CURRICULUM

DIPLOMA
Biomedical Engineering

(Three Year's Program - Semester System)

Council for Technical Education and Vocational Training
Curriculum Development and Equivalence Division
Sanothimi, Bhaktapur
2013
First Revised 2022

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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 for the broader application of Biomedical Engineering. This field has been helping the world for the 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 Engineering so as to meet the demand of such workforce in the country to contribute in the national economic development of Nepal. The knowledge and skills incorporated in this curriculum will be helpful to deliver the individual needs as well national needs in the field of Biomedical Engineering

Rational of Revision

Diploma in Biomedical Engineering curriculum was developed in 2013 AD. This is the first revision after the implementation of the curriculum. The rationales behind its revision are as follows:

- It crossed the 8 years period of its development and similarly the implementing agencies/ college have requested to revise this curriculum based on their teaching experiences.
- The semester wise re-adjustments of the existing subjects are felt necessary.
- Some new subjects seem to be introduced as per the advancement in technology.
- It is needed to revisit its weightage in both theory and practical marks and contents to make it more practical oriented.
- The technologies invented in the field of biomedical engineering are necessary to incorporated.

Furthermore, technology of biomedical occupation upgraded rapidly and new technology are introducing in the recent year. With the advent in technology trained technicians are needed throughout the world. To cope with the national and international demand, the knowledge and the skills should be updated to make the skills relevant and pertinent to the industry. Hence this curriculum is revised to equip the students as per the changing technology in changing environmental context.

Curriculum Title

Diploma in Biomedical Engineering (DBE)

Aim

The program aims to produce mid-level technical human resource equipped with knowledge and skills in allied field of study.

Objectives

This curriculum has following objectives to:

- Prepare technicians who are able to work as biomedical technician in different level of hospitals and nursing homes;
- Produce middle level competent technical workforce/human resources that could provide maintenance services of medical equipment;
- Prepare technical workforce who will demonstrate positive attitude and respect for the profession and socio-cultural values;

- Help in meeting the demand of biomedical technician required for the public and private hospitals of Nepal;
- Reduce the dependence on employing such technicians from foreign countries and
- Create self-employment opportunities.

Group Size

The group size is a maximum of 48 students.

Entry Criteria

- SLC pass or SEE or equivalent with minimum 1.6 Grade Point in altogether subjects and as per the provisions mentioned in the admission guidelines of Office of the Controller of Examinations, CTEVT.
- Pass entrance examination administered by CTEVT.

Duration

The total duration of this curricular program is three academic years [six semesters]. The program is based on semester system. Moreover, one semester consists of 19.5 academic weeks including evaluation period. Actual teaching learning Hrs. will be not less than 15 weeks in each semester.

Medium of Instruction

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

Pattern of Attendance

Minimum of 90% attendance in each subject is required to appear in the respective final examination.

Teacher (Instructor) and Student Ratio

The ratio between teachers and students must be:

- Overall ratio of teacher and student must be 1:12 (at the institution level)
- 1:24 for theory and tutorial classes
- 1:12 for practical/demonstration
- 1:6 for bench work
- 75 % of the technical teachers must be full timer

Qualification of Instructional Staff

- The program coordinator should be a master's degree holder in the related subject area.
- The disciplinary subject related teachers should be a bachelor's degree holder in the related subject area.
- The demonstrators should be a bachelor's degree holder or diploma or equivalent with 3 years work experience in the related subject area.
- The foundational subject related teacher (refer to course codes SH and MG) should be master's degree holder in the related subject area.

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, performance checklists, textbooks etc.

- ***Non-project media materials:*** Displays, models, photographs, flipchart, poster, writing board etc.
- ***Projected media materials****:* Slides, Multimedia Projector.
- ***Audio-visual materials:*** Audiotapes, films, slide-tapes, videodisc, etc.
- ***Computer based instructional materials:*** Computer based training, interactive video etc.
- **Web-Based Instructional Materials** (Online learning)
- **Radio/Television/Telephone**
- **Education-focused social media platform**

Teaching Learning Methodologies

The methods of teachings for this curricular program will be a combination of several approaches such as; illustrated lecture, tutorial, group discussion, demonstration, simulation, guided practice, fieldwork, block study, industrial practice, report writing, term paper presentation, heuristic and other independent learning exercises.

- **Theory**: Lecture, Group discussion, assignment and group work etc.
- **Practical**: Demonstration, observation and self-practice.
- **Internship**: Industrial Practice.

Approach of Learning

There will be inductive, deductive and learner-centered approaches of learning.

Examination and Marking Scheme

a. Internal assessment

- There will be a transparent/fair evaluation system for each subject both in theory and practical exposure.
- Each subject will have internal assessment at regular intervals and students will get the feedback about it.
- Weightage of theory and practical marks are mentioned in course structure.
- Continuous assessment format will be developed and applied by the evaluators for evaluating student's performance in the subjects related to the practical experience.

b. Final examination

- Weightage of theory and practical marks are mentioned in course structure.
- Students must pass in all subjects both in theory and practical for certification. If a student becomes unable to succeed in any subject, s/he will appear in the re-examination administered by CTEVT.
- Students will be allowed to appear in the final examination only after completing the internal assessment requirements.

c. Requirement for final practical examination

- Professional of relevant subject instructor must evaluate final practical examinations.
- One evaluator in one setting can evaluate not more than 24 students.
- Practical examination should be administered in actual situation on relevant subject with the provision of at least one internal evaluator from the concerned or affiliating institute led by external evaluator nominated by CTEVT.
- Provision of re-examination will be as per CTEVT policy.

d. Final practicum evaluation will be based on

- Institutional practicum attendance - 10%
- Logbook/Practicum book maintenance - 10%
- Spot performance (assigned task/practicum performance/identification/arrangement preparation/measurement) - 40%

- Viva voce :
    - Internal examiner - 20%
    - External examiner - 20%

e. Pass marks

- The students must secure minimum 40% marks in theory and 50% marks in practical. Moreover, the students must secure minimum pass marks in the internal assessment and in the semester final examination of each subject to pass the subject.

Provision of Back Paper

There will be the provision of back paper but a student must pass all the subjects of all semester within six years from the enrollment date; however, there should be provision of chance exam for final semester students as per CTEVT rules.

Disciplinary and Ethical Requirements

- Intoxication, insubordination or rudeness to peers will result in immediate suspension followed by the review of the disciplinary review committee of the institute.
- Dishonesty in academic or practical activities will result in immediate suspension followed by administrative review, with possible expulsion.
- Illicit drug use, bearing arms in institute, threats or assaults to peers, faculty or staff will result in immediate suspension, followed by administrative review with possible expulsion.

Grading System

The grading system will be as follows:

Grading	**Overall marks**
• Distinction:	80% and above
• First division:	65% to below 80%
• Second division:	50 % to below 65%
• Pass division:	Pass marks to Below 50

Certificate Awarded

- Students who pass all the components of all subjects of all six semesters are considered to have successfully completed the course.
- Students who have successfully complete the curricular program will be awarded with a degree of **"Diploma in Biomedical Engineering".**

Career Path

The graduates will be eligible for the position equivalent to Non-gazetted 1st class/Level 5 (technical) as prescribed by the Public Service Commission of Nepal and other related agencies.

General Attitudes Required

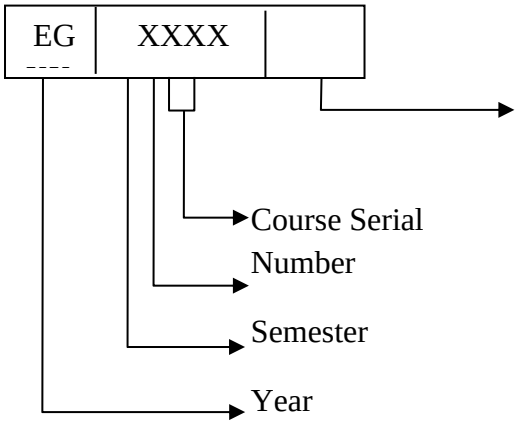
A student should demonstrate following general attitudes for effective and active learning.

Acceptance, Affectionate, Ambitious, Aspiring, Candid, Caring, Change, Cheerful, Considerate, Cooperative, Courageous, Decisive, Determined, Devoted, Embraces, Endurance, Enthusiastic, Expansive, Faith, Flexible, Gloomy, Motivated, Perseverance, Thoughtful, Forgiving, Freedom, Friendly, Focused, Frugal, Generous, Goodwill, Grateful, Hardworking, Honest, Humble, Interested, Involved, Not jealous, Kind, Mature, Open minded, Tolerant, Optimistic, Positive, Practical, Punctual, Realistic, Reliable, Distant, Responsibility, Responsive, Responsible, Self-confident, Self-directed, Self-disciplined, Self-esteem, Self-giving, Self-reliant, Selfless, Sensitive, Serious,

Sincere, Social independence, Sympathetic, Accepts others points of view, Thoughtful towards others, Trusting, Unpretentiousness, Unselfish, Willingness and Work-oriented.

Subjects Codes

Each subject is coded with a unique number preceded and followed by certain letters as mentioned in following chart:



Code of Offering Diploma Programmes:

1. AGE: Agricultural Engineering
2. AR: Architecture Engineering
3. AE: Automobile Engineering
4. BE: Biomedical Engineering
5. BM: Biomedical Equipment Engineering
6. CE: Civil Engineering
7. CT: Computer Engineering
8. EE: Electrical Engineering
9. EEX: Electrical & Electronics Engineering
10. EX: Electronics Engineering
11. GE: Geomatics Engineering
12. HE: Hydropower Engineering
13. IT: Information Technology
14. MG: Management
15. ME: Mechanical Engineering
16. MX: Mechatronics Engineering
17. RAE: Refrigeration & Air Conditioning Engineering
18. SH: Science and Humanities

Curriculum Structure

Diploma in Biomedical Engineering

YEAR: I **PART I**

S.N	Code No.	Subjects	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt Marks	Final Marks	Exam Hours	*Assmt Marks	Final Marks	Exam Hours		
1	EG 1101 SH	Applied Nepali	4				4	4	20	80	3				100	*Continuous assessment
2	EG 1102 SH	Applied English	4				4	4	20	80	3				100	
3	EG 1103 SH	Engineering Mathematics I	4	2			6	4	20	80	3				100	
4	EG 1104 SH	Engineering Physics I	4	2		2	8	5	20	60	3	10	10	2	100	
5	EG 1105 SH	Engineering Chemistry I	4	2		2	8	5	20	60	3	10	10	2	100	
6	EG 1101 AR	Engineering Drawing I	1		4		5	3				60	40	4	100	
7	EG 1101 CT	Computer Application	2		2		4	3	10	40	1.5	30	20	3	100	
TOTAL			**17**	**8**	**10**	**5**	**40**	**28**							**700**	

YEAR: I **PART II**

S.N	Code No.	Subjects	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt Marks	Final Marks	Exam Hours	*Assmt Marks	Final Marks	Exam Hours		
1	EG 1201 SH	Engineering Mathematics II	4	2			6	4	20	80	3				100	*Continuous assessment
2	EG 1202 SH	Engineering Physics II	4	2		2	8	5	20	60	3	10	10	2	100	
3	EG 1203 SH	Engineering Chemistry II	4	2		2	8	5	20	60	3	10	10	2	100	
4	EG 1201 CE	Workshop Practice I	2		6		8	5				60	40	4	100	
5	EG 1201 AR	Engineering Drawing II			4		4	2				60	40	4	100	
6	EG 1202 CE	Applied Mechanics	3	2		2/2	6	4	20	60	3	20			100	
TOTAL			**17**	**8**	**10**	**5**	**40**	**25**							**600**	

Diploma in Biomedical Engineering

YEAR: II **PART: I**

S.N	Code No.	Subject	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt Marks	Final Marks	Exam Hours	*Assmt Marks	Final Marks	Exam Hours		
1	EG 2101 BE	Biology	3			2	5	4	20	80	3	25			125	*Continuous assessment
2	EG 2102 BE	Basic Electronics Engineering	4	1	3		8	6	20	80	3	60	40	3	200	
3	EG 2103 BE	Basic Electrical Engineering	4	1	3		8	6	20	80	3	60	40	3	200	
4	EG 2104 BE	Basic Mechanical Engineering	4	1		2	7	5	20	80	3	25			125	
5	EG 2105 BE	Bioengineering Materials and Devices	3				3	3	20	80	3				100	
6	EG 2106 BE	Computer Programming	4	1	3		8	6	20	80	3	60	40	3	200	
TOTAL			**22**	**4**	**9**	**4**	**39**	**30**							**950**	

YEAR: II **PART: II**

S.N	Code No.	Subject	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt Marks	Final Marks	Exam Hours	*Assmt Marks	Final Marks	Exam Hours		
1	EG 2201 BE	Logic Circuit	4	1	3		8	6	20	80	3	60	40	3	200	*Continuous assessment
2	EG 2202 BE	Electronic Devices and Circuit	4	1	3		8	6	20	80	3	60	40	3	200	
3	EG 2203 BE	Human Anatomy and Physiology	3			1	4	4	20	80	3	25			125	
4	EG 2204 BE	Basics of Repair and Maintenance			4		4	2				60	40	3	100	
5	EG 2205 BE	Electrical Machine	4		3		7	6	20	80	3	60	40	3	200	
6	EG 2206 BE	Measurement & Instrumentation	4		2		6	5	20	80	3	30	20	2	150	
			19	**2**	**15**	**1**	**37**	**29**							**975**	

