COMPETENCY BASED CURRICULUM

DIPLOMA
IN
MEDICAL ELECTRONICS

(Duration 3 Years)
NSQF Level – 5

Under
Haryana State Board of Technical Education

Developed By

Curriculum Development Center

National Institute of Technical Teachers Training & Research

(Ministry of Education, Government of India)

Sector - 26, Chandigarh, UT, India.

(September,2024)

PREFACE

Learning and learning experience are the foundation of any education system. Appropriateness of education and its useful implications stand on the platform of knowledge and skill. But the knowledge and skill cannot be quantified qualitatively without ensuring learning experience. Curriculum is the pathway to select and organise learning experience. It helps the teachers to provide tangible resources, goals and objectives to learners. Curriculum acts as a catalyst to stimulate creativity, innovation, ethics, values, responsibility and many human factors. Curriculum embodies rigour and high standards and creates coherence to empower learner to meet the industrial and societal needs. Curriculum is a central guide for a teacher to plan a standard based sequence for the instructional delivery.

The industrial revolution 4.0 has forced the technical education system to reinvent the curriculum to meet the human resource requirement of the industry. The data driven systems relying on the subjects like machine-learning, Artificial Intelligence, Data Science etc are literally forcing the technical education system to offer different subjects differently to address the emerging challenges. The non-linear way of learning now facilitates students to choose path of knowledge to skill or vice-versa. The bi-directional process requires innovative curriculum design and revision. Diploma programme is now more challenging than ever. The level of skill and knowledge demanded by industry from diploma holders are highly interdisciplinary at the same time address special need. Hence, there is a need to align the curriculum to National Skill Qualification Framework (NSQF).

National Education Policy, NEP-2020 has now opened up diversities for the education system to explore and exploit to make the education relevant. The policy emphasises to inculcate value, ethics, respect to culture and society etc along with industry ready knowledge and skill among the students. The interdisciplinary nature of curriculum, academic bank of credits and integration of technology in teaching-learning envisaged in NEP-2020 make it more challenging for curriculum development. NITTTR, Chandigarh has developed the art of curriculum development over 54 years of its existence. The expertise and experience available in the institute follow time-tested and acclaimed scientific methods to design/revise curriculum. The experienced faculty members entrusted with the curriculum development or revision activities are well-versed with NSQF, NEP and Outcome based education. I am happy to note that **Haryana State Board of Technical Education, Punchkula, Haryana** reposed their confidence on this expertise to develop **AICTE/NSQF/NEP 2020** aligned curriculum for the state. This documented curriculum is an outcome of meticulous planning and discussions among renowned experts of the subject through series of workshops. The effective implementation of this curriculum supported with quality instructional resources will go a long way in infusing the learning experience among learners to make them industry ready.

Director

National Institute of Technical Teachers Training & Research, Chandigarh

ACKNOWLEDGEMENT

We gratefully acknowledge the assistance and guidance received from the following persons:

i) Principal Secretary Technical Education-cum-Chairman, Haryana State Board of Technical Education, Panchkula, Haryana for initiating this project on designing of AICTE/NSQF/NEP 2020 aligned curriculum.

ii) Director General, Technical Education, Haryana for taking keen interest in the design of this AICTE/NSQF/NEP 2020 aligned curriculum.

iii) Secretary, Haryana State Board of Technical Education, Panchkula, Haryana for his untiring assistance and support in the design of this AICTE/NSQF/NEP 2020 aligned curriculum.

iv) Management Officials of Haryana State Board of Technical Education, Panchkula, Haryana for taking keen interest in the design of this AICTE/NSQF/NEP 2020 aligned curriculum.

v) Director, National Institute of Technical Teachers' Training and Research, Chandigarh for his support and academic freedom provided to Curriculum Development Centre.

vi) All the participants from Industry / field Organizations, Academic Institutions, State Technical Universities / Polytechnics for their professional & academic inputs during curriculum workshops.

vii) Faculty and staff of Curriculum Development Centre, NITTTR, Chandigarh for their dedicated contribution and support in design of NSQF aligned curriculum.

viii) Faculty from different departments of NITTTR, Chandigarh for their valuable inputs in design of NSQF aligned curriculum.

Professor and Head
Curriculum Development Center
National Institute of Technical Teachers Training & Research, Chandigarh

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1. SALIENT FEATURES

1.	Name	:	**Diploma in Medical Electronics**
2.	Duration	:	**03 Years**
3.	Hours per week	:	**35**
4.	Entry Qualification	:	**10th Pass**
5.	Student Intake	:	**As per sanctioned strength**
6.	Pattern	:	**Semester**
7.	Scheme	**:**	**Multipoint Entry and Exit**
8.	NSQF Level	:	**5**
9.	Theory Practical Ratio	:	**35 : 65**
10.	Project Work	:	**Minor and Major Project**
11.	In-house/Industrial Internship	:	**Mandatory after First and Second Year**
11.	Professional Training	**:**	**Six Month internship**

2. NSQF GUIDELINES

National Skill Qualification Framework has defined total Ten Levels. Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Fig.1: NSQF Domains

NSQF LEVEL - 3 COMPLIANCE

The NSQF level - 3 descriptor is as follows:

Process	• Person may carry out a job which may require limited range of activities routine and predictable.
Professional Knowledge	• Basic facts, process and principle applied in trade of employment.
Professional Skill	• Recall and demonstrate practical skill, routine and repetitive in narrow range of application.
Core Skill	• Communication written and oral, with minimum required clarity, skill of basic arithmetic and algebraic principles, personal banking, basic understanding of social and natural environment.
Responsibility	• Under close supervision. Some responsibility for own work within defined limit.

Fig 2: NSQF Level – 3 Descriptor

Work requiring knowledge, skills and aptitudes at level 3 will be routine and predictable. Job holders will be responsible for carrying out a limited range of jobs under close supervision. Their work may require the completion of a number of related tasks. People carrying out these job roles may be described as "Semi skilled workers". Individuals in jobs which require level 3 qualifications will normally be expected to be able to communicate clearly in speech and writing and may be required to use arithmetic and algebraic processes. They will be expected to have previous knowledge and skills in the occupation and should know the basic facts, processes and principles applied in the trade for which they are qualified and be able to apply the basic skills of the trade to a limited range of straightforward jobs in the occupation.

They will be expected to understand what constitutes quality in their job role and more widely in the sector or sub-sector and to distinguish between good and bad quality in the context of the jobs they are given. Job holders at this level will be expected to carry out the jobs they are given safely and securely. They will work hygienically and in ways which show an understanding of environmental issues. This means that they will be expected to take responsibility for their own health and safety and that of fellow workers and, where appropriate, customers and/or clients. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social environment. They should be able to make a good contribution to team work.

NSQF LEVEL - 4 COMPLIANCE

The NSQF level-4 descriptor is given below:

Process	• Work in familiar, predictable, routine, situation of clear choice
Professional Knowledge	• Factual knowledge of field of knowledge or study.
Professional Skill	• Recall and demonstrate practical skill, routine and repetitive in narrow range of application, using appropriate rule and tool, using quality concepts.
Core Skill	• Communication written and oral, with required clarity, skill of basic arithmetic and algebraic principles, personal banking, basic understanding of social and natural environment.
Responsibility	• Responsibility for own work and learning.

