing Input Devices
- Interfacing Output Devices
- Address decoding using block decoders
- Interfacing Memory-mapped I/O

4.4. Memory Interfacing
- Memory structure and its requirement
- RAM and ROM chips
- Address decoding using NAND and block decoders

4.5. Direct memory access

Unit5. 8085 Interrupt processing [6hrs]

5.1. Programmed I/O
5.2. Interrupt Driven I/O
5.3. The 8085 Interrupt
5.4. 8085 Vectored Interrupts
5.5. Restart and software instructions

Unit6. Microcontroller Fundamentals and Design [10hrs]

6.1. Microcontroller and its applications
6.2. 8 Bit microcontroller – AT Mega 128 pin-out and electrical characteristics
6.3. Interfacing techniques with I/O and memory devices
6.4. Special functions – interrupts, timers
6.5. AT Mega 128 assembly programming, emulators
6.6. Application program model and design

Practical

Total Duration: 32 Hours

The practical exercise shall cover the low level program from simple programs for data transfer to complex programs for table processing

1. Basics of microcomputer system through the 8085 microprocessor trainer kit
2. Programs that uses data transfer instructions
3. Programs that uses arithmetic instructions
4. Programs that uses logical instructions
5. Programs with conditional and unconditional branching
6. Programs with conditional and unconditional subroutine call and stack
7. Programs involving loops and counters
8. Programs that involves masking and checking numbers
9. Programs to manipulate table of numbers
10. Program for BCD and ASCII manipulation
11. Programs to perform multiplication and division
12. Programs to read and write from the port

References:

1. Ramesh S. Gaonkar, “8085 Microprocessor programming and interfacing”, New Age
2. John Uffenbeck, “The 8080, 8085 & Z-80 Programming, Interfacing and Troubleshooting”, PHI
3. Albert Paul Malvino, Jerald A. Brown, “Digital Computer Electronics”, McGraw-Hill

Data Communication and Networking

EG1225 BM

Total: 6 hours/week
Year: I **Lecture: 3 hours/week**
Semester: II **Tutorial: hours/week**
Practical: 3 hours/week

Course description:

This course on Data Communication and Networking provides an introduction to the fundamental concepts on data communication and the design, deployment, and management of computer networks.

Course objectives:

After the completion of this course, students will be able:

5. To propose efficient, cost effective, reliable and appropriate technology to establish communication links
6. To design an enterprise network employing the common LAN technologies and be able to evaluate the advantages and disadvantages
7. To configure a PC to work as a host in a TCP/IP network and to use the IP based commands to facilitate the trouble shooting process
8. To describe the technical issues related to the Wide Area Networks and identify the common technologies available in establishing WAN infrastructure
9. To describe the specific actions that can be taken to enforce network level security.

Course Contents:

Theory

Unit 1. Fundamentals of digital communications [4hrs]

1.1 Introduction to digital communications
- 1.1.1 Definitions of terms
- 1.1.2 Signal propagation
- 1.1.3 Signal types
  - 1.1.3.1 Sine waves
  - 1.1.3.2 Square waves
- 1.1.4. Signal parameters
  - 1.1.4.1. Amplitude
  - 1.1.4.2. Frequency
  - 1.1.4.3. Phase

1.2 Channel effects on transmission
- 1.2.1. Attenuation
- 1.2.2. Effects of limited bandwidth
- 1.2.3. Delay distortion

1.2.4. Noise

1.3 Data rate limits in channels

1.3.1 Nyquist's theorem

1.3.2 Shannon's theorem

Unit 2. Physical layer characterization [6 hrs]

2.1 Transmission Media

2.1.1 Twisted pair cables

2.1.2 Co-axial cables

2.1.3 Fiber optic cables

2.1.4 Wireless media

2.2 Physical Layer Interfaces

2.2.1 RS 232 / EIA 232/ USB

Unit 3. Data transmission mechanisms [8 hrs]

3.1 Communication modes

3.1.1 Simplex

3.1.2 Half-duplex

3.1.3 Full - duplex

3.2 Transmission modes

3.2.1 Serial transmission

3.2.2 Parallel transmission

3.3 Synchronization

3.3.1 Asynchronous transmission

3.3.2 Synchronous transmission

3.4 Introduction to packet switching

3.4.1 Circuit switching vs. packet switching

3.4.2 Types of services

3.4.2.1 Connection oriented services (Virtual circuits)

3.4.2.2 Connectionless services (Datagrams)

3.5 Multiplexing

3.5.1 Frequency division multiplexing

3.5.2 Synchronous time division multiplexing

3.5.3 Statistical time division multiplexing

3.6 Error control methods

3.6.1 Feedback error recovery (ARQ) (E.g. Based on parity check)

3.6.2 Forward error correction (FEC) (E.g. CRC)

Unit 4. Network architectures [5hrs]

4.1 Introduction to computer networks

4.2 Network topologies: Bus, Star, Ring

4.3 Types of networks

4.3.1 Local area networks

4.3.2 Wide area networks

4.4 Personal area networks

4.5 Layered network model

4.5.1 OSI model
4.5.2 TCP/ IP model

Unit 5. Internet protocols [10hrs]

5.1 Introduction
5.2 History of the Internet protocols
5.3 Internet protocol stack
5.4 IP Addressing and
5.5 Sub-netting:Fixed and variable length
5.6 Unicast routing algorithms
5.7 Transport Layer protocols
  5.7.1 TCP
  5.7.2 UDP
5.8 IP Support Protocols
  5.8.1 ARP
  5.8.2 DHCP
  5.8.3 ICMP
5.9 Application Layer Protocols
  5.9.1 Domain Name System (DNS)
  5.9.2 Email – SMTP, POP, IMAP
  5.9.3 FTP
  5.9.4 HTTP
  5.9.5 RTP and VoIP
5.10 IP version 6

Unit 6. Local area networks [10hrs]

6.1 Introduction to LANs
6.2 Conventional LAN Architectures
  6.2.1 Access Protocols: CSMA/CD,Token Passing
  6.2.2 Interconnecting devices: Hubs, L2 /L3 Switch
6.3 IEEE 802 MAC layer standards: 802.3, 802.11 ,802.15
6.4 Switched Ethernet variants: Fast Ethernet, Gigabit Ethernet, 10GbEthernet
6.5 Wireless LANs: (802.11
  6.5.1 Access methods: CSMA/CA
  6.5.2 Frequency Bands: ISM
  6.5.3 Operating Modes: adhoc, Managed
  6.5.4 Variants: 802.11 a/ b/ g/ n
  6.5.5 Wireless interconnection devices: Hub, Router Bluetooth (802.15) wireless personal area network