Diploma in Biomedical Engineering

YEAR: III **PART: I**

S.N.	Code No.	Subject	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt Marks	Final Marks	Exam Hour	*Assmt Marks	Final Marks	Exam Hour		
1	EG 3101 BE	Data Communication and Networking	4		2		6	5	20	80	3	30	20	2	150	*Continuous assessment
2	EG 3102 BE	Microprocessor Basics and Microcontroller	3		2		5	4	20	80	3	30	20	2	150	
3	EG 3103 BE	Biomedical Instrumentation I	3		3		6	5	20	80	3	60	40	3	200	
4	EG 3104 BE	Biomedical Equipment Maintenance I	3		3		6	5	20	80	3	60	40	3	200	
5		Elective (One of the following)	3		3		6	5	20	80	3	60	40	3	200	
	EG 3105 BE.1	a. Surgical and ICU Equipment														
	EG 3105 BE.2	b. Medical Imaging Equipment														
	EG 3105 BE.3	c. Medical Laboratory Equipment														
6	EG 3106 BE	Project I			6		6	3				100	50	3	150	
			16		**19**		**35**	**27**							**1050**	

YEAR: III **PART: II**

S.N.	Code No.	Subject	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt Marks	Final Marks	Exam Hour	*Assmt Marks	Final Marks	Exam Hour		
1	EG 3201 BE	Biomedical Instrumentation II	3		3		6	5	20	80	3	60	40	3	200	*Continuous assessment
2	EG 3202 BE	Biomedical Equipment Maintenance II	4		9		13	7	20	80	3	150	100	4	300	
3	EG 3203 BE	Health Care Management	4			1	5	5	20	80	3	25			125	
4	EG 3201 MG	Entrepreneurship Development	3		2		5	4	20	60	3	10	10	2	100	
5	EG 3204 BE	Project II			8		8	4				120	80	4	200	
			14		**22**	**1**	**37**	**25**							**925**	

L=Lecture, T=Tutorial, P=Practical

First Year (First and Second Semester)

[See Separate Curriculum]
First Year Engineering All
(Year I Part I and Year I Part II)

Second Year
Part I & II
(Third and Fourth Semesters)

Third Semester, Year II Part I

Subjects:

1.	EG 2101 BE	Biology
2.	EG 2102 BE	Basic Electronics Engineering
3.	EG 2103 BE	Basic Electrical Engineering
4.	EG 2104 BE	Basic Mechanical Engineering
5.	EG 2105 BE	Bioengineering Materials and Devices
6.	EG 2106 BE	Computer Programming

Biology
EG 2101 BE

Year : II **Total: 5 hour/week**
Part : I **Lecture: 3 hour/week**
Tutorial: hour/week
Practical: hour/week
Lab: 2 hour/week

Course description:

This course is designed to provide basic knowledge and skills related to molecular cell biology and immunology to students pursuing Diploma in Biomedical Engineering. This course is prerequisite for subjects like Human Anatomy and Physiology, Biomaterials, Biomechanics and Tissue Device Interactions courses. Understanding biology at cellular and molecular level would assist students to design new biomedical equipment and artificial organs in future.

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

1. Explain scope of biology, branches and evolutionary theories
2. Classify biomolecules, and explain their biomedical importance and applications
3. Explain DNA replication, transcription and translation at molecular level
4. Differentiate prokaryotic and eukaryotic cells; describe cell structure and organelles; cell division and apoptosis processes and explain consequences of misregulations of these processes.
5. Explain blood composition; describe types of immunity; define antigen and antibody; draw structure of typical antibody and explain their types and functions
6. Explain working principles of different equipment used in Bio-lab.

***Course Content*:**

1. **Introduction to Biology** **[2 hrs]**
   - 1.1 Nature and Scope of Biology
   - 1.2 Branch and relation with other sciences
   - 1.3 Origin and evolution of life: Meaning of Evolution, A brief history of evolutionary ideas

2. **Chemical Bonds and Biomolecules** **[7 hrs]**
   - 2.1 Atomic bonds and Biomolecular interactions
   - 2.2 Proteins: amino acids, peptide bond, globular and fibrous proteins; Biomedical importance and applications
   - 2.3 Carbohydrates: Monosaccharides, Disaccharides, Oligosaccharides and Polysaccharides; Biomedical importance and applications
   - 2.4 Lipids: Simple lipids, complex lipids, saturated and unsaturated fatty acids; Biomedical importance and applications
   - 2.5 Nucleic acids: DNA and RNA; Biomedical importance and applications

3. **Molecular Biology and Genetics** **[5 hrs]**
   - 3.1 Central dogma of Molecular Biology: DNA replication, Transcription and Translation in prokaryotes
   - 3.2 Mutation: Types of Mutation: point mutation, frame shift mutation

3.3 Mendelian genetics: law of segregation, law of independent assortment, law of dominance, law of codominance
3.4 A brief introduction to genetic engineering

4. Cell Biology [8 hrs]

4.1 Prokaryotic and Eukaryotic cells
4.2 Structure and functions of cell organelles: plasma membrane, mitochondria, golgi apparatus, ribosomes, endoplasmic reticulum, lysosomes, perioxysomes, cytoskeletons
4.3 Cellular transport: facilitated diffusion, passive and active transportation
4.4 Cell Division: Cell Cycle, Mitosis and Meiosis
4.5 Apoptosis: Meaning of apoptosis, pathways of apoptosis
4.6 Cancer: Types of cancer, stages of cancer

5. Basics of Immunology [8 hrs]

5.1 Blood composition
5.2 Immunity: innate immunity, adaptive immunity: humoral and cell mediated immunity
5.3 Antigen and Antibody: meaning of antigen, immunogen and haptens, structure and effector functions of antibody, types of antibody and functions; antigen and antibody reactions
5.4 Introduction to hypersensitivity and autoimmune diseases

6. Basic working principles of instruments used in Biology lab [15 hrs]

6.1 Compound microscope
6.2 Colorimeter, Spectrophotometer, ELISA Reader
6.3 Biosafety cabinet
6.4 Incubators
6.5 Centrifuge
6.6 Chromatography- Thin layer chromatography and Column chromatography
6.7 PCR thermocyler
6.8 Agarose gel electrophoresis
6.9 SDS-PAGE

References:

1. Lodish, H. F., Berk, A., Zipursky, S. L., Matsudaira, P., Baltimore, D., & Darnell, (2006). *Molecular cell biology* (Vol. 4). New York: WH Freeman and company.
2. Chandar, N., & Viselli, S. (2012). *Cell and molecular biology*. Lippincott Williams & Wilkins.
3. Wilson, K., & Walker, J. (Eds.). (2010). *Principles and techniques of biochemistry and molecular biology*. Cambridge university press.

Practical/Laboratory [30 hrs]

1. Safety protocols that should be followed while working in Bio-lab
2. Handling of equipment in Bio-lab
3. Estimation of carbohydrates by Fehlings method
4. Estimation of protein by Biuret method
5. Preparation of medium for the growth of bacterial cells
6. Microscopy of bacterial cells and yeast cells

7. Blood cell count using hemocytometer
8. Separation of different components of blood using centrifugation technique
9. Separation of amino acids using chromatography
10. Identification of ABO blood groups
11. A field visit to reference laboratory and report

Marks Specification for Final Examination:

Unit	Content	Course Hour	Marks
1	Introduction to Biology	2	4
2	Chemical Bonds and Biomolecules	7	12
3	Molecular Biology and Genetics	5	9
4	Cell Biology	8	14
5	Basics of Immunology	8	14
6	Basic working principles of instruments used in Biology lab	15	27
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks.

Basic Electronics Engineering
EG 2102 BE

Year: II **Total: 8 hour/week**
Part: I **Lecture: 4 hour/week**
Tutorial: 1 hour/week
Practical: 3 hour/week
Lab: hour/week

Course Description:
This course focuses on the study, design and application of electronic devices/equipment used in biomedical equipment.

Course Objectives:
1. To introduce the fundamentals of analysis of electronic circuits
2. To provide basic understanding of semiconductor devices and analog integrated circuits

***Course Content*:**

Unit 1 Introduction to Electronic Passive Components [4 hrs]

1.1 Resistor: Types, characteristics and color code, combination of Resistors, application of Resistors
1.2 Capacitor: Types, characteristics and color code, combination of Capacitors, application of Capacitors
1.3 Inductor: Types, characteristics and color code, combination of Inductor and application of Inductors

Unit 2 Semiconductor Physics [6 hrs]

2.1 Review of basic atomic structure and energy levels
2.2 Introduction: Conductor, semiconductor and insulator
2.3 Energy levels, valence band & conduction band
2.4 Energy level diagram of conductors, insulators and semiconductors.
2.5 Conduction in solids: Electron and hole flow
2.6 Intrinsic and Extrinsic semiconductor
2.7 Doping, Diffusion, drift, carrier generation and recombination
2.8 Effect of heat and light on conductivity of intrinsic semiconductor
2.9 Extrinsic semiconductor
  2.9.1 P-type semiconductor
  2.9.2 N-type Semiconductor
  2.9.3 Effect of temperature on extrinsic semiconductors
2.10 Majority and Minority charge carrier

Unit 3 Semiconductor Diodes [14 hrs]

3.1 P-N Junction and Junction diode
3.2 Depletion layer and Barrier potential
3.3 Biasing, Types of biasing and V-I characteristics of PN junction diode
3.4 Analysis of diode circuit using ideal, simplified and linear piece wise model.
3.5 Application of PN junction diode: Rectifier and its types, clipper, clamper and voltage multiplier circuit

3.6 Types of Diode (construction, characteristics and its applications): Zener diode, Photo diode, Light emitting diode, Varactor diode, and Schottky diode
3.7 Zener diode as a Voltage Regulator

Unit 4 Bipolar Junction Transistor (BJT) [16 hrs]

4.1 Bipolar Junction Transistor: Physical structure and modes of operation, Types of BJT
4.2 Transistor configuration (CE, CB, CC): Graphical representation of transistor characteristics, current gain and their relation; Comparison between three configurations
4.3 Graphical load line analysis
4.4 Biasing methods and stabilization of operating point
4.5 Transistor as an amplifier
4.6 Small signal model of BJT
4.7 Multi stage transistor amplifier: Needs and Types
4.8 Transistor as a switch

Unit 5 Field Effect Transistor [10 hrs]

5.1 Classification of FET
5.2 JFET: Construction, working and characteristics of n-channel JFET
5.3 MOSFET: Construction, working and characteristics of n-channel E-MOSFET
5.4 Comparison between BJT and FET
5.5 Idea of CMOS

Unit 6 Power Supplies and Voltage Regulators [10 hrs]

6.1 Power Supplies: Unregulated Power Supply and Regulated Power Supply
6.2 Linear Voltage Regulator: Zener Voltage Regulator, Transistor series regulator
6.3 Protection of power supplies against overload and short circuit: basic circuit, working principle
6.4 Integrated circuit voltage regulator: Fixed and Variable
6.5 Introduction to Switching Mode Power Supply and UPS

Practical/Laboratory ***[45 hrs]***

1. Color coding of Resistor (4, 5 and 6 Band), capacitor, inductor and their measurement using multimeter
2. V-I characteristics of P-N junction diode and Zener diode
3. Half Wave and Full Wave Bridge Rectifier with/without capacitor filter
4. Input - output characteristics of Common Emitter BJT configuration
5. Calculation of practical voltage gain of single stage BJT CE amplifier
6. Transistor as a Switch
7. V-I characteristics of MOSFET
8. Transistor series regulator
9. IC voltage regulator practical (Eg. 78xx series, 79xx and LM317)
10. Project work on DC regulated power supply

Tutorial ***[15 hrs]***

Assist students for conceptual and critical problem solving

1. Simple problem to solve color coding of Resistor, Capacitor and Inductor
2. Simple Problem of PN Junction Diode Analysis
3. Problem to solve Zener Diode as a voltage Regulator
4. Problem to solve different BJT Biasing techniques
5. Problem regarding Q-point calculation of BJT
6. Graphical Load Analysis of BJT

References

1. Robert Boylested and Louis Nashelsky, "Electronics Devices and Circuit Theory", PHI
2. Thomas L. Floyd, "Electronics Devices", Pearson Education Inc.
3. Theodore F Bogart, Jeffrey S. Beasley and Guillermo Rico, "Electronics Devices and Circuits", Pearson Education India
4. J.B. Gupta, "An Integrated Course in Electronics Engineering", S.K Kataria & Sons
5. Bernard Grob, "Basic Electronics", New York: McGraw Hill

Marks Specification for Final Examination:

Unit	Content	Course Hour	Marks
1	Introduction to Electronic Passive Components	4	5
2	Semiconductor Physics	6	8
3	Semiconductor Diodes	14	20
4	Bipolar Junction Transistor (BJT)	16	21
5	Field Effect Transistor	10	13
6	Power Supplies and Voltage Regulators	10	13
	Total	**60**	**80**

Note: There might be minor deviation on the above specified marks.

