CURRICULUM
for
Diploma in Biomedical Equipment Engineering)

(One and half year program-semester system)

Council for Technical Education and Vocational Training

Curriculum Development and Equivalence Division

Sanothimi, Bhaktapur

Development: Ashad 2071 (June 2014)

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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 the national 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 Objective

The objectives of the course are to:

- Produce middle level technically competent workforce/human resources to work as biomedical technician in different level of health facilities.
- Reduce the dependency on employing such technicians from foreign countries.
- Discuss the relationship between human anatomy physiology and biomedical engineering and;
- Carry out management and maintenance 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 Engineering including provision of elective subjects. 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 consists of 20 academic weeks including

evaluation period. Actual teaching learning hours will be not less than 15 weeks in each semester.

7. Target group

The target group for this program 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.

Entry Criteria

- Should submit 10+2 equivalent to the science stream.
- Should pass entrance examination as administered by CTEVT.

11. Selection

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

12. Medium of instruction

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

13. Pattern of attendance

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

14. Teacher and student ratio

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

15. Teachers and demonstrators

- The disciplinary subjects' related teachers should 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.

16. 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.).

17. Teaching learning methodologies

The methods of teaching learning will 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.

18. 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.

19. 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.

20. 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.

21. 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.

22. 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 %

23. Certification and degree awards:

- Students who have passed 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"**.

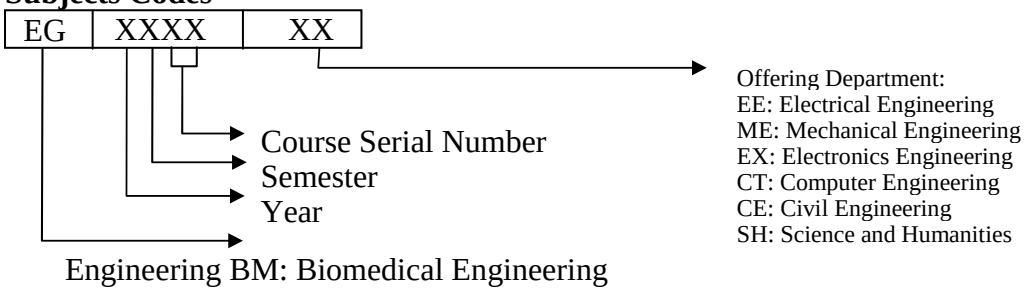
24. Career path:

The graduates will be eligible for the position equivalent to Non-gazette 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).

25. 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.

26. Subjects Codes



27. Provision of specialization:

There will be no provision of specialization but some subjects are offered here with the provision of elective; Surgery and ICU Equipment, Medical Imaging Equipment and Medical Laboratory Equipment

28. 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 of Diploma in Biomedical Equipment Engineering

First Semester

Teaching Scheme									Examination Scheme						Total Marks	Remarks
S.N.	Course Code	Subject	Mode				Weekly Hours	Credit Hours	Theory			Practical				
			L	T	P	lab			Assmt. Marks	Final		Assmt. Marks	Final			
										Marks	Time (Hrs)		Marks	Time (Hrs)		
1	EG1121BM	Human Anatomy and Physiology	3		1		4	4	20	80	3	25			125	*Continuous assessment
2	EG1122BM	Engineering Drawing	1		3		4	3	-	-	-	60	40	3	100	
3	EG1123BM	Basic Electrical Circuit and Machine	4		3		7	6	20	80	3	60	40	3	200	
4	EG1124BM	Bio-Medical Chemistry	3		1		4	4	20	80	3	25			125	
5	EG1125BM	Electronics and Logic Circuit I	4		3		7	6	20	80	3	60	40	3	200	
6	EG1126BM	Engineering Mathematics	3	1	0		4	4	20	80	3	-	-	-	100	
7	EG1127BM	Workshop Technology	1		3		4	3	-	-	-	60	40	3	100	
8	EG1128BM	Computer and Programming	3		3		6	5	20	80	3	60	40	3	200	
		Total	**22**	**1**	**17**		**40**	**35**	**120**	**480**		**350**	**200**		**1150**	

Second Semester

	Teaching Scheme								Examination Scheme						Total Marks	Remarks
S.N.	Course Code	Subject	Mode				Weekly Hours	Credit Hours	Theory			Practical				
			L	T	P	Lab			Assmt. Marks	Final		Assmt. Marks	Final			
										Marks	Time (Hrs)		Marks	Time (Hrs)		
1	EG1222BM	Electronics and Logic Circuit II	4		3		7	6	20	80	3	60	40	3	200	*Continuous assessment
2	EG1221BM	Bio-Medical Instrumentation I	3		3		6	5	20	80	3	60	40	3	200	
3	EG1223BM	Measurements & Instrumentation	3		2		5	4	20	80	3	30	20	2	150	
4	EG1224BM	Microprocessors and Micro Controller	3		2		5	4	20	80	3	30	20	2	150	
5	EG1225BM	Data Communication and Networking	4		2		6	5	20	80	3	30	20	2	150	
6	EG1228BM	Health Care Management	4		1		5	5	20	80	3	25	-	-	125	
7	EG1227BM	Bio-Medical Equipment Maintenance I	3		3		6	5	20	80	3	60	40	3	200	
	Total		**24**	**0**	**6**		**40**	**34**	**140**	**560**		**280**	**190**		**1175**	

Diploma in Biomedical Equipment Engineering

Third Semester

S.N	Course Code	Subject	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	Theory			Practical				
			L	T	P	Lab			Assmt. Marks	Final		Assmt. Marks	Final			
										Marks	Time (Hrs)		Marks	Time (Hrs)		
1	EG2121BM	Bio-Medical Instrumentation II	3		3		6	5	20	80	3	60	40	3	200	*Continuous assessment
2	EG2122BM	Bio-Medical Equipment Maintenance II	4	1	8		13	9	20	80	3	120	80	4	300	
3	EG2125BM	Elective 1.Surgery and ICU Equipment 2.Medical Imaging Equipment 3.Medical Laboratory Equipment	3		3		6	5	20	80	3	60	40	3	200	
4	E3201SH	Entrepreneurship Development	3		2		5	4	20	60	3	10	10	2	100	
5	EG2123BM	Project work	0		10		10	5	-	-	3	120	80	4	200	
		Total	**13**	**1**	**26**		**40**	**28**	**60**	**240**		**360**	**240**		**1000**	
	Internship (12 weeks)															

First Semester

Anatomy and Physiology

EG1121BM

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

First semester

Course Description

This course is designed to provide knowledge of human anatomy and physiology required for biomedical field. This provides knowledge about the cells, the chemical composition of cells and & normal structure and function of the various systems of the human body.

Course objective

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

1. Identify the classifications of the systems of the human body.
2. Locate and describe the structure and function of the components of each body system.
3. Explain the interrelationship of the body systems.
4. Transfer knowledge of anatomy and physiology of the body to medical and surgical circumstances.
5. Explain the mechanisms of body repair and resistance to disease.
6. Describe the physical changes that occur during normal growth and development, from conception to senescence.

Course content

Theory

Unit 1 Introduction to Anatomy: **[1hr]**

1.1 Define Anatomy, Physiology, level of body organization
1.2 Describe various body positions and body planes
1.3 Name the main body cavity and important organs within this cavity

Unit 2 Introduction to the chemistry of life: Body fluid and Electrolyte **[2hrs]**

2.1 General outline of Body fluid and electrolyte distribution
2.2 P^H mechanism of body fluids: Acidosis and Alkalosis
2.3 Knowledge of various transport mechanism across cell membrane
  2.3.1 Active Transport and Passive Transport
2.4 Define Homeostasis:
  2.4.1 Knowledge of Positive and Negative Feedback Mechanism

Unit 3 Introduction to cells and Tissue **[2hrs]**

3.1 Structure and function of Human cell
3.2 Structure and function of tissues

Unit 4 Introduction to Skeletal System **[2hrs]**

4.1 Outline: division of Skeletal System
4.2 Study of different types of bone
4.3 Functions of bone
4.4 Enlist the name & functions of bones (Skull, Vertebral Column, Thoracic Cage, Upper and Lower Limbs bone)

Unit 5 Introduction to Joints

[2hrs]

5.1 Define and Classify Joints
5.2 Classify Synovial joint and its range of Movement

Unit 6 Introduction to Muscular System

[2hrs]

6.1 Introduction of different type of Muscle
6.2 Outline muscle function

Unit 7 Introduction to Blood

[**2hrs]**

7.1 Composition of blood
7.2 Revision of blood functions
7.3 Learning of Hemostasis Mechanism
7.4 Blood Grouping System

Unit 8 Introduction to Cardiovascular System

[**4hrs]**

8.1 Anatomy & function of heart
8.2 Structure of Cardiac muscle
8.3 Cardiac Cycle, Heart Sound, Cardiac output, blood pressure
8.4 Learning of Conduction System of heart
8.5 Blood supply of heart
8.6 Pathway of the blood through the heart
8.7 Define ECG

Unit 9 Introduction to Lymphatic System

[2hrs]

9.1 Structure and function of Lymphatic System
9.2 Lymphatic vessel
9.3 Structure and functions of Lymph nodes, Spleen and Tonsils
9.4 Knowledge of Immunoglobulin and its type

Unit 10 Introduction to Digestive System

[4hrs]

10.1 Definition of Digestion
10.2 Structure and functions of digestive organs involved in Digestive
10.3 System & its accessory organs: Salivary gland, Pancreas, Liver, Gall bladder
10.4 Functions of Digestive System
10.5 Physiology of digestion

Unit 11 Introduction to Respiratory System

[4hrs]

11.1 Define respiratory system
11.2 Structure and functions of various organs of respiratory system
11.3 Lungs & its topography, Pleural and Pleural cavity
11.4 Learning of Lung Volume and Capacities
11.5 Knowledge of PFT Test
11.6 Mechanism of breathing: Inspiration and Expiration Mechanism

11.7 Physiology of Respiration: External respiration, Internal respiration, Transport of gases through blood

Unit 12 Introduction to Urinary System

[2hrs]

12.1 Structure and function of urinary system: Kidney, ureter, urinary bladder, urethra
12.2 Topography of Kidney
12.3 Short review of mechanism of urine formation
12.4 Composition of urine

Unit 13 Introduction to Endocrine System

[2hrs]

13.1 Structure and function of Endocrine glands: Pituitary gland, Thyroid gland, Parathyroid gland, Adrenal gland, Pancreas, ovaries and testis
13.2 Hormone produced by different glands and its functions

Unit 14 Introduction to Nervous System

[4hrs]

14.1 Describe the structure of neuron
14.2 Classification of neurons
14.3 Locate the chief parts of the brain and its function
14.4 Covering of brain and spinal cord
14.5 Describe the structure of spinal cord
14.6 Peripheral Nervous System: Cranial nerves and Spinal Nerves
Describe Autonomic Nervous System
14.7 Define CSF and its function

Unit 15 Introduction to Reproductive System

[5hrs]

15.1 Structure and functions of External and Internal Female Reproductive Organs
15.2 Describe Menstrual Cycle
15.3 Structure and function of Breast
15.4 Structure and function of male reproductive system
15.5 T.S of Testis
15.6 Spermatogenesis process
15.7 Function of Seminal Vesicles and Prostate gland

Unit 16 Introduction to Sensory System

[5hrs]

16.1 Structure and function of the Skin
16.2 Mechanism of Wound Healing
16.3 Structure and function of Eye
16.4 Eye Accommodation
16.5 Visual pathway
16.6 Structure and function of Ear
16.7 Mechanism of Hearing

Reference

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

Anatomy and Physiology

Practical

Practical: 1 hour/week

1. Identify the bones of Skull
2. Identify the bones of Vertebral Column
3. Identify the bones of Thoracic Cage
4. Identify the bones of Upper Limb
5. Identify the bones of Lower limb
6. Identify the major muscle of the head, neck, thorax, spine and extremities
7. Demonstrate movements of Synovial Joint
8. Identify anatomical position and structure of Lungs, Heart, Liver, Pancreas, Spleen and Kidney
9. Identify anatomical position and structure of Brain and Spinal cord
10. Identify anatomical position and structure of Eye and Ear
11. Identity anatomical position and structure of Male and Female 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

Marks Scheme

Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
Hrs	1	2	2	2	2	2	2	4	2	4	4	2	2	4	5	5	45
Marks	2	2	4	4	4	4	4	8	2	8	8	4	2	8	8	8	80

Engineering Drawing
EG1122BM

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

First semester

Course Description:

This course deals with geometrical construction, orthographic projections and symbols used in engineering drawing.

Course Objectives:

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

1. Represent different shapes accurately by applying geometrical constructions.
2. Project the point, line and geometrical solids
3. Represent three dimensional objects in orthographic form and dimension them.
4. Discuss the different types of symbols used in field of bio-medical engineering.

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Course content

Theory

Unit 1 Instrumental Drawing, Technical Lettering Practices and Techniques

[2hrs]

1.1. Equipment and materials
1.2. Description of drawing instruments, auxiliary equipment and drawing materials
1.3. Techniques of instrumental drawing
1.4. Pencil sharpening, securing paper, proper use of T- squares, triangles, scales dividers, compasses.
1.5. Lettering strokes, letter proportions, use of pencils and pens, uniformity and appearance of letters, freehand techniques, inclined and vertical letters and numerals, upper and lower cases, standard English lettering forms.

Unit 2 Dimensioning

[1hrs]

2.1 Fundamentals and techniques
2.2 Size and location dimensioning, SI conversions about various types of units
2.3 Use of scales, measurement units, reducing and enlarging drawings
2.4 Placement of dimensions: aligned and unidirectional

Unit 3 Geometrical Construction

[2hrs]

3.1 Plane geometrical construction: Proportional division of lines & angles
3.2 Construction of polygons: triangle, square, hexagon, octagon.
3.3 Construction of arcs and curves: arc tangent in lines, circular arcs in two circles, parabola

Unit 4 Projection of points, lines and solids

[4hrs]

4.1 Principle planes of projection four quadrants.
4.2 Projection of point on two planes of projection.
4.3 Projection of line.

4.4 Orthographic projection.
- 4.4.1. First and third angle projection
- 4.4.2. Principle views: methods of obtaining orthographic views, analysis of three views
- 4.4.3. Dimensioning the three views drawing

Unit 5 Familiarization with Graphical Symbols used in different engineering fields **[2hrs]**

5.1 Standard symbols for Electrical, mechanical and industrial components.
5.2 Standard symbols for Electronics, Communication and computer components.
5.3 Standard piping symbols and piping drawing.

Unit 6 Introduction to Computer Added Design **[4hrs]**

6.1 Loading software, screen organization, menus, command line, function keys
6.2 Creating point, lines, circles, arcs, polygons
6.3 Modifying commands: erasing, trimming, scaling, chamfer, fillet
6.4 Working with text, layer and dimension
6.5 Plotting drawing
6.6 Introduction to 3D printing

Engineering Drawing
PRACTICAL

Practical: 3 hours/week

1. Drawing Sheet Layout, Freehand Lettering, Sketching of parallel lines, circles, Dimensioning
2. Applied Geometry (Sketch and Instrumental Drawing)
3. Projection of Point and Lines (Sketch and Instrumental Drawing)
4. Multiview Drawings
5. Multiview drawing and Dimensioning
6. Familiarization with graphical symbol
7. Draw connection diagram of 220V/6V AC to DC conversion adaptor with full wave rectification.
8. AutoCAD
   - 8.1 Familiarization with Software Environment, Setting up Drawing
   - 8.2 2D Drawing Consisting Straight Lines, Circle Arcs and Polygons
   - 8.3 2D Drawing Using Modifying Commands
   - 8.4 Inserting Text and Dimensions of 2D Drawing
   - 8.5 Plotting 2D Drawings
   - 8.6 Demonstration of 3D printer and printing of cylinder

References

1. M. C. Luintel, “Engineering Drawing I”, Heritage Publishers and distributors P Ltd
2. P. S. Gill, “A Text Book of Engineering Drawing”, S. K. Kataria and Sons, India
3. R. K. Dhawan, “A Text Book of Engineering Drawing”, S. Chand and Company Limited, India
4. W. J. Luzadder, “Fundamentals of Engineering Drawing”, Prentice Hall
5. “AutoCAD User's Guide”, Autodesk, 2012
6. R. Goutam, G. Goutam, “Machine Drawing with autocad”, Pearson

Basic Electrical Circuit and Machines
EG1123BM

Lecture: 4hours/week
Tutorial: 0 hours/week
Practical: 3 hours/week
Total: 7 hours/week

First semester
Course Description:

This course is design to equip the students with knowledge and skills on Basics of Electrical Circuit and Machines.