Fig 3: NSQF Level – 4 Descriptor

Work requiring knowledge, skills and aptitudes at level 4 will be carried out in familiar, predictable and routine situations. Job holders will be responsible for carrying out a range of jobs, some of which will require them to make choices about the approaches they adopt. They will be expected to learn and improve their practice on the job. People carrying out these jobs may be described as "skilled workers". Individuals in jobs which require level 4 qualifications should be able to communicate clearly in speech and writing and may be required to use arithmetic and algebraic processes. They will be expected to have previous knowledge and skills in the occupation in which they are employed, to appreciate the nature of the occupation and to understand and apply the rules which govern good practice. They will be able to make choices about the best way to carry out routine jobs where the choices are clear.

They will be expected to understand what constitutes quality in the occupation and will distinguish between good and bad quality in the context of their job roles. Job holders at this level will be expected to carry out their work safely and securely and take full account of the health and safety on colleagues and customers. They will work hygienically and in ways which show an understanding of environmental issues. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social and political environment. They should be able to guide or lead teams on work within their capability.

NSQF LEVEL - 5 COMPLIANCE

The NSQF level-5 description is given below:

Process	• Job that requires well developed skill, with clear choice of procedures in familiar context.
Professional Knowledge	• Knowledge of facts, principles, processes and general concepts, in a field of work or study.
Professional Skill	• A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information.
Core Skill	• Desired mathematical skill; understanding of social, political; and some skill of collecting and organising information, communication.
Responsibility	• Responsibility for own work and learning and some responsibility for others' works and learning

Fig 4: NSQF Level – 5 Descriptor

Work requiring knowledge, skills and aptitudes at level 5 will also be carried out in familiar situations, but also ones where problems may arise. Job holders will be able to make choices about the best procedures to adopt to address problems where the choices are clear. Individuals in jobs which require level 5 qualifications will normally be responsible for the completion of their own work and expected to learn and improve their performance on the job. They will require well developed practical and cognitive skills to complete their work. They may also have some responsibility for others' work and learning. People carrying out these jobs may be described as "fully skilled workers" or "supervisors".

Individuals employed to carry out these jobs will be expected to be able to communicate clearly in speech and writing and may be required to apply mathematical processes. They should also be able to collect and organise information to communicate about the work. They will solve problems by selecting and applying methods, tools, materials and information. They will be expected to have previous knowledge and skills in the occupation, and to know and apply facts, principles, processes and general concepts in the occupation. They will be expected to understand what constitutes quality in the occupation and will distinguish between good and bad quality in the context of their work. They will be expected to operate hygienically and in ways which show an understanding of environmental issues. They will take account of health and safety issues as they affect the work they carry out or supervise.

In working with others, they will be expected to conduct themselves in ways which show an understanding of the social and political environment.

3. NATIONAL EDUCATION POLICY (NEP) - 2020

NEP 2020 aims at a comprehensive holistic education to develop all capacities of human beings - intellectual, aesthetic, social, physical, emotional, and moral - in an integrated manner. A holistic arts education will help develop well-rounded individuals that possess: critical 21st century capacities in fields across the arts, humanities, languages, sciences, social sciences, and professional, technical, and vocational fields; an ethic of social engagement; soft skills, such as communication, discussion and debate; and rigorous specialization in a chosen field or fields. Such a holistic education shall be, in the long term, the approach of all undergraduate programmes, including those in professional, technical, and vocational disciplines.

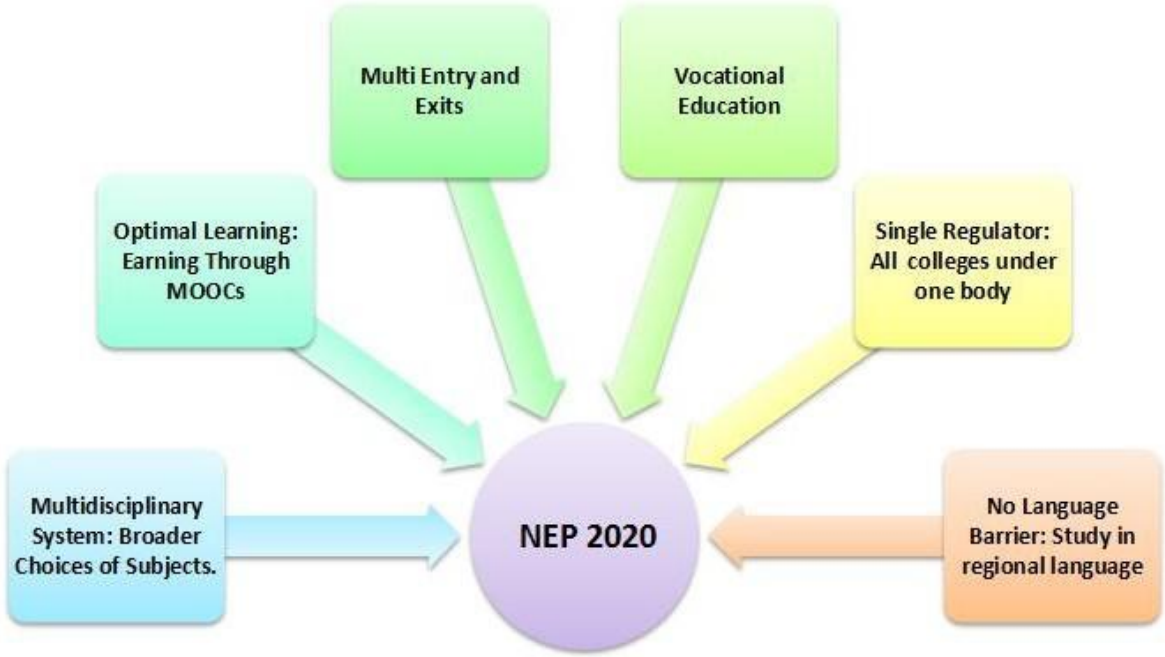

Fig 5: NEP 2020

Flexibility in curriculum and novel and engaging course options will be on offer to students, in addition to rigorous specialisation in a subject or subjects. Pedagogy for courses will strive for significantly less rote learning and an increased emphasis on communication, discussion, debate, research, and opportunities for cross-disciplinary and interdisciplinary thinking. The flexible and innovative curriculum shall emphasize on offering credit-based courses and projects in the areas of community engagement and service, environmental education and value-based education. as part of a holistic education, students will be provided with opportunities for internships with local industry, businesses, artists, crafts persons, villages and local communities, etc., as well as

research internships with faculty and researchers at their own or other HEIs or research institutions, so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

Effective learning requires relevant curriculum, engaging pedagogy, continuous formative assessment and adequate student support. The curriculum must be updated regularly aligning with the latest knowledge requirements and shall meet specified learning outcomes. High-quality pedagogy is then necessary to successfully impart the curricular material to students; pedagogical practices determine the learning experiences that are provided to students - thus directly influencing learning outcomes. The assessment methods have to be scientific and test the application of knowledge. Higher Education Institutes should move to a criterion-based grading system that assesses student achievement based on the learning goals for each programme, making the system fairer and outcomes more comparable. HEIs should also move away from high-stakes examinations towards more continuous and comprehensive evaluation.