Basic Electrical Engineering
EG 2103 BE

Year: II **Total: 8 hour/week**
Part: I **Lecture: 4 hour/week**
Tutorial: 1 hour/week
Practical: 3 hour/week
Lab: hour/week

Course description:
This course deals with fundamentals of electric circuit, basic laws and three phase system that deal with electrical network analysis.

Course objectives:
After completion of this course the students will be able to:
1. Understand the basic concept of electric current and voltage
2. Identify the basics network theorems and their use
3. Understand the fundamental AC circuit
4. Understand the basic three phase system

Course Content:

Unit 1. Electric Circuit Fundamentals **[8 hrs]**

1.1 Introduction of current, voltage and resistance
1.2 Direct and alternating current
1.3 Circuit elements: Resistor, Inductor and Capacitor
1.4 Ohm's law
1.5 Voltage and current sources
1.6 Independent and dependent sources
1.7 Series and parallel circuits
1.8 Electrical power and energy

Unit 2. Network Theorems and Circuit Analysis **[18 hrs]**

2.1 Kirchhoff's current and voltage law
2.2 Circuit Analysis methods:
- 2.2.1 Mesh current method
- 2.2.2
- 2.2.3 Node voltage method
- 2.2.4 Thevenin's theorem
- 2.2.5 Norton's theorem
- 2.2.6 Superposition theorem
- 2.2.7 Maximum power transfer theorem

Unit 3. Electrostatics **[10 hrs]**

3.1 Laws of Electric forces
3.2 Electric field, electric fluxes and flux density
3.3 Dielectric and permittivity

3.4 Electric potential, potential difference
3.5 Capacitor and capacitance
3.6 Series and parallel connection of capacitors
3.7 Energy stored in charged capacitor
3.8 Charging and discharging of capacitor

Unit 4. Fundamentals of AC circuit **[15 hrs]**

4.1 Wave forms, terms & definition
4.2 Average and RMS values of current and voltage
4.3 AC through pure ohmic Resistance, phasor diagram, wave form of current & voltage and necessary mathematical expression with analysis
4.4 AC through pure inductance only, phasor diagram, wave form of current & voltage, power, variation of reactance with frequency.
4.5 AC through pure capacitor only, phasor diagram, wave form of current, voltage, power & necessary mathematical expression with analysis.
4.6 Analysis of series R-L, R-C, R-L-C circuits
4.7 Analysis of parallel R-L-C circuit
4.8 Resonance in AC series and parallel circuit

Unit 5. Three Phase Electric Circuit **[9 hrs]**

5.1 Definition and advantage of three phase system
5.2 Three phase connection: star (Y) and delta (Δ) connection
5.3 Line and phase quantities
5.4 Importance of phase sequence
5.5 Voltage, current and power consumption in star and delta connection

Tutorials ***[15 hrs]***

1. Problem related to series and parallel combination of resistance [2 hrs]
2. Numerical exercise related to mesh current and node voltage method [2 hrs]
3. Numerical exercise related to superposition theorem [2 hrs]
4. Numerical exercise related to Thevenin's theorem and maximum power transfer theorem [2 hrs]
5. Numerical exercise related to Norton's theorem [1 hr]
6. Numerical exercise related to average and RMS value of AC [2 hrs]
7. Numerical exercise of series R-L-C circuit [2 hrs]
8. Numerical exercise related to voltage, current and power in three phase Star – delta connection [2 hrs]

Practical/Laboratory ***[45 hrs]***

1. Verify of Ohm's law
2. Measure V,I and resistance in the series and parallel connection of resistor
3. Verify of Kirchhoff's current and voltage law
4. Verify superposition theorem
5. Verify the maximum power transfer theorem
6. Handle oscilloscope to analyze charging and discharging of capacitor
7. Measure ac quantities such as peak values, RMS value, time period & frequency
8. Measure voltage, current & power of R-L-C series circuit
9. Measure the voltage, current and power consumption in three phase star and delta load connection
10. Demonstrate the role of phase sequence in reverse/forward direction control of three phase induction motor.

Reference

1. Theraja, B. L. (2008). *A textbook of electrical technology*. S. Chand Publishing.
2. Gupta, J. B. (2009). *Fundamentals of Electrical Engg. & Electronics*. SK Kataria and Sons.
3. Grayson, L. P. (1966). Principles of electrical engineering: by Vincent Del Toro. NJ, Prentice-Hall, Inc.
4. Cogdell, J. R. (1995). *Foundations of electrical engineering*. Prentice-Hall, Inc...

Marks Specification for final examination

Unit	Content	Course Hours	Marks
1	Electric Circuit Fundamentals	8	12
2	Network Theorems and Circuit Analysis	18	24
3	Electrostatics	10	12
4	Fundamentals of AC circuit	15	20
5	Three Phase Electric Circuit	9	12
	Total	**60**	**80**

Note: There might be minor deviation on the above specified marks.

Basic Mechanical Engineering
EG 2104 BE

Total: 7 hour/week

Year: II **Lecture: 4 hour/week**

Part: I **Tutorial: 1 hour/week**

Practical: hour/week

Lab: 2 hour/week

Course Description:

This course deals with the overview of basic contents from mechanical engineering sector. It covers introduction to mechanics and strength of materials, basics of thermodynamics and heat transfer, basics of fluid mechanics and machine elements. This course is expected to bridge the two sectors of engineering as mechanical and bio medical through basic theories and numerical problems with practical applications.

Course Objectives:

After completing this course, the student will be able to:

1. Explain the types of mechanics and its application
2. Explain Laws of thermodynamics and processes, heat transfer process and basic application
3. Apply the basic theories of fluid mechanics and flow equations
4. Identify and explain the basic machine components

Course contents:

Unit 1: Introduction to mechanics [6 hrs]

1.1 Review of applied mechanics
1.2 Introduction to kinematic and kinetic
1.3 Types of motion
1.4 Rectilinear motion of particles: displacement, velocity, speed, acceleration and distance traveled by particles
1.5 Curvilinear motion of particles: radius vector, displacement, velocity, and acceleration
1.6 Newton's laws of motion
1.7 Principle of impulse and momentum
1.8 Introduction to work, power and energy

Unit 2: Introduction to strength of materials [6 hrs]

2.1 Direct stress and direct strain – compressive and tensile
2.2 Statement of Hooke's law and Stress-strain diagram
2.3 Thermal stresses
2.4 Definition of linear strain, lateral strain and poison's ratio, volumetric strain, bulk modulus.
2.5 Introducing theory of Bending and Bending Equation of beam
2.6 Concept of shear stress and torsion

Unit 3: Basic concept of thermodynamics and laws [14 hrs]

3.1 Definition and importance of thermodynamics
3.2 Thermodynamic system (closed, open and isolated system)
3.3 Properties of system (intensive and extensive properties)

3.4 Thermal equilibrium
3.5 Thermodynamic state
3.6 Thermodynamic process, cycle: Constant volume, pressure, temperature, adiabatic, polytropic
3.7 Forms of energy
3.8 Sensible heat and latent heat
3.9 Laws: Statement and application – Zeroth, First and Second
3.10 Refrigeration and air conditioning system: Components, working principle and application.

Unit 4: Heat transfer [6 hrs]

4.1 Modes of heat transfer (conduction, convection and radiation)
4.2 Fourier's law of heat conduction (Temperature gradient, Thermal conductivity)
4.3 Newton's law of heat transfers by free convection
4.4 Heat transfer by radiation, Stefan- Boltzmann law of thermal radiation
4.5 Cooling system of different electronic devices: nature cooling, fins, fans and cooling using liquid

Unit: 5 Basic concept of Fluid Mechanics [16 hrs]

5.1 Introduction of fluid
5.2 Properties of fluid: Density, specific volume, specific weight and specific gravity, viscosity
5.3 Fluid pressure and forces: pressure at a point, equation of fluid static, center of pressure concept
5.4 Absolute pressure, gauge pressure and atmospheric pressure
5.5 Types of Pressure measuring devices
5.6 Introduction to Buoyancy and floatation
5.7 Basic fluid flow equation: Statement and application-Continuity, Bernoulli's, Momentum
5.8 Flow measuring devices: construction and working principle- orifice, venturi-meter, notches

Unit 6: Introduction to machine components [12 hrs]

6.1 Shaft, axles: concept, types and comparison
6.2 Bearing: types, application
6.3 Belt, pulleys: types, application
6.4 Gear: types, application
6.5 Chains: types, application
6.6 Ropes: types, application
6.7 Couplings: types, application
6.8 Springs: types and application
6.9 Seals: types and application
6.10 Joints: types and application - Nut and bolts, Key and pins, rivet, soldering
6.11 Industrial hydraulic system: components, working principle and application
6.12 Industrial pneumatic system: components, working principle and application

Tutorial: ***[15 Hrs]***

Assist students for simple problem solving on:

1. Introduction to mechanics: rectilinear and curvilinear motion, work power and energy [3 hrs]
2. Introduction to strength of materials: Stress strain, Poisson's ratio, bending equation [3 hrs]
3. Basic concept of thermodynamics and laws: properties of system, thermodynamic processes[4 hrs]
4. Basic concept of Fluid Mechanics: Properties of fluid, fluid static, pressure measurement by simple manometers, use of continuity equation [5 Hrs]

Practical/Laboratory: ***[30 hrs]***

1. Demonstration on concept of bending and torsion
2. Compare different types of thermometers
3. Determine thermal conductivity of given specimen
4. Demonstration on components and working of air conditioning system
5. Study of fluid properties on hydrostatic bench
6. Study of Archimedean Principle
7. Pressure measurement of human body and water pipe line
8. Identification of basic machine components
9. Demonstration on components and working of hydraulic system
10. Demonstration on components and working of pneumatic system

References:

1. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition
2. R.S. Khurmi : Applied Mechanics and Strength of Materials ; S. Chand & Co, Delhi
3. S.S. Bhavikatti: Strength of Materials; Vikas Publishing House, New Delhi.
4. M. C. Luintel, "Fundamentals of Thermodynamics and Heat Transfer", Heritage Publishers & Distributors Pvt. Ltd., Nepal
5. R.S. Khurmi and J.K. Jupta, "A text book of Thermal Engineering", S. Chand Publishing, India
6. R. K. Rajput, "Fluid Mechanics and Hydraulics Machines", S Chand and Company Ltd., New Delhi, India
7. F.M. White, "Fluid Mechanics", McGraw-Hill Book Company, Singapore
8. R. S. Khurmi and J. K. Gupta, "A Text Book of Machine Design", S. Chand Publishing, India
9. S. Ilango, V. Soundarayan, Introduction to Hydraulics and Pneumatics

Marks Specification for final examination

Unit	Content	Course Hours	Marks
1	Introduction to mechanics	6	8
2	Introduction to strength of materials	6	8
3	Basic concept of thermodynamics and laws	14	18
4	Heat transfer	6	8
5	Basic concept of Fluid Mechanics	16	22
6	Introduction to machine components	12	16
	Total	**60**	**80**

Note: There might be minor deviation on the above specified marks

Bioengineering Materials and Devices
EG 2105 BE

Year: II **Total: 3 hour/week**
Part: I **Lecture: 3 hour/week**
Tutorial: hour/week
Practical: hour/week
Lab: hour/week

Course Description:

This course provides knowledge about the various implantable devices and the components that are used in those devices. This course covers various materials which are implanted into the human body that includes polymers (natural materials, glass, and ceramics), metals, composites, and their properties appropriate to the application site as well as duration along with the device type to be used during different disabilities.

Course objectives:

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

1. Learn about the different materials used in the biomedical field.
2. Explain about different implantable devices that are being used.
3. Know the properties of various materials that are suitable for implantation within the human body.

Course contents:

Unit 1. Introduction to Biomaterials [2 hrs]

1.1 Biomaterial science: An interdisciplinary course.
1.2 Classes of materials used in medicine.

Unit 2. Properties of Materials [6 hrs]

2.3 Introduction.
2.4 Bulk properties of materials.
2.5 Surface properties of materials.
2.6 Measurement techniques
2.4.1 Contact Angle Method
2.4.2 Introduction to Scanning Electron Microscopy (SEM)

Unit 3. Metals [4 hrs]

3.1. Mechanical properties and applications of various metals relating to biomaterials.
3.2. Steps in the fabrication of implants.
3.3. Different metals and alloys used in implants.
3.3.1 Stainless steel
3.3.2 Titanium
3.3.3 Cobalt alloys

Unit 4. Polymers [6 hrs]

4.1 Types and properties of polymers used in medicine and their application
4.1.1 Silicone
4.1.2 Polyethylene (PE)
4.1.3 Polyhydroxyethylmethacrylate (PHEMA)
4.1.4 Polyvinyl chloride (PVC)
4.1.5 Poly(methyl methacrylate) (PMMA)
4.1.6 Polytetrafluroethylene (PTFE)
4.2 Molecular weight and synthesis.