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

1. Fundamental concept of DC, AC & 3-phase electrical circuits
2. Fundamental concept of AC and DC machine

Course Content

Theory

Unit 1 General Electric System

[4hrs]

1.1. Drift of electrons in metals, current flow in a circuit, EMF and potential difference
1.2. Good conductors, bad conductors and semiconductors.
1.3. Ohm's law: definition, explanation and verification
1.4. Resistors, Resistance and Resistivity

Unit 2 Network Theorems

[12hrs]

2.1 Kirchhoff's laws: KCL and KVL
2.2 Mesh current method of circuit analysis
2.3 Node voltage method of circuit analysis
2.4 Thevenin's theorem
2.5 Superposition theorem
2.6 Norton's theorem
2.7 Maximum power transfer theorem
2.8 Reciprocity theorem

Unit 3 Fundamentals of AC circuit

[10hrs]

3.1 Comparison between AC and DC voltage and current.
3.2 Generation of AC EMF, Sinewave
3.3 Wave forms, terms &definitions
3.4 Average and RMS values of current &voltage
3.5 AC through pure ohmic Resistance, phaser diagram, wave form of current & voltage, wave form of power & necessary mathematical expression with analysis
3.6 AC through pure inductance only, phaser diagram, wave form of current & voltage, power, variation of reactance with frequency.
3.7 AC through pure capacitor only, phaser diagram, wave form of current, voltage, power & necessary mathematical expression with analysis.
3.8 Analysis of series R-L, R-C, R-L-C circuits

3.9 Analysis of parallel R-L, R-C, R-L-C circuit

Unit 4 Three-Phase Circuit Analysis

[10hrs]

4.1 Basic concept & advantage of Three-phase circuit
4.2 Phasor representation of star & delta connection
4.3 Phase and line quantities
4.4 Voltage, current and power computation in 3-phase circuits (star and delta connection balanced)
4.5 Wattmeter method: Three wattmeter method and two wattmeter methods

Unit 5 Transformer

[12hrs]

5.1 Constructional Details, recent trends
5.2 Working principle and EMF equation
5.3 Ideal Transformer
5.4 No load and load Operation
5.5 Operation of Transformer with load
5.6 Equivalent Circuits and Phasor Diagram
5.7 Tests:
  5.7.1 Polarity Test
  5.7.2 Open Circuit test, Short Circuit test and
  5.7.3 Equivalent Circuit Parameters
5.8 Losses in a transformer
5.9 Efficiency, condition for maximum efficiency and all-day efficiency
5.10 Basics of Three Phase Transformers

Unit 6 DC Machine

[12hrs]

6.1 Construction and working principle of D.C. generator.
6.2 EMF Equation
6.3 Method of excitation: separately excited, self-excited,
6.4 Characteristics of shunt, series and compound generator
6.5 Introduction and working principle of DC motor
6.6 Torque developed by the motor
  6.6.1 Mathematical Expression
  6.6.2 Characteristics and Application
6.7 Losses and efficiency of D.C. motor
6.8 Basic introduction on different types of motors (Induction motor, servo motor, Scharge motor)

Basic Electrical Circuit and Machines
Practical

Practical: 3 hours/week

1. Familiarization and handling basic devices and components (Resistors, DC Supply, AC Supply Ammeter, Voltmeter, Multimeter)
2. Familiarization with different types of wires and selection of appropriate wires used in circuit and machines.
3. Measurement of Voltage, current & power in DC circuit
   3.1 Verification of Ohm's Law
   3.2 Temperature effects in Resistance
4. AC Fundamentals
   4.1 Measurement of amplitude, frequency and time with oscilloscope Calculate & verify average and rms value
   4.2 Examine phase relation in RL& RC circuit
5. Three-phase AC circuits
   5.1 Measurement of Voltage, current& power in a three-phase circuit
   5.2 Two-wattmeter method for power measurement in star and delta connection
   5.3 Star to delta conversion and vice-versa.
6. Two Winding Transformer
   6.1 To perform turn ratio test
   6.2 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
7. DC Generator
   7.1 To draw open circuit characteristic (OCC) of a DC shunt generator and to calculate:
      7.1.1 Maximum voltage built up
      7.1.2 Critical resistance and critical speed of the machine

References:

1. J.RCogdell, "Foundations of Electrical Engineering", printice Hall, Englewood Chiffs, New Jersy, 1990.
2. I.M Smith," Haughes Electrical Technology", Addison-Wesley, ISRRprint,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

Marks Scheme

Unit	1	2	3	4	5	6	Total
Unit Hours	4	12	10	10	12	12	60
Marks	4	20	10	10	20	16	80

Biomedical Chemistry
EM1124BM

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

First semester

Course Description:

This subject consists of five units related to Energy Rich compounds and its transport mechanism Electrochemistry; Biomolecules and synthetic materials; Instrumental methods of analysis and Acid, Base, Salt and Buffers 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.

Course contents

Theory

Unit 1 Energy Rich compounds and its transport **[5hrs]**

1.1 High energy or energy rich components
1.2 Free energy and compounds with large free energy
1.3 Types of high energy bonds
1.4 ATP as an energy carrier
1.5 Electron transport chain

Unit 2 Electro chemistry **[8hrs]**

2.1 Introduction of electrochemistry
2.2 Principles of electrochemical technique
  2.2.1 Schematic representation of electrochemical technique
  2.2.2 Introduction to potentiometry: Types of indicators and reference electrodes
  2.2.3 Introduction to voltammetry
2.3 Electro chemical cells and cell reactions
2.4 Electrode and electrode potentials

Unit 3 Biomolecules and synthetic materials **[10hrs]**

3.1 Introduction to biomolecules
  3.1.1 Carbohydrate, Lipids, Amino acids and Proteins: Classification, Properties and functions
  3.1.2 Molecular nature of Genetic materials: DNA and RNA
3.2 Synthetic materials
  3.2.1 Polymers and polymerization
  3.2.2 Classification of polymers based on occurrence, thermal behavior, types of polymerization and chemical structure
  3.2.3 Polymer in medicine: Preparation, properties and applications of Kevlar, Polyurethane, polycarbonate, polypropylene, polyethylene, polyvinyl chloride (PVC)

Unit 4 Instrumental methods of Analysis **[18hrs]**

4.1 Centrifugation techniques [2hrs]
Introduction, Principle, Types, instrumental components and applications

4.2 Colorimetry [2hrs]
Introduction, Lambert's – Beers Law, instrumental components of colorimeter and applications

4.3 Introduction to Electrophoresis [2hrs]
Basic principle, classification and application

4.4 Introduction to Chromatographic techniques [2hrs]
Introduction classification, HPLC and GC Principle, Instrumental components and application

4.5 Spectroscopic techniques [2hrs]
Introduction, Electromagnetic resonance (EMR), Atomic and molecular spectroscopic technique

4.6 Mass Spectroscopic Technique [2hrs]
Introduction, Principle, instrumental components and applications

4.7 Radioisotope Technique [2hrs]
Radioactivity Alpha, Beta Gama Radiations handling of Radiochemical, measurement of radiation with GM Counter, Medical uses of Radio Isotopes of Iodine131, Iron -59, Gold 198, Technitium 99, Markers, and Calcium 47, FDG.

4.8 Nucleic Acid Amplification Technique [4hrs]
Introduction of PCR, Principle, Nucleic acid extraction and preparation for amplification, types (conventional and real time), components of PCR, thermos cyclic and its types

Unit 5 Acid, Base, Salt and Buffers **[4hrs]**

5.1 Different concept of Acid, base and salt, buffer and types of buffers, biological buffers and their importance, Handerson-Hessel batch equation

5.2 Auto-ionization of water, pH and pH scale, pH meter, membrane indicator electrode

5.3 Electrolytes: Introduction, types of electrolytes, conductance, conducto meter, conductivity cell

Biomedical Chemistry
Practical

Practical: 1 hour/week

1. Orientation of different glass wares and analytical lab equipment.
2. Preparation of acidic buffer solution and verify its pH with the help of pH meter.
3. Determination of Concentration of Acid/Base with the help of pH meter.
4. Carry out the conductometric titration between strong acid and strong base.
5. Determine the λ max of potassium permanganate and verify Lambert- Beer's Law.
6. Perform the separation of mixture components by centrifugation technique.
7. Perform the electrophoresis technique for the separation of proteins.
8. Perform the potentiometric titration for the determination of concentration of given sample.
9. Demonstration of PCR Machine.

References:

1. Foundations of Chemistry MK Sthapit and RR Pradhanga
2. Essentials of Physical Chemistry ArunBahl, BS Bahl G.D Tuli
3. A text book of Organic Chemistry BS Bahl and ArunBahl

Marks Scheme

Unit	1	2	3	4	5	Total
Hours	5	8	10	18	4	45
Marks	8	16	18	30	8	80

Electronics and Logic Circuits I
EG1125BM

Lecture: 4 Hours/week
Tutorial: 0 Hours/Week
Practical: 3 Hours/Week
Total: 7 Hours/Week

First semester

Course Description:

This course focuses on the study, design and application of electronic devices/equipment along with logical concept that are based on digital techniques used in biomedical equipment.

Course Objectives:

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

1. To introduce the fundamentals of analysis of electronic circuits
2. To provide basic understanding of semiconductor devices and analog integrated circuits
3. To introduce basic principles of digital logic design, its implementation and applications.

Course Contents

Theory

Unit 1 Introduction to electronic passive components **[6hrs]**

1.1. Resistors and Resistance
  1.1.1.Introduction and classifications of fixed and variable resistors
  1.1.2.Color coding of Resistor
  1.1.3 Resistance circuit: Series and Parallel Connection
1.2. Inductors and Inductance
  1.2.1 Introduction and classifications of fixed and variable Inductors
  1.2.2 Types of Inductors used in electronic circuit
  1.2.3 Inductance circuit: Series and Parallel Connection
1.3. Capacitors and Capacitance
  1.3.1 Introduction and classifications of capacitors
  1.3.2 Color coding of Capacitor
  1.3.3 Capacitance circuit: Series and Parallel Connection
  1.3.4 Applications of resistor, inductor and capacitor

Unit 2 Principle of Semiconductor Devices **[6hrs]**

2.1 Introduction: Conductor, Semiconductor and Insulator
2.2 Energy levels, Valence band & Conduction Band
2.3 Conduction in solids: Electron and Hole flow
2.4 Intrinsic and Extrinsic semiconductor
2.5 Doping, Diffusion, Drift, Carrier Generation and Recombination
2.6 Effect of heat and light on conductivity of Intrinsic semiconductor
2.7 Extrinsic semiconductor
  2.7.1 P-type semiconductor
  2.7.2 N-type Semiconductor

2.7.3 Effect of temperature on extrinsic semiconductors

2.8 Majority and Minority charge carrier

Unit 3 Semiconductor Diodes

[8hrs]

3.1 P-N Junction and junction diode

3.2 Depletion layer and Barrier potential

3.3 Biasing of P-N Junction diode

3.2.1 Forward biasing

3.2.2 Reverse biasing

3.4 Ideal and Practical Semiconductor diodes: Forward and Reverse bias characteristics

3.4.1 Breakdown voltage, Knee voltage, Maximum forward current, Peak inverse voltage, Maximum power rating

3.5 Diode equation derivation

3.6 P-N junction breakdown: Zener and Avalanche effect

3.7 Zener diode:

3.7.1 Ideal and Practical Characteristics

3.7.2 Zener diode as a voltage regulator

3.8 P-N junction diode Applications: Switching, AC blocking, Protection

Unit 4 Power Supplies

[8hrs]

4.1 Introduction and types of Rectifier circuit

4.2 Half wave Rectifier: Construction, working, Advantages and Disadvantages

4.3 Full Wave Rectifier: Construction, working, Advantages and Disadvantages

4.3.1 Center tapped Rectifier

4.3.2 Bridge Rectifier

4.4 Analysis of Rectifier circuit: Output frequency, DC output current and voltage, RMS current and voltage, Peak factor, form factor, Rectification efficiency, and Ripple factor

4.5 Comparison between Half wave, Center tap and Bridge rectifier

4.6 LM317 and LM78XX, 79XX voltage regulators

4.7 Introduction to SMPS

Unit 5 Introduction to Digital Electronics

[6hrs]

5.1 Introduction to Analog & Digital electronics system

5.2 Advantages of Analog signals over Digital Signal

5.3 Digital Computer

5.3.1 Block Diagram

5.3.2 Advantages of Digital system

5.4 Clock waveform

5.4.1 Edge Triggered: Positive & Negative

5.4.2 Level triggered: High Level & Low Level

5.5 Positive & Negative Logic

5.6 Logic level diagram

5.7 Basic Concept of Integrated circuits and level of Integration: SSI, MSI, LSI, VLSI, ULSI

Unit 6 Number System and codes

[4hrs]

6.1 Binary Octal, Decimal, Hexadecimal Number System and their conversion
6.2 Representations of BCD, ASCII, Excess-3, Gray and EBCDIC codes
6.3 Code conversion Binary/BCD/Excess-3/Gray
6.4 Binary arithmetic: Addition Signed and Unsigned binary numbers
6.5 Subtraction, Multiplications and Division
6.6 1's, 2's, 9's and 10's Complement

Unit 7 Fundamental of Digital Electronics

[22hrs]

7.1 Introduction to logic gates:
  7.1.1 Basic gates: NOT, OR, AND
  7.1.2 Derived gates: NOR, NAND, EX-OR, EX-NOR
7.2 Universal gates
7.3 De-Morgan's laws
7.4 Boolean algebra: Theorems and Simplifications
7.5 Simplification of Logic functions using K-Map up to 4 variables
  7.5.1 SOP Expressions
  7.5.2 POS Expressions
  7.5.3 Don't care conditions
7.6 Adder
  7.6.1 Half adder
  7.6.2 Full Adder
  7.6.3 Fast Adder
  7.6.4 Implementation of Half adder in to full adder
7.7 Subtractor
  7.7.1 Half Subtractor
  7.7.2 Full Subtractor
  7.7.3 Adder Subtractor
  7.7.4 Implementation of Half subtractor in to full subtractor
7.8 Encoder
  7.8.1 Decimal to binary
  7.8.2 Decimal to BCD
7.9 Decoder
  7.9.1 BCD to decimal
  7.9.2 BCD to 7-segment
7.10 Multiplexers
7.11 De-multiplexers
7.12 Implementation of Mux, De-Mux, Encoder, Decoder
7.13 Magnitude comparator (Up to 3 bits)
7.14 Odd and Even Parity generator and checker
7.15 Application of combinational logic circuits

Electronics and Logic Circuits I

Practical

Practical: 3 Hours/Week

1. Introduction to Laboratory equipment
2. Measurement of voltage, current, resistance and series & parallel resistance circuit
3. To verify P-N junction diode characteristics
4. To verify Zener diode characteristics
5. To design and construct Rectifiers and smoothing circuits
6. To verify positive and negative fixed voltage DC power supply using three terminal voltage regulator IC (7805, 7812, 7905, LM 317)
7. Familiarization with logic breadboard with verification of truth table of Basic and Derived Logic Gates
8. To verify De-Morgan Laws
9. To verify NAND& NOR gate as Universal Gates
10. Verify the operations of Encoder, Decoder, Multiplexers [4:1] and De-Multiplexers [1:4]
11. Verify the operations of BCD to Decimal Decoder
12. Verify the operations of Binary to Gray Code conversion and vice-versa
13. Design and verifications of BCD to 7 segment Decoder
14. Design and verification of 3bit Parity Generator and Checker
15. Design and verifications of 2bit Magnitude Comparator
16. Design and implementations of Full Adder/Subtractors using Half Adders/Subtractors

References:

1. Robert L. Boylestad and Louis Nashelsky, “Electronic Device and Circuit Theory”, Pearson
2. J.B. Gupta, “Electronic Devices and Circuits”, Katson
3. M. Morris Mano, “Digital Logic and Computer Design”, Pearson
4. Floyd T.L. “Digital Fundamentals”, Pearson
5. Dr. Sanjay Sharma, “Electronic Principles”, Katson

Marks Scheme

Unit	1	2	3	4	5	6	7	Total	
Hours	6	6	8	8	6	4	22	60	
Marks	8	8	12	12	8	8	24	80	

Engineering Mathematics
EG1126BM

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

First semester
Course Description:

This subject consists of six units related to matrix algebra; trigonometry; calculus; statistics, and probability and probability distribution, necessary to develop mathematical and statistical knowledge which is helpful for the understanding and practicing the related engineering works.