Unit 7. Practical aspects of networking [5 hrs]

7.1 Structured cabling and specifications: StandardCAT5, 5E, etc..
7.2 Network security
  7.2.1 Firewalls and NAT
  7.2.2 VLANs, VPNs

7.2.3 Proxy servers
7.2.4 Wireless security

7.3 User access technologies
7.3.1 Wired: xDSL, FTTH
7.3.2 Cellular wireless: GPRS, EDGE, HSPDA
7.3.3 Broadband wireless: 802.16

Practical

Total Duration: 48 Hours

1. Practical will be covering all the chapters related to data communication mentioned above. The students should visit the communication related company and prepare the report.
2. In practical, students should be able to set up small networks. Also, they should be able to configure network hardware and network software.
3. Installation of network interface card and various network devices like hub, switch, router etc.
4. Cabling: construction of straight-through and cross-over cable and verify the physical layer connectivity
5. Installation and configuration of workstation PC
6. Setup peer-to-peer networking and verify it
7. Install and configure server for client server networking; also verify it
8. Familiarization with basic network commands: Observing IP address and MAC address, Setting IP address and default gateway in PC, Verifying network layer connectivity
9. Configure the PC to obtain IP from DHCP, Release the leased IP, Renew IP (for this there should a DHCP server)
10. Create multiple networks and route packets across multiple networks using static routing
11. Dynamic routing (e.g. RIP) and default route
12. Configure HTTP, FTP, DHCP server and verify it
13. Configuration of DNS and e-mail server
14. Design of local area network (LAN)
15. Case study: Organizational visit to study existing network system

References:

1. Tanenbaum Andrew S., Computer Networks, 4th edition (2nd Impression 2006)
2. William Stallings, Data and Computer Communications, 7th Edition (3rd Impression 2007)
3. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, 4th Edition
4. Halsall Fred, Data Communications, Computer Networks and OSI, 4th edition (10th Indian reprinting 2005)

Medical Electronics

EG 1226 BM

Total: 6 hours/week
Year: I **Lecture: 3 hours/week**
Semester: II **Tutorial: hours/week**
Practical: 3 hours/week

Course description:
This course deals with the fundamentals of Medical Electronics and in depth knowledge in electronics related to various medical equipment. This course provides knowledge about the various implantable devices and the components that are used in those devices. Students will understand basic concepts, principles of various medical instruments especially bio-potential signal measuring techniques.

Course objectives:
After the completion of this course, students will be able to:

1. Explain the origin of bio-potentials
2. Describe the medical signal processing and transmission.
3. Explain about different implantable devices that are being used.
4. Basic concept of medical electronics
5. Diagnostic and Imaging Techniques.

Course Contents:

Theory

Unit 1. The origin of bio potentials (7hrs)
- 1.1 Electrical activity of excitable cells
- 1.2 Volume conductor fields
- 1.3 The Electro cardiogram (ECG)
- 1.4 The Electroencephalogram (EEG)
- 1.5 The Electromyogram (EMG)

Unit 2. Basic medical signal processing and transmission (7 hrs)
- 2.1 Basic op-amp characteristics
- 2.2 Instrumentation amplifier
- 2.3 Biomedical pre-amplifier and power amplifiers
- 2.4 Signal amplification, attenuation, integration, differentiation, network isolation and wave shaping
- 2.5 Effects of noise, analog filtering, digital filtering

Unit 3. Basic concepts of medical electronics and its instruments (10hrs)
- 3.1 Terminology of medicine and medical devices
- 3.2 Generalized medical instrumentation system
- 3.3 Alternative operational modes
- 3.4 Medical measurement constraints

- Classification of biomedical instruments
- Interfering and modifying inputs
- Compensation techniques
- Inherent insensitivity
- Negative feedback
- Signal filtering
- Opposing inputs

3.5 Biostatics
3.6 Generalized static characteristics
3.7 Generalized dynamic characteristics
- Transfer functions
- Zero-order instrument
- First- order instrument
- Second- order instrument
- Time delay

3.8 Design criteria
3.9 Commercial medical instrumentation development process
3.10 Regulation of medical devices

Unit 4 Implantable Devices (6 hrs)

4.1 Dental Implants
4.2 Pacemaker
4.3 Ventricular Assist Device

Unit 5. Diagnostics and Imaging Instruments (8 hrs)

5.1 Principle of ultrasonic measurement
5.2 Ultrasonic imaging system
5.3 X-Ray and radio instruments
- Basic definition of radiology
- X-ray tubes
- Block diagram of x-ray machine
- Biological effects of x-rays

5.4 CT scan machine
5.5 Nuclear magnetic resonance imaging system

Unit 6. Fiber-optics & Lasers [10hrs]

6.1 Fiber Optic Technology
6.2 Losses in Fiber Optic System
6.3 Fiber Optic Communication System
6.4 Lasers & Their types
6.5 Driver circuit for solid state laser diodes
6.6 Laser Diode receiver circuit

Practical

Total Duration: 16 Hours

1. Experimental works on current and voltage sources.
2. Simplified electrocardiography recording system.
3. Resistive sensors design concept, bridge circuits design concept.
4. Piezoelectric materials and study of piezoelectric sensors design concept.
5. Instrumentation amplifier system.
6. Bio-potential sources and its measurements.
7. Study of different types of electrodes.

References:

1. John G. Webster, Medical Instrumentation, Application and Design: Third edition, John Wiley and sons, New York
2. Leslie Cromwell, Bio medical Instrument and measurements, Prentice Hall, Inc, Englewood cliffs
3. “Biomaterials Science”, Ed by Buddy Ratner et. al, Academic Press, 1996
4. “Implantation Biology”, Ed. Ralph Greco, CRC Press Inc.
5. Len Jones, Basic Electronics, Cambridge University Press
6. N.N bhargava, Basic Electronics and Linear Circuits, Technical Teachers Training Institute, Tata Mc Graw Hill
7. Onkar N. Pandey, Bio medical Electronics and Instrumentation, S.K. Kataria and sons, Publishers of Engineering and Computer books
8. S. Wolf and R.F Smith, Students reference Manual for electronic Instrumentation Laboratories, Prentice Hall.