Unit 5. Bioresorbable and Bioerodible Materials [4 hrs]

5.1. Introduction and types of degradable biomaterials and implants.

5.2. Currently available degradable biomaterials
5.2.1 Polylactic Acid (PLA)
5.2.2 Polyglycolic Acid (PGA)

Unit 6. Ceramics, Glasses and Composites: [6 hrs]

6.1. Structure, chemistry, and properties of ceramics and glasses used in medical evices.
6.2. Types of bio-ceramics.
6.3. Definition of composite and their types

Unit 7. Introduction to Natural Materials [4 hrs]

7.1. Different types of natural materials used as biomaterials
7.1.1 Introduction to Protein (Silk, Collagen, Elastin, Myosin)
7.1.2 Introduction to Polysaccharides (Cellulose, Chitin)

Unit 8. Introduction to Implantable Devices [9 hrs]

8.1 Skin Grafts
8.2 Dental Implants
8.3 Heart Lung Machine
8.4 Pacemaker
8.5 Heart Valves
8.6 Ventricular Assist Device

Unit 9. Recent developments in Biomaterials [4 hrs]

9.1 Updates on recent trends in Biomaterials

References:

1. "Biomaterials Science: An introduction to Materials in Medicine", Edited by Buddy Ratner et. al, Academic Press.
2. "Implantation Biology", Edited by Ralph Greco, CRC Press Inc.
3. "The Williams Dictionary of Biomaterials", Compiled by D.F. Williams, Liverpool University Press.

Marks Specification for final examination

Unit	Content	Course Hours	Marks
1	Introduction to Biomaterials	2	4
2	Properties of Materials	6	12
3	Metals	4	8
4	Polymers	6	12
5	Bioresorbable and Bioerodible Materials	4	6
6	Ceramics, Glasses and Composites	6	12
7	Introduction to Natural Materials	4	6
8	Introduction to Implantable Devices	9	18
9*	Recent developments in Biomaterials	4	2
	Total	**45**	**80**

Note:

1. *Students are required to study any new development in biomaterials and submit a detailed report pertaining to chapter 9.

2. There might be minor deviation on the above specified marks.

Computer Programming
EG 2106 BE

Year : II **Total: 8 hour/week**
Part : I **Lecture: 4 hour/week**
Tutorial: 1 hour/week
Practical: 3 hour/week
Lab: hour/week

Course description:
This course deals with the fundamentals of Computer Programming. The students will learn to develop logic and algorithms to solve various problems along with the effective use of the C programming language syntax to develop special programs, and provide I/O control for special/ specific applications.

Course objectives:
After the completion of this course, students will be able:
1. Discuss the basic skills needed in programming
2. Write, compile, debug and run a program in C
3. Describe the uses of all data types in C
4. Discuss different control structures
5. Describe the use of functions and write functions in C
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:

Unit 1. Fundamentals of programming language [5 hrs]

1.1 Introduction to programming language
1.2 Types of Programming Language
2.2.1 Low Level Languages (Machine language and Assembly language)
2.2.2 High Level Languages
1.3 Programming Paradigms
2.3.1 Procedural Programming
2.3.2 Modular Programming
2.3.3 Object Oriented Programming
1.4 Language Translator
1.4.1 Assembler
1.4.2 Compiler
1.4.3 Interpreter
1.5 Problem solving in programming
2.5.1 Problem Analysis
2.5.2 Algorithm development and flowcharts (Definition with standard symbols, rules and guidelines including examples)
2.5.3 Coding (Basic concepts with examples)
2.5.4 Compilation and Execution
2.5.5 Debugging and Testing (Bugs, errors, debugging process, white box testing vs. black box testing)
2.5.6 Program Documentation

Unit 2. Introduction to C [6 hrs]

2.1 Overview and History of C language
2.2 Basic structure of a C program, Compiling process
2.3 Character set, Keywords, Identifiers, Rules for naming identifiers
2.4 Constants, Variables, Data types
2.5 Operators, Expressions, Statements, Escape sequences and Comments
2.6 Header files and Preprocessor Directives

Unit 3. Input and Output **[4 hrs]**

3.1 Types of I/O
3.2 Format specifiers (%d, %ld, %c, %f, %lf, %Lf, %o, %x, %X)
3.3 Formatted I/O (scanf(), printf())
3.4 Unformatted I/O (getchar(), putchar(), gets(), puts(), getch(), putch(), getche())
3.5 Programming Using I/O

Unit 4. Control Statements **[8 hrs]**

4.1 Decision Control Instructions
  4.1.1 If
  4.1.2 If-else
  4.1.3 If-else-if
  4.1.4 Nested if-else
  4.1.5 Conditional operator
  4.1.6 Switch statement
4.2 Loop Control Instructions
  4.2.1 For Loop
  4.2.2 While Loop
  4.2.3 Do While
  4.2.4 Nested Loop
4.3 Unconditional control
  4.3.1 Goto statement
  4.3.2 Break statement
  4.3.3 Continue statement
4.4 exit() function

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

5.1 Introduction to Functions
5.2 Components of Function
  5.2.1 Name of a function
  5.2.2 Body of a function
  5.2.3 Local variables of a function
  5.2.4 Parameters or Arguments to a function
  5.2.5 Return Values
  5.2.6 Prototype of a function
5.3 Rules of using a function
5.4 Recursive function

Unit 6. Array **[7 hrs]**

6.1 Introduction to array
6.2 Array Declaration
6.3 Array Initialization
6.4 Accessing individual elements of an array
6.5 Two Dimensional Arrays

6.6 Accessing the elements of a two-dimensional array
6.7 Passing an array element to a function
6.8 Rules of using an array

Unit 7 Pointers **[7 hrs]**

7.1 Introduction to pointer
7.2 Declaring a Pointer variable
7.3 Initializing a pointer variable
7.4 Using a Pointer Variable
7.5 Null and wild pointer
7.6 Pointer Arithmetic
7.7 Use of pointers
  7.7.1 As function arguments (By reference)
  7.7.2 Pointers and array
  7.7.3 Passing an entire array to a function
  7.7.4 Functions returning a Pointer Variable

Unit 8. Strings **[6 hrs]**

8.1 Introduction to string
8.2 String I/O
8.3 String Manipulation Functions (strlen(), strcpy(), strcat(), strcmp(), strrev(),strrev(), strlwr(), strupr())

Unit 9. Structures and union **[4 hrs]**

9.1 Declaring, Accessing Structure and union
9.2 Variables Uses of Structures and union

Unit 10. File Handling **[6 hrs]**

10.1 File Pointer
10.2 Opening a File
10.3 Closing a File
10.4 Seeking in a file

Tutorials: ***[15 hrs]***

Tutorials Sheet I **[3 hrs]**

1. Write an algorithm and draw flowchart for finding sum of any two numbers.
2. Write an algorithm and draw flowchart for calculating Simple Interest.
3. Write an algorithm and draw flow chart to determine whether a number is positive or negative.
4. Write an algorithm and draw flow chart to test if a number is even or odd.
5. Write an algorithm and draw flow chart to find largest among two numbers.
6. Write an algorithm and draw flow chart to find larger number among three numbers.
7. Write an algorithm and draw flow chart to calculate factorial of given Number.
8. Write an algorithm and draw flow chart to check if given Number is prime or not.
9. Write an algorithm and draw flow chart to find square roots of quadratic equation (Both real and Imaginary)

Tutorials Sheet II **[3 hrs]**

1. Write a program (WAP) to add two numbers.
2. WAP to find product of two numbers.
3. WAP to calculate area and circumference of a circle having radius r (input r from user).
4. WAP to convert temperature in Centigrade into Fahrenheit.
5. WAP to find sum and average of 5 numbers.
6. WAP to take marks of 5 subjects from student and calculate Total marks and percentage.
7. WAP to convert Cartesian coordinates to polar coordinates.
8. WAP to calculate Simple Interest.
9. WAP to read height and base of triangle and calculate its area.
10. WAP to read three sides of triangle and calculate its area.
11. WAP for asking cost of pen in paisa. Convert it into nearest rupee and paisa.
12. WAP to enter 4- digit number and find the sum of first and last digit of the number.
13. WAP to enter 4-digit number and find the sum of its digits. Basic salary of Ram is input through the keyboard. His medical allowance is 10% of basic salary, house rent allowance is 8% of his basic salary and provident fund is 10% of basic salary. WAP to find his net salary.
14. WAP to find the area of triangle, if the length of sides of triangle a, b, c is given by user.
15. WAP to find area of circle. Ask radius to user and also define value of PI as symbolic constant.
16. Write conditional operator to evaluate the following functions

    y=2.4x + 3, for x<=2

    y=3x – 5, for x>2

Tutorials Sheet III **[3 hrs]**

1. Give the output of the following program and justify your answer with reason

```
#include<stdio.h>
int main()
        {
        int x=3, y=5,z=7;
        int a, b;
        a=x*2+y/5-z*y;
```

```
b=++x*(y-3)/2 - ++*y;
 printf("a=%d",a);
printf("b=%d",b);
 return 0;
}
```

2. Give the output of the following program and justify your answer with reason

```
#include<stdio.h>
int main()
  {
      int a=2, b=3, c;
      a=(b++)+(++b)+a;
      c=a>b?a:b;  b=(a++)+(b--)+a;
      c=c++*b--;
      printf("a=%d\n b=%d\n c=%d", a, b, c);
      return 0;
   }
```

3. Rewrite the following program by correcting any errors, if present and also write down the output of the corrected code.

```
Define MAX '5'
int main()
{
        int case[MAX]={2,3,5,4,10},i,sum=0;
        for(i=0, i<MAX, i+=1)
        {
                printf("Case %d = %3.2d\n", i, case[i]);
                sum += *case+i;
        };
        average = sum/MAX;
        printf("%06.2f", average);
        return 1;
}
```

4. Rewrite the following program by correcting any syntactical errors, if present. Also show the output of the corrected code.

```
#include<stdio.h>
int main ()
{
        float root, int i=1; // here after float root, semicolon must be written. //
                do
                {
                        sum=2*i-1;
                       printf("\t%d\n", sum);
```

```
                    i *=5/3;
                } while (sum <= 15);
                root = pow (i, 1/2);
            printf("\n%.3f", root);
            return void;
        }
```

5. WAP to generate following output

```
1
1 2
1 2 3
1 2 3 4
1 2 3 4 5
```

6. WAP to generate following output

```
1
2 2
3 3 3
4 4 4 4
5 5 5 5 5
```

7. WAP to generate following output

```
1 2 3 4 5
1 2 3 4
1 2 3
1 2
1
```

8. WAP to generate following output

```
1
2     3
4     5     6
7     8     9     10
11    12    13    14    15
```

9. WAP to generate following output

```
        1
      1 1
    1 2 2 1
  1 2 3 3 2 1
1 2 3 4 4 3 2 1
```

10. WAP to generate following output

1
1 2
1 2 3
1 2 3 4
1 2 3 4 5
1 2 3 4 5
1 2 3 4
1 2 3
1 2
1

11. WAP to generate following output

1 2 3 4 5 4 3 2 1
1 2 3 4 3 2 1
1 2 3 2 1
1 2 1
1

Tutorials Sheet IV **[2 hrs]**

1. WAP to check if a given number is even or odd
2. WAP to check if given number is +ve or –ve.
3. WAP to read three numbers from user and determine the largest number among them.
4. WAP to read the percentage of a student then determine the division using following condition
   Percentage greater than or equal to 80 -> Distinction
   Percentage between 60 and below 80 -> First Division
   Percentage between 45 and below 60 -> First Division
   Percentage between 32 and below 45 -> First Division
   Percentage less than 32 fail.
5. WAP to calculate factorial of a number.
6. WAP that asks an integer number n and calculate sum of all-natural numbers from 1 to n.
7. WAP to add two numbers and display their sum. The program must ask next two numbers and add until user wants.
8. WAP to read a number from keyboard until zero or negative number is keyed in. Finally, calculate the sum and average of entered numbers.
9. WAP to ask a number to user and add another number to it till user wants.
10. WAP to determine whether a number is prime or not.
11. WAP that reads two numbers and an arithmetic operator (+, -, *, /, %) and perform the operation as per operator supplied using switch case.
12. WAP to read a character from keyboard and convert it into uppercase if it is in lowercase and vice versa.
13. The monthly electricity bill is computed as follows:
    Minimum Rs. 80/- for up to 20 units
    Rs. 7.30 per units for next 100 units
    Rs 9.00 per units for any units beyond 120 units

WAP to compute monthly bill for given numbers of units consumed by a customer.