Course Objectives:

After the completion of this course students will be able to:
1. Matrix algebra and apply them in the field of the related engineering area
2. Trigonometric ratios and equations, inverse circular functions and properties of triangles
3. Function, limit and continuity, derivatives and integrations
4. Statistics, measures of central tendency, measures of dispersion, simple correlation and simple linear regression
5. Probability and probability distribution

Course content

Theory

Unit 1 Matrix Algebra **[6hrs]**

1.1 Introduction and Definition of Matrices
1.2 Algebra of Matrices
1.3 Determinants and its properties
1.4 Adjoint and Inverse of Matrices
1.5 Solution of System of Linear Equations (Cramer's Rule, Row – equivalent method and Inverse of Matrix method)

Unit 2 Trigonometry **[8hrs]**

2.1 Basic trigonometric formulae
2.2 Trigonometric identities and conditional identities
2.3 Trigonometric equations:
  2.3.1 General solutions of the following equations:
    2.3.1.1 Sin x = k, cos x = k and tan x = k using trigonometric equations
2.4 Inverse circular functions:
  2.4.1 Domain and their graphs
  2.4.2 Formulae involving inverse circular functions
  2.4.3 Simple identities and equations involving circular functions
2.5 Properties of triangles:
  2.5.1 Sine law
  2.5.2 Cosine law
  2.5.3 Projection law

2.5.4 Half angle law
2.5.5 Area of a triangle
2.5.6 Encircles and ex – circles of a triangle

Unit 3 Calculus

[9hrs]

3.1 Function, Limit and Continuity
3.2 Derivatives from definition (first Principle) of simple function like: x^n, $(ax+b)^n$, $\sin(ax+b)$, $\cos(ax+b)$, e^{ax}, ax and $logx$.
3.3 Derivatives of sum, difference, product and quotient of functions, chain rule, parametric and implicit functions
3.4 Integration, rules for finding integrals
3.5 Standard integrals and their uses
3.6 Definite integrals – definition and evaluation
3.7 Definite integral as limit of sum

Unit 4 Statistics

[12hrs]

4.1 Introduction of Statistics (Definition, functions, limitations and applications)
4.2 Collection, classification and representation of data (Histogram, frequency polygon, frequency curve, cumulative frequency curve, bar chart and pie chart)
4.3 Measures of central tendency
4.4 Measures of dispersion
4.5 Simple correlation and simple regression
4.5.1 Definition of simple correlation
4.5.2 Types of correlation
4.5.3 Methods of measuring simple correlation
4.5.4 Simple linear regression

Unit 5 Probability and Probability Distribution

[6hrs]

5.1 Concept of probability
5.2 Laws of probability addition and multiplication
5.3 Concept:
5.3.1 Conditional probability
5.3.2 Theoretical probability distribution
5.3.2.1 Binomial distribution
5.3.2.2 Poisson distribution
5.3.2.3 Normal distribution

Unit 6 Applications of MS - Excel in Statistics

[4hrs]

6.1 Introduction and Definition of Matrices
6.2 Algebra of Matrices
6.3 Determinants and its properties
6.4 Adjoint and Inverse of Matrices
6.5 Solution of System of Linear Equations (Cramer's Rule, Row – equivalent method and Inverse of Matrix method)

Reference

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. E. Kreyszig, Advanced Engineering Mathematics, Wiley-Easter Publication, New Delhi, 1990.

Marks Scheme

Unit	1	2	3	4	5	6	Total
Hours	6	8	9	12	6	4	45
Marks	12	16	18	22	10	2	80

Workshop Technology
EG1127BM

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

First semester
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 related activities. The content includes identification of basic hand tools, measuring instruments, power tools, along with their uses, care and safety in the mechanical engineering sector.

Course Objectives:
After the completion of this course students will be able to:
1. Discuss on safety, uses and application involved in medical equipment activities in work area.
2. Describe on mechanical engineering workshop activities related to bio medical field.

Contents

Theory

Unit 1 Safety

[2hrs]

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.

Unit 2 Measurements

[2hrs]

In all the topics safe working and correct procedure to be 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.

Unit 3 Material removal process

[3hrs]

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

Unit 4 Joining- temporary joining

[2hrs]

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.

Unit 5 Joining Process Permanent Joining

[3hrs]

5.1 Different methods of fastening sheet metal by soldering.
5.2 Brazing operation and its application in hospital pipe network.
5.3 Riveted joints for sheet metal working.
5.4 Detailed introduction into gas welding.
5.5 Detailed introduction into metal arc welding.

Unit 6 Electrical Safety of Medical Equipment

[4hrs]

6.1 Basic concept of Electric Shock and safety rule.
6.2 National and international safety standards
6.3 Care, uses, and application of industrial hygiene & safety. (Special for gas safety & Device/appliances)
6.4 Prevention of electrical accident with medical Equipment.
6.5 Care, uses, handling and application of basic electrical tools.
6.6 Safe use of electrical equipment and compressed air equipment. (with repair & maintenance schedule)
6.7 Basic chemical safety
6.8 Radiation hazards

Workshop Technology
Practical

Practical: 3 hours/week

1. Bench tools and hand operation – Introduction to workshop tools, measuring, layout cutting, filling, drilling, tapping and safety tips.
2. Fitting exercise: marking out, cutting out and filing to size. Squared, angled, curved and tangential surface.
3. Fitting exercise: filing, drilling, tapping, grinding and assembly of components.
4. Fitting exercise: marking out, cutting out, bending, shearing, punching and riveting on thin sheets.
5. Soldering exercise: soft soldering, joining metal by soldering, electric connection by solder
6. Brazing exercise: braze welding of copper tubes.
7. Material removal process: lathe
8. Maintenance: Cleaning working place, storing tools in appropriate place.

References

1. S. K. HajraChoudhury and A. K. HajraChoudhury, “Elements of Workshop Technology - Vol. I (Manufacturing Processes)”, Media Promoters and Publishers Pvt. Ltd., Bombay, INDIA.
2. S. K. HajraChoudhury, S. K. Bose and A. K. HajraChoudhury, “Elements of Workshop Technology - Vol. II: (Machine Tools)”, Media Promoters and Publishers Pvt. Ltd., Bombay, INDIA.
3. P. C. Sharma, “A Textbook of Production Engineering”, S Chand, India
4. M. Adithan, A.B. Gupta, “Manufacturing Technology”, New Age International P Ltd, India
5. R. S. Khurmi and J. K. Gupta, “A text book of Workshop Technology”, S. Chand and Company Ltd, New Delhi. INDIA

PROJECT LIST

S No	Project	Skill	Metal/ Work piece	Size /mm	Time /hrs.
1	Measurement and first aid	Introduction to working tools, tools cleaning and placement, introduction to safety, first aid	As per need	As per need	1
2	Pen Holder	Measuring, marking, sawing, filing, drilling, thread cutting, riveting	MS Sheet	As per need	8
3	Bottle opener	Measuring, marking, sawing, filing, drilling	MS flat	As per need	9
4	Dust pan	Measuring, marking, Heming, seaming, cutting, folding, riveting	GI sheet 22 gauge	350 x 400	9
5	Soldering	Soldering in PCB, flux, solder	As per need	As per need	6
6	Brazing	Measuring, marking, sawing , closed butt joint brazing	Copper	Ø 16 x 700	9
7	Welding	Striking, padding, Butt joint , lap joint	MS flat	100x100	6
8	Material Removal process	Facing, turning, parting, threading in Lathe.	MS rod	Ø 16 x 500	3
9	Practical Test	Evaluate the all the bench work sharping the hand tool and power Tool	As per need	As per need	

Computer and Programming
EG1128BM

Lecture: 3 hours/week
Tutorial: hours/week
Practical: 3 hours/week
Total: 6 hour/week

First semester
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. Describe the basic skills needed in programming
2. Write, compile, debug and run a program in C
3. Discuss the uses of all data types in C
4. Describe the use of functions and write functions in C
5. Discuss different control structures
6. Use Arrays, Strings and Pointers in their programs
7. Use input/output statements in a program.
8. Read/write/search in a file through a C program.

Course Contents:

Theory

Unit 1 Introduction to Computer and its Application

[2hrs]

1.1. Introduction
1.2. History of computer development
1.3. Application of Computer in Biomedical Instrumentation

Unit 2 Problem Solving Using Computer

[5hrs]

2.1 Introduction to programming language
2.2 Different Programming Techniques
  2.2.1 Procedural Programming
  2.2.2 Modular Programming
  2.2.3 Object Oriented Programming
2.3 Problem solving steps in Computer Programming
  2.3.1 Problem Analysis
  2.3.2 Algorithm Development and Flowcharts
  2.3.3 Coding
  2.3.4 Compilation and Execution
  2.3.5 Debugging and Testing
  2.3.6 Program Documentation

Unit 3 Introduction to C

[5hrs]

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

[2hrs]

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
  5.1.1 If
  5.1.2 If-else
  5.1.3 If-else-if
  5.1.4 Nested if-else
  5.1.5 Conditions
5.2 Loop Control Instructions
  5.2.1 For Loop
  5.2.2 While Loop
  5.2.3 Do While
5.3 Unconditional branching
  5.3.1 Break statement
  5.3.2 Goto
  5.3.3 Continue
5.4 Selection Instructions

Unit 6 Functions

[5hrs]

6.1 Introduction to Functions
6.2 Components of Function
  6.2.1 Name of a function
  6.2.2 Body of a function
  6.2.3 Local variables of a function
  6.2.4 Parameters or Arguments to a function
  6.2.5 Return Values
  6.2.6 Prototype of a function
6.3 Rules of using a function
6.4 Recursive function

Unit 7 Array

[5hrs]

7.1 Introduction to 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 Introduction to 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 Use of pointers
  8.6.1 As function arguments (By reference)
  8.6.2 Pointers and array
  8.6.3 Passing an entire array to a function
  8.6.4 Functions returning a Pointer Variable

Unit 9 Strings

[4hrs]

9.1 Introduction to string
9.2 String I/O
9.3 String Manipulation Functions

Unit 10 Structures and union

[4hrs]

10.1 Declaring, Accessing Structure and union
10.2 Variables Uses of Structures and union

Unit 11 Filing

[4hrs]

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

Computer and Programming

Practical: 3 hours/week

Practical

1. Familiar with C IDEs
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 and union
   6.1 Familiar with Structures and union
7. Data files
   7.1 Familiar with Data files

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
6. A Text Book of C Programming, Babu Ram Dawadi and Ram Datta Bhatta, Vidhyarthi Publication

Marks Scheme

Unit	1	2	3	4	5	6	7	8	9	10	11	Total
Hours	2	5	5	2	4	5	5	5	4	4	4	45
Marks	4	8	8	4	8	8	8	8	8	8	8	80

Second Semester

Electronics and Logic Circuits II
EM1222BM

Lecture: 4 hour/week
Tutorial: 0 hours/Week
Practical: 3 hour/week
Total: 7 hour/week

Second Semester

Course Description:

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

Course Objectives:

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

1. Introduce the fundamentals of analysis of electronic circuits
2. Provide basic understanding of semiconductor devices and analog integrated circuits
3. Introduce basic principles of digital logic design, its implementation and applications.
4. Introduce basic understanding of power electronics devices.

Course content

Theory

Unit 1 Transistors **[2hrs]**

1.1 Introduction and Classification
1.2 Transistor Construction: NPN and PNP
1.3 Transistor Geometry and Doping level

Unit 2 Bipolar Junction Transistor (BJT) **[10hrs]**

2.1 Bipolar Junction Transistor Terminals: Emitter, Base and Collector
2.2 Transistor equations (Relation between α and β)
2.3 BJT configuration: Input and Output Characteristics
  2.3.1 Common Emitter Configuration (CE Amplifier)
  2.3.2 Common Base Configuration (CB Amplifier)
  2.3.3 Common Collector Configuration (CC Amplifier)
2.4 Active, Saturation, cut off mode and punch through effect
  2.4.1 BJT as a switch
  2.4.2 BJT as a differential amplifier
  2.4.3 Definition, Characteristics and Applications of Amplifier circuit: Class A, Class B, Class AB, Class C:

Unit 3 Field Effect Transistor (FET) **[12hrs]**

3.1 Junction field effect Transistor JFET: Basic Construction, Standard Notations: Source, Drain, Gate and Channel, Schematic Symbols, Polarity Conventions, Working Principle, IV characteristics and different region of operations
3.2 MOSFET: Construction, working Principle, Schematic Symbols, characteristics and different region of operations
3.3 MOSFET types: Enhancement and Depletion, Working with different voltage conditions, I-V characteristics and operating regions

3.4 MOSFET as switch
3.5 Introduction to CMOS
3.6 Comparison of BJT, JFETs and MOSFETs

Unit 4 Special Semiconductor Devices:

[12hrs]

4.1 Working principles, functional circuits, characteristics and applications of UJT, PUT, SCR, DIAC, TRIAC and IGBT
4.2 LED and LCD: Characteristics and applications
4.3 Photo Transistor and Photocell: Characteristics and applications
4.4 Opto-Couplers and Isolators: Brief introduction
4.5 Hall Effect Devices: Brief introduction and Applications
4.6 Types of Diode: LDR, Photodiode, Tunnel diode, Schottky Diode

Unit 5 Sequential Circuit

[14hrs]

5.1 Latches and Flip Flops
  5.1.1 Triggering of Flip Flop: Edge triggering & Level Triggering
  5.1.2 Flip Flops: Graphic Symbol, Logic diagram, Characteristics table, State Transition Table, State equations, Excitation Table, State Transition Diagram, Wave diagram
    5.1.2.1 SR flip flop
    5.1.2.2 D-flip flop
    5.1.2.3 JK- flip flop and Race around condition
    5.1.2.4 T-flip flop
    5.1.2.5 Master Slave flip flop
    5.1.2.6 Realization of one flip flop into others
5.2 Shift Registers
  5.2.1 Serial in Serial Out (SISO)
  5.2.2 Serial In Parallel Out (SIPO)
  5.2.3 Parallel In Serial Out (PISO)
  5.2.4 Parallel In Parallel Out (PIPO)
  5.2.5 Applications of Shift Registers: Ring Counter and Johnson Counter
5.3 Counters
  5.3.1 Asynchronous and Synchronous counters
  5.3.2 Design of Ripple Up and Down Counters
  5.3.3 Design of 3 bit serial Up and Down Counters
  5.3.4 BCD/Decade Counter
  5.3.5 Modulus counter (Mod 5, 7, 11) and Design principles
  5.3.6 Application of Counters: Frequency Counter & Digital Watch

Unit 6 Introduction to Memory and programmable logic

[6hrs]

6.1 Static and Dynamic memory
6.2 Types of Memory: RAM, ROM, PROM, EPROM, EEPROM
6.3 Programmable logic: PAL, PLA and ROM

Unit 7 Digital Displays

[4hrs]

7.1 LED Display
7.2 LCD Display
7.3 Gas-Plasma Display
7.4 7-swgment system
7.5 Alphanumeric Display
    7.5.1 Principles", Katson

Electronics and Logic Circuits II
Practical

Practical :3hour/week

1. Transistor as a Switch and Relay Control
2. Testing BJT transistor Common emitter (CE) characteristics
3. Testing JFET Characteristics
4. Testing MOSFET characteristics
5. Testing SCR characteristics
6. Construct and analyze NOT gate using BJT and FETs
7. Verify operations of various Flip Flops
8. Verify operations of Shift Registers (SISO, SIPO, PISO, PIPO)
9. Verify operation of Ring counter, Up/Down Counter (up to 4 bit)
10. Verify operation of Asynchronous and Synchronous Counters
11. Design and Realizations of BCD and Modulo-Counters
12. Design of electronic circuits using software tools and fabrication of PCB.