Bio-Medical Equipment Maintenances-1

EG 1227 BM

Total: 6 hours/week
Year: I **Lecture: 2 hours/week**
Semester: II **Tutorial: hours/week**
Practical: 4 hours/week

Course description:
The course deals with overall introduction, working principle of medical devices according to types and technology. It contains block diagram, circuit diagram, flow chart of the certain medical devices. It comprises fault finding, repair and maintenance, testing and calibration. In our context, sometimes improvised adjustment is also needed so that this technique is applied as necessary.

For the effective and efficient health service delivery,patients, users and visitors are needed with safe environment. Therefore, the subject related to medical safety hazards is included.

To keep the consistent history of the equipment, a record keeping is essential. Therefore,the student will be trained on record keeping of the equipment right from the procurement, inspection, installation, commissioning preventive maintenance, corrective maintenance and decommissioning procedures.

Course objectives:
After the completion of the course, students will be able to:

1. Understand the working principle and operating system of the medical devices based on their types and technology.
2. Do preventive maintenance, repair and perform test and calibration of the medical equipment, safe handling of the appropriate tool and test equipment.
3. Avoid the biomedical hazards
4. Apply confidently their skill and knowledge in timely for repair and maintenance of medical equipment to provide the efficient health care service delivery at the health facilities.

Course Contents:

Theory

Unit 1: Safety **2hrs**

1.0. Electrical Safety
1.1. Use of safety analyzer
1.2. Professional Hazard
1.3. Standard rules

Unit 2: Study and Using operation, maintenance manuals, data books and record keeping **4 hrs**

2.1 Using manuals and data books.
2.2 The importance of inventory, Record keeping and reporting of equipment status
2.3 Using a logbook
2.4 Maintenance management
2.5 Using computerized inventory and equipment database.

Unit **3: Patient and Hospital Environment** **2 hrs**

3.1 How to work around patients,
3.2 Infection control,
3.3 Medical and surgical asepsis.
3.4 Visits to hospitals for observation and training.
3.5 Hospital waste management.

Unit 4: **Different modules of equipment** **8 hrs**

4.1 General

4.1.1 Sphygmomanometer

Introduction and its working principle
Type of BP machine
- Aneroid BP machine
- Digital BP machine
- Mercury type BP machine.

Parts of BP machine
Maintenance and repair
- Preventive maintenance
- Corrective maintenance
- Trouble shooting.
- Calibration of BP machine

4.1.2 Stethoscope

Introduction and its working principle
Type of Stethoscope
Parts of Stethoscope
Maintenance and repair
- Preventive maintenance
- Corrective maintenance
- Trouble shooting.

4.1.3 **Syringe pump**

Introduction and its working principle
Type of Syringe pump
Parts of Syringe pump
Maintenance and repair
- Preventive maintenance
- Corrective maintenance
- Trouble shooting
- Calibration of syringe pump

4.1.4 **Infusion pump**

- Introduction and its working principle
- Type of infusion
- Parts of Infusion
- Maintenance and repair
  - Preventive maintenance
  - Corrective maintenance
  - Trouble shooting.
  - Calibration of Infusion pump

4.1.5 Nebulizers

- Introduction and its working principle
- Type of nebulizer
- Parts of nebulizer
- Maintenance and repair
  - Preventive maintenance
  - Corrective maintenance
  - Trouble shooting.
  - Calibration of Nebulizer (pressure)

4.1.6 **Oxygen cylinder**

- Introduction and its working principle
- Type of Oxygen cylinder
- Parts of Oxygen cylinder
- Maintenance and repair
  - Preventive maintenance
  - Corrective maintenance
  - Trouble shooting.
  - Calibration (flow and regulating pressure)

4.1.7 **Oxygen concentrator**

- Introduction and its working principle
- Parts of Oxygen Concentrator
- Maintenance and repair
  - Preventive maintenance
  - Corrective maintenance
  - Trouble shooting.
  - Calibration (flow, regulating pressure and % of Oxygen)

4.1.8 **Weighing machine**

- Introduction and its working principle
- Type of weighing machine
- Parts of weighing machine
- Maintenance and repair
  - Preventive maintenance
  - Corrective maintenance
  - Trouble shooting.
  - Calibration (weight) of weighing machine

4.1.9 **Central gas delivery system**

Oxygen delivery system
Medical air delivery system
Central Vacuum system

Hospital visit (wards)

4.2 **Delivery** **4 hrs**

4.2.1 **Baby warmer**

Introduction and its working principle
Type of baby warmer
Parts of baby warmer
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting.
Calibration (Temperature) of baby warmer

4.2.2 **Infant incubator**

Introduction and its working principle
Type of Infant incubator
Parts of Infant incubator
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting.
Calibration (Temperature, humidity, setting)

4.2.3 **Fetal Doppler**

Introduction and its working principle
Type of fetal Doppler
Parts of fetal Doppler
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting.
Calibration

4.2.4 Delivery table

Introduction and its working principle
Type of delivery table
Parts of fetal Delivery table
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting.

4.2.5 Vacuum extractor

Introduction and its working principle
Type of vacuum extractor
Parts of vacuum extractor
Maintenance and repair
- Preventive maintenance
- Corrective maintenance
- Trouble shooting.
- Calibration

Hospital visit (Delivery department)

4.3. Intensive Care Unit (ICU) 4 hrs

4.3.1 Patient Monitor

Introduction and its working principle
Type of Patient Monitor
Parts of Patient Monitor
Maintenance and repair
- Preventive maintenance
- Corrective maintenance
- Trouble shooting.
- Calibration(pulse rate, NIBP, SPO2, ECG wave form)

4.3.2 Ventilator

Introduction and its working principle
Type of Ventilator
Parts of Ventilator
Maintenance and repair
- Preventive maintenance
- Corrective maintenance
- Trouble shooting.
- Calibration (tidal volume, respiration rate, pressure,)

4.3.3 Defibrillators

Introduction and its working principle
Operating principle
Parts of Defibrillators
Maintenance and repair
- Preventive maintenance
- Corrective maintenance
- Trouble shooting.
- Calibration (energy, synchrony, Discharge)

Hospital visit (ICU department)

4.4 Sterilizing **4 hrs**

Sterilizing Methods
Types of sterilizer
Autoclave
Introduction and its working principle
Types of Autoclave
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting.
Calibration (pressure, temperature) of autoclave

Hospital visit (CSSD)

4.5 Dialysis Equipment **4 hrs**

Hospital visit (kidney center)

Practical

Total Duration: 64 hours

Operation, preventive maintenance, corrective maintenance, trouble shooting and calibration of following equipment;

- Sphygnometers, Stethoscope, Syringe pump, Infusion pump, Nebulizers, Oxygen cylinder, Oxygen concentrator, Weighing machine, Central gas delivery system, Baby warmer, Infant incubator, Fetal Doppler, Delivery table, Vacuum extractor, Patient monitor, Ventilator, Defibrillator, Autoclave, ECG and Dialysis equipment.