14. A Bank has introduced an incentive policy. A bonus of 2% of the balance is given to everyone, irrespective of their balances and 5% is given to female account holder if their balance is more than 5000/-. WAP to represent this policy and calculate balance after bonus.
15. WAP to print ASCII value of all characters.
16. WAP to generate Fibonacci series of n terms enter by user using iteration.
17. WAP to compute the sum of digits of a given integer number.
18. WAP to compute the sum of digits of a given integer number till single digit is obtained.
19. WAP to reverse the digits of a number.
20. WAP to find cubes and squares of first 10 natural numbers.
21. WAP to check whether entered number is perfect or not. (A perfect number is a positive number which sum of all positive divisor excluding that number is equal to that number).
22. WAP to check if the entered number is strong or not. (A number is strong if its sum of factorial to its digit is equal to number itself. E.g. 145= 1! + 4! +5!).
23. WAP to read a number and find prime factors of it.
24. WAP to read a number from keyboard and check it for palindrome.
25. WAP to check if the entered number is Armstrong or not.
26. WAP to convert decimal numbers to its equivalent binary numbers.
27. WAP to convert binary numbers to its equivalent decimal numbers.
28. WAP to read two numbers from user and compute hcf and lcm.
29. WAP to print all the prime numbers between n1 and nb2. Where n1 and n2 is entered by user.
30. WAP to print all the Armstrong numbers between n1 and n2. Where n1 and n2 is entered by user.
31. WAP to print all the perfect numbers between n1 and n2. Where n1 and n2 is entered by user.
32. WAP to print all the strong numbers between n1 and n2. Where n1 and n2 is entered by user.
33. WAP to read set of numbers and calculate its maximum and minimum value.
34. WAP to find roots of quadratic equation (both real and imaginary)
35. WAP to check whether an integer given from user is triangular or not
36. WAP to display all the prime factors of given number.
37. WAP to display all the triangular numbers in Range.

Tutorials V **[2 hrs]**

1. Write a program using a function that returns the largest number from an array of numbers that is passed to the function.
2. Write a program to illustrate the “functions with no arguments and no return values”.
3. Write a program to illustrate the “functions with arguments and no return values”.
4. Write a program to swap the values of two variables using pass by reference.
5. Write a recursive function to generate particular term in Fibonacci series,
6. Write a program to display Armstrong numbers between the ranges entered by a user and also display their counts. You must use a function to check for Armstrong numbers and display them from main.
7. Write a program to calculate the sum of the series: 1+11+111+.....+up to N terms using recursive function. If N is read as 5, the series is: 1+11+111+1111+11111.

8. Write a C program to read two matrices from user, add them and display the result in matrix form.
9. Write a program to read name of five persons and sort them to display in ascending order.
10. Write a program to read a word from a main function, pass it into a function that will convert all of its characters into uppercase if the first character is in lower case and into lower case if the first character is in upper case. Display the converted string from main function.
11. A multinational company has hired 3 sales persons for marketing/selling its 3 different products in Kathmandu. Each sales person sells each of these products. Write a program to read number of each product sold by all sales-persons. Calculate total sells of each item and the total sells of each sales-person. Use array.
12. Write a program to read a string and check whether it is palindrome or not.

Tutorials VI **[2 hrs]**

1. WAP to concatenate two strings entered by the user. Also use string manipulation functions.
2. WAP in C to multiply two complex numbers entered by the user using the concept of structure.
3. Create a structure called student with member variables roll, name, address and marks. WAP to input these data creating an instance of type student and display the entered information.
4. WAP to write the name, ID, and salary of n employees in a file named "employee.txt".
5. WAP to read the file "employee.txt" created in question number 2.

Practical/Laboratory ***[45 hour]***

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 Specification for final examination

Unit	Content	Course Hours	Marks
1	Fundamentals of programming language	5	6
2	Introduction to C	6	8
3	Input and Output	4	4
4	Control Statements	8	12
5	Functions	7	10
6	Array	7	10
7	Pointers	7	10
8	Strings	6	8
9	Structures and union	4	4
10	File Handling	6	8
	Total	**60**	**80**

Note: There might be minor deviation on the above specified marks.

Fourth Semester: Year II Part II

Subjects:

1	EG 2201 BE	Logic Circuit
2	EG 2202 BE	Electronic Devices and Circuit
3	EG 2203 BE	Human Anatomy and Physiology
4	EG 2204 BE	Basics of Repair and Maintenance
5	EG 2205 BE	Electrical Machine
6	EG 2206 BE	Measurement & Instrumentation

Logic Circuit
EG 2201 BE

Year: II **Total: 8 hour/week**
Part: II **Lecture: 4 hour/week**
Tutorial: 1 hour/week
Practical: 3 hour/week
Lab: hour/week

Course Description:
This course focuses on the study, design and application of digital logic techniques and its practical applications in computer and digital system.

Course Objectives:
1 To provide foundation in the core fundamentals of digital technology.
2 To introduce basic principles of digital logic design, its implementation and applications.

Course Contents:
Unit 1 Introduction to Digital Electronics [6 hrs]

1.1. Analog & Digital Signal
1.2. Need of digitization and applications of digital systems
1.3. Digital Computer
  1.3.1. Block Diagram
  1.3.2. Advantages of Digital system
1.4. Representations of Digital Signal: Clock waveform
  1.4.1. Edge Triggered: Positive & Negative
  1.4.2. Level triggered: High Level & Low Level
1.5. Positive & Negative Logic
1.6. Logic level diagram
1.7. Integrated circuits and level of Integration: SSI, MSI, LSI, VLSI, ULSI

Unit 2 Number System and Codes [6 hrs]
2.1 Binary Octal, Decimal, Hexadecimal Number System and their conversion
2.2 Signed and Unsigned binary numbers
2.3 Representations of BCD, ASCII, Excess-3, Gray and EBCDIC codes
2.4 Code conversion: Binary/BCD/Excess-3/Gray
2.5 Error detection and Correction codes: Parity Method of Error detection

Unit 3 Arithmetic Logic Operations [6 hrs]
3.1 Binary Arithmetic: Addition, Subtraction, Multiplication, Division
3.2 Subtraction using 1's, 2's, 9's and 10's Complement
3.3 The Adder- Subtractor
3.4 Fast adder and Parallel adder
3.5 Nibble Adder

Unit 4 Fundamental of Digital Electronics [8 hrs]
4.1 Introduction to logic gates
  4.1.1 Basic gates: NOT, OR, AND
  4.1.2 Derived gates: NOR, NAND, EX-OR, EX-NOR

4.2 Universal gates
4.3 De-Morgan's laws
4.4 Boolean algebra: Theorems and Simplifications
4.5 Simplification of Logic functions using K-Map up to 4 variables
    4.5.1 SOP Expressions
    4.5.2 POS Expressions
4.6 Don't care conditions

Unit 5 Combinational Circuit **[14 hrs]**

5.1 Adder
    5.1.1 Half adder
    5.1.2 Full Adder
    5.1.3 Implementation of Half adder in to Full adder
5.2 Subtractor
    5.2.1 Half Subtractor
    5.2.2 Full Subtractor
    5.2.3 Implementation of Half subtractor in to Full subtractor
5.3 Encoder
    5.3.1 Decimal to Binary
    5.3.2 Decimal to BCD
5.4 Decoder
    5.4.1 BCD to 7-segment decoder
    5.4.2 BCD to decimal
5.5 Multiplexers
5.6 De-Multiplexers
5.7 Implementation of Mux, De-Mux, Encoder, Decoder
5.8 Magnitude comparator (Up to 3 bits)
5.9 Odd and Even Parity generator and checker
5.10 Application of combinational logic circuits

Unit 6 Sequential Circuit **[15 hrs]**

6.1 Latches and Flip Flops
    6.1.1 Latches: SR and D Latch using both NOR and NAND gate
    6.1.2 Triggering of Flip Flop: Edge triggering & Level Triggering
    6.1.3 Flip Flops: Graphic Symbol, Logic diagram, Characteristics table, State Transition Table, State equations, Excitation Table, State Transition Diagram, Wave diagram
        6.1.3.1 SR flip flop
        6.1.3.2 D-flip flop
        6.1.3.3 JK- flip flop and Race around condition
        6.1.3.4 T-flip flop
        6.1.3.5 Master Slave flip flop
        6.1.3.6 Realization of one flip flop into others
6.2 Shift Registers
    6.2.1 Serial In Serial Out (SISO)
    6.2.2 Serial In Parallel Out (SIPO)
    6.2.3 Parallel In Serial Out (PISO)
    6.2.4 Parallel In Parallel Out (PIPO)
    6.2.5 Applications of Shift Registers: Ring Counter and Johnson Counter

6.3 Counters
- 6.3.1 Asynchronous and Synchronous counters
- 6.3.2 Design of Ripple Up and Down Counters
- 6.3.3 Design of 3 bit serial Up and Down Counters
- 6.3.4 BCD/Decade Counter
- 6.3.5 Modulus counter (Mod 5, 7, 11) and Design principles
- 6.3.6 Application of Counters: Frequency counter & Digital Watch

Unit 7 Introduction to Memory and Programmable Logic [5 hrs]

7.1 Static and Dynamic memory
7.2 Types of Memory: RAM, ROM, PROM, EPROM, EEPROM
7.3 Programmable Logic: PAL, PLA and ROM

Practical/Laboratory ***[45 hrs]***

1. Familiarization with logic breadboard with verification of truth table of Basic and Derived Logic Gates
2. To verify De-Morgan Laws
3. To verify NAND& NOR gate as Universal Gates
4. Verify the operations of Encoder, Decoder, Multiplexers [4:1] and De-Multiplexers [1:4]
5. Verify the operations of BCD to Decimal Decoder
6. Verify the operations of Binary to Gray Code conversion and vice-versa
7. Design and verifications of BCD to 7 segment Decoder
8. Design and verification of 3 bit Parity Generator and Checker
9. Design and verifications of 2 bit Magnitude Comparator
10. Design and implementations of Full Adder/Subtractors using Half Adders/Subtractors
11. Verify operations of various Flip Flops
12. Verify operations of Shift Registers (SISO, SIPO, PISO, PIPO)
13. Verify operation of Ring counter, Up/Down Counter (up to 4 bit)
14. Verify operation of Asynchronous and Synchronous Counters
15. Design and Realizations of BCD and Modulo-Counters

Tutorials ***[15 hrs]***

Assist students for conceptual and critical problem solving on

1. Number Conversion: both Integral and Fractional
2. Simple circuit designing of a circuit through K-Map on standard SOP & POS
3. 7-Segment Display Design
4. Designing Asynchronous and Synchronous counter
5. Digital Watch Design though Counters

References

1. M. Morris Mano, “Digital Logic and Computer Design”, Pearson
2. Floyd T.L. “Digital Fundamentals”, Pearson
3. Malvino Leach, “Digital Electronics and Applications”, Tata McGral Hill, New Delhi
4. Dr. Sanjay Sharma, “Electronic Principles”, Katson

Marks Specification for Final Examination:

Unit	Content	Course Hour	Marks
1	Introduction to Digital Electronics	6	8
2	Number System and Codes	6	8
3	Arithmetic Logic Operations	6	8
4	Fundamental of Digital Electronics	8	12
5	Combinational Circuit	14	18
6	Sequential Circuit	15	20
7	Introduction to Memory and Programmable Logic	5	6
	Total	**60**	**80**

Note: There might be minor deviation on the above specified marks.

Electronic Devices and Circuit
EG 2202 BE

Year: II **Total: 8 hour/week**
Part: II **Lecture: 4 hour/week**
Tutorial: 1 hour/week
Practical: 3 hour/week
Lab: hour/week

Course Description:
This course focuses on the study, design and application of electronic devices/equipment used in biomedical equipment. It primarily focuses on various electronic devices and circuits, mainly with use of transistors in analog circuits like power amplifier, multistage amplifier and oscillators.

Course Objectives:
1 To introduce the fundamentals of analysis of Power electronic devices
2 To explain the basic constructional details and operation of power electronic devices: Thyristor, DIAC, TRIAC, MOSFET

Course Contents:

Unit 1 Output Stages and Power Amplifiers [8 hrs]

1.1 Classification of output Stages
1.2 Class A output stages
1.3 Class B output stages
1.4 Class AB Output Stages:
1.5 Tuned amplifiers
1.6 Heat Sink

Unit 2 Operational Amplifier [10 hrs]

2.1 Ideal characteristics of Op-amp
2.2 Practical Op-amp and its applications
2.3 Inverting and Non-inverting configuration of Op-Amp
2.4 Op-amp as Adder, Subtractor, Integrator, Differentiator, Comparator, Buffer
2.5 Instrumentation Amplifier: Single Op-Amp and 3 Op-Amp
2.6 Isolation amplifier
2.7 Practical Op-amp (eg 741) characteristics: **Definition only**

Unit 3 Feedback and Oscillators [12 hrs]

3.1 Feedback: Definition, negative and positive feedback equation and their applications
3.2 Effect of negative feedback on gain, stability, noise, distortion and bandwidth of an amplifier
3.3 Basic Principle of sinusoidal oscillator, Conditions for Oscillation (Barkhausen Criterion)
3.4 Classification of Oscillator
  3.4.1 LC Oscillator: Hartley Oscillator and Colpitts Oscillator
  3.4.2 RC Oscillator: RC Phase Shift and Wien Bridge Oscillator
  3.4.3 Crystal Oscillator and Application

Unit 4 Multi-Vibrators [6 hrs]

4.1 Introduction of Astable, Mono-stable and Bi-stable Multi-vibrator
4.2 Astable Multi-vibrator using 555 timer IC

4.3 Generation of Square and Triangular waveform

Unit 5 Filters: Passive RC and LC Filter [10 hrs]

5.1 Low Pass Filter
5.2 High Pass Filter
5.3 Band Pass Filter
5.4 Band Stop Filter
5.5 Introduction to Active Filter

Unit 6 Introduction to Power Electronics and Optoelectronics [14 hrs]

6.1 Silicon Controlled Rectifier (SCR) and its Applications
6.2 Diac and Triac: Working, Characteristics and Applications
6.3 Photo Transistor: Working, Characteristics and Applications
6.4 Opto-Coupler and solar cell: Working principle and Applications
6.5 Laser and Optical fibre: Construction, Working principle and Applications
6.6 Inverters: Single phase Half Bridge and Full Bridge Inverter
6.7 DC to DC conversion: Basic principle of step up and step down conversion

Practical/Laboratory ***[45 hrs]***

1. Inverting and Non inverting Op-Amp configuration
2. Efficiency calculation of class B complementary symmetry push pull configuration
3. Class A and class B Power amplifiers: Efficiency and distortion (Crossover Distortion)
4. Single Op-amp instrumentation amplifier
5. Op-amp as Integrator and differentiator
6. Generation of sinusoidal wave using RC oscillator and LC oscillator
7. Generation of square waveform using 555 time IC
8. V-I characteristics of Silicon Controlled Rectifier and TRIAC circuit
9. V-I characteristics of Optocoupler and Solar cell
10. Observe transfer characteristic of different types of Active and Passive filter
11. LP, BP and HF filter circuits: Cutoff points and frequency response.