References:

1. Robert L. Boylestad and Louis Nashelsky, “Electronic Device and Circuit Theory”, Pearson
2. J.B. Gupta, “Electronic Devices and Circuits”, Katson
3. M. Morris Mano, “Digital Logic and Computer Design”, Pearson
4. Floyd T.L. “Digital Fundamentals”, Pearson
5. Dr. Sanjay Sharma, “Electronic Principles”, Katson

Marks Scheme

Unit	1	2	3	4	5	6	7	Total
Hours	2	10	12	12	14	6	4	60
Marks	4	12	16	14	18	10	6	80

Bio-Medical Instrumentation I

EM1221BM

Lecture: 3 hour/week
Tutorial: hours/Week
Practical: 3 hour/week
Total: 6 hour/week

Second Semester

Course description:

This course is designed to present the basic concepts of medical instruments, design analysis ofvarious 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. Explain working, parts and troubleshooting of various medical instruments.

Course contents:

Theory

Unit 1 Fundamentals of Medical Instrumentation **[2hrs]**

- 1.1 Introduction
- 1.2 Medical Instrumentation System
  - 1.2.1 Subject
  - 1.2.2 Stimulus
  - 1.2.3 Transducers
  - 1.2.4 Signal conditioning equipment
  - 1.2.5 Display
  - 1.2.6 Recording and data transmission
  - 1.2.7 Data storage
- 1.3 Implantable Medical Devices
  - 1.3.1 Concept
  - 1.3.2 Examples

Unit 2 Signals and Electrodes **[4hrs]**

- 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
  - 2.6.1 Bio-potential electrodes
  - 2.6.2 Microelectrodes
  - 2.6.3 Skin surface electrodes

Unit 3 Physiological Transducers

[4hrs]

3.1 Active transducers
3.2 Passive transducers
  3.2.1 Passive transducers using resistive elements
  3.2.2 Passive transducers using inductive elements
  3.2.3 Passive transducers using capacitive elements
3.3 Transducers for biomedical applications

Unit 4 Measuring and monitoring system

[16hrs]

4.1 Electrocardiograph (ECG)
  4.1.1 The electrocardiogram
  4.1.2 The electrocardiographic diagnosis
  4.1.3 ECG lead configurations
  4.1.4 Introduction to Holter
4.2 Electroencephalograph (EEG)
  4.2.1 EEG electrode configurations
  4.2.2 EEG recording techniques
  4.2.3 Practical; details of EEG
4.3 Electromyograph (EMG)
  4.3.1 Electromyographic recording techniques
4.4 Oximetry
  4.4.1 Pulse Oximeter
  4.4.2 Skin Reflectance Oximeter
4.5 B.P monitoring
4.6 Patient Monitoring System
  4.6.1 Introduction to patient monitoring system
  4.6.2 Central patient monitoring system
4.7 Pulmonary Function Test
  4.7.1 Introduction
  4.7.2 Working Principle
  4.7.3 Pulmonary function measurements
  4.7.4 Spirometry
4.8 Biotelemetry
  4.7.1 Introduction to Biotelemetry
  4.7.2 The components of a biotelemetry system

Unit 5 Therapeutic Biomedical devices

[15hrs]

5.1 Cardiac pacemakers
  5.1.1 General working principle
  5.1.2 Types
5.2 Defibrillators
  5.2.1 General working principle
  5.2.2 Types
5.3 Dialysis Equipment
  5.3.1 Introduction and its working principle
  5.3.2 Types of dialysis
  5.3.3 Peritoneal dialysis and hemodialysis

5.4 ESWL
5.5 Ventilators
    5.5.1 Mechanism of breathing
    5.5.2 Artificial Ventilation
    5.5.3 Types and parts of Ventilators
5.6 Anesthesia Machine
5.7 Syringe pump and infusion pump

Unit 6 Laser application in Biomedical filed.

[4hrs]

6.1 Introduction to laser
6.2 Principle of laser
6.3 Application of laser
    6.3.1 Surgical application
    6.3.2 Therapeutic application

Bio-Medical Instrumentation I
Practical

Practical: 3 hour/week

Note: Practical of Biomedical Instrumentation-I/ II and Biomedical Equipment Maintenance-I/ II will be done together

1. Demonstrate different types of electrodes and transducer used in medical electronics.
2. Measurement of Heart Sounds and Blood Pressure.
3. ECG analysis and their recording techniques.
4. EEG analysis and their recording techniques.
5. EMG analysis and their recording techniques.
6. Pulmonary function analysis and their recording techniques.
7. Demonstration of
   - 7.1 Defibrillator
   - 7.2 Ventilator
   - 7.3 Anesthesia machine
   - 7.4 Hemodialysis machine
   - 7.5 Syringe pump and infusion pump

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.

Marks Scheme

Unit	1	2	3	4	5	6	Total
Hours	2	4	4	16	15	4	45
Marks	4	8	8	28	24	8	80

Measurement and Instrumentation

EG1223BM

Lecture :3 hour/week
Tutorial :0 hour/week
Practical: 2 hour/week
Total: 5 hour/week

Second Semester

Course Objectives:

After completion of this course the student will be able to

1. Describe construction and operation of various types of electrical instrument.
2. Describe the operation of different types of bridge for resistance, inductance and capacitance measurement.
3. Learn about digital measurement system.

Course Contents:

Theory

Unit 1 Fundamentals of Measurements **[4hrs]**

- 1.1 System of Units
  - 1.1.1 Fundamental and derives units
  - 1.1.2 System International (SI) units
- 1.2 Measurement terminologies
  - 1.2.1 Accuracy
  - 1.2.2 Precision
  - 1.2.3 Sensitivity
  - 1.2.4 Resolution
  - 1.2.5 Response time
  - 1.2.6 Frequency response and Bandwidth
- 1.3 Errors in measurement and error types
- 1.4 Basic Principle of Indicating Instrument
  - 1.4.1 Torque and deflection
  - 1.4.2 Permanent magnet moving coil (PMMC) mechanism

Unit 2 Measuring Instruments **[12hrs]**

- 2.1 Analog and digital Multi-meter and Clamp meter
  - 2.1.1 Working Principle and Characteristics
  - 2.1.2 Basic Block Diagram
- 2.2 Oscilloscope
  - 2.2.1 Working Principle
  - 2.2.2 Basic Block Diagram
  - 2.2.3 Applications

Unit 3 Transducers **[10hrs]**

- 3.1 Introduction
- 3.2 Classification
- 3.3 Application

3.3.1 Measurement of displacement
- 3.3.1.1 Resistive Potentiometer
- 3.3.1.2 Linear variable displacement transformer (LVDT)
- 3.3.1.3 Variable capacitance transducers

3.3.2 Measurement of angular velocity
- 3.3.2.1 DC Generator tachometer
- 3.3.2.2 Photo electric pick-up tachometer

3.3.3 Piezoelectric transducers
- 3.3.3.1 Materials, Constructions, Operating principles and Application of piezoelectric transducers

3.3.4 Measurement of temperature
- 3.3.4.1 Thermistor and thermocouple
  Principle, Construction and Application

Unit 4 Electrical Signal Processing

[6hrs]

4.1 Characteristics of Ideal and practical Op-amp
4.2 Signal amplification, attenuation, integration, differentiation, network isolation, wave shaping using Op-amp
4.3 Instrumentation amplifier
4.4 Introduction to noise and distortion
4.5 Filter: LPF, HPF, BPF and BSF (notch filter) and application

Unit 5 Analog - Digital and Digital - Analog Conversion

[6hrs]

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

Unit 6 Digital Instrumentation

[2hrs]

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

Unit 7 Biomedical Testing Equipment

[5hrs]

7.1 Introduction to:
- 7.1.1 Safety – Analyzer
- 7.1.2 Defibrillator tester
- 7.1.3 Patient Simulator
- 7.1.4 Pulse Oximeter Calibration
- 7.1.5 Oxygen analyzer
- 7.1.6 Gas Analyzer
- 7.1.7 KVP, mA, Time, mAs, Dose meter
- 7.1.8 Ultrasound Phantom
- 7.1.9 Insulation tester
- 7.1.10 Earthing test

Measurement and Instrumentation
Practical

Practical: 2 hour/week

1 Measurement of average value of quantity and range of error.
2 Estimation of cross error and calculating limiting error.
3 Converting multi-meter range and measurement of current, voltage and resistance.
4 AC/DC voltage and frequency measurement using Oscilloscope.
5 Study of Transducer for measurement
  5.1 Displacement (resistive, inductive and capacitive)
  5.2 Angular displacement using tachometer
  5.3 Working of Piezoelectric sensor
  5.4 Temperature measurement with thermistor and thermocouple
6 Instrumentation amplifier as:
  6.1 Voltage Follower
  6.2 Inverting Op-Amp
  6.3 Non-inverting Op-Amp
  6.4 A differentiator and an integrator.
7 Construction of LPF and HPF
8 Digital to Analog, Analog to Digital Conversion
  8.1 Perform static testing of D/A and A/D converter

Reference Books

1 Electronic Instrumentation and Measurement Technique by, Heldrick and Copper PHI, India
2 Barney GC. “Intelligent Instrumentation” – PHI- 1998
3 Electronic Instrumentation H.S Kalsi, TMC New Delhi
4 Biomedical Instrumentation and Measurements. R. Anandanatarajan
5 Handbook of Biomedical Instrumentation. R. S. Khandpur

Marks Scheme

Unit	1	2	3	4	5	6	7	Total
Hours	4	12	10	6	6	2	5	45
Marks	6	19	19	13	13	4	6	80

Microprocessor Basics and Microcontroller
EM1224BM

Lecture: 3 hour/week
Tutorial: 0 hour/week
Practical: 2 hour/week
Total: 5 hour/week

Second Semester
Course Description:
This course deals with the fundamentals of microprocessor, architecture and interfacing of microcontrollers in C programming language.

Course Objectives:

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

1. Discuss the basics of microprocessor
2. Discuss the architecture of 8051 microcontroller
3. Use C programming language for I/O interfacing with 8051 micro controller

Course Contents:

Theory

Unit 1 Introduction to Microprocessor

[3hrs]

1.1. Microprocessor
1.2. Stored Program concept, Harvard architecture, Von-Neumann architecture
1.3. Bus Organization in microprocessor
1.4. Microcontroller and its applications
1.5. RISC vs CISC

Unit 2 8085 Microprocessor

[5hrs]

2.1 Internal architecture of 8085 microprocessor
2.2 Schematic and pin diagrams, pin functions
Introduction of Assembly Programming Language
2.3 Generation of control signals, 8085 machine cycles, fetch and execution of MOV, STA, OUT, and LDA instruction with timing diagram.

Unit 3 8051 Microcontroller

[4hrs]

3.1 CPU architecture block diagram, Pin diagram and Pin Functions
3.2 Introduction to MCS-51 family microcontrollers
3.3 Basic terminologies in a microcontroller: ROM, RAM, Timer, I/O pins, Serial Port, Interrupt Sources, (speed) frequency
3.4 Features of 8051: ROM, RAM, Timer, I/O pins, Serial Port, Interrupt Sources
3.5 General Purpose and Special Function Registers
3.6 Memory organization, Internal program and data memory

Unit 4 8051 Assembly Language Programming

[5hrs]

4.1 Structure of assembly language
4.2 Assembling and running an 8051 program
4.3 Program counter and ROM space in 8051
4.4 8051 data types and directives
4.5 Flag bits and PSW register
4.6 Register banks and stack
4.7 Assembly language program examples

Unit 5 8051 Programming in C

[10hrs]

5.1 Data types and time delay in 8051 C
5.2 I/O port programming in 8051 C
5.3 Logic operations in 8051 C
5.4 Data conversion programs in 8051 C
5.5 Accessing code ROM space using 8051 C
5.6 Control statements and loops in embedded C
5.7 Data serialization using 8051 C
5.8 Functions and Arrays in embedded C
5.9 Programming 5081 times
5.10 Counter programming

Unit 6 8051 Interrupts

[6hrs]

6.1 Concept of Interrupt
6.2 Types of interrupts
6.3 Interrupt vector routines
6.4 Software generated interrupt
6.5 Interrupt handler subroutine for timer/counter and serial data transmission/reception in C

Unit 7 Design and Interface

[12hrs]

7.1 Interfacing of LEDs, 7 Segment display device
7.2 Push Button switches
7.3 LCD display interface
7.4 Keypad interface
7.5 Interfacing A/D converter, D/A converter
7.6 Sensor interfacing, signal conditioning and noise reduction
7.7 Relay, opto-isolator, stepper motor interface
7.8 DC motor and PWM

Microprocessor Basics and Microcontroller

Practical

Practical: 2 hours/week

1. To demonstrate IDE and Assembler directives.
2. To use 8051 Assembly language programming for addition, subtraction, multiplication and division of two 8-bit numbers.
3. To use: Pushing onto, popping from the stack simulation in 8051 Assembly
4. To demonstrate 8051 registers and memory with a simulator in 8051 Assembly.
5. To perform I/O port programming in embedded C.
6. To perform Timers and Counters programming in C for time delay and frequency measurement using ISRs.
7. Programing of 8051 using C
   - 7.1 Digital clock programming using 7-segment display
   - 7.2 Programming of LCD
   - 7.3 Programming of keyboard
   - 7.4 Serial communication and UART programming
   - 7.5 Interfacing sensors
   - 7.6 Interfacing Stepper Motor.
   - 7.7 Speed Control of DC motor using PWM Technique

References:

1. Microprocessor Architecture, Programming, and Applications with the 8085, By Romesh Gaonkar, Penram International Publishing (India) LTD.
2. The 8051 Microcontroller and Embedded Systems Using Assembly and C, 2/e by Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin Mc Kinlay (Second Edition. Pearson Education)
3. The 8051 Microcontroller & Embedded Systems using Assembly and C By K. J. Ayala,D. V. Gadre (Cengage earning ,India Edition).
4. Using the MCS-51 Microcontrollers by Han Way Huang Oxford Uni Press
5. Programming and Customizing the 8051 Microcontroller by Myke Predko Tata McgrawHill.

Marks Scheme

Unit	1	2	3	4	5	6	7	Total
Hours	3	5	4	5	10	6	12	45
Marks	6	10	8	10	16	14	16	80

Data Communication and Networking
EG1225BM

Lecture: 4 hour/week
Tutorial: 0 hour/week
Practical: 2 hour/week
Total: 6 hour/week

Second Semester

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:

1. Propose efficient, cost effective, reliable and appropriate technology to establish communication links
2. Design an enterprise network employing the common LAN technologies and be able to evaluate the advantages and disadvantages
3. 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
4. Describe the technical issues related to the Wide Area Networks and identify the common technologies available in establishing WAN infrastructure
5. Describe the specific actions that can be taken to enforce network level security.