4. DIPLOMA PROGRAMME OUTCOMES

The program outcomes are derived from five domains of NSQF Level namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this programme, the student will be able to:

PO1: Acquire knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Medical electronics engineering problems.

PO2: Acquire knowledge of principles and processes to solve broad-based Medical Electronics Engineering problems.

PO3: Develop skills accomplish quality tasks and solve problems using methods, tools, materials and information in limited range of Medical electronics activities.

PO4: Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.

PO5: Develop strategies and Take the responsibility for ongoing professional development to enhance work performance as a medical electronics technician.

PO6: Engage in multidisciplinary fields in the context of technological changes for independent and life-long learning activities.

5. DERIVING CURRICULUM SUBJECT AREAS FROM DIPLOMA PROGRAMME OUTCOMES

The following curriculum subject areas have been derived from Programme outcomes:

Sr. No.	Programme Outcomes	Curriculum Subject Areas
1.	PO1: Acquire knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Medical electronics engineering problems	● Applied Physics – I ● Applied Mathematics - I ● Applied Mathematics-II ● Applied Physics - II ● Fundamentals of Electrical Engineering ● Engineering Graphics ● Environmental Studies & Disaster Management ● Measurement and Instrumentation ● Biomedical Instrumentation-I ● Medical Laboratory Instruments
2.	PO2:Acquire knowledge of principles and processes to solve broad-based Medical Electronics Engineering problems.	● Applied Physics - I ● Fundamentals of Electrical Engineering ● Fundamentals of Medical Electronics ● Applied Physics - II ● Analog & Digital Electronics ● Human Anatomy & Physiology ● Medical Imaging Techniques ● Medical Laboratory Instruments ● Therapeutic Medical Equipment
3.	PO3: Develop skills accomplish quality tasks and solve problems using methods, tools, materials and information in limited range of Medical electronics activities	● Electronics Workshop ● Applied Physics - II ● Analog & Digital Electronics ● Industrial / In - House Training I-II ● Engineering Graphics ● Bio-Mechanics and Bio Materials ● Biomedical Instrumentation-II ● Telemetry and Telemedicine ● Troubleshooting and Maintenance of Bio medical Equipment ● Therapeutic Medical Equipment

4.	PO4: Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.	● English and Communication Skills - I ● Applied Mathematics - I ● Fundamentals of IT ● Applied Mathematics - II ● Environmental Studies & Disaster Management ● Rehabilitation Engineering ● Medical Devices Regulations & Hospital Management
5.	PO5: Develop strategies and take the responsibility for ongoing professional development to enhance work performance as a medical electronics technician.	● Fundamentals of Medical Electronics ● Electronics Workshop Entrepreneurship Development & ● Management ● Telemetry and Telemedicine ● Minor Project ● Advance Medical Imaging Techniques ● Troubleshooting and Maintenance of Bio medical Equipment ● Medical Devices Regulations & Hospital Management ● Industrial / In - House Training I ● Industrial Training II
6.	PO6: Engage in multidisciplinary fields in the context of technological changes for independent and life-long learning activities.	● Multidisciplinary Elective ● Open Elective ● Bio-Mechanics and Bio Materials ● Laser and Fiber Optics in Medicine ● Rehabilitation Engineering

FIRST YEAR
NSQF LEVEL – 3

6. DIPLOMA PROGRAMME STUDY AND EVALUATION SCHEME
FIRST YEAR

FIRST SEMESTER:

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
1.1	*English & Communication Skill-I	2	2	2+1=3	40	40	80	60	60	120	200
1.2	*Applied Mathematics-I	4	0	4+0=4	40	-	40	60	-	60	100
1.3	*Applied Physics-I	2	2	2+1=3	40	40	80	60	60	120	200
1.4	**Fundamentals of Electrical Engg.	3	4	3+2=5	40	40	80	60	60	120	200
1.5	* Fundamentals of IT	2	4	2+2=4	40	40	80	60	60	120	200
1.6	* Engineering Graphics	-	6	0+3=3	-	40	40	60	-	60	100
#Student Centred Activities (SCA)		-	4	-	-	-	-	-	-	-	-
Total		**13**	**22**	**22**	**200**	**200**	**400**	**360**	**240**	**600**	**1000**

* Common with other diploma programmes.

* * Common with diploma in Electrical Engineering and Instrumentation &Control Engineering programmes

Student Centred Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Games, Yoga, Human Values & Ethics, Knowledge of Indian System, Hobby Clubs e.g. Photography etc., Seminars, Declamation Contests, Educational Field Visits, NCC, NSS, Cultural Activities and Self-study etc.

SECOND SEMESTER:

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
2.1	*Applied Mathematics -II	4	0	4+0=4	40	-	40	60	-	100	100
2.2	*Applied Physics-II	2	2	2+1=3	40	40	80	60	60	120	200
2.3	Fundamentals of Medical Electronics	3	4	3+2=5	40	40	80	60	60	120	200
2.4	**Analogue & Digital Electronics	3	4	3+2=5	40	40	80	60	60	120	200
2.5	* Environmental Studies and Disaster Management	2	-	2+0=2	40	-	40	60	-	60	100
2.6	Electronics Workshop	-	6	0+3=3	-	40	40	-	60	60	100
#Student Centred Activities (SCA)		-	5	-	-	-	-	-	-	-	-
Total		**14**	**21**	**22**	**200**	**160**	**360**	**300**	**240**	**540**	**900**

* Common with other diploma programmes

* * Common with diploma in Electrical Engineering and Instrumentation &Control Engineering programmes

Student Centred Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Games, Yoga, Human Values & Ethics, Knowledge of Indian System, Hobby Clubs e.g. Photography etc., Seminars, Declamation Contests, Educational Field Visits, NCC, NSS, Cultural Activities and Self-study etc.

Summer Industrial/In-house Training: After 2nd semester, students shall undergo Summer Training of 4 Weeks.

7. DIPLOMA PROGRAMME HORIZONTAL AND VERTICAL ORGANIZATION OF SUBJECTS

Sr. No.	Subjects/Areas	Hours Per Week	
		First Semester	Second Semester
1.	English and Communication Skills - I	4	-
2.	Applied Mathematics - I	4	-
3.	Applied Physics - I	4	-
4.	Fundamentals of IT	6	-
5.	Fundamentals of Electrical Engineering	7	-
6.	Engineering Graphics	6	
7.	Applied Mathematics-II	-	4
8.	Applied Physics - II	-	4
9.	Fundamentals of Medical Electronics		7
10.	Analogue & Digital Electronics		7
11.	Electronics Workshop	-	8
12.	Environmental Studies & Disaster Management	-	2
13.	Student Centered Activities	4	3
	Total	**35**	**35**

8. COMPETENCY PROFILE & EMPLOYMENT OPPORTUNITIES

Medical electronics is a very important subject since the growth of biomedical industry depends upon electronics to a great extent. Medical electronics provides the ideas and the basic knowledge of human anatomy, physiology and the need of electronics principle and applications of equipments used in the medical field as well as introduce the concept of safety aspects for medical instruments. Medical Electronics is an integration of Environmental Science and Medicine with Engineering theories and Practices. Medical Electronics Engineers design and develop Instruments and Devices used to solve medical and physical fitness-related problems. Medical Electronics Engineering Technology is a broader field of study that appeals to aspirants desiring to be technological, and, at the same time, dedicate their careers to saving lives by helping physicians and nurses in their treatment process and patients as well who are suffering from various kinds of ailments.