Tutorials ***[15 hrs]***

Assist students for conceptual and critical problem solving

1. Simple design and problem to solve Op-Amp Characteristics: Adder, Subtractor, Integrator, Differentiator, Comparator
2. Simple problem on Oscillator: Weinbridge Oscillator
3. Simple Problem on cutoff frequency calculation of Filter

References

1. Robert Boylested and Louis Nashelsky, “Electronics Devices and Circuit Theory”, PHI
2. Thomas L. Floyd, “Electronics Devices”, Pearson Education Inc.
3. Theodore F Bogart, Jeffrey S. Beasley and Guillermo Rico, “Electronics Devices and Circuits”, Pearson Education India
4. J.B. Gupta, “An Integrated Course in Electronics Engineering”, S.K Kataria & Sons
5. B.W. Williams, “Power Electronics: Devices, Drivers and Applications”, Mc Graw Hill
6. Muhammad H Rashid, “Power Electronics: Circuits, Devices and Applications”, Pearson Education India

Marks Specification for Final Examination:

Unit	Content	Course Hour	Marks
1	Output Stages and Power Amplifiers	8	10
2	Operational Amplifier	10	14
3	Feedback and Oscillators	12	16
4	Multi-Vibrators	6	8
5	Filters: Passive RC and LC Filter	10	14
6	Introduction to Power Electronics and Optoelectronics	14	18
	Total	**60**	**80**

Note: There might be minor deviation on the above specified marks.

Human Anatomy and Physiology
EG 203 BE

Year : II **Total: 4 hour/week**
Part : II **Lecture: 3 hour/week**
Tutorial: hour/week
Practical: hour/week
Lab: 1 hour/week

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

Unit 1 Introduction to Anatomy: [1 hr]

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 [2 hrs]

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 [2 hrs]

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

Unit 4 Introduction to Skeletal System [2 hrs]

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 **[2 hrs]**

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

Unit 6 Introduction to Muscular System **[2 hrs]**

6.1 Introduction of different type of Muscle
6.2 Outline muscle function

Unit 7 Introduction to Blood [**2 hrs]**

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 [**4 hrs]**

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 **[2 hrs]**

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 **[4 hrs]**

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 **[4 hrs]**

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 **[2 hrs]**

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 [2 hrs]

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 [4 hrs]

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 [5 hrs]

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 [5 hrs]

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

Practical/Laboratory ***[15 hrs]***

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

Marks Specification for Final Examination:

Unit	Content	Course Hour	Marks
1	Introduction to Anatomy	1	2
2	Introduction to the chemistry of life: Body fluid and Electrolyte	2	2
3	Introduction to cells and Tissue	2	4
4	Introduction to Skeletal System	2	4
5	Introduction to Joints	2	4
6	Introduction to Muscular System	2	4
7	Introduction to Blood	2	4
8	Introduction to Cardiovascular System	4	8
9	Introduction to Lymphatic System	2	2
10	Introduction to Digestive System	4	8
11	Introduction to Respiratory System	4	8
12	Introduction to Urinary System	2	4
13	Introduction to Endocrine System	2	2
14	Introduction to Nervous System	4	8
15	Introduction to Reproductive System	5	8
16	Introduction to Sensory System	5	8
	Total	**60**	**80**

Note: There might be minor deviation on the above specified marks.

Basics of Repair and Maintenance
EG 2204 BE

Total: 4 hour/week
Year: II **Lecture: hour/week**
Part: II **Tutorial: hour/week**
Practical: 4 hour/week
Lab: hour/week

Course description

This course deals with the procedures of testing, repairing and maintenance of essential domestic electrical and electronic appliances which is related to principle with biomedical equipment.

Course objectives

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

1. Test and identify the defect in domestic electrical appliance
2. Troubleshoot the faulty parts/section
3. Repair and Replace the faulty part in domestic electrical appliances
4. Observe and prepare circuit diagram of domestic electrical appliances

Course Contents:

Unit 1. Introduction to maintenance principles [3 hrs]

1.1 Overview of safety measures to be adopted during maintenance
1.2 Introduction to fault diagnosis techniques, using basic flow chart
1.3 Types of maintenance: Preventive and corrective maintenance
1.4 Use of manuals and datasheet for maintenance

Unit 2. Simple Electrical wiring [8 hrs]

2.1 Revision of wiring
2.2 Practice wiring based on layout and wiring diagram with simple DB repair technique (identify MCB status, Connections, wire size and rating of MCB and fuse)

Unit 3. Power Supply [15 hrs]

3.1 Practice soldering and de-soldering techniques
3.2 Visual inspection and follow sequential electrical component testing procedure: check fuse, plug, switch, wire and use primary component
  3.2.1 Identification of the components and tracing the power supply
    - Check transformer, Diode (half wave, full wave, and bridge rectifier) and related component by use of Multimeter
    - Identify the different types of fixed positive and negative regulator ICs (78/79 series)
  3.2.2 Construct a fixed voltage regulator using 78xx/79xx series ICs
  3.2.3 Construct a variable voltage regulator using LM 317.
  3.2.4 Construct a multi output power supply box 0-30V variable, +5V, +12V, -12V
  3.2.5 Observe the output voltage of different IC regulators by varying the input voltage
3.3 Switching Mode Power Supply (SMPS)
  3.3.1 Check high voltage side – rectifier, filters, and electronic component (transistor, IC, MOSFET, optocoupler etc
  3.3.2 Check low voltage side- transformer, rectifier, filter and voltage regulator, and polarity protection system.

Unit 4. Battery- charger [4 hrs]

4.1 Check Transformer, rectifiers-filter, electronic circuit, float and boost charger indicator.

4.2 Set the output voltage according to battery type.

4.3 SMPS based battery charges

4.3.1 Check high voltage side – rectifier, filters, and electronic component (transistor, IC, MOSFET, optocoupler etc

4.3.2 Check low voltage side- transformer, rectifier, filter, voltage regulator, polarity protection and charge cut-off system.

Unit 5. Electrical Protection device [10 hrs]

5.1 Volt guard

5.1.1 Visual inspection and follow sequential electrical component testing procedure: check fuse, plug, switch, wire and use primary component

5.1.2 Check transformer, electronic device according to circuit diagram, relay, VDR and for metal body volt guard check for leakage current.

5.1.3 Check low and high voltage cut-off using variac

5.1.4 Automatic Voltage Switch: Check electronic component according to circuit diagram.

5.2 Stablizer

5.2.1 Visual inspection and follow sequential electrical component testing procedure: check fuse, plug, switch, wire and use primary component

5.2.2 Check auto-transformer, electronic device according to circuit diagram, relay and for metal body stabilizers for leakage current.

5.2.3 Check regulated voltage (220-240VAC) using variac

5.2.4 Electronic Voltage Stabilizers: Check electronic component according to circuit diagram.

5.3 UPS/Inverter

5.3.1 Visual inspection and follow sequential electrical component testing procedure: check fuse, plug, switch, wire, primary component and battery connection and conditions.

5.3.2 Check error status with error codes using manual

5.3.3 Dismantle the UPS and identify the major parts

- Testing of major components
- Testing of power modules
- Charging, discharging, condition and testing of batteries.

Unit 6. Heating, cooling system and controlling [20 hrs]

6.1 Heater

6.1.1 Visual inspection and follow sequential electrical component testing procedure: check fuse, plug, switch, wire, primary component by dismantling the unit

6.1.2 Check heater, fuse, switch and identify the faulty part/s

6.1.3 Check leakage current

6.2 Kettle

6.2.1 Visual inspection and follow sequential electrical component testing procedure: check fuse, plug, switch, wire, primary component by dismantling the unit

6.2.2 Check heater, fuse, switch and identify the faulty part/s

6.2.3 Check leakage current

6.3 Hot pot

6.3.1 Visual inspection and follow sequential electrical component testing procedure: check fuse, plug, switch, wire, primary component by dismantling the unit

6.3.2 Check heater (warming and heating), fuse, switch, thermostat, dispenser motor and identify the faulty part/s

6.3.3 Check leakage current

6.4 Electric Iron

6.4.1 Visual inspection and follow sequential electrical component testing procedure: check fuse, plug, switch, wire, primary component by dismantling the unit

6.4.2 Check heating element, Bi-metallic thermostat.

6.4.3 Check leakage current

6.5 Refrigerator and Air conditioner

6.5.1 Visual inspection and follow sequential electrical component testing procedure: check fuse, plug, switch, wire, primary component by dismantling the unit

6.5.2 Check necessary parts thermostat, overload relay, motor winding, door switch, door gasket, defrosting and identify the faulty part/s for refrigerator

6.5.3 Check indoor and outdoor unit: Motor, Fan, Gas status and remote controller for Air Conditioner

6.5.4 Check proper operation and leakage current.

References:

1. Troubleshooting and Repairing Major Appliances, 3 editions by Eric Kleinert
2. Electrical motor Repair - Robert Rosenberg
3. Handbook of Repair and Maintenance of Domestic Electronics by Shashi Bhushan Sinha
4. The Complete Guide to the Maintenance and Repair of Domestic Electrical by Graham Dixon
5. Troubleshooting Repairing Consumer Electronics Without a Schematic by Homer L. Davidson
6. Consumer Electronics Troubleshooting and Repair Handbook by Homer L. Davidson
7. Troubleshooting Electronic Equipment by R. Khandpur
8. The complete microwave oven service handbook operation, maintenance, troubleshooting, and repair by J. Carlton Gallawa
9. Manufacturer’s catalogue and repair manual

Electrical Machine
EG 2205 BE

Year: II **Total: 7 hour/week**
Part: II **Lecture: 4 hour/week**
Tutorial: hour/week
Practical: 3 hour/week
Lab: hour/week

Course Description:
This course covers the transformer, dc generator, dc motor and induction motor. It deals with the constructional details, operating principle, characteristics application of the above machines.

Course objectives:
After completion of this course the students will be able to:
1. Understand the constructional detail of transformer, dc machines and induction motor
2. Understand the fundamental operating principles of electrical machines
3. Identify the application of transformer, dc machines and induction motor

Course Contents:

Unit 1. Electromagnetism and Electromagnetic Induction [8 hrs]

1.1 Definition of magnetic field, magnetic flux, flux density, field intensity and permeability of magnetic material
1.2 Magnetic field due to current carrying conductor, force on a current carrying conductor
1.3 Faraday's laws of electromagnetic induction, induced EMF equation, Lenz's law
1.4 Magnetic circuit concept, analogy to electric circuit
1.5 Hysteresis loop for magnetic material, hard and soft magnetic material

Unit 2. Transformer [16 hrs]

2.1 Basic construction, operating principle, derivation of emf equation, Transformation ratio
2.2 Concept of ideal transformer
2.3 Core type and shell type transformer
2.4 No load operation of transformer: equivalent circuit and phasor diagram
2.5 Operation of transformer with load: equivalent circuit and phasor diagram
2.6 Transformer test:
  2.6.1 Polarity test
  2.6.2 Open circuit test
  2.6.3 Short circuit test
2.7 Losses in transformer
2.8 Efficiency of transformer, condition for maximum efficiency and all day efficiency
2.9 Operation and application of auto-transformer
2.10 Three phase transformer:
  2.10.1 Connections: Star/Star, Delta/Delta, Star/Delta, Delta/Star, Open delta
  2.10.2 Components of power transformer: Tank, Conservator, Breather, Explosion vent, Transformer oil, Terminal bushing, arching horns, Buchhloz's relay, tap-changer.