Note: practical of Bio-medical Instrumentation-Iand bio-medical equipment maintenance-I will be done together.

Third Semester

Bio-Medical Instrumentation II

EG 2121 BM

Total: 7 hours/week
Year: II **Lecture: 3 hours/week**
Semester: I **Tutorial: hours/week**
Practical: 4 hours/week

Course description:
This course is designed to present the basic concepts of medical instruments, design analysis of various types of medical instruments currently using in medical, clinical and hospital field. This course deals with study, design, uses and applications of advanced biomedical equipment.

Course objectives:
After the completion of this course, students will be able to:

1. Describe the uses of various kinds of cell counters and Analyzers
2. Explain and introduce of various therapy instruments
3. Perform Checking, maintenance, diagnosis and testing of various medical and analytical instruments
4. Maintain electrical hazards and safety of different medical equipment.

Course Contents:

Theory

Unit 1. Blood Cell Counters **(2 hrs)**

1.1 Introduction
1.2 Types of Blood Cells
1.3 Method of Cell Counting
1.4 Coulter Counter
1.5 Differential counting of Cells

Unit 2. Biomedical Blood Gas Analyzers **(4 hrs)**

2.1 Acid base Balance
2.2 Blood Ph Measurement
2.3 Blood pO2 Measurement
2.4 Blood pCo2 Measurement
2.5 A Complete Blood Gas Analyzer

Unit 3. Audiometers and Hearing Aids **(4 hrs)**

3.1 Hearing Aids
- Mechanism of Hearing
- Basic Audiometer
- Pure Tone Audiometer and Speech Audiometer

3.2 Calibrations of Audiometers

Unit 4. Physiotherapy and Radiotherapy Equipment **(6hrs)**

4.1 High Frequency Heat Therapy
4.2 Short wave Diathermy
4.3 Microwave Diathermy

4.4 Ultrasonic Therapy Unit
4.5 Electro diagnostic and Therapeutic Apparatus
4.6 Use of High Voltage X-ray Machine

Unit 5. Laboratory Based Various Diagnostic Instruments (15hrs)

5.1 Principle of Colorimeter and Spectrophotometer
5.2 Water bath
5.3 Centrifuge
5.4 Lab incubator / Lab oven
5.5 Microscopy
5.6 pH Meter
5.7 Refrigerator
5.8 Flame Photometer
5.9 Micro Pipette
5.10 Semi Auto Analyzer

Unit 6. Surgical Instruments (5hrs)

6.1 Surgical Diathermy Machine

Unit 7. Principle and Operation of Various Biomedical Materials and Devices (5 hrs)

7.1 Orthopedic Instruments
7.2 Cardiovascular

Unit 8. Electrical safety of Medical Equipment (7 hrs)

8.1 Introduction
8.2 Physiological effects of electricity
8.3 Leakage currents
8.4 Physiological effects due to magnetic fields
8.5 Safety code for the electro-medical equipment
8.6 Basic approaches to protection against shock
8.7 Safety Aspects in Electro surgical Units
8.8 Protection of the hospital equipment
- Grounding system
- Distribution of electric power
- Isolated power system
- Ground fault circuit interrupter
- Protection: Equipment design
- Test of electrical appliances

Practical

Total Duration: 64 Hours

1. Orientation of Radiotherapy Machine
2. Study of electrically safety of medical Instruments

3. Operation, preventive maintenance, corrective maintenance, trouble shooting and calibration of following equipment;
   Lab equipment, ENT equipment, Dental equipment, Imaging equipment, ophthalmic equipment, Endoscope

References:

2. John G. Webster, Medical Instrumentation, Application and Design: Third edition, John Wiley and sons, New York
3. Leslie Cromwell, Bio medical Instrument and measurements, Prentice Hall, Inc, Englewood cliffs
4. Onkar N. Pandey, Bio medical Electronics and Instrumentation, S.K. Kataria and sons, Publishers of Engineering and Computer books
5. Handbook of Biomedical Instrumentation, R.S Khandpur, Tata McGraw Hill

Bio-Medical Equipment Maintenances-2

EG 2122 BM

Total: 13 hours/week
Year: II **Lecture: 4 hours/week**
Semester: I **Tutorial: 1 hours/week**
Practical: 8 hours/week

Course description:
The course deals with overall introduction, working principle of medical devices according to types and technology. It contains block diagram, circuit diagram, flow chart of the certain medical devices. It comprises fault finding, repair and maintenance, testing and calibration. In our context, sometimes improvised adjustment is also needed so that this technique is applied as necessary.

For the effective and efficient health service delivery,patients, users and visitors are needed with safe environment. Therefore, the subject related to medical safety hazards is included.

To keep the consistent history of the equipment, a record keeping is essential. Therefore,the student will be trained on record keeping of the equipment right from the procurement, inspection, installation, commissioning preventive maintenance, corrective maintenance and decommissioning procedures.

Course objectives:
After the completion of the course, students will be able to:

1. **Understand the working principle and operating system of the medical devices based on their types and technology.**
2. **Do preventive maintenance, repair and perform test and calibration of the medical equipment, safe handling of the appropriate tool and test equipment.**
3. **Avoid the biomedical hazards**
4. **Apply confidently their skill and knowledge in timely for repair and maintenance of medical equipment to provide the efficient health care service delivery at the health facilities.**

Course Contents:

Theory

Unit 1 Basic preventive maintenance **2 hrs**
Unit 2 Basic theory, operation, calibration, maintenance and repair **2 hrs**
Unit 3 Trouble shooting theory **2 hrs**
Unit 4 mechanical repairs & part replacement guides **2 hrs**
Unit 5 Different modules of equipment
5.1 Lab **9hrs**
5.1.1 Centrifuge
Introduction and its working principle

Types of centrifuge
Parts of centrifuge
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting.
Calibration (Speed) of centrifuge

5.1.2 Water bath

Introduction and its working principle
Types of Water bath
Parts of Water bath
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting.
Calibration (Thermostat) of Lab Incubator

5.1.3 Lab Incubator

Introduction and its working principle
Types of Lab Incubator
Parts of Lab Incubator
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting.
Calibration (Thermostat) of Lab Incubator

5.1.4 Lab oven

Introduction and its working principle
Types of Lab oven
Parts of Lab oven
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting.
Calibration (Thermostat) of Lab oven

5.1.5 Colorimeter

Introduction and its working principle
Parts of Colorimeter
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting.
Calibration (filter, light) of Colorimeter

5.1.6 Spectrophotometer

Introduction and its working principle
Parts of Spectrophotometer
Maintenance and repair

Preventive maintenance
Corrective maintenance
Trouble shooting.
Calibration (filter, light) of Spectrophotometer

5.1.7 SA analyzer

Introduction and its working principle
Parts of SA analyzer
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting.
Calibration (Aspirator light) of Sa analyzer

5.1.8 Microscopes

Introduction and its working principle
Type of microscope
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting.
Calibration

5.1.9 Safety cabinet

Introduction and its working principle
Type of Safety cabinet
Parts of Safety cabinet
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting.