The NSQF Level – 3 pass out students are expected to recall and demonstrate practical routine and repetitive skills, in narrow range of Medical Electronics. In government and private sectors related to Medical Electronics, "Semi Skilled workers" are required to carry out a limited range of predictable tasks under close supervision. They are normally expected to communicate clearly in speech and along with knowledge of arithmetic and algebraic processes. They should know the basic facts, processes and principles applied in limited area of Medical Electronics. Skills acquired through course will help the student to troubleshoot medical equipments. The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency

They have wide scope as

Service Engineer – in Electronics / ECE / Instrumentation), Field Service Engineer, Engineer - Field Service, Sales/Service Engineer.

Bio-Medical Equipment Technician; Electronics Technician; Biomedical Engineering Technician, Medical Equipment Technician; Biomedical Electronics Technician, and Biomedical Engineering Technician (BMET). Medical Laboratory Technician; (MLT) Medical Laboratory Scientists. Medical Electronics Fitter, Technician Medical Electronics Medical Electronics Mechanic; Medical Electronic Equipment Mechanic ECG Technician (ECG operation); tests programmer

Any student completing this diploma can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager. He can become Entrepreneur in the related field. He can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC) and join Crafts as Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.

9. PROGRAMME OUTCOMES

The programme outcomes are derived from five domains of NSQF Level – 3 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this programme, the student will be able to:

PO1: Perform out a task which may require limited range of predictable activities related to the medical electronics.

PO2: Acquire knowledge of facts, process and principles related to Medical Electronics for sustainability and employment.

PO3: Demonstrate the ability to perform the skills essential in narrow range of Medical Electronics applications.

PO4: Communicate accurately and appropriately and demonstrate professional behavior along with skill of basic arithmetic and algebraic principles, and basic understanding of social and natural environment.

PO5: Be responsible to perform task under close supervision with some responsibility withindefined limit.

10. ASSESSMENT OF PROGRAMME AND COURSE OUTCOMES

Programme Outcomes to be Assessed	Assessment Criteria for the Course Outcomes
PO1: Perform out a task which may require limited range of predictable activities related to the medical electronics.	• Illustrate the geometric shapes used in engineering problems by Co-ordinate Geometry and Trigonometry. • Formulate engineering problems into mathematical formats with the use matrices, co-ordinate geometry and trigonometry. • Identify physical quantities, select their units for use in engineering solutions, and make measurements with accuracy. • Represent physical quantities as scalar and vector and identify type of motions, various forms of energy, their conversion and applications. • Comprehend properties of matter and effect of temperature on various matter and phenomenon. • Acquire knowledge and understand the elements of electricity and DC circuits. • Describe the fundamental behaviour of AC circuits and solve AC circuit problems. • Comprehend the concept of Electrostatics and magentostatics and apply the knowledge. • Formulate the engineering problems into mathematical format with the use of differential equations • Discuss the purposes of measures of central tendency and calculate the measures of central tendency (mode, median, mean) for a set of data.

	• Differentiate between types of waves and their motion. • Illustrate laws of reflection and refraction of light. • Demonstrate competency in phenomena of electrostatics and electricity. • Detail basic concepts of biomedical instrumentation and their applications. • Familiarize with the various bioelectric signals & theirs measurements. • Comprehend the functioning of various bio potential electrodes.
PO2: Acquire knowledge of facts, process and principles related to Medical Electronics for sustainability and employment.	• Formulate engineering problems into mathematical formats with the use matrices, co-ordinate geometry and trigonometry • Calculate the approximate value of roots of certain expressions in engineering problems by application of binomial theorem. • Explore the idea of location, graph, and linear relationships between two variables. • Learn about basic fundamentals about MATLAB/ SciLab and mathematical calculation with MATLAB/ SciLab software. • Elaborate scientific work, energy and power, forms of friction and solve problems related to them. • Comprehend properties of matter and effect of temperature on various matter and phenomenon. • Describe the fundamental behaviour of AC circuits and solve AC circuit problems.

	• Comprehend the concept of Electrostatics and magentostatics and apply the knowledge. • Use various batteries as storage devices and be aware of safe disposal of batteries. • Formulate the engineering problems into mathematical format with the use of differential equations and differential • Use the differentiation and Integration in solving various Mathematical and Engineering problems. • Discuss the purposes of measures of central tendency and calculate the measures of central tendency (mode, median, mean) for a set of data. • Demonstrate competency in phenomena of electrostatics and electricity. • Characterize properties of material to prepare new materials for various engineering applications. • Familiarize with the various bioelectric signals & theirs measurements. • Elaborate basic theory behind biomedical recorders & their classification. • Comprehend the functioning of various bio potential electrodes. • Describe the basic characteristics of transducer & their classification • Describe different Semiconductor devices and explain their characteristics • Acquire the knowledge of transistor in CB and CE mode and demonstrate the working of transistor as an amplifier. • Explain the fundamentals of FETs & MOSFETs and their applications.

PO3: Demonstrate the ability to perform the skills essential in narrow range of Medical Electronics applications	• Apply the knowledge of basic circuital law and simplify the network • Use various batteries as storage devices and be aware of safe disposal of batteries. • Draw Orthographic views of different objects viewed from different angles. • Draw and interpret sectional views of an object which are otherwise not visible in normal view. • Draw Isometric views of different solids and develop their surfaces. • Identify conventions for different engineering materials, symbols, sections of regular objects and general fittings used in Civil and Electrical household appliances /fittings. • Draw orthographic views of different objects by using basic commands of AutoCAD. • Characterize properties of material to prepare new materials for various engineering applications. • Demonstrate a strong foundation on Modern Physics to use at various technical and engineering applications [• Elaborate basic theory behind biomedical recorders & their classification. • Comprehend the functioning of various bio potential electrodes. • Describe different Semiconductor devices and explain their characteristics • Acquire the knowledge of transistor in CB and CE mode and demonstrate the working of transistor as an amplifier.

	• Explain the fundamentals of FETs & MOSFETs and their applications. • Evaluate and realize the various digital circuits. • Analyze sequential and combinational digital circuits • Identify electronics components like resistors, capacitors, diodes, transistors etc. • Implement soldering and de-soldering on electronic circuit interconnections. • Identify different active electronic components and assemble circuits on breadboard. • Use measuring instruments like Multimeter, Function generator, Power Supply & DSO. • Able to test various electronic circuitry and batteries.
PO4: Communicate accurately and appropriately and demonstrate professional behavior along with skill of basic arithmetic and algebraic principles, and basic understanding of social and natural environment.	• Identify the nuances of Communication, both Oral and Written. • Acquire knowledge of the meaning of communication, communication process and speaking skills. • Acquire enhanced vocabulary and in-depth understanding of Grammatical Structures and their usage in the communication. • Communicate effectively with an increased confidence to read, write and speak in English language fluently. • Illustrate the geometric shapes used in engineering problems by Co-ordinate Geometry and Trigonometry.