Unit 3. DC Generator **[12 hrs]**

3.1 Constructional Details: Yoke, Field poles, Field winding, Armature and its winding.
3.2 Operation, operating principle, emf equation,
3.3 Types of dc generator:
  3.3.1 Separately excited: terminal voltage equation, characteristics and application
  3.3.2 Self-excited:
    - Types: shunt, series and compound dc generator
    - Voltage build up process
    - Relation between emf generated and load terminal voltage
    - Characteristics and applications of self-excited dc generator
3.4 Losses and efficiency
3.5 Armature reaction and method of reducing armature reaction
3.6 Commutation
3.7 Application and significance of DC generator

Unit 4. DC Motor **[12 hrs]**

4.1 Operation: operating principle, torque equation, back emf, role of back emf
4.2 Types of dc motor: Shunt, series and compound, their characteristics and applications
4.3 Losses and efficiency
4.4 Importance of dc motor starter, 3-point dC motor starter
4.5 Speed control of shunt and series dc motor
4.6 Application and significance of DC motor
4.7 Introduction of stepper motor

Unit 5. Induction Motor **[12 hrs]**

5.1 Three phase induction motor:
  5.1.1 Construction details
  5.1.2 Types: squirrel cage and phase wound
  5.1.3 Operating principle
  5.1.4 Power stages, losses and efficiency
  5.1.5 Starting method: DOL, primary resistor, auto-transformer and star-delta method
  5.1.6 Speed control: rotor resistance method and frequency control method

5.2 Single phase motors:
  5.2.1 Construction, operating principle and application of split phase induction motor, capacitor start - run motor, shaded pole motor, universal motor.

Practical/Laboratory **[45 hrs]**

1. Perform the turn ratio test of single phase transformer
2. Perform the no-load test of single phase transformer
3. Perform the short circuit test of single phase transformer
4. Perform the polarity test on two separate single phase transformer

5. Obtain and draw the open circuit curve (OCC) of dc shunt generator
6. Perform the speed control of dc shunt motor by field control and armature control method.
7. Perform the speed control of dc series motor by flux control and armature resistance control method.
8. Perform an experiment to start three phase induction motor with DOL starter and star-delta starter.
9. Obtain the torque-speed characteristics of shaded pole motor.
10. Obtain the torque speed characteristics of capacitor start and run motor.

Reference:

1. Nagrath I.J. and Kothari D.P., (2017). Electric Machines, (Third edition), Tata McGraw-Hill publication.
2. Gupta J.B., (2013). Theory and performance of Electrical Machines, (Ninth edition), S.K. Kataria & Sons, India
3. Theraja, B. L. (2008). A textbook of electrical technology, S. Chand Publishing.

Marks Specification for Final Examination:

Unit	Content	Course Hours	Marks
1	Electromagnetism and Electromagnetic Induction	8	8
2	Transformer	16	24
3	DC Generator	12	16
4	DC Motor	12	16
5	Induction Motor	12	16
	Total	**60**	**80**

Note: There might be minor deviation on the above specified marks.

Measurement and Instrumentation
EG 2206 BE

Year: II **Total: 6 hour/week**
Part: II **Lecture: 4 hour/week**
Tutorial: hour/week
Practical: 2 hour/week
Lab: hour/week

Course Description:
This course focuses on the study, design and application of measuring electronic devices/equipment used in biomedical sector.

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

Course Contents:
Unit 1 Fundamentals of Measurements **[10 hrs]**

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
1.5 Measurement of Low, Medium and High Resistance
1.6 AC Bridge: Measurement of Inductance and Capacitance (Maxwell and Schering)

Unit 2 Measuring Instruments **[10 hrs]**

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: Cathode Ray Oscilloscope and Digital Storage Oscilloscope
  2.2.1 Working Principle
  2.2.2 Basic Block Diagram
  2.2.3 Applications

Unit 3 Transducers **[16 hrs]**

3.1 Introduction and classification of Transducer
3.2 Resistive Transducer: Potentiometer, Strain Gauge: Working and Applications

3.3 Inductive Transducer: Linear Variable Differential Transformer (LVDT)- Working and Applications
3.4 Capacitive Transducer: By varying overlapping area, distance and permittivity of dielectric between plates: Working and Applications
3.5 Piezoelectric and Hall Effect Transducers: Working and Applications
3.6 Thermistors and Thermocouples: Working and Applications

Unit 4 Analog to Digital and Digital to Analog Conversion [10 hrs]

4.1 Analog signal and Digital signal
4.2 Digital to Analog convertors (DAC) - weighted resistor type, R-2R ladder type, DAC Errors
4.3 Analog to digital convertors (ADC) - successive approximation type, dual-slope ramp type and Flash ADC
4.4 Introduction to A/D Conversion: Sampling theorem, Sample and Hold Circuit

Unit 5 Grounding and Shielding [4 hrs]

5.1 Noise, Noise coupling mechanism and prevention
5.2 Single point grounding and ground loop
5.3 Decoupling capacitors
5.4 Different kinds of shielding mechanism
5.5 Protecting against electrostatic discharge

Unit 6 Biomedical Testing Equipment [10 hrs]

6.1 Introduction to:
- 6.1.1 Safety – Analyzer
- 6.1.2 Defibrillator Tester
- 6.1.3 Patient Simulator
- 6.1.4 Pulse Oximeter Calibration
- 6.1.5 Oxygen analyzer
- 6.1.6 Gas Analyzer
- 6.1.7 KVP, mA, Time, mAs, Dose meter
- 6.1.8 Ultrasound Phantom
- 6.1.9 Insulation tester
- 6.1.10 Earthing test

Practical/Laboratory ***[30 hrs]***

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.
   - 4.1 Testing of probe, calibration of oscilloscope
   - 4.2 Measure the dc-voltage of a source;
   - 4.3 Measure the peak-to-peak voltage, time period and frequency of a sinusoidal waveform
   - 4.4 Measure the phase difference between two sinusoidal waveforms
5. Study of Transducer for Measurement of

5.1 Displacement (Resistive, Inductive and Capacitive)
5.2 Sensitivity Calculation of Resistive, Inductive and Capacitive Transducer
5.3 Angular displacement using tachometer
5.4 Working and characteristics of Piezoelectric sensor
5.5 Temperature measurement with thermistor and thermocouple

6. Measurement of Resistance using Wheatstone Bridge
7. Measurement of high resistance and insulation resistance using Megger
8. Observe output of R-2R ladder DAC and Any one of ADC

References:

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 Specification for Final Examination:

Unit	Content	Course Hour	Marks
1	Fundamentals of Measurements	10	14
2	Measuring Instruments	10	12
3	Transducers	16	24
4	Analog to Digital and Digital to Analog Conversion	10	14
5	Grounding and Shielding	4	4
6	Grounding and Shielding	10	12
	Total	**60**	**80**

Note: There might be minor deviation on the above specified marks.

Third Year
Part I & II
(Fifth and Sixth Semester)

Fifth Semester: Year III Part I

Subjects:

1	EG 3101 BE	Data Communication and Networking
2	EG 3102 BE	Microprocessor Basics and Microcontroller
3	EG 3103 BE	Biomedical Instrumentation I
4	EG 3104 BE	Biomedical Equipment Maintenance I
5	Elective (One of the following)	
	EG 3105 BE.1	a. Surgery and ICU Equipment
	EG 3105 BE.2	b. Medical Imaging Equipment
	EG 3105 BE.3	c. Medical Laboratory Equipment
6	EG 3106 BE	Project I

Data Communication and Networking
EG 3101 BE

Total: 6 hour/week
Year : III **Lecture: 4 hour/week**
Part : I **Tutorial: hour/week**
Practical: 2 hour/week
Lab: hour/week

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

Course objectives:
After the completion of this course, students will be able:
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:
Unit 1 Fundamentals of data communications & networking [8 hrs]
- 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 **[6 hrs]**

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 **[8 hrs]**

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 **[10 hrs]**

- 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 **[10 hrs]**

- 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 **[6 hrs]**

- 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 **[4 hrs]**

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 **[8 hrs]**

8.1 Introduction to Biotelemetry
1.1.1 Applications of Telemetry
1.1.2 Elements of Biotelemetry System
8.1.2.1 Amplitude Modulation
8.1.2.2 Frequency Modulation
8.1.2.3 Pulse Modulation
1.2 Introduction to Control Area Network, PACS, DICOM
1.3 Introduction to Telemedicine & Telesurgery

Practical/Laboratory ***[30 hrs]***

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 Specification for Final Examination:

Unit	Content	Course Hour	Marks
1	Fundamentals of data communications & networking	8	9
2	Physical layer	6	7
3	Data Link Layer	8	9
4	Network Layers	10	13
5	Transport Layer	10	13
6	Application Layer	6	9
7	Introduction to IPV6	4	7
8	Practical Aspects of Networking	8	13
	Total	**60**	**80**

Note: There might be minor deviation on the above specified marks

Microprocessor Basics and Microcontroller
BE 3102 BE

Total: 5 hour/week
Year : III **Lecture: 3 hour/week**
Part : I **Tutorial: hour/week**
Practical: 2 hour/week
Lab: hour/week

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:

Unit 1 Introduction to Microprocessor [3 hrs]
- 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 [5 hrs]
- 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 [4 hrs]
- 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 [5 hrs]
- 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 **[10 hrs]**

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 **[6 hrs]**

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 **[12 hrs]**

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

Practical/Laboratory ***[30 hrs]***

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 Specification for Final Examination:

Unit	Content	Course Hour	Marks
1	Introduction to Microprocessor	3	6
2	8085 Microprocessor	5	10
3	8051 Microcontroller	4	8
4	8051 Assembly Language Programming	5	10
5	8051 Programming in C	10	16
6	8051 Interrupts	6	14
7	Design and Interface	12	16
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks.

Biomedical Instrumentation I
EG 3103 BE

Year : III **Total: 6 hour/week**
Part : II **Lecture: 3 hour/week**
Tutorial: hour/week
Practical: 3 hour/week
Lab: hour/week

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:

Unit 1 Fundamentals of Medical Instrumentation **[2 hrs]**
- 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 **[4 hrs]**
- 2.1 Bioelectric potential
- 2.2 Resting potential
- 2.3 Action potential
- 2.4 Propagation of action potential
- 2.5 Biological signals
- 2.6 Electrodes
  - 2.6.1 Bio-potential electrodes
  - 2.6.2 Microelectrodes
  - 2.6.3 Skin surface electrodes

Unit 3 Physiological Transducers **[4 hrs]**
- 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 [16 hrs]

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 [15 hrs]

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 **[4 hrs]**

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

Practical/Laboratory ***[45 hrs]***

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 Specification for Final Examination:

Unit	Content	Course Hour	Marks
1	Fundamentals of Medical Instrumentation	2	4
2	Signals and Electrodes	4	8
3	Physiological Transducers	4	8
4	Measuring and Monitoring System	16	28
5	Therapeutic Biomedical Devices	15	24
6	Laser Application in Biomedical Filed	4	8
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks.

Biomedical Equipment Maintenance I
EG 3104 BE

Total: 6 hour/week
Year : III **Lecture: 3 hour/week**
Part : I **Tutorial: hour/**
Practical: 3 hour/week
Lab: hour/week

Course description:
The course deals with overall introduction working principle of medical devices according to types and technology. It contains block diagram, circuit diagram, flow chart of the certain medical devices. It comprises fault finding repair and maintenance testing and calibration.

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:

Unit 1 Safety in **[3 hrs]**
- 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 **[2 hrs]**
- 2.1 Working around patients
- 2.2 Infection prevention and control
- 2.3 Medical and surgical asepsis

Unit 3 Different modules of equipment **[2 hrs]**
- 3.1 Concept of Medical Equipment Maintenance
  - 3.1.1 Introduction to maintenance
  - 3.1.2 Types of maintenance
    - 1.1.2.1 Preventive maintenance
    - 1.1.2.2 Corrective maintenance
    - 1.1.2.3 Use of manuals and datasheet

1.1.2.4 Record keeping

3.2 General equipment [10 hrs]

3.2.1 Stethoscope
- 1.2.1.1 Introduction and its working principle
- 1.2.1.2 Type of Stethoscope
- 1.2.1.3 Parts of Stethoscope
- 1.2.1.4 Maintenance and repair
  - 1.2.1.4.1 Preventive Maintenance
  - 1.2.1.4.2 Troubleshooting and Corrective maintenance

3.2.2 Sphygmomanometer (BP Machine)
- 1.2.2.1 Introduction and its working principle
- 1.2.2.2 Type of BP machine
- 1.2.2.3 Aneroid BP machine and Digital BP machine.
- 1.2.2.4 Parts of BP machine
- 1.2.2.5 Maintenance and repair
  - 1.2.2.5.1 Preventive Maintenance
  - 1.2.2.5.2 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 [8 hrs]

3.1.1 Oxygen Plant
3.1.1.1 Introduction and Types: PSA & VSA
3.1.1.2 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 [5 hrs]

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) [8 hrs]

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 [4 hrs]

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 [3 hrs]

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

Practical/Laboratory ***[45 hrs]***

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 [2 hrs]

2 General Equipment [10 hrs]

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 [8 hrs]

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 [6 hrs]

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) [8 hrs]

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 [4 hrs]

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 [10 hrs]

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 Specification for Final Examination:

Unit	Content	Course Hour	Marks
1	Safety in	3	6
2	Patient and Hospital Environment	2	4
3	Oxygen generators and storage device	40	70
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks.