Course Contents:

Theory

Unit 1 Fundamentals of data communications & networking **[8hrs]**

- 1.1 Introduction to data communications & networking
  - 1.1.1 Uses of data communication
  - 1.1.2 Networking model & its type
  - 1.1.3 Network Topology
  - 1.1.4 Layered Architecture
  - 1.1.5 OSI & TCP/IP model
- 1.2 Communication modes
  - 1.2.1 Simplex
  - 1.2.2 Half-duplex
  - 1.2.3 Full - duplex
- 1.3 Transmission modes
  - 1.3.1 Serial transmission
  - 1.3.2 Parallel transmission
- 1.4 Synchronization
  - 1.4.1 Asynchronous transmission
  - 1.4.2 Synchronous transmission
- 1.5 Channel effects on transmission
  - 1.5.1 Attenuation
  - 1.5.2 Effects of limited bandwidth
  - 1.5.3 Delay distortion

1.5.4 Noise

1.6 Network Topologies
- 1.6.1 Bus
- 1.6.2 Star
- 1.6.3 Mesh
- 1.6.4 Ring
- 1.6.5 Hybrid

1.7 Types of Network
- 1.7.1 Local Area Network
- 1.7.2 Personal Area Network
- 1.7.3 Wide Area Network
- 1.7.4 Metropolitan Area Network

Unit 2 Physical layer

[6hrs]

2.1 Network Monitoring
- 2.1.1 Bandwidth
- 2.1.2 Latency
- 2.1.3 Throughput
- 2.1.4 Delay

2.2 Transmission Media
- 2.2.1 Twisted pair cables
- 2.2.2 Co-axial cables
- 2.2.3 Fiber optic cables
- 2.2.4 Wireless media

2.3 Switching
- 2.3.1 Circuit Switching,
- 2.3.2 Packet Switching
- 2.3.3 Telecommunication switching system
- 2.3.4 T1 & E1 Carrier system

2.4 Multiplexing
- 2.4.1 Frequency division multiplexing (FDM)
- 2.4.2 Time division multiplexing (TDM)
- 2.4.3 Wavelength division multiplexing (WDM)

Unit 3 Data Link Layer

[8hrs]

3.1 Function of Data link layer

3.2 Framing

3.3 Error Detection and Correction
- 3.3.1 Error Detection: Parity Check, Checksum, CRC
- 3.3.2 Error Correction: Hamming Code

3.4 Flow Control
- 3.4.1 Stop and Wait
- 3.4.2 Sliding Window

3.5 Data link Protocol
- 3.5.1 HDLC
- 3.5.2 PPP

3.6 Access Sub-layer (MAC)

3.7 Medium Access Protocol

3.7.1 Random Access: ALOHA, CSMA
3.7.2 Controlled Access: Reservation, Polling, Token Passing

3.8 IEEE Standard
3.8.1 IEEE 802.3 (Ethernet)
3.8.2 IEEE 802.4 (Token Bus)
3.8.3 IEEE 802.4 (Token Ring)
3.8.4 802.11 (Wireless LAN)
3.8.5 FDDI

Unit 4 Network Layers

[10hrs]

4.1 Internetworking Devices
4.1.1 Hub
4.1.2 Bridges
4.1.3 Repeaters
4.1.4 Switches
4.1.5 Router
4.1.6 Gateway

4.2 Addressing
4.2.1 Internet Address
4.2.2 Classful Address

4.3 Subnetting

4.4 Routing Technique
4.4.1 Static routing
4.4.2 Dynamic routing
4.4.3 Routing table for classful address

4.5 Routing Protocols
4.5.1 RIP
4.5.2 OSPF
4.5.3 BGP

4.6 Routing Algorithm
4.6.1 Shortest path algorithm
4.6.2 Flooding
4.6.3 Distance vector routing
4.6.4 Link state routing

4.7 Routing Protocols
4.7.1 ARP
4.7.2 RARP
4.7.3 IP
4.7.4 ICMP

Unit 5 Transport Layer

[10hrs]

5.1 Transport layer services

5.2 Transport layer protocols
5.2.1 User Datagram Protocol (UDP)
5.2.2 Transmission Control Protocol (TCP)

5.3 Addresses
5.3.1 Physical Address
5.3.2 Logical Address

5.3.3 Port Address
5.3.4 Socket Address
5.4 Connection establishment and termination
5.5 TCP synchronization or 3-way handshaking
5.6 Flow control & buffering
5.7 Congestion Control Algorithm
5.7.1 Token Bucket Algorithm
5.7.2 Leaky Bucket Algorithm

Unit 6 Application Layer

[6hrs]

6.1 Web
6.1.1 HTTP
6.1.2 HTTPS
6.2 File Transfer
6.2.1 FTP
6.2.2 PuTTY
6.3 Electronic Mail
6.3.1 SMTP
6.3.2 POP3
6.3.3 IMAP
6.4 DNS
6.5 RTP
6.6 VoIP

Unit 7 Introduction to IPV6

[4hrs]

7.1 IPV6 Advantages
7.2 IPV6 packet format
7.3 IPV6 extension headers
7.4 Transition from IPV4 to IPV6
7.4.1 Dual Stack
7.4.2 Tunneling
7.4.3 Header Translation
7.5 Multicasting
7.6 Firewalls and VPN

Unit 8 Practical aspects of networking

[8hrs]

8.1 Introduction to Biotelemetry
8.1.1 Applications of Telemetry
8.1.2 Elements of Biotelemetry System
8.1.2.1 Amplitude Modulation
8.1.2.2 Frequency Modulation
8.1.2.3 Pulse Modulation
8.2 Introduction to Control Area Network, PACS, DICOM
8.3 Introduction to Telemedicine & Telesurgery

Data Communication and Networking

Practical

Practical: 2 hour/week

1. Use of software tools for Installation of network interface card and various network devices like hub, switch, router etc.
2. Cabling: construction of straight-through and cross-over cable and verify the physical layer connectivity
3. Prototyping Setup networking for Telemedicine
4. Familiarization with basic network commands: Observing IP address and MAC address, Setting IP address and default gateway in PC, Verifying network layer connectivity
5. Configure the PC to obtain IP from DHCP, Release the leased IP, Renew IP (for this there should a DHCP server)
6. Create multiple networks and route packets across multiple networks using static routing/dynamic routing.
7. Design of local area network (LAN)
8. Case study: Organizational visit to study existing network system

References:

1. Tanenbaum Andrew S., Computer Networks, 4thedition (2ndImpression 2006)
2. William Stallings, Data and Computer Communications, 7th Edition (3rdImpression 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)

Marks Scheme

Unit	1	2	3	4	5	6	7	8	Total
Unit Hours	8	6	8	10	10	6	4	8	60
Marks	9	7	9	13	13	9	7	13	80

Healthcare Management
EG1228GM

Lecture: 4 hours/week
Tutorial: hours/week
Practical: 1 hours/week
Total: 5 hours/week

Second Semester

Course description:

This course deals with overall introduction of healthcare setup management to be done by equipment maintenance personnel for safety handling and operation of biomedical equipment &instruments as well as help the management team.

Course objectives:

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

1. Explain the basic concept of Hospital Management
2. Assess of technical requirements for the department
3. Discuss the equipment inventory, procurement process, stores management, maintenance management, other hospital management aspects.
4. Discuss the equipment operation & safety
5. Discuss the workshop layouts

Course Contents:

Theory

Unit 1 Introduction to Healthcare Management **[2hrs]**

1.1 Definition
1.2 Scope
1.3 Importance
1.4 Terminologies on healthcare management.
1.5 Hospitals: Definition, History, Types, Organogram

Unit 2 Healthcare Technology Management and Budgeting in Health **[4hrs]**

2.1 Definition
2.2 Healthcare Technology Management Cycle
2.3 Standardization of Healthcare Technology
2.4 Impacts of Healthcare Technology Management on health system
2.5 Myths and Realities in Healthcare Technology Management.
2.6 Types of budget: Capital and recurrent
2.7 Budgeting system
2.8 Budget cycle steps
2.9 MoH's role in health budget

Unit 3 Hospital Information System **[5hrs]**

3.1 Introduction
3.2 Definition
3.3 Benefits and Objectives of HIS
3.4 Critical Issues
3.5 Planning of HIS
3.6 Concept on EHS and EHR

3.7 Common mistakes in selection of IT system in Hospital
3.8 Ethical Issues of IT

Unit 4 Procurement Management

[10hrs]

4.1 Concept
4.2 Definition
4.3 Objectives
4.4 Elements of good purchasing
4.5 Fundamentals of purchasing
4.6 Principles of purchasing
4.7 Legal aspects of purchasing
4.8 Tender administration
4.9 Factors to be considered while procuring hospital equipment's
4.10 Law governing procurement in Nepal: Public Procurement Act & Regulations (concept and provision/ sections under law and regulations)

Unit 5 Inventory Control and Stores Management

[12hrs]

5.1 Aim, objectives and scope of inventory control
5.2 Types of inventory
5.3 Selective inventory control tools: ABC, VED, FSN, XYZ, HML, SDE, GOLF
5.4 Inventory related cost
5.5 Inventory ordering system: Fixed order quantity, Economic Order Quantity, Periodical Inventory system
5.6 Lead time, Reorder level, Safety stock
5.7 Introduction Store standardization and codification
5.8 Store accounting and stock verification: FIFO, LIFO, FEFO
5.9 Organization and layout of stores
5.10 Types of store
5.11 Space requirements
5.12 Relationship between Store and Biomedical department
5.13 Process of material requisition and transfer
5.14 Preservation of store: Deterioration, Factors responsible, agents of deterioration.

Unit 6 Hospital Quality Management

[8hrs]

6.1 Concept of quality, myth, need and principles
6.2 Quality and cost
6.3 Quality management process
  6.3.1 Quality Assurance and Quality control
  6.3.2 Total Quality Management (TQM)
  6.3.3 Quality issues in healthcare management.
6.4 Six sigma concept
6.5 Accreditation and certification

Unit 7 Hospital Infection and Waste Management

[6hrs]

7.1 Introduction
7.2 Hospital acquired infections
7.3 Classification of waste

7.4 Healthcare waste management
7.5 Planning, segregation, storage & transportation of healthcare wastes

Unit 8 Maintenance Management

[8hrs]

8.1 Planned preventive maintenance
8.2 Repair/ corrective maintenance
8.3 Safety and calibration testing
8.4 Maintenance contract and types
8.5 Records of maintenance works: registers, history cards
8.6 Management of tools, work facilities, spares parts and Introduction and Importance
8.7 maintenance materials
8.8 Reporting and feedback
8.9 Workshop layout

Unit 9 Other aspects in Healthcare Management

[5hrs]

9.1 Purchasing, donation, replacement and disposal policy
9.2 Equipment specifications and technical data
9.3 Energy audit: Introduction, Global standards of Energy Audit, Energy Audit process.

Healthcare Management
Practical

Practical: 1 hours/week

1. To perform Codification of assets
2. Perform the entry of hospital Equipment Inventory using software recommended by the Institute.
3. Familiarization with record keeping & report writing for Hospital management.
4. Design and develop biomedical workshop layout
5. To perform manual development of Bin card, issue vouchers and other record keeping.

References:

1. B. M. Sakharkar, '**Principles of Hospital Administration and Planning**' 2nd edition, 2009, JaypeeBrotherss, India
2. J. R. McGibony, '**Principles of Hospital Administration**' 2nd edition, Macmillan, Toronto
3. A hand book for Hospital Biomedical Engineering Departments. By W. Sanford Topham, PHD
4. Ducel, G. et al., **Prevention of Hospital Acquired Infection, A practical guide**, World Health Organization.
5. Sharma, M. **Hospital Waste Management and Its Monitoring.** New Delhi: Jaypee Brothers Medical Publish.
6. Caroline Temple –Bird, ManjitKaur, Andreas Lenel, WilliKawohl, 'How to Manage' Series for Healthcare Technology, Guide 1- 5, '**How to Organize a System of Healthcare Technology Management.**'

Marks Scheme

Unit	1	2	3	4	5	6	7	8	9	Total
Unit Hours	2	4	5	10	12	8	6	8	5	60
Marks	5	5	5	15	20	10	5	10	5	80

Bio-Medical Equipment Maintenances-I

EG1227BM

Lecture: 3 hours/week
Tutorial: hours/week
Practical: 3 hours/week
Total: 6 hour/week

Second Semester

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.

For the effective and efficient health service delivery, patients, clinicians and visitors must be ensured for safe environment clinical environment, therefore, the course also includes topic of medical safety and hazards control.

Course Objectives:

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

1. Describe the working principle and operating system of the medical devices based on their types and technology.
2. Perform preventive maintenance repair, functional test and calibration of the medical equipment.
3. Ensure safe handling and appropriate use of too land test equipment.
4. Discuss the biomedical hazards

Course Contents*:*

Theory

Unit 1 Safety in Engineering **[3hrs]**

- 1.1 Basic Terms related to safety:
  Safety, Risk, Hazard, Safety Engineering, Safety practice
- 1.2 Electrical Safety
  - 1.2.1 Physiological effect of current
  - 1.2.2 Electrical hazard
  - 1.2.3 Control of electrical hazard
- 1.3 Biohazard
- 1.4 Professional Hazard
- 1.5 Personal Protective Equipment
- 1.6 Use of safety analyzer

Unit 2 Patient and Hospital Environment **[2hrs]**

- 2.1 Working around patients
- 2.2 Infection prevention and control
- 2.3 Medical and surgical asepsis

Unit 3 Different modules of equipment

- 3.1 Concept of Medical Equipment Maintenance

[2hrs]

3.1.1 Introduction to maintenance
3.1.2 Types of maintenance
- 3.1.2.1 Preventive maintenance
- 3.1.2.2 Corrective maintenance
- 3.1.2.3 Use of manuals and datasheet
- 3.1.2.4 Record keeping

3.2 General equipment

[10hrs]

3.2.1 Stethoscope
- 3.2.1.1 Introduction and its working principle
- 3.2.1.2 Type of Stethoscope
- 3.2.1.3 Parts of Stethoscope
- 3.2.1.4 Maintenance and repair
  - 3.2.1.4.1 Preventive Maintenance
  - 3.2.1.4.2 Troubleshooting and Corrective maintenance

3.2.2 Sphygmomanometer (BP Machine)
- 3.2.2.1 Introduction and its working principle
- 3.2.2.2 Type of BP machine
- 3.2.2.3 Aneroid BP machine and Digital BP machine.
- 3.2.2.4 Parts of BP machine
- 3.2.2.5 Maintenance and repair
  - 3.2.2.5.1 Preventive Maintenance
  - 3.2.2.5.2 Troubleshooting and Corrective maintenance

3.2.3 Nebulizers
- 3.2.3.1 Introduction and its working principle
- 3.2.3.2 Type of nebulizer
- 3.2.3.3 Parts of nebulizer
- 3.2.3.4 Maintenance and repair
- 3.2.3.5 Preventive maintenance
- 3.2.3.6 Troubleshooting and Corrective maintenance

3.2.4 Suction Aspirator
- 3.2.4.1 Introduction and its working principle
- 3.2.4.2 Type of Suction Aspirator
- 3.2.4.3 Parts of Suction Aspirator
- 3.2.4.4 Maintenance and repair
- 3.2.4.5 Preventive maintenance
- 3.2.4.6 Troubleshooting and Corrective maintenance

3.2.5 Electrocardiograph (ECG)
- 3.2.5.1 Introduction and its working principle
- 3.2.5.2 Type of ECG machine
- 3.2.5.3 Parts of ECG machine
- 3.2.5.4 Maintenance and repair
- 3.2.5.5 Preventive maintenance
- 3.2.5.6 Troubleshooting and Corrective maintenance

3.2.5.7 Calibration using patient simulator

3.2.6 Defibrillators

3.2.6.1 Introduction and its Operating principle
3.2.6.2 Types of defibrillators
3.2.6.3 Monophasic, biphasic and AED
3.2.6.4 Parts of defibrillators
3.2.6.5 Maintenance and repair
3.2.6.6 Preventive maintenance
3.2.6.7 Troubleshooting and Corrective maintenance
3.2.6.8 Calibration using defibrillator tester (energy, synchrony, Discharge)

3.3 Oxygen generators and storage device

[8hrs]

3.3.1 Oxygen Plant

3.3.1.1 Introduction and Types: PSA & VSA
3.3.1.2 Pressure swing adsorption (PSA) oxygen generating plants
3.2.1.2.1 Introduction and its working principle
3.2.1.2.2 Parts of PSA Plant
3.2.1.2.3 Maintenance and repair of PSA plant
3.2.1.2.4 Preventive maintenance
3.2.1.2.5 Troubleshooting and Corrective maintenance
3.2.1.2.6 Calibration using oxygen analyzer (flow, regulating pressure and % of Oxygen)

3.2.2 Oxygen Concentrator

3.3.2.1 Introduction and its working principle
3.3.2.2 Parts of Oxygen Concentrator
3.3.2.3 Maintenance and repair
3.3.2.4 Preventive maintenance Corrective maintenance
3.3.2.5 Troubleshooting
3.3.2.6 Calibration using oxygen analyzer (flow, regulating pressure and % of Oxygen)

3.2.3 Cryogenic oxygen plant

3.2.3.1 Introduction and its working principle
3.2.3.2 Parts of cryogenic oxygen plant

3.2.4 Oxygen cylinder

3.2.4.1 Introduction and its working principle
3.2.4.2 Type of Oxygen cylinder
3.2.4.3 Parts of Oxygen cylinder
3.2.4.4 Standards (Color code, valve, size according to WHO)
3.2.4.5 Maintenance and repair
3.2.4.6 Preventive maintenance and Corrective maintenance
3.2.4.7 Troubleshooting

3.2.5 Medical Gas Pipeline System

3.2.5.1 Medical air delivery system

3.2.5.2 Central Vacuum system
3.2.5.3 Standards (Color code, valve and hose size)

3.4 Delivery related equipment

[5hrs]

3.4.1 Delivery table

3.4.1.1 Introduction and its working principle
3.4.1.2 Types of delivery table
3.4.1.3 Parts of fetal Delivery table
3.4.1.4 Maintenance and repair
3.4.1.4.1 Preventive maintenance
3.4.1.4.2 Troubleshooting and Corrective maintenance

3.4.2 Vacuum extractor

3.4.2.1 Introduction and its working principle
3.4.2.2 Types of vacuum extractor
3.4.2.3 Parts of vacuum extractor
3.4.2.4 Maintenance and repair
3.4.2.4.1 Preventive maintenance
3.4.2.4.2 Troubleshooting and Corrective maintenance