	• Formulate engineering problems into mathematical formats with the use matrices, co-ordinate geometry and trigonometry • Calculate the approximate value of roots of certain expressions in engineering problems by application of binomial theorem. • Explore the idea of location, graph, and linear relationships between two variables. • Explain the basic components of Computers, Internet and issues of abuses/ attacks on information and computers. • Handle the computer/laptop/mobiles/ Internet Utilities and Install/Configure OS • Assemble a PC and connect it to external devices • Manage and Use Office practiced Automation Tools • Develop worksheets and Prepare presentations • Comprehend the importance of sustainable ecosystem. • Clarify interdisciplinary nature of environmental issues. • Describe corrective measures for the abatement of pollution. • Identify the role of non-conventional energy resources in environmental protection. • Recognize various types of disasters.

PO5: Be responsible to perform task under close supervision with some responsibility withindefined limit.	• Apply the knowledge of basic circuital law and simplify the network • Use various batteries as storage devices and be aware of safe disposal of batteries. • Calculate the approximate area under a curve by applying integration and numerical methods. • Discuss the purposes of measures of central tendency and calculate the measures of central tendency (mode, median, mean) for a set of data. • Learn about basic fundamentals about MATLAB/ SciLab and mathematical calculation with MATLAB/ SciLab software. • Demonstrate a strong foundation on Modern Physics to use at various technical and engineering applications. • Comprehend the functioning of various bio potential electrodes. • Evaluate and realize the various digital circuits. • Analyze sequential and combinational digital circuits • Implement soldering and de-soldering on electronic circuit interconnections. • Identify different active electronic components and assemble circuits on breadboard. • Use measuring instruments like Multimeter, Function generator, Power Supply & DSO. • Able to test various electronic circuitry and batteries.

11. SUBJECTS & DETAILED CONTENTS

FIRST SEMESTER

1.1 ENGLISH & COMMUNICATION SKILLS – I

L	P
2	2

RATIONALE

Language as the most commonly used medium of self-expression remains indispensable in all spheres of human life –personal, social and professional. This course is intended to break fresh ground in teaching of Communicative English as per the requirements of National Skill Quality Framework. This course is designed to help students to acquire the concept of communication and develop an ability or skills to use them effectively to communicate with the individuals and community.

COURSE OUTCOMES

After undergoing this subject, the students will be able to:

CO1: Identify the nuances of Communication, both Oral and Written.

CO2: Acquire knowledge of the meaning of communication, communication process and speaking skills.

CO3: Acquire enhanced vocabulary and in-depth understanding of Grammatical Structures and their usage in the communication.

CO4: Communicate effectively with an increased confidence to read, write and speak in English language fluently.

DETAILED CONTENTS

UNIT I

Reading

1.1 Techniques of reading: Skimming and Scanning

1.2 Extensive and Intensive Reading: Textual Study

1.3 Homecoming – R.N. Tagore

1.4 Life Sketch of Sir Mokshagundam Visvesvarayya

1.5 Life Sketch of Dr. Abdul Kalam

1.6 Narayan Murthy’s speech at LBSNA, Dehradun

UNIT II

Fundamentals of Communication

2.1 Concept and Process of Communication

2.2 Types of Communication (Verbal Communication)

2.3 Barriers to Communication
2.4 Speaking Skill: Significance and essentials of Spoken Communication
2.5 Listening Skill: Significance and essentials of Listening

UNIT III

Grammar and Usage

3.1 Nouns
3.2 Pronouns
3.3 Articles
3.4 Verbs(Main and Auxiliary)
3.5 Tenses

UNIT IV

Writing Skills

4.1 Significance, essentials and effectiveness of Written Communication
4.2 Notice Writing
4.3 Official Letters and E-mails.
4.4 Frequently-used Abbreviations used in Letter-Writing
4.5 Paragraph Writing
4.6 Netiquettes

PRACTICAL EXERCISES

1. Reading

Reading Practice of lessons in the Lab Activity classes.

i. Comprehension exercises of unseen passages along with the lessons prescribed.
ii. Vocabulary enrichment and grammar exercises based on the selected readings.
iii. Reading aloud Newspaper headlines and important articles.

2. Fundamentals of Communication

i. Introducing oneself, others and leave- taking(talking about yourself)
ii. Just a minute (JAM) sessions: Speaking extempore for one minute on given topics
iii. Situational Conversation: Offering-Responding to offers; Congratulating; Apologizing and Forgiving; Complaining; Talking about likes and dislikes, Self-introduction Mock Interviews

3. Grammar and Usage

i. Written and Oral Drills will be undertaken in the class to facilitate holistic linguistic competency among learners.
ii. Exercises on the prescribed grammar topics.

4. Writing Skills

i. Students should be given Written Practice in groups so as to inculcate team-spirit and collaborative learning .
ii. Group exercises on writing paragraphs on given topics.
iii. Opening an e-mail account, receiving and sending emails

RECOMMENDED BOOKS

1. Alvinder Dhillon and Parmod Kumar Singla, "Text Book of English and Communication Skills Vol – 2", M/S Abhishek Publications, Chandigarh.
2. V Sasikumar & PV Dhamija, "Spoken English", Tata MC Graw Hills, New Delhi, Second Edition.
3. JK Gangal, "A Practical Course in Spoken English", PHI Learning Pvt. Ltd., New Delhi.
4. NK Aggarwal and FT Wood, "English Grammar, Composition and Usage", Macmillan Publishers India Ltd., New Delhi.
5. RC Sharma and Krishna Mohan, "Business Correspondence & Report writing", Tata MC Graw Hills, New Delhi, Fourth Edition.
6. Kavita Tyagi & Padma Misra, "Professional Communication", PHI Learning Pvt. Ltd., New Delhi.
7. Nira Konar, "Communication Skills for professionals", PHI Learning Pvt. Ltd., New Delhi.
8. Krishna Mohan & Meera Banerji, "Developing Communication Skills", Macmillan Publishers India Ltd., New Delhi, Second Edition
9. M. Ashraf Rizwi, "Effective Technical Communication", Tata MC Graw Hills, New Delhi.
10. Andrea J Rutherfoord, "Basic Communication Skills for Technology", Pearson Education, New Delhi.

INSTRUCTIONAL STRATEGY

This is practice based subject and topics taught in the class should be practiced as exercises in the Lab regularly for development of communication skills in the students. The students should be involved in activities to enhance their personality skills. This subject contains four units of equal weightage.

1.2 APPLIED MATHEMATICS - I

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RATIONALE

Contents of this course provide fundamental base for understanding engineering problems and their solution algorithms. Contents of this course will enable students to use basic tools like logarithm, binomial theorem, matrices, t-ratios and co-ordinates for solving complex engineering problems with exact solutions in a way which involve less computational task. By understanding the logarithm, they will be able to make long calculations in short time and it is also a pre-requisite for understanding Calculus.