5.1.10 Electronic balance

Central lab visit (different department)

5.2 Operation Theater **8 hrs**

5.2.1 Operating table

Introduction and its working principle
Type of operating table
Parts of operating table
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting

5.2.2 Operating Light.

Introduction and its working principle
Type of operating Light

Parts of operating Light
Maintenance and repair
- Preventive maintenance
- Corrective maintenance
- Trouble shooting

5.2.3 Anesthesia machines

Introduction and its working principle
Parts of Anesthesia machines
Maintenance and repair
- Preventive maintenance
- Corrective maintenance
- Trouble shooting
- Calibration (flow, leakage, gas percentage)

5.2.4 Pulse oximeter

Introduction and its working principle
Type of Pulse oximeter
Parts of Pulse oximeter
Maintenance and repair
- Preventive maintenance
- Corrective maintenance
- Trouble shooting
- Calibration (O2 percentage and pulse)

5.2.5 Suction machine

Introduction and its working principle
Type of Suction machine
Parts of Suction machine
Maintenance and repair
- Preventive maintenance
- Corrective maintenance
- Trouble shooting
- Calibration (vacuum, leakage)

5.2.6 Electrosurgical unit (Cautery machine)

Introduction and its working principle
Type of Electrosurgical machine
Parts of Electrosurgical machine
Maintenance and repair
- Preventive maintenance
- Corrective maintenance
- Trouble shooting
- Calibration (Power, RF signal leakage, Frequency)

Hospital visit (Operation Theater)

5.3 ENT 4 hrs

5.3.1 ENT set

- Introduction and its working principle
- Type of ENT set
- Parts of ENT set
- Maintenance and repair
  - Preventive maintenance
  - Corrective maintenance
  - Trouble shooting

5.3.2 Audiometer

- Introduction and its working principle
- Type of Audiometer
- Parts of Audiometer
- Maintenance and repair
  - Preventive maintenance
  - Corrective maintenance
  - Trouble shooting (db, frequency) of Audiometer

5.3.3 Tympano meter

- Introduction
- Operating principle
- Type of tympano meter
- Parts of tympano meter
- Maintenance and repair
  - Preventive maintenance
  - Corrective maintenance
  - Trouble shooting
  - Calibration (air pressure)

5.3.4 Bone drill

- Introduction
- Operating principle
- Type of drill
- Parts of drill
- Maintenance and repair
  - Preventive maintenance
  - Corrective maintenance
  - Trouble shooting
  - Calibration (speed, bit lock) of drill

5.3.5 ENT Microscope

- Introduction
- Operating principle

Parts of microscope
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting
Calibration

Hospital visit (ENT department)

5.4 Dental **4 hrs**

5.4.1 Dental chair
Introduction
Operating principle
Types of dental chair
Parts of Dental chair
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting

5.4.2 Dental unit

5.4.3 Compressor
Introduction
Operating principle
Types of compressor
Parts of Compressor
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting
Calibration (Pressure) of Dental chair

5.4.4 Curate light
Introduction
Operating principle
Types of curate light
Parts of curate light
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting

5.4.5 Dental light
Introduction
Operating principle

Parts of dental light
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting

5.4.6 Dental X-ray
Introduction
Operating principle
Parts of dental X-ray
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting
Calibration(mA)

Hospital visit (Dental department)

5.5 Imaging Equipment **18 hrs**

5.5.1 X-ray
Introduction
Operating principle
Type of X-ray
Parts of X-ray
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting
Calibration (mA, KVP, MAS, time) of X-ray

5.5.2 Ultra sound
Introduction
Operating principle
Type of Ultra sound
Parts of Ultra sound
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting
Calibration

5.5.3 C-arm
Introduction
Operation principle

5.5.5 CT
Introduction
Operation principle

5.5.6 MRI
Introduction

Operation principle

` 5.5.7 Accessories
Cassette
Film
Chest stand
X- Ray table
Grid
Bucky

5.5.7.1 Manual film processing
Chemical (Developer, Fixture and dryer)

5.5.7.2 Automatic film processing
Introduction
Operating principle
Type of Automatic film processing
Parts of Automatic film processing
Maintenance and repair
Preventive maintenance
Corrective maintenance
Trouble shooting
Calibration (Speed temperature)

Hospital visit (X-ray department)

5.6 Ophthalmic equipment **4hrs**

5.7 Endoscope **4hrs**

5.8 Physiotherapy **5 hrs**

4.7.1 Therapy diathermy
4.7.2 TMT machine
4.7.3 Wax bath,
4.7.4 Traction machine

Practical

Total Duration: 128 hours

Operation, preventive maintenance, corrective maintenance, trouble shooting and calibration of following equipment;
Lab equipment, ENT equipment, Dental equipment, Imaging equipment, ophthalmic equipment, Endoscope

Note: practical of Bio-medical Instrumentation II and bio-medical equipment maintenance- II will be done together.

Project work

EG 2123 BM

Total: 8 hours/week

Year: II **Lecture: hours/week**

Semester: I **Tutorial: hours/week**

Practical: 8 hours/week

COURSE OBJECTIVES: The objective of this project work is to give knowledge on project planning, researching, designing, reporting and presentation skill. Student should plan and complete an individual biomedical engineering design project under the supervision of teacher and prepare project reports

Procedures:

1.0 A detailed 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 A mid-termprogress report not exceeding 12 double-spaced pages shall be submitted before the end of the 8^{th} week of the term. An oral presentation will take place during the 9^{th} week of term. This mid-term written and oral reports will account for 25% of the final marks.