3.4.3 Fetal Doppler

3.4.3.1 Introduction and its working principle
3.4.3.2 Types of fetal Doppler
3.4.3.3 Parts of fetal Doppler
3.4.3.4 Maintenance and repair
3.4.3.4.1 Preventive maintenance
3.4.3.4.2 Troubleshooting and Corrective maintenance

3.4.4 Radiant warmer

3.4.4.1 Introduction and its working principle
3.4.4.2 Type of radiant warmer
3.4.4.3 Parts of radiant warmer
3.4.4.4 Maintenance and repair
3.4.4.4.1 Preventive measures
3.4.4.4.2 Troubleshooting and Corrective maintenance
3.4.4.4.3 Calibration (Temperature)of radiant warmer

3.4.5 Infant incubator

3.4.5.1 Introduction and its working principle
3.4.5.2 Type of Infant incubator
3.4.5.3 Parts of Infant incubator
3.4.5.4 Maintenance and repair
3.4.5.4.1 Preventive measure
3.4.5.4.2 Troubleshooting and Corrective maintenance
3.4.5.4.3 Calibration (Temperature,humidity,setting)

3.4.6 Cardiotocograph (CTG) machine

3.4.6.1 Introduction and its working principle
3.4.6.2 Parts of CTG
3.4.6.3 Maintenance and repair

3.4.6.4 Preventive maintenance
3.4.6.5 Troubleshooting and Corrective maintenance

3.5 Equipment of Intensive Care Unit (ICU)

[8hrs]

3.5.1 Patient Monitor

3.5.1.1 Introduction and its working principle
3.5.1.2 Type of Patient Monitor
3.5.1.3 Parts of Patient Monitor
3.5.1.4 Maintenance and repair
3.5.1.4.1 Preventive maintenance
3.5.1.4.2 Troubleshooting and Corrective maintenance
3.5.1.4.3 Calibration using patient simulator (pulse rate, NIBP, SpO_2, ECG waveform)

3.5.2 Ventilator

3.5.2.1 Introduction and its working principle
3.5.2.2 Type of Ventilator
3.5.2.3 Parts of Ventilator
3.5.2.4 Maintenance and repair
3.5.2.4.1 Preventive maintenance
3.5.2.4.2 Troubleshooting and Corrective maintenance
3.5.2.4.3 Calibration using ventilator tester (tidal volume respiration rate pressure,)

3.5.3 Syringe pump

3.5.3.1 Introduction and its working principle
3.5.3.2 Type of Syringe pump
3.5.3.3 Parts of Syringe pump
3.5.3.4 Maintenance and repair
3.5.3.4.1 Preventive measure
3.5.3.4.2 Troubleshooting and Corrective maintenance
3.5.3.4.3 Calibration of syringe pump

3.5.4 Infusion pump

3.5.4.1 Introduction and its working principle
3.5.4.2 Type of infusion pump
3.5.4.3 Parts of Infusion pump
3.5.4.4 Maintenance and repair
3.5.4.4.1 Preventive maintenance
3.5.4.4.2 Troubleshooting and Corrective maintenance
3.5.4.4.3 Calibration of Infusion pump

3.6 Sterilizing

[4hrs]

3.6.1 Definition and methods of Sterilizing
3.6.2 Different types of sterilization techniques
3.6.3 Autoclave
3.6.3.1 Introduction and its working principle of autoclave
3.6.3.2 Types of Autoclaves
3.6.4 Vertical, horizontal and table top
3.6.4.1 Maintenance and repair
3.6.4.2 Preventive maintenance
3.6.4.3 Troubleshooting and Corrective maintenance.
3.6.4.4 Calibration (pressure temperature) of autoclave

3.7 Hemodialysis Equipment

[3hrs]

3.7.1 Introduction and parts of hemodialysis
3.7.2 Maintenance and repair
  3.7.2.1 Preventive maintenance
  3.7.2.2 Troubleshooting and Corrective maintenance

Bio-Medical Equipment Maintenances-1
Practical

Practical: 3 hours/week

Note: Practical of Biomedical Instrumentation-I/ II and Biomedical Equipment Maintenance-I/ II will be done together

1 Use of electrical safety analyzer to test various medical equipment [2hrs]

2 General Equipment

[10hrs]

To realize operating principle, identify parts and perform preventive maintenance, troubleshooting, corrective maintenance and calibration of following equipment:

2.1 Sphygmomanometers and Stethoscope
2.2 Nebulizers
2.3 ECG
2.4 Suction Aspirator
2.5 Defibrillator
2.6 Pulse Oximeter

3 Oxygen generators and storage device

[8hrs]

3.1 To realize operating principle, identify parts and perform preventive maintenance, troubleshooting, corrective maintenance and calibration of following equipment:
  3.1.1 Oxygen cylinder
  3.1.2 Oxygen concentrator
  3.1.3 MGPS
3.2 Field visit for observation of PSA plant and cryogenic oxygen plant.

4 Delivery related equipment

[6hrs]

4.1 To realize operating principle, identify parts and perform preventive maintenance, troubleshooting, corrective maintenance and calibration of following equipment:
  4.1.1 Baby warmer
  4.1.2 Infant incubator
  4.1.3 Fetal Doppler and CTG
  4.1.4 Vacuum extractor and Delivery table

5 Equipment of Intensive Care Unit (ICU)

[8hrs]

5.1 To realize operating principle, identify parts and perform preventive maintenance, troubleshooting, corrective maintenance and calibration of following equipment:
  5.1.1 Patient monitor
  5.1.2 Ventilator
  5.1.3 Syringe and Infusion pump

6 Sterilizing

[4hrs]

To realize operating principle, identify parts and perform preventive maintenance, troubleshooting, corrective maintenance and calibration of vertical, horizontal and table top autoclave

7 Dialysis Equipment

[10hrs]

7.1 To realize operating principle, identify parts and perform preventive maintenance, troubleshooting, corrective maintenance and calibration of hemodialysis

7.2 Field visit for observation and hands on practice on hemodialysis machine

References:

1. John G.Webster Medical Instrumentation Application and Design. Third edition John Wiley and sons New York
2. Leslie Crom well Biomedical Instrument and measurements Prentice Hall Inc Engle wood cliffs
3. Onkar N Pandey Biomedical Electronics and Instrumentation S.K.K ataria and sons Publishers of Engineering and Computer books
4. Hand book of Biomedical Instrumentation R.S Khandpur Tata Mc Graw Hill

Marks Scheme

Unit	1	2	3	Total
Hours	4	2	40	45
Marks	8	2	70	80

Third Semester

Bio-Medical Instrumentation II
EG2121BM

Lecture: 3 hours/week
Tutorial: 0 hours/week
Practical: 3 hours/week
Total: 6 hours/week

Third semester

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 Content

Theory

Unit 1 Laboratory Based Diagnostic Instruments.

[8hrs]

1.1 Blood Cell Counters
  1.1.1 Introduction
  1.1.2 Types of blood cells
  1.1.3 Methods of cell counting
  1.1.4 Coulter Counter
  1.1.5 Differential counting of cells
1.2 Colorimetry and spectrophotometry
  1.2.1 Introduction and principle
  1.2.2 Biochemistry analyzer
1.3 Ion Selective Electrolyte

Unit 2 Biomedical Blood Gas Analysis

[4hrs]

2.1 Acid base Balance
2.2 Blood Ph Meausrement
2.3 Blood pO_2 Measurement
2.4 Blood pCO_2 Measurement
2.5 Complete Blood Gas Analyzer

Unit 3 Audiometers and Hearing Aids

[4hrs]

3.1 Mechanism of hearing

3.2 Audiometer
3.2.1 Pure tone audiometer and speech audiometer
3.2.2 Calibrations of audiometers
3.4 Hearing aids
3.5 Introduction
3.5.1 Types

Unit 4 Physiotherapy Equipment

[4hrs]

4.1 High Frequency Heat Therapy
4.2 Shortwave Diathermy
4.3 Microwave Diathermy
4.4 Ultrasonic Therapy Unit

Unit 5 Surgical devices

[5hrs]

5.1 Surgical Diathermy
5.1.1 Principle of Surgical Diathermy
5.1.2 Surgical Diathermy machine
5.1.3 Types
5.1.4 Safety aspects in electrosurgical unit
5.2 Surgical Instruments
5.2.1 Introduction to open surgical instruments
5.2.2 Introduction to laparoscopic surgical instruments

Unit 6 Radiology Equipment

[20hrs]

6.1 X-ray
6.1.1 Introduction and its operating
6.1.2 principle
6.1.3 Type of X-ray
6.1.4 Parts of X-ray
6.2 Digital Radiography
6.2.1 Computed Radiography (CR)
6.2.2 Direct Radiography (DR)

6.3 Ultrasound Machine
6.3.1 Introduction and its operating principle
6.3.2 Type of Ultrasound Machine
6.3.3 Parts of Ultrasound Machine
6.4 CT Scan
6.4.1 Introduction and its operation principle
6.4.2 Type of CT scan
6.4.3 Parts of CT scan
6.5 MRI
6.5.1 Introduction and its operation principle
6.5.2 Types of MRI scan
6.5.3 Parts of MRI

Bio-Medical Instrumentation II
Practical

Practical: 3 hours/week

Note: Practical of Biomedical Instrumentation-I/ II and Biomedical Equipment Maintenance-I/ II will be done together

1. To realize operating principle, identify parts and perform preventive maintenance, and troubleshooting, of following equipment:
   - 1.1 Blood cell counter
   - 1.2 Biochemistry analyzer
   - 1.3 ISE analyzer
   - 1.4 Blood gas analyzer
   - 1.5 Electro Surgical Unit
2. Familiarization and identification of physiotherapy equipment
3. Familiarization and identification of surgical instruments
4. Field visits for observation of following equipment:
   - 4.1 X-ray
   - 4.2 CR and DR
   - 4.3 CT Scan
   - 4.4 USG
   - 4.5 MRI

References:

1. John G Webster, Medical Instrumentation Application and Design Third edition John Wiley and sons New York
2. Leslie Crom well Biomedical Instrument and measurements Prentice Hall Inc Engle wood cliffs.
3. Onkar N Pandey Biomedical Electronics and Instrumentation S.K Kataria and sons Publishers of Engineering and Computer books

Hand book of Biomedical Instrumentation RS khandpur Tata Mc Graw

Marks Scheme

Unit	1	2	3	4	5	6	Total
Hours	8	4	4	4	5	20	45
Marks	12	8	8	8	12	32	80

Bio-Medical Equipment Maintenances-II
EG2122BM

Lecture: 4 hour/week
Tutorial: 1 hours/week
Practical: 8 hour/week
Total: 13 hour/week

Third semester

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.
For the effective and efficient health service delivery, patients, clinicians and visitors must be ensured for safe environment clinical environment, therefore, the course also includes topic of medical safety and hazards control.

Course objectives:

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

1. Describe the working principle and operating system of the medical devices based on their types and technology.
2. Perform preventive maintenance, repair, functional test and calibration of the medical equipment.
3. Ensure safe handling and appropriate use of too land test equipment.
4. Discuss the biomedical hazards

Course Contents:

Theory

Unit 1 Laboratory Equipment

[14hrs]

1.1 Centrifuge

- 1.1.1 Introduction and its working principle
- 1.1.2 Types of centrifuges
- 1.1.3 Parts of centrifuge
- 1.1.4 Maintenance and repair
- 1.1.5 Preventive maintenance
- 1.1.6 Troubleshooting
- 1.1.7 Corrective maintenance
- 1.1.8 Calibration (Speed) of centrifuge

1.2 Water bath

- 1.2.1 Introduction and its working principle
- 1.2.2 Types of Water bath
- 1.2.3 Parts of Water bath
- 1.2.4 Maintenance and repair
- 1.2.5 Preventive maintenance
- 1.2.6 Troubleshooting
- 1.2.7 Corrective maintenance

1.2.8 Calibration (Thermostat)

1.3 Lab Incubator

1.3.1 Introduction and its working principle
1.3.2 Types of Lab Incubator
1.3.3 Parts of Lab Incubator
1.3.4 Maintenance and repair
1.3.5 Preventive maintenance
1.3.6 Corrective maintenance
1.3.7 Calibration (Thermostat) of Lab Incubator

1.4 Lab oven

1.4.1 Introduction and its working principle
1.4.2 Types of Lab oven
1.4.3 Parts of Lab oven
1.4.4 Maintenance and repair
1.4.5 Preventive maintenance
1.4.6 Troubleshooting
1.4.7 Corrective maintenance
1.4.8 Calibration (Thermostat)of Lab oven

1.5 Biochemistry Analyzers

1.5.1 Colorimeter

1.5.1.1 Introduction and its working principle
1.5.1.2 Parts of Colorimeter
1.5.1.3 Maintenance and repair
1.5.1.4 Preventive maintenance
1.5.1.5 Troubleshooting
1.5.1.6 Corrective maintenance
1.5.1.7 Calibration (filter, light) of Colorimeter

1.5.2 Spectro photometer

1.5.2.1 Introduction and its working principle
1.5.2.2 Parts of Spectrophotometer
1.5.2.3 Maintenance and repair
1.5.2.4 Preventive maintenance
1.5.2.5 Troubleshooting
1.5.2.6 Corrective maintenance
1.5.2.7 Calibration (filter, light) of Spectrophotometer

1.5.3 Semi-automated analyzer

1.5.3.1 Introduction and its working principle
1.5.3.2 Parts of semiautomated analyzer
1.5.3.3 Maintenance and repair
1.5.3.4 Preventive maintenance
1.5.3.5 Troubleshooting
1.5.3.6 Corrective maintenance
1.5.3.7 Calibration (Aspirator light) of Sa analyzer

1.5.4 Fully automated analyzer

1.5.4.1 Introduction and its working principle
1.5.4.2 Parts of fully automated analyzer
1.5.4.3 Basic Maintenance and repair

1.5.5 Microscopes

1.5.5.1 Introduction and its working principle
1.5.5.2 Parts of microscope
1.5.5.3 Maintenance and repair
1.5.5.4 Preventive maintenance
1.5.5.5 Troubleshooting
1.5.5.6 Corrective maintenance

1.5.6 Biosafety cabinet

1.5.6.1 Introduction and its working principle
1.5.6.2 Type/ class of Biosafety cabinet
1.5.6.3 Parts of Biosafety cabinet
1.5.6.4 Maintenance and repair
1.5.6.5 Preventive maintenance
1.5.6.6 Troubleshooting
1.5.6.7 Corrective maintenance

1.5.7 Electronic balance

1.5.6.1 Introduction and its working principle
1.5.6.2 Parts of electronic balance
1.5.6.3 Maintenance and repair
1.5.6.4 Preventive maintenance
1.5.6.5 Troubleshooting
1.5.6.6 Corrective maintenance
1.5.6.7 Calibration of electronic balance

Unit 2 Operation Theater Equipment

[8hrs]

2.1 Operating table

2.1.1 Introduction and its working principle
2.1.2 Type of operating table
2.1.3 Parts of operating table
2.1.4 Maintenance and repair
2.1.5 Preventive maintenance
2.1.6 Troubleshooting
2.1.7 Corrective maintenance

2.2 Operating Light

2.2.1 Introduction and its working principle
2.2.2 Type of operating Light
2.2.3 Parts of operating Light
2.2.4 Maintenance and repair
2.2.5 Preventive maintenance
2.2.6 Troubleshooting
2.2.7 Corrective maintenance

2.3 Anesthesia machines

2.3.1 Introduction and its working principle
2.3.2 Parts of Anesthesia machines
2.3.3 Maintenance and repair
2.3.4 Preventive maintenance
2.3.5 Troubleshooting
2.3.6 Corrective maintenance
2.3.7 Calibration (flow leakage, gas percentage)

2.4 Electro surgical unit (Cautery machine)

2.4.1 Introduction and its working principle
2.4.2 Parts of Electrosurgical machine
2.4.3 Maintenance and repair
2.4.4 Preventive maintenance
2.4.5 Troubleshooting
2.4.6 Corrective maintenance
2.4.7 Calibration (Power, RF signal leakage, Frequency)

Unit 3 ENT Equipment

[5hrs]