COURSE OUTCOMES

After undergoing this subject, the students will be able to:

CO1: Illustrate the geometric shapes used in engineering problems by Co-ordinate Geometry and Trigonometry.

CO2: Formulate engineering problems into mathematical formats with the use matrices, co-ordinate geometry and trigonometry

CO3: Calculate the approximate value of roots of certain expressions in engineering problems by application of binomial theorem.

CO4: Explore the idea of location, graph, and linear relationships between two variables.

CO5: Learn about basic fundamentals about MATLAB/ SciLab and mathematical calculation with MATLAB/ SciLab software.

DETAILED CONTENTS

UNIT I

Algebra

1.1 Complex Numbers: definition of complex number, real and imaginary parts of a complex number, Polar and Cartesian Form and their inter conversion, Conjugate of a complex number, modulus and amplitude, addition subtraction, multiplication and division of complex numb

1.2 Logarithms and its basic properties

UNIT II

Binomial Theorem, Determinants and Matrices

2.1 Meaning of ${}^{n}P_{r}$ & ${}^{n}C_{r}$ (mathematical expression). Binomial theorem (without proof) for positive integral index (expansion and general form); binomial theorem for any index (expansion up to 3 terms - without proof), first binomial approximation with application to engineering problems.

2.2 Determinants and Matrices – Evaluation of determinants (upto 2^{nd}order), solution of equations (upto 2 unknowns) by Crammer's rule, definition of Matrices and its types, addition, subtraction and multiplication of matrices (upto 2^{nd} order).

UNIT III

Trigonometry

3.1 Concept of angle, measurement of angle in degrees, grades, radians and their conversions.

3.2 T-Ratios of Allied angles (without proof), Sum, Difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa

3.3 Applications of Trigonometric terms in engineering problems such as to find an angle of elevation, height, distance etc.

UNIT-IV

Co-ordinate Geometry

4.1 Cartesian and Polar co-ordinates (two dimensional), Distance between two points, mid-point, centroid of vertices of a triangle.

4.2 Slope of a line, equation of straight line in various standards forms (without proof); (slope intercept form, intercept form, one-point form, two-point form, symmetric form, normal form, general form), intersection of two straight lines, concurrency of lines, angle between straight lines, parallel and perpendicular lines, perpendicular distance formula, conversion of general form of equation to the various forms.

UNIT V

Geometry of Circle and Software

Circle

5.1 General equation of a circle and its characteristics. To find the equation of a circle, given:

i. Centre and radius
ii. Three points lying on it
iii. Coordinates of end points of a diameter

Software

5.2 **MATLAB Or SciLab software –** Theoretical Introduction, MATLAB or Scilab as Simple Calculator (Addition and subtraction of values –Trigonometric and Inverse Trigonometric functions) – General Practice

RECOMMENDED BOOKS

1. R. D. Sharma, "Applied Mathematics – I & II for Diploma Courses", Dhanpat Rai Publications.
2. "Mathematics for Class XI", NCERT Publication, New Delhi.
3. "Mathematics for Class XII", NCERT Publication, New Delhi.
4. H. K Dass, "Applied Mathematics for Polytechnics", CBS Publishers & Distributers.
5. A Ganesh and G Balasubramanian, "Textbook of Engineering Mathematics – I", CBS Publisher, New Delhi.
6. A Ganesh and G Balasubramanian, "Textbook of Engineering Mathematics –II", CBS Publisher, New Delhi.
7. G. B. Thomas, R. L. Finney, "Calculus and Analytic Geometry", Addison Wesley, Ninth Edition.
8. B S Grewal, "Elementary Engineering Mathematics", Khanna Publishers, Delhi, Thirty-fifth Edition.
9. R.K. Jain and S.R.K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, New Delhi, Second Edition, 2003.
10. SS Sabharwal & Dr Sunita Jain, "Applied Mathematics Vol. I & II", Eagle Parkashan, Jalandhar.
11. S Kohli, "Engineering Mathematics Vol. I & II", IPH, Jalandhar.
12. Reena Garg & Chandrika Prasad, "Advanced Engineering Mathematics", Khanna Publishing House, New Delhi
13. R. Pratap, "Getting Started with MATLAB 7", Oxford University Press, Seventh Edition.
14. E-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://www.scilab.org

INSTRUCTIONAL STATREGY

This is theoretical subject and contains five units of equal weight age.

Basic elements of algebra, trigonometry and co-ordinate geometry can be taught in the light of

their applications in the field of engineering and technology. By laying more emphasis on applied part, teacher can also help in providing a good continuing education base to the students. Students need to be taught the skills needed to use software tools built by experts through multiple problem solving based on the topics related to Algebra, Trigonometry and Coordinate Geometry that the industry requires. Examples to be used should be related to engineering. Useful software MATLAB or open source software SciLab can be taught theoretically by books/online literatures and basic operations can be shown practically with practical software laboratory or small mobile apps of these software or authentic Trial version of MATLAB/ SciLab software. Students should be able to relate to the actual use of these examples and the way mathematical calculations will help them in doing their job.

1.3 APPLIED PHYSICS-I

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RATIONALE

Applied physics includes the study of a large number of diverse topics all related to things that go on in the world around us. It aims to give an understanding of this world both by observation and by prediction of the way in which objects will behave. Concrete use of physical principles and analysis in various technical fields are given prominence in the course content.

COURSE OUTCOMES

After completing this subject, student should be able to:

CO1: Identify physical quantities, select their units for use in engineering solutions, and make measurements with accuracy.

CO2: Represent physical quantities as scalar and vector and identify type of motions, various forms of energy, their conversion and applications.

CO3: Elaborate scientific work, energy and power, forms of friction and solve problems related to them.

CO4: Comprehend properties of matter and effect of temperature on various matter and phenomenon.

CO5: Demonstrate the use of physical principles and analysis in various technical fields.

DETAILED CONTENTS

UNIT I

Unit and Dimensions

1.1 Definition of Physics, physical quantities- fundamental and derived

1.2 Units: fundamental and derived

1.3 System of units: CGS, FPS, MKS, SI

1.4 Dimension, dimensional formulae and SI units of physical quantities-distance, displacement, area, volume, density, velocity, acceleration, linear momentum, force, impulse, work, power, energy, pressure, surface tension, stress, strain)

1.5 Dimensional equations, principle of homogeneity of dimensional equation

1.6 Application of dimensional analysis: checking the correctness of physical equation, conversion of system of unit (force, work, acceleration)

UNIT II

Force and Motion

2.1 Scalar and vector quantities– definition and examples, representation of vector, types of vector (unit vector, position vector, co-initial vector, collinear vector, co-planar vector)

2.2 Vector algebra- addition of vectors, Triangle & Parallelogram law (statement and formula only),

2.3 Scalar and vector product (statement and formula only)

2.4 Force and its units, resolution of force (statement and formula only)

2.5 Newton's laws of motion (statement and examples)

2.6 Linear momentum, Law of conservation of linear momentum (statement and examples), Impulse

2.7 Circular motion: definition of angular displacement, angular velocity, angular acceleration, frequency, time period; Relation between linear and angular velocity, centripetal and centrifugal forces (definition and formula only), application of centripetal force in banking of road