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

4.0 An oral presentation of the final report is to be conducted during the 16^{th} week of the term by a panel of internal examiner. The oral defence carries 25% of the final marks.

Final Presentation: 2 hours

Elective
(Any one of the following)

1. **EG 2124 BM ENT, Dental and Ophthalmic Equipment**
2. **EG 2124 BM Medical Imaging Equipment**
3. **EG 2124 BM Tele medicine**
4. **EG 2124 BM Hospital Equipment Management**

ENT, Dental and Ophthalmic Equipment

EG 2124 BM

Total: 7 hours/week

Year: II **Lecture: 3 hours/week**

Semester: I **Tutorial: 1 hours/week**

Practical: 3 hours/week

Course description:

This course is designed for understanding the basic concepts of medical instruments used to diagnose and treatment in ENT, Dental and Ophthalmology and correlating clinical knowledge in preventive maintenance work of those medical Equipment.

Course objectives:

After the completion of this course, students will be able to:

1. Understand basic working concept of medical equipment using in ENT, Dental and Ophthalmology.
2. Describe the uses of ENT, Dental and Ophthalmic Equipment
3. Correlate and check the Instruments with clinical values.
4. Operate, maintain, Test & Calibration of ENT, Dental and Ophthalmic Equipment properly.

Course Contents:

Theory

Unit 1. ENT Diagnostic & Treatment Instruments / Equipment **8 hrs**

- 1.1 Introduction
- 1.2 Principle, Application & purpose
- 1.3 ENT workstation, Headlight set, Endoscopy system
- 1.4 Different types of Operation Theater Instrument & Equipment
- 1.5 Audiometer, Hearing aid, Tuning fork

Unit 2. DentalDiagnostic & Treatment Instruments/Equipment **10 hrs**

- 1.1 Introduction
- 1.2 Categories - Maxillo facial Surgery, Orthodontist, Prosthodontist , Periodontist Pedodontist, Conservative dentistry, Community dentistry
- 2.3 Principle, Application & purpose
  Dental chair, Dental scalar, Intra oral Camera, Curing Lights, Air Compressor Micro Motor, Air rotor Hand Piece, Contra Angular Hand Piece, Straight Hand Piece, Pulp Tester, Apex Locator, Three way syringe, Air motor, Automatic X-ray Processor, Amalgam Mixture
- 2.4 X-Ray (IOPA), OPG X-Ray,
- 2.5 ORAL OPERATIVE /SURGERY INSTRUMENTS

Unit 3. Dental Laboratory Based Instrumental Methods of Analysis **6 hrs**

- 3.1 Ceramic Furnace&Metal Furnace
- 3.2 Model Trimmer
- 3.3 Dental Lath, Hanging Motor, Lab Micro Motor,
- 3.4 Welder and Solder Machine, Casting Machine,
- 3.5 Steam Cleaner, Wax melting machine

Unit 4. Sterilization Equipment and Disinfection solution **6 hrs**

4.1 Introduction
4.2 Principle, Application & purpose
4.3 Principle of Measurements

Unit 5. Measuring and Monitoring System of Ophthalmology (Eye) **7 hrs**

5.1 Introduction of Vision Science
5.3 Origin of Bioelectric signals
5.4 Electrodes for ERG&EOG
5.5 Electrophysiological Tests
5.6 Electroretinogram
5.7 Electrooculogram
5.8 Eye Pressure

Unit 6. Ophthalmology Instruments **6 hrs**

1.1 Types of Ophthalmoscope/Retinoscope
1.2 Types of Slit lamp
1.3 Lens meter, Refractor &Keratometer
1.4 Intraocular Pressure& Types of Tonometer
1.5 Biometry &Pachymetry
1.6 Types of Refractive system

Unit 7. Advanced Method in Ophthalmology **5 hrs**

7.1 Ultrasound in Ophthalmology (A/B Scan)
7.2 Types of Ophthalmic Laser System
7.3 Types of Ophthalmic diagnostic Cameras
7.4 Different types of Operation Theater Instrument & Equipment (Cyro,Vitrectomy, Phaco)

Practical

Total Duration: 48 hours

1. Study &Orientation of different types of medical equipment using in ENT, Dental and Ophthalmology.
2. Demonstration of Dental Lab
3. Study and orientation of different Ophthalmoscopes

References:

1. John G. Webster, Medical Instrumentation, Application and Design: Third edition, John Wiley and sons, New York
2. Leslie Cromwell, Bio medical Instrument and measurements, Prentice Hall, Inc, Englewood cliffs
3. Onkar N. Pandey, Bio medical Electronics and Instrumentation, S.K. Kataria and sons, Publishers of Engineering and Computer books
4. Handbook of Biomedical Instrumentation, R.S Khandpur, Tata McGraw Hill

Medical Imaging Equipment

EG 2124 BM

Total: 7 hours/week
Year: II **Lecture: 3 hours/week**
Semester: I **Tutorial: 1 hours/week**
Practical: 3 hours/week

Course description:

The following course focuses on repair and maintenance of the diagnostic imaging equipment. Those students who complete the course will be able to perform the installation, repair, maintenance and preventive maintenance of the imaging equipment.

Course objectives:

After completion of this course, the students will be able to:

- Learn the fundamental concepts of imaging equipment.
- Study about imaging equipment system
- Learn the importance of the radiation hazard.
- Installation of imaging equipment.
- Do the preventative maintenance and repair of X-ray

Course Contents

Theory

Unit 1: X-ray **2hrs**

1.1 Introduction
1.2 Construction of x-ray

1.3 Type of X-ray **4hrs**

1.3.1 Conventional
1.3.2 High frequency
1.3.3 Condenser Discharge

1.4 Parts of X-ray unit **4 hrs**

1.4.1 Control panel
1.4.2 X-ray head
1.4.3.Rotating & Stationary anode
1.4.4 EHT unit
1.4.5 Filament transformer
1.4.8 Diodes
1.4.9 Oil
1.4.10 General-X-ray table
1.4.11 Tilting table
1.4.12 Chest stand

1.5 X-ray machine installation 4hrs
1.6 Preventive maintenance of X-ray **5hrs**

1.6.1 Repair
1.6.2 Calibration
1.8.2. mA
1.8.3 KVP using by step
1.8.4 MAS & time using by spine top)

Unit 2 Ultra Sound **4hrs**

2.1 Introduction
2.2 Operating principle
2.3 Parts of Ultra sound
2.4 Preventive maintenance of Ultra sound
2.5 Repair & calibration of Ultra sound

UNIT 3 C arm **2 hrs**

3.1Introduction
3.2Operation principle

UNIT 4 CT **3**hrs

4.1Introduction
4.2Operation principle

UNIT 5 MRI **3hrs**

5.1Introduction
5.2Operation principle

UNIT 6: Accessories **6hrs**

6.1 Cassette
6.2 Film
6.3 Chest stand
6. 4 Grid
6.5 Bucky
6. 6 Cassette and intensifying screens
1.6.1 Identify different sizes of cassette.
1.6.2 Intensifying screens.