3.1 ENT set

3.1.1 Introduction and its working principle
3.1.2 Type of ENT set
3.1.3 Parts of ENT set
3.1.4 Maintenance and repair
3.1.5 Preventive maintenance
3.1.6 Troubleshooting
3.1.7 Corrective maintenance

3.2 Audiometer

3.2.1 Introduction and its working principle
3.2.2 Type of Audiometer
3.2.3 Parts of Audiometer
3.2.4 Maintenance and repair
3.2.5 Preventive maintenance
3.2.6 Troubleshooting
3.2.7 Corrective maintenance
3.2.8 Calibration (db frequency) of Audiometer

3.3 Tympanometer

3.3.1 Introduction and its working principle
3.3.2 Type of tympanometer
3.3.3 Parts of tympanometer
3.3.4 Maintenance and repair
3.3.5 Preventive maintenance
3.3.6 Troubleshooting
3.3.7 Corrective maintenance
3.3.8 Calibration (air pressure) of tympanometer

3.4 ENT Microscope

3.4.1 Introduction and its working principle
3.4.2 Parts of ENT microscope
3.4.3 Maintenance and repair
3.4.4 Preventive maintenance
3.4.5 Troubleshooting
3.4.6 Corrective maintenance

Unit 4 Dental Equipment

[4hrs]

4.1 Dental chair

4.1.1 Introduction and its Operating principal
4.1.2 Parts of Dental chair
4.1.3 Maintenance and repair
4.1.4 Preventive maintenance
4.1.5 Troubleshooting
4.1.6 Corrective maintenance

4.2 Curate light

4.2.1 Introduction and its operating principle
4.2.2 Types of curate light
4.2.3 Parts of curate light
4.2.4 Maintenance and repair
4.2.5 Preventive maintenance
4.2.6 Troubleshooting
4.2.7 Corrective maintenance

4.3 Dental X-ray

4.3.1 Introduction and its operating principle
4.3.2 Parts of dental X-ray
4.3.3 Maintenance and repair
4.3.4 Preventive maintenance
4.3.5 Troubleshooting
4.3.6 Corrective maintenance Calibration(mA)

Unit 5 Imaging Equipment

[15hrs]

5.1 X-ray

5.1.1 Introduction and its operating principle
5.1.2 Type of X-ray
5.1.3 Parts of X-ray
5.1.4 Maintenance and repair
5.1.5 Preventive maintenance
5.1.6 Troubleshooting
5.1.7 Corrective maintenance

5.2 Ultrasound Machine

5.2.1 Introduction and its operating principle
5.2.2 Type of Ultrasound Machine
5.2.3 Parts of Ultrasound Machine
5.2.4 Maintenance and repair
5.2.5 Preventive maintenance
5.2.6 Troubleshooting
5.2.7 Corrective maintenance

5.3 C-arm

5.3.1 Introduction and its operating principle
5.3.2 Type of C-arm
5.3.3 Parts of C-arm
5.3.4 Maintenance and repair
5.3.5 Preventive maintenance
5.3.6 Troubleshooting
5.3.7 Corrective maintenance

5.4 Radiographic film processing system

5.4.1 Introduction to Manual and automated Film
5.4.1.1 Processing
5.4.2 Introduction to CR and DR
5.4.3 Parts of CR and DR

Unit 6 Ophthalmic equipment

[6hrs]

6.1 Refraction Unit

6.1.1 Introduction to vision drum, trail set and trail frame
6.1.2 Basic maintenance and repair

6.2 Slit Lamp

6.2.1 Introduction and its operating principle
6.2.2 Type of slit lamp
6.2.3 Parts of slit lamp
6.2.4 Basic maintenance and repair

6.3 Ophthalmoscope and Retinoscope

6.3.1 Introduction and its operating principle
6.3.2 Type of ophthalmoscope and retinoscope
6.3.3 Parts of ophthalmoscope and retinoscope
6.3.4 Basic maintenance and repair

6.4 Tonometry

6.4.1 Introduction and its operating principle
6.4.2 Types
6.4.2.1 Contact and non-contact

6.5 Ultrasound in ophthalmology (A/B Scan)

6.5.1 Introduction and its operating principle
6.5.2 Type of ultrasound in ophthalmology
6.5.3 Parts of ultrasound used in ophthalmology
6.5.4 Basic maintenance and repair

6.6 Ophthalmic (Surgical) Microscope

6.6.1 Introduction and its operating principle
6.6.2 Type of microscope in ophthalmology
6.6.3 Parts of microscope used in ophthalmology
6.6.4 Basic maintenance and repair

Unit 7 Endoscope

[4hrs]

7.1 Introduction and operating principle
7.2 Type of endoscope
7.2.1 Flexible endoscope and rigid endoscope
7.3 Parts of endoscope
7.4 Basic maintenance and repair

Unit 8 Physiotherapy

[4hrs]

8.1 **Therapy diathermy**

8.1.1 Introduction and its operating principle
8.1.2 Parts
8.1.3 Basic maintenance and repair

8.2 **TMT machine**

8.2.1 Introduction and its operating principle
8.2.2 Parts
8.2.3 Basic maintenance and repair

8.3 **Wax bath**

8.3.1 Introduction and its operating principle
8.3.2 Parts
8.3.3 Basic maintenance and repair

8.4 **Traction machine**

8.4.1 Introduction and its operating principle
8.4.2 Parts
8.4.3 Basic maintenance and repair

Bio-Medical Equipment Maintenances-II

Practical

Practical: 8 hour/week

Note: Practical of Biomedical Instrumentation-I/ II and Biomedical Equipment Maintenance-I/ II will be done together

1. **Laboratory Equipment**
   - 1.1 To realize operating principle, identify parts and perform preventive maintenance, troubleshooting, corrective maintenance and calibration of following equipment:
     Centrifuge, Water bath, Lab Incubator, Lab oven, Colorimeter, Semiautomated analyzer, Hematology analyzer, Electrolyte analyzer, ABG, Microscopes, Electronic balance
   - 1.2 Field visit to medical laboratory for observation of Fully automated analyzer, Biosafety cabinet and other laboratory equipment

2. **Operation Theater Equipment**
   To realize operating principle, identify parts and perform preventive maintenance, troubleshooting, corrective maintenance and calibration of following equipment:
   Operating table, Operating Light, Anesthesia machines, Electro surgical unit (Cautery machine)

3. **ENT Equipment**
   To realize operating principle, identify parts and perform preventive maintenance, troubleshooting, corrective maintenance and calibration of following equipment:
   ENT set, Audiometer, Tympanometer, ENT Microscope

4. **Dental Equipment**
   To realize operating principle, identify parts and perform preventive maintenance, troubleshooting and corrective maintenance of following equipment:
   Dental chair, Compressor, Curate light, Dental X-ray

5. **Imaging Equipment**
   - 5.1 To realize operating principle, identify parts and perform preventive maintenance, troubleshooting and corrective maintenance of following equipment:
   - 5.2 X-ray, Ultrasound Machine and C-arm
   - 5.3 Field visit to hospital/ medical imaging center for observation of CT scan, MRI, CR and DR

6. **Ophthalmic equipment**

   To realize operating principle, identify parts and perform preventive maintenance, troubleshooting and corrective maintenance of following equipment:
   Refraction Unit, Slit Lamp, Ophthalmoscope and Retinoscope, Ultrasound in ophthalmology (A/B Scan), Ophthalmic Microscope

7. **Endoscope**

   To realize operating principle, identify parts and perform preventive maintenance, troubleshooting and corrective maintenance of Flexible endoscope and rigid endoscope

8. **Physiotherapy equipment**
   To realize operating principle, identify parts and perform preventive maintenance, troubleshooting and corrective maintenance of following equipment:
   Therapy diathermy, TMT machine, Wax bath, Traction machine.

References:

1. John G.Webster Medical Instrumentation Application and Design. Third edition John Wiley and sons New York
2. Leslie Crom well Biomedical Instrument and measurements Prentice Hall Inc Engle wood cliffs
3. Onkar N Pandey Biomedical Electronics and Instrumentation S.K.K ataria and sons Publishers of Engineering and Computer books
4. Hand book of Biomedical Instrumentation R.S Khandpur Tata Mc Graw Hill

Marks Scheme

Unit	1	2	3	4	5	6	7	8	Total
Hours	14	8	5	4	15	6	4	4	60
Marks	16	12	8	8	20	4	8	4	80

Surgical and ICU Equipment
Elective

EG2125BM

Lecture: 3 hour/week
Tutorial: hours/week
Practical: 3 hour/week
Total: 6 hour/week

Third semester

Course description:

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, uses and applications of advanced biomedical equipment specific to operation theater (OT) and intensive care unit (ICU)

Course objectives:

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

1. Describe the application of Surgical and ICU equipment
2. Explain and introduction of various Diagnostic Surgical Equipment
3. Perform diagnosis and testing of surgical and ICU equipment

Course Contents:

Theory

Unit 1 Operation theater **[4hrs]**

- 1.1 Introduction
- 1.2 Types of OT
  - 1.1 General (Non-modular)
  - 1.2 Modular
- 1.3 Basic equipment used in OT
- 1.4 layout of operation theater
- 1.5 Basic concept of catheterization laboratory (Cath lab)

Unit 2 Surgical equipment **[13hrs]**

- 2.1 Operation theatre Lights (OT light)
  - 2.1.1 Introduction
  - 2.1.2 Principle and characteristic
  - 2.1.3 Types
  - 2.1.4 Preventive measures and Troubleshooting Guides
- 2.2 Operating table
  - 2.2.2 Introduction
  - 2.2.3 Working principle
  - 2.2.4 Types based on application
    - 2.2.4.1 General, Orthopedic and Spine, Neuro, Urology, Cardiac and Thoracic
  - 2.2.5 Preventive measures and Troubleshooting Guides
- 2.3 Anesthesia Machine
  - 2.3.1 Introduction

2.3.2 Working principle
2.3.3 Types
2.3.4 Preventive measures and Troubleshooting Guides

2.4 Electrosurgical unit (cautery machine)
2.4.1 Introduction
2.4.2 Types of electrosurgical unit (ESU)
2.4.3 Electrodes used with ESU
2.4.4 Safety aspects in ESU
2.4.5 Preventive measures and Troubleshooting Guides

2.5 Surgical Microscope
2.5.1 Ophthalmic, ENT and Neuro Microscope
2.5.1.1 Introduction
2.5.1.2 Working Principle
2.5.1.3 Preventive measures and Troubleshooting Guides

Unit 3 Endoscope technology in surgery

[12hrs]

3.1 Introduction
3.2 Basic equipment and instrument
3.2.1 Endoscope
3.2.2 Camera
3.2.3 Light source
3.2.4 Medical monitor
3.2.5 Insufflator
3.2.6 Surgical instruments
3.3 Types
3.3.1 Rigid endoscope
3.3.2 Flexible endoscope
3.4 Application
3.4.1 Diagnostic: Gastroenterology and bronchoscopy
3.4.2 Surgical: Laparoscopy, Endo-Urology, Gynecology, Arthroscopy
3.5 Preventive measures and Troubleshooting Guides
3.6 New trends and perspectives of endoscopic technology

Unit 4 General Applications of Minimally Invasive surgery

[2hrs]

4.1 Minimally invasive cardiovascular surgery
4.2 Minimally invasive neuro surgery

Unit 5 Intensive care unit (ICU)

[2hrs]

5.1 Introduction
5.2 Types of ICU in hospital setup
5.3 Basic equipment used in ICU
5.4 layout of modern ICU
5.5 Remote collaboration systems (eICU)

Unit 6 Ventilators

[4 hrs]

6.1 Mechanism of Respiration

6.2 Artificial Ventilation
6.3 Ventilators Terms
6.4 Types of Ventilators
6.5 Modes of Ventilators
6.6 High Frequency Ventilators
6.7 Accessories and consumables
6.8 Sensors, Exhalation valve, Humidifiers and Nebulizers
6.9 Preventive measures and Troubleshooting Guides.

Unit 7 Automated Drug Delivery System

[4hrs]

7.1 Introduction
7.2 Infusion Pumps and syringe pump
7.3 Working Principle
7.4 Parts
7.5 Preventive measures and Troubleshooting Guides

Unit 8 Patient Monitoring and Therapy Systems

[4hrs]

8.1 Bed side ICU Patient Monitoring Systems
8.2 Central Monitoring system
8.3 Ambulatory Monitoring Instruments (Holter and ABP)
8.4 Defibrillator

Surgical and ICU Equipment

Practical

Practical 3 hrs/week

Topics

Unit 1 Operation theater

1.1 Demonstration of basic equipment used in operation theater

1.2 Hospital visit

Unit 2 Surgical equipment

Demonstration and hands on practice of preventative measures, troubleshooting and calibration of following equipment

2.1 OT light

2.2 OT table

2.3 Anaesthesia machine

2.4 Surgical Diathermy machine

2.5 Ophthalmic microscope

2.6 Neuro microscope

ENT microscope

Unit 3 Endoscope surgery

Demonstration and hands on practice of preventative measures, troubleshooting and calibration of following equipment

3.1 Camera

3.2 Light source

3.3 Medical monitor

3.4 Insufflator

3.5 Rigid endoscope

3.6 Flexible endoscope

3.7 Leak test

(For high end equipment, use videos displaying parts of equipment and surgery performed by clinician)

Unit 5 Ventilators

Demonstration and hands on practice of preventative measures, troubleshooting and calibration

Unit 6 Automated Drug Delivery System

Demonstration and hands on practice of preventative measures, troubleshooting and calibration of syringe pump and infusion pump

Unit 7 Patient Monitoring Systems and Therapy Systems

7.1 Demonstration of central monitoring system setup in ICU

7.2 Demonstration and hands on practice of preventative measures, troubleshooting and calibration of patient monitor and defibrillator.

References:

1. Handbook of Biomedical instrumentation, RS Khandpur, Tata McGraw Hill
2. John G. Webster, Medical instrumentation, Application and Design: Third edition, John Wiley and Sons, New York
3. Leslie Crowell, Biomedical instrument and measurement, Prentice Hall, Inc, England Cliff

4. Onkar N. Pandey, Bio medical Electronics and Instrumentation, S.K. Kataria and sons, Publishers of Engineering and Computer books
5. “Minimally invasive medical technology” John G. Webster

Marks Scheme

Unit	1	2	3	4	5	6	7	8	Total
Hours	4	13	12	2	2	4	4	4	45
Marks	5	25	20	5	5	10	5	5	80

Medical Imaging Equipment
(Elective)
EG2125BM

Lecture: 3 hour/week
Tutorial: hours/week
Practical: 3 hour/week
Total: 6 hour/week

Third semester

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:
1. Discuss the fundamental concepts of imaging equipment.
2. Familiar with imaging equipment system
3. Discuss the importance of the radiation hazard.
4. Installation of imaging equipment.
5. Perform the preventative maintenance and repair of X-ray machine, USG, C-arm

Course Contents

Theory

Unit 1 Introduction to medical imaging technology **[1hrs]**

Unit 2 Radiation hazard and safety **[2hrs]**

2.1 Biological effect of radiation
2.2 Radiation monitoring and protection devices

Unit 3 X-ray **[10hrs]**

3.1 Introduction
3.2 Production of x-ray
3.3 Type of X-ray Generators
- 3.3.1 Conventional
- 3.3.2 High frequency
- 3.3.3 Power Storage X-ray Generators
- 3.3.4 Condenser Discharge
- 3.3.5 Battery Powered
- 3.3.6 DR System

3.4 Parts of X-ray unit
- 3.4.1 Control panel
- 3.4.2 X-rayTube, Self-rectifying tube
- 3.4.3 Rotating and Stationary anode
- 3.4.4 X-ray Generator/Main Controller
- 3.4.5 EHT/HVT unit

3.4.5.1 Diodes
3.4.5.2 Oil
3.4.6 Filament transformer
3.4.7 X-ray Examination table
3.4.7.1 Simple Table
3.4.7.2 Floating Table
3.4.7.3 Manually Tilting Table
3.4.7.4 Motorized Table
3.4.7.5 Chest stand, Ionizing Chamber

3.5 X-ray machine installation

3.5.1 Room Layout/ Space Requirement for x-ray installation
3.5.2 Electro-mechanical requirements
3.5.3 Room environment (Temperature and Humidity)

3.6 Preventive maintenance of X-ray machine

3.6.1 Repair and adjustments
3.6.2 X-ray tube overload protection
3.6.3 mA Calibration
3.6.4 KV measuring
3.6.5 Spinning Top Test
3.6.6 Penetrometer Tests using Step Wedge
3.6.7 Cleaning and Lubrication
3.6.8 Function test and verification