2.8 Rotational motion: definition with examples

2.9 Definition of torque, angular momentum, moment of inertia and its physical significance

UNIT III

Work, Power and Energy

3.1 Work- definition, symbol, formula and SI unit, types of work (zero work, positive work and negative work) with example

3.2 Friction– definition and its simple daily life applications

3.3 Power- definition, formula and units

3.4 Energy- definition and its SI unit, examples of transformation of energy.

3.5 Kinetic energy- definition, examples, formula and its derivation

3.6 Potential energy- definition, examples, formula and its derivation

3.7 Law of conservation of mechanical energy for freely falling bodies (with derivation)

3.8 Simple numerical problems based on formula of Power and Energy

UNIT IV

Properties of Matter

4.1 Elasticity and plasticity- definition, deforming force, restoring force, example of elastic and plastic body

4.2 Definition of stress and strain, Hooke's law, modulus of elasticity

4.3 Pressure- definition, atmospheric pressure, gauge pressure, absolute pressure, Pascal's law

4.4 Surface tension- definition, SI unit, applications of surface tension, effect of temperature on surface tension

4.5 Viscosity: definition, unit, examples, effect of temperature on viscosity

UNIT V

Heat and Temperature

5.1 Definition of heat and temperature (on the basis of kinetic theory)

5.2 Difference between heat and temperature

5.3 Principle and working of mercury thermometer

5.4 Modes of transfer of heat- conduction, convection and radiation with examples.

5.5 Properties of heat radiation

5.6 Different scales of temperature and their relationship

PRACTICAL EXERCISES

1. Familiarization of measurement instruments and their parts (for example - vernier calliper, screw gauge, spherometer, travelling microscope etc.), and taking a reading. (compulsory to all students)
2. To find diameter of solid cylinder using a vernier calliper
3. To find internal diameter and depth of a beaker using a vernier calliper and hence find its volume.
4. To find the diameter of wire using screw gauge
5. To find thickness of paper using screw gauge.
6. To determine the thickness of glass strip using a spherometer
7. To determine radius of curvature of a given spherical surface by a spherometer.
8. To verify parallelogram law of force
9. To determine the atmospheric pressure at a place using Fortin's Barometer
10. To determine force constant of spring using Hooke's law
11. Measuring room temperature with the help of thermometer and its conversion in different scale.

RECOMMENDED BOOKS

1. "Text Book of Physics for Class XI (Part-I, Part-II)", N.C.E.R.T., Delhi.
2. Dr. HH Lal, "Applied Physics, Vol. I and Vol. II", TTTI Publications, Tata McGraw Hill, Delhi.
3. AS Vasudeva, "Applied Physics – I", Modern Publishers, Jalandhar.
4. R A Banwait, "Applied Physics – I", Eagle Prakashan, Jalandhar.
5. E-books/e-tools/relevant software to be used as recommended by AICTE/ HSBTE/ NITTTR.
6. C. L. Arora, "Practical Physics", S Chand Publication.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. The Physics Classroom
3. https://www.khanacademy.org/science/physics

INSTRUCTIONAL STATREGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

Teacher may use various teaching aids like models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. Students need to be exposed to use of different sets of units and conversion from one unit type to another. Software may be used to solve problems involving conversion of units. The teacher should explain about field applications before teaching the basics of mechanics, work, power and energy, rotational motion, properties of matter etc. to develop proper understanding of the physical phenomenon. Use of demonstration can make the subject interesting and develop scientific temper in the students. Teachers should give examples of engineering/technology applications of various concepts and principles in each topic so that students are able to appreciate learning of these concepts and principles. In all contents, SI units should be followed. Working in different sets of units can be taught through relevant software.

1.4 FUNDAMENTALS OF ELECTRICAL ENGINEERING

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RATIONALE

A diploma holder may be involved in various jobs ranging from preventive maintenance of electrical installation to fault location. In addition, he/she may be working in testing laboratories where he/she uses measuring instruments. To carry out these jobs effectively, knowledge of basic concepts, principles and their applications is very essential. This course will enable the students to understand the basic concepts and principles of DC and AC fundamental, ac circuits, batteries, electromagnetic induction, voltage and current sources etc.

COURSE OUTCOMES

After successful completion of the subject, the student will be able to:

CO1: Acquire knowledge and understand the elements of electricity and DC circuits.
CO2: Apply the knowledge of basic circuital law and simplify the network
CO3: Describe the fundamental behaviour of AC circuits and solve AC circuit problems.
CO4: Comprehend the concept of Electrostatics and magentostatics and apply the knowledge.
CO5: Use various batteries as storage devices and be aware of safe disposal of batteries.

DETAILED CONTENTS

UNIT I

Electrical Fundamentals

1.1 Nature of Electricity, Charge, free electrons, Electric current, Electric potential and potential difference, Electric current, Electrical Energy, Electrical power and their unit.
1.2 Resistance: Definition, Unit, Laws of resistance, conductivity and resistivity, Effect of temperature on resistance, Temperature coefficient of resistance, Types of resistance & their applications, Color coding of resistance.
1.3 Inductors and capacitors with their wattage consideration.
1.4 Factors affecting capacitance of a capacitor. Capacitors in series and parallel.

UNIT II

DC Circuits & Theorems

2.1 Ohm's law and its verification.
2.2 Kirchhoff’s current law and Kirchhoff’s voltage law.
2.3 Star – Delta connections.

2.4 Voltage and current source, symbol and graphical representation, characteristics of ideal and practical sources.

2.5 Mesh and Loop analysis

2.6 Thevenin's theorem, Norton's theorem, Superposition Theorem, Maximum Power Transfer Theorem.

UNIT III

AC Circuits

3.1 AC Fundamentals: Cycle, frequency, time period, amplitude, difference between AC and DC, instantaneous value, average value, r.m.s. value, maximum value, form factor and peak factor.

3.2 Concept of conductance, susceptance, admittance, impedance and concept of inductive and capacitive reactance

3.3 RL-RC Circuits

3.4 Introduction to series and parallel resonance and its conditions

3.5 Power in pure resistance, inductance and capacitance, power in combined RLC circuits.

3.6 Power factor, active and reactive power: Definition and their significance.

UNIT IV

Electro Magnetic Circuit

4.1 Concept of electro-magnetic field produced by flow of electric current, magnetic circuit, concept of magneto-motive force (MMF), flux, reluctance, permeability, analogy between electric and magnetic circuit.

4.2 Faraday's laws of electro-magnetic induction, principles of self and mutual induction, self and mutually induced emf.