Elective Subjects

Elective (one of the following)

EG 3105 BE.1 a. Surgical and ICU Equipment
EG 3105 BE.2 b. Medical Imaging Equipment
EG 3105 BE.3 c. Medical Laboratory Equipment

Surgical and ICU Equipment (Elective)
EG 3105 BE.1

Total: 6 hour/week
Year : III **Lecture: 3 hour/week**
Part : I **Tutorial: hour/week**
Practical: 3 hour/week
Lab: hour/week

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:

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

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 **[13 hrs]**

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 [12 hrs]

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 [2 hrs]

4.1 Minimally invasive cardiovascular surgery
4.2 Minimally invasive neuro surgery

Unit 5 Intensive care unit (ICU) [2 hrs]

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 [4 hrs]

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 [4 hrs]

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

Practical/Laboratory ***[45 hrs]***

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 4 Ventilators

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

Unit 5 Automated Drug Delivery System

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

Unit 6 Patient Monitoring Systems and Therapy Systems

6.1 Demonstration of central monitoring system setup in ICU

6.2 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 Specification for Final Examination:

Unit	Content	Course Hour	Marks
1	Operation theater	4	5
2	Surgical equipment	13	25
3	Endoscope technology in surgery	12	20
4	General applications of minimally invasive surgery	2	5
5	Intensive care unit (ICU)	2	5
6	Ventilators	4	10
7	Automated drug delivery system	4	5
8	Patient monitoring and therapy systems	4	5
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks.

Medical Imaging Equipment (Elective)
EG 3105 BE.2

Total: 6 hour/week
Year : III **Lecture: 3 hour/week**
Part : I **Tutorial: hour/week**
Practical: 3 hour/week
Lab: hour/week

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

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

Unit 1. Introduction to medical imaging technology **[1 hr]**
Unit 2. Radiation hazard and safety **[2 hrs]**
- 2.1 Biological effect of radiation
- 2.2 Radiation monitoring and protection devices

Unit 3. X-ray **[10 hrs]**
- 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 [2 hrs]
4.1 Introduction
4.2 Operating principle
4.3 Parts

Unit 5. C arm [4 hrs]
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 [12 hrs]
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 **[4 hrs]**
- 7.1 Introduction
- 7.2 Principle of CT Scan
- 7.3 Stationary and Rotating Part
- 7.4 Image Generation

Unit 8. Ultrasound **[4 hrs]**
- 8.1 Introduction
- 8.2 Operating Principle
- 8.3 Parts of Ultrasound
- 8.4 Preventive Maintenance
- 8.5 Repair and Calibration

Unit 9. MRI **[4 hrs]**
- 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 **[2 hrs]**
- 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

Practical/Laboratory ***[45 hrs]***

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

Reference:

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 Specification for Final Examination:

Unit	Content	Course Hour	Marks
1	Introduction to medical imaging technology	1	4
2	Radiation hazard and safety	2	
3	X-ray	10	20
4	Mammography	2	4
5	C arm	4	8
6	Radiographic imaging process	12	12
7	CT Scan	4	12
8	Ultrasound	4	8
9	MRI	4	8
10	Innovation and development in healthcare imaging technology	2	4
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks.

Medical Laboratory Equipment (Elective)
EG 3105 BE.3

Total: 6 hour/week
Year : III **Lecture: 3 hour/week**
Part : I **Practical: 3 hour/week**
Tutorial: hour/week
Lab: hour/week

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:

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

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 [8 hrs]

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 [5 hrs]

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 **[2 hrs]**

5.1 Introduction, application, basic maintenance and repair of:

5.1.1 Blood Culture Analyzer
5.1.2 CO2 Incubator

Unit 6 Immunology **[6 hrs]**

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 **[3 hrs]**

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 **[4 hrs]**

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 **[2 hrs]**

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 **[2 hrs]**

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

Practical/Laboratory ***[45 hrs]***

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 Specification for Final Examination:

Unit	Content	Course Hour	Marks
1	Overview of Medical Laboratory	3	8
2	General Laboratory Equipment	10	20
3	Clinical Biochemistry	8	12
4	Hematology	5	8
5	Medical Microbiology	2	4
6	Immunology	6	8
7	Histology	3	4
8	Molecular	4	8
9	Blood Bank	2	4
10	Quality Control	2	4
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks.

Project I
EG 3106 BE

Year: III **Total: 6 hour/week**
Part: I **Lecture: hour/week**
Tutorial: hour/week
Practical: 6 hour/week
Lab: hour/week

Course Description:
Students are required to carry out a practical oriented project work related to biomedical engineering under the supervision of teacher. The project could be a new job or continuation of the previous projects. The project work shall be focused to learn the process in developing any piece of equipment and develop and enhance testing skill.

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.

Course Contents:
Procedures:

1. **Topic Selection**
   The project topic should be based on the course contents. Students may propose their own project and get approval from the department or student may choose a project offered by the department. The project should be focused on areas around development or improvisation of biomedical devices and health systems.
2. **Project Proposal**: A detailed project proposal should not be less than 10 pages in the format provided by the institution is to be 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. Oral presentation of the project proposal is to be done by the students and 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.
3. **Mid-Term Evaluation**: A mid-term progress report should not be less than15 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.
4. **Final Evaluation**: Final report minimum of 40 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 15th week of the term by a panel of internal and external examiner. The oral defense carries 25% of the final marks.

	% in Marks by Internal	**% in Marks by External**
Proposal	**10%**	
Mid Term	**25%**	
Final Report	**40%**	
Final Viva (by internal + External)	**25%**	

Note: A group of maximum of six students shall select a project. Each project shall be supervised by a teacher from the department.

Sixth Semester: Year III Part II

Subjects:

1	EG 3201 BE	Biomedical Instrumentation II
2	EG 3202 BE	Biomedical Equipment Maintenance II
3	EG 3203 BE	Health Care Management
4	EG 3201 MG	Entrepreneurship Development
5	EG 3204 BE	Project II

Biomedical Instrumentation II
EG 3201 BE

Total: 6 hour/week
Year : III **Lecture: 3 hour/week**
Part : II **Tutorial: hour/week**
Practical: 3 hour/week
Lab: hour/week

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

Course objectives:
After the completion of this course students will be able to:
1. Describe the uses of various kinds of cell counters and Analyzers
2. Explain and introduce of various therapy instruments
3. Perform Checking maintenance diagnosis and testing of various medical and analytical instruments.
4. Maintain electrical hazards and safety of different medical equipment.

Course Content

Unit 1 Laboratory Based Diagnostic Instruments **[8 hrs]**

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 **[4 hrs]**

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 **[4 hrs]**

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 **[4 hrs]**

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

Unit 5 Surgical Devices **[5 hrs]**

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 **[20 hrs]**

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

Practical/Laboratory ***[45 hrs]***

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 Specification for Final Examination:

Unit	Content	Course Hour	Marks
1	Laboratory Based Diagnostic Instruments	8	12
2	Biomedical Blood Gas Analysis	4	8
3	Audiometers and Hearing Aids	4	8
4	Physiotherapy Equipment	4	8
5	Surgical Devices	5	12
6	Radiology Equipment	20	32
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks.

Biomedical Equipment Maintenance II
EG 3202 BE

Total: 13 hour/week
Year : III **Lecture: 4 hour/week**
Part : II **Tutorial: hour/week**
Practical: 9 hour/week
Lab: hour/week

Course Description:
The course deals with overall introduction working principle of medical devices according to types and technology. It contains block diagram, circuit diagram, flow chart of the certain medical devices. It comprises fault finding, repair and maintenance testing and calibration.
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:
Unit 1 Laboratory Equipment **[14 hrs]**

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 [8 hrs]

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 [5 hrs]

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 **[4 hrs]**

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 **[15 hrs]**

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 [6 hrs]

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 [4 hrs]

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 [4 hrs]

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

Practical/Laboratory [135 hrs]

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 endoscop

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 Specification for Final Examination:

Unit	Content	Course Hour	Marks
1	Laboratory Equipment	14	16
2	Operation Theater Equipment	8	12
3	ENT Equipment	5	8
4	Dental Equipment	4	8
5	Imaging Equipment	15	20
6	Ophthalmic Equipment	6	4
7	Endoscope	4	8
8	Physiotherapy	4	4
	Total	**60**	**80**

Note: There might be minor deviation on the above specified marks.

Health Care Management
EG 3203 BE

Total: 5 hour/week
Year : III **Lecture: 4 hour/week**
Year : II **Tutorial: hour/week**
Practical: 1 hour/week
Lab: hour/week

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:

Unit 1 Introduction to Healthcare Management [2 hrs]
- 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 [4 hrs]
- 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 [5 hrs]
- 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 [10 hrs]

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 [12 hrs]

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 [8 hrs]

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 [6 hrs]

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 [8 hrs]

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 [5 hrs]

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.

Practical/Laboratory ***[15 hrs]***

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 Specification for Final Examination:

Unit	Content	Course Hour	Marks
1	Introduction to Healthcare Management	2	5
2	Healthcare Technology Management and Budgeting in Health	4	5
3	Hospital Information System	5	5
4	Procurement Management	10	15
5	Inventory Control and Stores Management	12	20
6	Hospital Quality Management	8	10
7	Hospital Infection and Waste Management	6	5
8	Maintenance Management	8	10
9	Other Aspects in Healthcare Management	5	5
	Total	**60**	**80**

Note: There might be minor deviation on the above specified marks.

Entrepreneurship Development
EG 3201 MG

Year: III **Total: 5 hour/week**
Part: II **Lecture: 3 hour/week**
Tutorial: hour/week
Practical: 2 hour/week
Lab: hour/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:

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: [10 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]
- 4.1 Sources and method of finding business idea(s)
- 4.2 Selection of viable business ideas
- 4.3 Legal provisions for MSMEs in Nepal

Unit 4: Business Plan Formulation: [17 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/ Laboratory: ***[30 hrs]***

Unit 1: Overview of Business & Entrepreneurship [2 hrs]

1. Collect business information through interaction with successful entrepreneur

Unit 2: Exploring and Developing Entrepreneurial Competencies [2 hrs]

1. Generate innovative business ideas

Unit 3: Product or Service Identification and Selection [2 hrs]

1. Analyze business ideas using SWOT method

Unit 4: Business Plan Formulation [22 hrs]

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

Marks specification for final examination

Unit	Content	Course Hours	Mark
1	Introduction to Business & Entrepreneurship	9	16
2	Exploring and Developing Entrepreneurial Competencies	10	16
3	Business identification and Selection	4	8
4	Business Plan Formulation	17	32
5	Small Business Management	5	8
	Total	45	80

Note: There might be minor deviation on final mark distribution.

Project II
EG 3204 BE

Year: III **Total: 8 hour/week**
Part: II **Lecture: hour/week**
Tutorial: hour/week
Practical: 8 hour/week
Lab: hour/week

Course Description:
Students are required to carry out a practical oriented project work related to biomedical engineering under the supervision of teacher. The project could be a new job or continuation of the previous projects. The project work shall be focused to learn the process developing any piece of equipment and develop and enhance testing skill.

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.

Course Contents:

Procedures:

1. **Topic Selection**
   The project topic should be based on the course contents. Students may propose their own project and get approval from the department, or it could be the continuation of the project I or student may choose a project offered by the department. The project should be focused on areas around development or improvisation of biomedical devices and health systems.

2. **Project Proposal**: A detailed project proposal should not be less than 12 pages in the format provided by the institution is to be 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. Oral presentation of the project proposal is to be done by the students and 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.

3. **Mid-Term Evaluation**: A mid-term progress report should not be less than 30 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.
4. **Final Evaluation**: Final report of minimum 50 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 and demonstration of the final report is to be conducted during the 15th week of the term by a panel of internal and external examiner.

	% in Marks by Internal	% in Marks by External
Proposal	10%	
Mid Term	25%	
Final Report	40%	
Final Viva (by Internal+External)	25%	

The oral defense carries 25% of the final marks.

Note: A group of maximum of six students shall select a project. Each project shall be supervised by a teacher from the department.

Experts Involved in Curriculum Revision, 2022

S.N.	Name	Position	Organization
1	Dr. Surya Prasad Adhikari	Assoc. Professor	IOE, Pulchowk Campus
2	Rishi Baniya	Asst. Professor	College of Biomedical Engineering & Applied Sciences, Kupandol
3	Kamal K.C.	Asst. Professor	College of Biomedical Engineering & Applied Sciences, Kupandol
4	Raj Kumar Chaulagain	Lecturer	IOE, Thapathali Campus
5	Umesh Kant Ghimire	Lecturer	IOE/Nepal Health Training Center
6	Pradip Neupane	Coordinator	Balaju School of Engineering & Technology, Balaju
7	Shekhar Khanal	Assoc. Professor	College of Biomedical Engineering & Applied Sciences, Kupandol
8	Alaka Acharya	Asst. Professor	College of Biomedical Engineering & Applied Sciences, Kupandol
9	Mukunda Khatiwada	Biomedical Engineer	College of Biomedical Engineering & Applied Sciences, Kupandol
10	Anuj Purush Dhakal	Lecturer	Nepal Health Training Center, Teku, Kathmandu
11	Suresh Shrestha	Lecturer	Nepal Health Training Center, Teku, Kathmandu
12	Ashish Chauhan	A. Team Leader	Nepal Health Training Center, Teku, Kathmandu
13	Pawan Kumar Karn	Asst. Professor	College of Biomedical Engineering & Applied Sciences, Kupandol

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