Unit 7: X-ray dark room **5**

7.1 Lay out of dark room.
7.2 Construction of walls, floor & ceilings including ventilation, light system, illumination, safe light, cassette hatches, load bench and location of processors.
7.3 The radiation protection measures in a dark room

Unit 8: The radiographic Image **6**

8.1 Sharpness of image, radiographic contrast, exposure factors and resolution
8.2 Manual film processing (Developer, Fixture and dryer)
8.3 Automatic film processing

- Introduction
- Operating principle
- Type of Automatic film processing
- Parts of Automatic film processing
- Preventive maintenance of Automatic film processing
- Repair & calibration (temperature) of Automatic film processing

Hospital visit (X-ray department)Practical will be included during the visit of Unit 4- CT & Unit 5 MRI.

Practical

Total Duration: 48 hours

1. The student will perform the practical works on control panel, X-ray head, EHT.
2. The student observes all accessories and practices it.
3. The student operate and observe the all functions.

REFERENCES:

1. Hand book of Bio-medical instrumentation, KS Khandpur, TATA McGraw Hill Education Pvt. Limited

2) Text book of Bio-medical Instrumentation, K.N. Scott and A.K. Mathur, CBS Publishers & Distributors

3) Bio-medical Instrumentation and Measurements, R. Anadaanatarjan, PHI Learning Private Limited.

4) Bio-medical Instrumentation and Measurements, Leslie Cromwell, Fred J. WeibellErich A. Pfeiffer, Pearson Education

Tele medicine

EG 2124 BM

Total: 7 hours/week

Year: II **Lecture: 3 hours/week**

Semester: I **Tutorial: 1 hours/week**

Practical: 3 hours/week

Course description:

This course is designed to enable the students to acquire knowledge about the principles of Telemedicine.

Course objectives:

After the completion of this course, students will be able to:

- Learn the fundamental concepts necessary for any telemedicine and Tele- health activity.
- Study about Tele-medicine system.
- Learn the importance of secure management of medical data for transmission and retrieval system.

Course contents

Theory

Unit 1: HISTROY AND FUNDAMENTAL CONCEPT IN TELEMEDICINE. (4 hrs)

- Introduction of telemedicine
- History of telemedicine
- Evolution of telemedicine
- Functional block of Telemetry and Tele-control system
- Scope, Benefits and Limitations of telemedicine on healthcare delivery

Unit 2: INTRODUCTION TO TELECOMMUNICATIONS, COMPUTER NETWORKING TECHNOLOGIES & HEALTHCARE PRACTICE (12 hrs)

I. Telecommunications

- What are communications and telecommunications?
- Elements of telecommunications systems
- Modalities of telecommunications systems

II. Computer Networking Technologies

- Introduction of networking
- Types of topologies
- Global scenario of Computers and Networking Industry

III. ICT Applications in Health Care

- History of ICT in Medicine
- Information Systems in Healthcare
- Overview of Medical Informatics
- Healthcare Management Information System

Unit 3: TELEMEDICINE EQUIPMENT AND SYSTEM (12 hrs)

- Video conferencing: Familiarization with hardware/software components.
- Tele-medical workstation
- Vital sign monitoring devices: Respiratory monitoring devices, Neurological monitoring devices, Video scopes
- Robotics and virtual reality devices
- Medical Image Scanning system
- Remote sensing and Networking (Local, national and Global)

Unit4: MEDICAL APPLICATION (10hrs)

- Digital Imaging and Communication in Medicine (DICOM)
- **T**ele- Cardiology, Tele- Dermatology, Tele-radiology Tele- Home care, Tele-Neurology, Tele- Oncology, Tele- Ophthalmology, Tele-rehabilitation, Tele-Pathology & Tele-surgery.
- PACS

Unit5: ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE (10hrs)

- Ethical and legal aspects of telemedicine: confidentiality, and the law, patient rights and consent, access to medical Records, reimbursements
- Ethical standard and Intellectual property rights
- Data security and Standards: Encryption, Cryptography, Mechanism and phase of encryption- Protocols and Standards- encryption.
- Roles of clinicians and paramedical personnel
- Implications of trainings and cost

PRACTICAL

Total Duration: 48 hours

1. Familiarization with Hardware components of telecommunications systems and Networking.
2. Observe video conferencing.
3. Observe the implementation of wireless technology within the hospital.eg: Central ICU Monitoring.
4. Perform Patient Information System Management.

TEXT BOOKS:

1. B.D Gupta, “Introducing Telemedicine(Applications, Challenges, Needs and Benefits, components and infrastructure)”
2. Olga Ferrer –Roca, M. Sosa Ludicissa, “Handbook of Telemedicine “IOS press 2002.
3. A.C Noris, “Essential of Telemedicine and Tele-care’’.
4. Bernard Fong, A.C.M. Fong, C. K. Li, “Telemedicine Technologies”.
5. Adam William Darkins, Margaret Ann Cary,“Telemedicine and Tele-Health”.

REFERENCES:

1. Marlene Maheu, Pamela Whitten, Ace Allen, “E-health, Tele-health and Telemedicine “.t
2. Bashshur R L, Shannon G W, “History of Telemedicine “. New Rochelle. NY, Mary Ann Liebert Publisher, 2009.

Hospital Equipment Management

EG 2124 BM

Total: 7 hours/week
Year: II **Lecture: 3 hours/week**
Semester: I **Tutorial: 1 hours/week**
Practical: 3 hours/week

Course description:
This course deals with overall introduction of hospital equipment management for safety handling and operation of biomedical equipment &instruments.