Unit 4 Mammography

[2hrs]

4.1 Introduction
4.2 Operating principle
4.3 Parts

Unit 5 C arm

[4hrs]

5.1 Introduction
5.2 Operating principle
5.3 Parts of C arm
5.4 Preventive Maintenance
5.5 Basic Repair

Unit 6 Radiographic Imaging Process

[12hrs]

6.1 The radiographic Image Quality

6.1.1Sharpness, Contrast and resolution of radiographic image, and exposure factors

6.2 X-ray dark room

6.2.1 Lay out of dark room.
6.2.2 Construction of walls, floor & ceilings including ventilation, light system,

6.2.3 Illumination, safe light, cassette hatches, load bench and location of Auto film processor.

6.3 X-ray film processing

6.3.1 Manual film processing (Developer, Fixture, Washer and dryer)
6.3.2 Automatic Film Processor
6.3.3 Operating Principle and Types of Automatic film processor
6.3.3.1 Parts of Automatic film processor
6.3.3.2 Preventive maintenance, Repair and temperature calibration of Automatic film processor

6.4 CR and DR retrofit kit

6.4.1 Introduction
6.4.2 Operating Principle
6.4.3 Parts of CR, DR

6.5 Accessories

6.5.1 Cassette
6.5.2 Film
6.5.3 Grid
6.5.4 Bucky
6.5.5 Intensifying screens

Unit 7 CT Scan

[4hrs]

7.1 Introduction
7.2 Principle of CT Scan
7.3 Stationary and Rotating Part
7.4 Image Generation

Unit 8 Ultrasound

[4hrs]

8.1 Introduction
8.2 Operating Principle
8.3 Parts of Ultrasound
8.4 Preventive Maintenance
8.5 Repair and Calibration

Unit 9 MRI

[4hrs]

9.1 Introduction
9.2 Operating principle
9.2.1 Excitation
9.2.2 Relaxation
9.2.3 Acquisition
9.2.4 MR Pulse Sequence
9.3 Types of Magnets

Unit 10 Innovation and development in Healthcare Imaging Technology

[2hrs]

10.1 Knowledge sharing on current development in Imaging technologies in healthcare
10.2 Introduction on Cardiology and Radiology Intervention, DEXA, SPECT System, SPECT CT, PET CT, PET MR

Medical Imaging Equipment

Practical

Practical: 3 hours/week

1. Demonstration of different parts of X-ray Machine
2. Demonstration and Hands-on practice on control panel, X-ray head, EHT, Generator and X-ray accessories
3. To trace system circuit on the basis of circuit diagram of conventional x-ray system
4. To Measure Filament Voltage, Changing KV and Input voltage
5. To Measure waveform and actual value of mA, KV
6. To Calculate frequency of firing pulses of filament and inverter circuit
7. Troubleshooting of conventional x-ray
8. To demonstrate different imaging parts of C-arm (X-ray II and CCD)
9. Troubleshooting of C-arm
10. To demonstrate different parts of Ultrasound
11. Troubleshooting of USG
12. To demonstrate different parts of CT Scan
13. Educational Site visit for CT, Mammography CR, DR retrofit, DR system, MRI

REFFRENCE:

1. Handbook of Bio-medical instrumentation, KS Khandpur, TATA McGraw Hill Education Pvt. Limited
2. Textbook 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.

Marks Scheme

Unit	1	2	3	4	5	6	7	8	9	10	Total
Hours	1	2	10	2	4	12	4	4	4	2	45
Marks		4	20	4	8	12	12	8	8	4	80

Medical Laboratory Equipment
Elective
EG2125BM

Lecture: 3 hrs /week
Practical: 3 hrs/week
Tutorial :0 hrs/week
Total: 6 hrs/week

Third semester

Course description:

To present the basic concepts of medical laboratory instruments, design analysis of various laboratory equipment used in the different types of medical laboratory. This course deals with the study, uses and applications, operating and handling technique, Maintenance and repair of basic to advance medical laboratory equipment.

Course objectives:

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

1. Identify and describe the uses of medical laboratory equipment
2. Explain and introduction of various medical laboratory equipment
3. Identify the cause, diagnosis and rectification of problem in the laboratory equipment.

Course Contents:

Theory

Unit 1 Overview of Medical Laboratory **[3hrs]**

1.1 Medical laboratory and its importance
1.2 Classification of Laboratory in Nepal
1.3 Laboratory Information Management System
1.4 Biosafety and Waste Management
1.4.1 Laboratory hazards, Laboratory safety measures and waste management.

Unit 2 General Laboratory Equipment **[10hrs]**

2.1 Pipette
2.1.1 Introduction and working principle
2.1.2 Types and parts
2.1.3 Calibration
2.1.4 Maintenance and repair

2.2 Microscope
2.2.1 Introduction and working principle
2.2.2 Types and parts
2.2.2.1 Simple and compound
2.2.2.2 Inverted, fluorescence and electron microscope
2.2.2.3 Maintenance and repair of compound microscope

2.3 Centrifuge
2.3.1 Introduction and working principle

2.3.2 Types and parts
2.3.2.1 Bench top centrifuge
2.3.2.2 Refrigerated centrifuge, microcentrifuge, spinner
2.3.3 Calibration of speed bench top centrifuge
2.3.4 Maintenance and repair bench top centrifuge

2.4 Refrigerator
2.4.1 Introduction
2.4.2 Types and parts
2.4.3 Maintenance and repair

2.5 Basic equipment
2.5.1 Introduction, working principle, basic maintenance and repair of:
2.5.5.1 Waterbath
2.5.5.2 Incubator and Oven
2.5.5.3 Autoclave
2.5.5.4 Balance

Equipment based on department:

Unit 3 Clinical Biochemistry

[8hrs]

3.1 Colorimeter and Spectrophotometry
3.3.1 Introduction and working principle
3.3.2 Parts of colorimeter
3.3.2.1 Maintenance and repair of colorimeter

3.2 Semi-automated Biochemistry Analyzer
3.2.1 Introduction and working principle
3.2.2 Parts
3.2.3 Maintenance and repair

3.3 Fully automated Biochemistry Analyzer
3.3.1 Introduction and working principle
3.3.1.1 Dry Chemistry
3.3.1.2 Wet Chemistry
3.3.2 Parts
3.3.3 Maintenance and repair

3.4 Electrolyte Analyzer
3.4.1 Introduction working principle
3.4.1.1 Flame Emission Photometry
3.4.1.2 Ion Selection Electrode (ISE)
3.4.2 Parts of ISE
3.4.3 Maintenance and repair of ISE

Unit 4 Hematology

[5hrs]

4.1 Coulter Counter
4.1.1 Introduction and working principle

4.1.2 Electrical Impedance
4.1.3 Optical method
4.1.3.1 Types
4.1.3.2 Parts
4.1.3.3 Maintenance and repair

4.2 Other equipment in Hematology

4.2.1 Introduction, application, basic maintenance and repair of:

4.2.1.1 ESR Analyzer
4.2.1.2 Coagulometer
4.2.1.3 HPLC
4.2.1.4 Flowcytometry

Unit 5 Medical Microbiology **[2hrs]**

5.1 Introduction, application, basic maintenance and repair of:

5.1.1 Blood Culture Analyzer
5.1.2 CO2 Incubator

Unit 6 Immunology **[6hrs]**

6.1 CLIA

6.1.1 Introduction and working principle
6.1.2 Parts
6.1.3 Maintenance and repair

6.2 Elisa Washer, Reader and Printer

6.2.1 Introduction and working principle
6.2.2 Parts
6.2.3 Maintenance and repair
6.2.4 General introduction to ELISA Printer

Unit 7 Histology **[3hrs]**

7.1 Introduction, application, basic maintenance and repair of:

7.1.1 Automated slide stainer
7.1.2 Automated tissue processor
7.1.3 Microtome
7.1.4 Flotation waterbath
7.1.5 Paraffin wax dispenser
7.1.6 Hot Plate

Unit 8 Molecular **[4hrs]**

8.1 Conventional/Real Time Thermal PCR

8.1.1 Introduction and application

8.2 Biosafety Cabinet

8.2.1 Introduction and purpose
8.2.2 Types and parts

8.2.3 Maintenance and repair

Unit 9 Blood Bank

[2hrs]

9.1 Introduction, application, basic maintenance and repair of:

9.1.1 Platelet incubator with agitator
9.1.2 Blood bank refrigerated centrifuge
9.1.3 Plasma extractor
9.1.4 Dual pan balance

Unit 10 Quality Control

[2hrs]

10.1 Quality control in medical laboratory and its importance
10.2 Basic introduction to lyophilizer.

Medical Laboratory Equipment
Practical

Practical: 3 hrs /week

1. **Overview of Medical Laboratory**
   1.1 Field visit to medical laboratory.

2. **Basic Laboratory Equipment**
   2.1 To identify types, parts and perform preventive maintenance, troubleshooting, corrective maintenance and calibration of following equipment:
   Pipette, Microscope, Centrifuge, Refrigerator, Waterbath, Incubator, Oven, Autoclave and Balance.

3. **Clinical Biochemistry**
   3.1 To identify types, parts and perform preventive maintenance, troubleshooting, corrective maintenance and calibration of following equipment:
   Colorimeter and Spectrophotometer, Semi-automated Biochemistry Analyzer, fully- automated Biochemistry Analyzer, Electrolyte

4. **Hematology**
   4.1 To identify types, parts and perform preventive maintenance, troubleshooting, corrective maintenance and calibration of hematology analyzer.
   4.2 Field visit of ESR Analyzer, Coagulometer, HPLC, Flowcytometry.

5. **Medical Microbiology**
   Field visit Blood Culture Analyzer and CO2 incubator

6. **Immunology**
   6.1 To identify types, parts and perform preventive maintenance, troubleshooting of CLIA
   6.2 To identify types, parts and perform preventive maintenance, troubleshooting of ELISA washer, reader and printer.

7. **Histology**
   Familiarization and preventive maintenance of Automated slide stainer, Automated tissue processor, Microtome, Flotation waterbath, Paraffin wax dispenser, Hot plate.

8. **Molecular**
   8.1 Field visit for familiarization with Conventional/ Real Time PCR thermal cycler
   8.2 Familiarization, handling technique and preventive maintenance of Biosafety cabinet.

9. **Blood Bank**
   Familiarization with Platelet incubator with agitator, Blood bank refrigerated centrifuge, Plasma extractor and Dual pan balance.

10. **Quality Control**
    Field visit

References:

1 Handbook of Biomedical Instrumentation, R SKhandpur, Tata MeGraw Hill

2 John G. Webster, Medical Instrumentation, Application and Design: Third edition John Wiley and sons, New York

3 Maintenance and repair Manual for Laboratory Equipment, 2nd edition, WHO.

Marks Scheme

Unit	1	2	3	4	5	6	7	8	9	10	Total
Hours	3	10	8	5	2	6	3	4	2	2	45
Marks	8	20	12	8	4	8	4	8	4	4	80

Entrepreneurship Development
E320ISH

Year: **Total: 5 Hrs. /week**
Semester: III **Lecture: 3 Hrs./week**
Tutorial: Hr./week
Practical: 2 Hrs./week
Lab: Hrs./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 and
5. Manage small business.

Course Contents:

Theory

Unit 1: Introduction to Business & Entrepreneurship: [9 Hrs.]
- 1.1 Overview of entrepreneur and entrepreneurship
- 1.2 Wage employment, self- employment and business
- 1.3 Synopsis of types and forms of enterprises
- 1.4 Attitudes, characteristics & skills required to be an entrepreneur
- 1.5 Myths about entrepreneurs
- 1.6 Overview of MSMEs (Micro, Small and Medium Enterprises) in Nepal

Unit 2: Exploring and Developing Entrepreneurial Competencies: [9 Hrs.]
- 2.1 Assessing individual entrepreneurial inclination
- 2.2 Assessment of decision-making attitudes
- 2.3 Risk taking behavior and risk minimization
- 2.4 Creativity and innovation in business
- 2.5 Enterprise management competencies

Unit 3: Business identification and Selection: [4 Hrs.]
- 3.1 Sources and method of finding business idea(s)
- 3.2 Selection of viable business ideas
- 3.3 Legal provisions for MSMEs in Nepal

Unit 4: Business plan Formulation: **[18 Hrs.]**

4.1 Needs and importance of business plan

4.2 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

4.3 Business operation plan

- Process of product or service creation
- Required fix assets
- Level of capacity utilization
- Depreciation & amortization
- Estimation office overhead and utilities

4.4 Organizational and human resource plan

- Legal status of business
- Management structure
- Required human resource and cost
- Roles and responsibility of staff

4.5 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

4.6 Business plan appraisal

- Return on investment
- Breakeven analysis
- Risk factors

Unit 5: Small Business Management: **[5 Hrs.]**

5.1 Concept of small business management

5.2 Market and marketing mix

5.3 Basic account keeping

Practical

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.]

- 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.]

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

Unit 5: Small Business Management [2 Hrs.]

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

Project

Year: II **Tutorial: hours/week**
Semester: III **Practical: 10 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. **Project Proposal**: 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. **Mid-Term Evaluation**: A mid-term progress report not exceeding 12 double-spaced pages shall be submitted before the end of the 8th week of the term. An oral presentation will take place during the 9th week of term. This mid-term written and oral reports will account for 25% of the final marks.

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

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

Internship (12 weeks)

Third semester
Course Description

Internships are off-campus experiential learning activities designed to provide students with opportunities to make connections between the theory and practice of academic study and the practical application of that study in a professional work environment. Internships offer the opportunity to "try out" a career while gaining relevant experience and professional connections. Internships are completed under the guidance of an on-site supervisor and faculty, who in combination with the student will create a framework for learning and reflection.

Course Objective

Objective of the internship is to train, acquire skills and make acquainted students with real working environment. Students will be aware of management and technical issues that are to be dealt by Biomedical Technician in the field.

Methodology

1. Students will be deployed to the hospital/ organization assigned by the college.
2. Students need to perform following activities under the guidance of supervisor assigned by hospital/organization:
   - 2.1 Data collection and inventory of Biomedical equipment of hospital
     - Date collection and inventory will be performed using specific forms provided by the college and must be verified by the supervisor.
   - 2.2 Perform daily round of various department of hospital/organization
     - Round shall be done as a member of the hospital's biomedical team.
   - 2.3 Perform preventive maintenance, corrective maintenance of Biomedical equipment
     - Preventive maintenance (PM) and corrective maintenance (CM) of various biomedical equipment will be performed under direct supervision of the supervisor.
   - 2.4 Prepare log and record of the preventive maintenance and corrective maintenance.
     - Detail report of all the PM and CM will be prepared in the specific format provided by the college and approved by the supervisor.
3. The representative of college will visit to internship site to assess the performance of the students.
4. After completion of the internship, internship report approved by supervisor must be submitted to the college.

Curriculum Structure Finalization Workshop

Curriculum Structure Finalization Workshop		
1	Mr. Prem Paudyal	Subject Specialist
2	Dr. Naresh Maharjan	Subject Specialist
3	Mr. Bimal Shrestha	Subject Specialist
4	Er. Chiranjavi Dahal	Subject Specialist
5	Mr. Arbin Kumar Gupta	Subject Specialist
6	Er. Salomi Paudel	Subject Specialist
7	Er. Umesh Kanta Ghimire	Subject Specialist
8	Er. Ashish Chauhan	Subject Specialist
9	Er. Anuj Purush Dhakal	Subject Specialist
10	Er. Kishwor Darshandahri	Subject Specialist
11	Er. Rishav Poudyal	Subject Specialist
12	Er. Achyut Shah Thakuri	Subject Specialist
13	Er. Sagar Singh	Subject Specialist
14	Er. Prakash Aryal	Subject Specialist
15	Er. Saurav Sharma	Subject Specialist
16	Er. Samit Kumar Singh	Subject Specialist
Technical Committee Meeting		
1	Er. Saurav Sharma	Subject Specialist
2	Er. Ashish Chauhan	Subject Specialist
3	Er. Umesh Kanta Ghimire	Subject Specialist
4	Er. Dina K.C.	Subject Specialist
5	Er. Sakar Niroula	Subject Specialist
6	Er. Shanta Maharjan	Subject Specialist
7	Er. Suresh Shrestha	Subject Specialist
8	Er. Pravin Bhattarai	Subject Specialist