Course objectives:
After the completion of this course, students will be able to:

1. Explain the basic concept of Hospital Equipment Management
2. Able to do the assessment of technical requirements for the department
3. Know about the equipment inventory, Planned preventive maintenance, Corrective maintenance and calibration testing
4. Able to set goals for equipment operation & safety
5. Have knowledge about the workshop layouts

Course Contents:

Theory

Unit 1. Introduction (12hrs)

1.1 Healthcare Technology Management
1.2 Healthcare Technology Management Cycle
1.3 Standardization of Healthcare Technology
1.4 Assessment of Technical Requirements
1.5 Assessment of workload Requirements
1.6 Impacts on Health Delivery system
1.7 Goals & Monitor Progress

Unit 2. Planning & Budgeting (12hrs)

2.1 Equipment procurement
2.2 Incoming Inspection
1.3 Equipment Inventory
1.4 Different types of expenditures
1.5 Purchasing, Donations, Replacement & Disposal Policy
1.6 Equipment Specification & technical Data
1.7 Capital Budget & Recurrent Budget
1.8 Equipment Development Plan (EDP)
1.9 Issues to consider when choosing an Equipment

Unit 3. Effective Operation & Safety (12hrs)

3.1 Correct Operation & Application
3.2 Safety during equipment Operation
3.3 Fault Reporting
3.4 Control of Hazards
3.5 Equipment related Infection Control
3.6 Waste Management
3.7 Storage System & procedures
3.8 Decommissioning, Disposal & replacement of equipment
3.9 Setting goals for equipment operation

Unit 4. Maintenance Management (12 hrs)

4.1 Planned Preventive Maintenance
4.2 Repairs/Corrective Maintenance
4.3 Safety & Calibration Testing
4.4 Annual Maintenance Contracts
4.5 Record of Maintenance work
4.6 Management of tools & work facilities
4.7 Management of spare parts & maintenance materials
4.8 Reporting & Feedback
4.9 General Maintenance Register
4.10 History Cards
4.11 Workshop Layout

PRACTICAL

Total Duration: 48 hours

1. Student will perform the entry of hospital Equipment Inventory using software recommended by the Institute.
2. Familiarization with record keeping & report writing in concurrence with the visit to the related offices and workshops for Hospital management related to the 4.1 to 4.11 as mentioned above.

References:

1. A hand book for Hospital Biomedical Engineering Departments. By W. Sanford Topham, PHD
2. Caroline Temple –Bird, Manjit Kaur, Andreas Lenel, Willi Kawohl, 'How to Manage' Series for Healthcare Technology, Guide 1- 5, '**How to Organize a System of Healthcare Technology Management.**'
3. B. M. Sakharkar, '**Principles of Hospital Administration and Planning**' 2nd edition, 2009, JaypeeBrotherss, India
4. Ministry of Health and Family welfare, '**Medical Equipment Maintenance Manual**' 2010, New Delhi, India
5. J. R. McGibony, '**Principles of Hospital Administration**' 2nd edition, Macmillan, Toronto

Entrepreneurship Development

EG 3201 SH

Total: 5 hours/week
Year: II **Lecture: 3 hours/week**
Semester: I **Tutorial: hours/week**
Practical: 2 hours/week

Course description:

This course is designed to provide the knowledge and skills on formulating business plan and managing small business. The entire course deals with assessing, acquiring, and developing entrepreneurial attitude; skills and tools that are necessary to start and run a small enterprise.

Course objectives:

After completion of this course students will be able to:

1. Understand the concept of business and entrepreneurship
2. Explore entrepreneurial competencies
3. Analyze business ideas and viability
4. Learn to formulate business plan with its integral components
5. Manage small business

Course contents:

Theory

Unit 1: Introduction to business & entrepreneurship (9 hrs)

1. Overview of entrepreneur and entrepreneurship
2. Wage employment , self- employment and business
3. Synopsis of types and forms of enterprises
4. Attitudes, characteristics & skills required to be an entrepreneur
5. Myths about entrepreneurs
6. Overview of MSMEs (Micro, Small and Medium Enterprises) in Nepal

Unit 2: Exploring and developing entrepreneurial competencies (10 hrs)

1. Assessing individual entrepreneurial inclination
2. Assessment of decision making attitudes
3. Risk taking behavior and risk minimization

4. Creativity and innovation in business
5. Enterprise management competencies

Unit 3: Business identification and selection **(4 hrs)**

1. Sources and method of finding business idea(s)
2. Selection of viable business ideas
3. Legal provisions for MSMEs in Nepal

Unit 4: Business plan formulation **(17 hrs)**

1. Needs and importance of business plan
2. Marketing plan
    - Description of product or service
    - Targeted market and customers
    - Location of business establishment
    - Estimation of market demand
    - Competitors analysis
    - Estimation of market share
    - Measures for business promotion
3. Business operation plan
    - Process of product or service creation
    - Required fix assets
    - Level of capacity utilization
    - Depreciation & amortization
    - Estimation office overhead and utilities
4. Organizational and human resource plan
    - Legal status of business
    - Management structure
    - Required human resource and cost
    - Roles and responsibility of staff
5. Financial plan
    - Working capital estimation
    - Pre-operating expenses
    - Source of investment and financial costs
    - Per unit cost of service or product
    - Unit price and profit/loss estimation of first year
6. Business plan appraisal
    - Return on investment
    - Breakeven analysis
    - Risk factors

Unit 5: Small business management **(5 hrs)**

1. Concept of small business management
2. Market and marketing mix
3. Basic account keeping

Practical

Total Duration: 45 Hours

Unit 1: Overview of business & entrepreneurship **(2 hrs)**

1. Collect business information through interaction with successful entrepreneur

Unit 2: Exploring and developing entrepreneurial competencies **(2 hrs)**

1. Generate innovative business ideas

Unit 3: Product or service identification and selection **(2 hrs)**

1. Analyze business ideas using SWOT method

Unit 4: Business plan formulation **(22 hrs)**

2. Prepare marketing plan
3. Prepare operation plan
4. Prepare organizational and human resource plan
5. Prepare financial plan
6. Appraise business plan
7. Prepare action plan for business startup

Unit 5: Small business management **(2 hrs)**

2. Prepare receipt and payment account
3. Perform costing and pricing of product and service

Text books:

क) प्रशिक्षकहरुकालागिनिर्मित निर्देशिकातथा प्रशिक्षण सामग्री, प्राविधिकशिक्षातथाव्यावसायिकतालीम परिषद्, २०६९
ख) प्रशिक्षार्थीहरुकालागिनिर्मित पाठ्यसामग्रीतथाकार्यपुस्तिका, प्राविधिकशिक्षातथाव्यावसायिकतालीम परिषद् (अप्रकाशित), २०६९

Reference book:

Entrepreneur's Handbook, TechnonetAsia, 1981.