4.3 Energy stored in an inductor, series and parallel combination of inductors.

UNIT V

Batteries

5.1 Basic idea of primary and secondary cells.

5.2 Construction, working principle and applications of Lead-Acid, Nickel-Cadmium, Li- Ion batteries.

5.3 Series and parallel connections of batteries.

5.4 Introduction to maintenance of free batteries.

5.5 Disposal of batteries

5.6 General idea of solar cells, solar panels and their applications.

PRACTICAL EXERCISES

1. Familiarization of measuring instruments viz voltmeter, ammeter, CRO, Wattmeter and multi-meter and other accessories.
2. To measure (very low) resistance of an ammeter and (very high) resistance of a voltmeter
3. To verify Ohm's law by drawing a graph between voltage and current.
4. To observe change in resistance of a bulb in hot and cold conditions, using voltmeter and ammeter.
5. To determine the value of resistance using colour coding method.
6. Verification of Kirchhoff's Current and Voltage Laws in a DC circuit on bread board.
7. Verification of Thevenin's theorem.
8. Verification of Norton's theorem.
9. Verification of Superposition theorem.
10. Verification of Maximum Power theorem.
11. Alternating voltage applied to resistance and inductance, resistance and capacitance in series.
12. To find the voltage current relationship in a single phase R-L circuits, draw their impedance triangles.
13. To find the voltage current relationship in R-C Series circuits, draw their impedance triangles.
14. Measurement of power and power factor in a single phase R,L,C. circuit
15. Calculation of active and reactive powers in the circuit.
16. To test a lead - acid storage battery and measure its specific gravity.
17. Care and maintenance of lead-acid battery.
18. Visit to a nearby Power Station and prepare a report.

RECOMMENDED BOOKS

1. SK Bhattacharya, KM Rastogi, "Experiments in Basic Electrical Engineering", New Age International (P) Ltd., Publishers, New Delhi, January 2007.
2. BR Gupta, "Principles of Electrical Engineering", S Chand and Co, New Delhi, 2001.
3. JB Gupta, "Basic Electrical Engineering", SK Kataria and Sons, New Delhi, Eighth Edition, January 2020.
4. T.S. Anand, "Basic Electrical Engineering", North Publications, Jalandhar, March 2019.
5. Edward Hughes, "Electrical Technology", Fifth Edition, Longman Publishers, 2008.
6. GP Chhalhotra, "Experiments in Basic Electrical Engineering", Khanna Publishers, New Delhi, 2016-17.
7. SK Sahdev, "Basic Electrical and Electronics Engineering", Dhanpat Rai and Sons, New Delhi, November 2017.

SUGGESTED WEBSITES

1. http://swayam.gov.in

INSTRUCTIONAL STRATEGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

The teacher should make the students aware about the basic knowledge of electrical circuits including A.C and D.C circuit. The teacher should explain the importance of the electrical engineering, and reinforce theory with practical exercises. Teacher may encourage student to perform practical simultaneously for better understanding of the subject and verification of theoretical subject.

1.5 FUNDAMENTALS OF IT

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RATIONALE

Information technology has great influence on all aspects of life. Almost all work places and living environment are being computerized. In order to prepare diploma holders to work in these environments, it is essential that they are exposed to various aspects of information technology such as understanding the concepts of information technology and its scope, operating a computer: use of various office management tools, using internet and mobile applications etc. This course is intended to make new students comfortable with computing environment - Learning basic computer skills, learning basic application software tools, Understanding Computer Hardware, Cyber security awareness.

COURSE OUTCOMES

At the end of the subject student will be able to:

CO1: Explain the basic components of Computers, Internet and issues of abuses/ attacks on information and computers
CO2: Handle the computer/laptop/mobiles/Internet Utilities and Install/Configure OS
CO3: Assemble a PC and connect it to external devices
CO4: Manage and Use Office practiced Automation Tools
CO5: Develop worksheets and Prepare presentations

DETAILED CONTENTS

UNIT I

Basics of Computer

Brief history of development of computers, Definition of Computer, Block diagram of a Computer, Hardware, Software, Booting: Cold and Hot Booting, Interaction between the CPU and Memory with Input/Output devices, Function of CPU and major functional parts of CPU.

Memory, Bit, Nibble, Byte, KB, MB, GB, TB, PB, Functions of memory, Use of storage devices in a Computer, List types of memory used in a Computer, Importance of cache memory, CPU speed and CPU word length

UNIT II

Basic Internet Skills

Understanding browser, Introduction to WWW, efficient use of search engines, awareness about Digital India portals (state and national portals) and college portals. Advantages of Email, Various email service providers, Creation of email id, sending and receiving emails, attaching documents with email and drive.

Effective use of Gmail, G-Drive, Google Calendar, Google Sites, Google Sheets, Online mode of communication using Google Meet & WebEx.

Unit III

Basic Logic building

Introduction to Programming, Steps involved in problem solving, Definition of Algorithm, Definition of Flowchart, Steps involved in algorithm development, differentiate algorithm and flowchart, symbols used in flowcharts, algorithms for simple problems, flowcharts for simple problems, Practice logic building using flowchart/algorithms

Unit IV

Office Tools

Office Tools like LibreOffice/OpenOffice/MSOffice.

OpenOffice Writer – Typesetting Text and Basic Formatting, Inserting Images, Hyperlinks, Bookmarks, Tables and Table Properties in Writer

Introducing LibreOffice/OpenOffice *Calc*, Working with Cells, Sheets, data, tables, using formulae and functions, using charts and graphics.

OpenOffice Impress – Creating and Viewing Presentations, Inserting Pictures and Tables, Slide Master and Slide Design, Custom Animation.

Unit V

Use of Social Media

Introduction to Digital Marketing – Why Digital Marketing, Characteristics of Digital Marketing, Tools for Digital Marketing, , Effective use of Social Media like LinkedIn, Google+, Facebook, Twitter, etc.: Features of Social media, Advantages and Disadvantages of Social Media.

PRACTICAL EXERCISES

1. Browser features, browsing, using various search engines, writing search queries
2. Visit various e-governance/Digital India portals, understand their features, services offered
3. Read Wikipedia pages on computer hardware components, look at those components in lab, identify them, recognize various ports/interfaces and related cables, etc.

4. Using Administrative Tools/Control Panel Settings of Operating Systems
5. Connect various peripherals (printer, scanner, etc.) to computer, explore various features of peripheral and their device driver software.
6. Explore features of Open Office tools and MS-Office, create documents, create presentation, create spread sheet, using these features, do it multiple times
7. Working with Conversion Software like pdfToWord, WordToPPT, etc.
8. Working with Mobile Applications – Searching for Authentic Mobile app, Installation and Settings, Govt. of India Mobile Applications
9. Creating email id, sending and receiving mails with attachments.
10. Using Google drive, Google calendar
11. Create Flow chart and Algorithm for the following

i. Addition of n numbers and display result
ii. To convert temperature from Celsius to Fahrenheit
iii. To find Area and Perimeter of Square
iv. Swap Two Numbers
v. find the smallest of two numbers
vi. Find whether given number is Even or Odd
vii. To print first n even Numbers
viii. find sum of series 1+2+3+…..+N
ix. print multiplication Table of a number
x. generate first n Fibonacci terms 0,1,1,2,3,5…n (n>2)
xi. sum and average of given series of numbers
xii. Factorial of number n (n!=1x2x3x…n)
xiii. Armstrong Number
xiv. Find whether given number is Prime or not

RECOMMENDED BOOKS

1. R.S. Salaria, “Computer Fundamentals”, Khanna Publishing House.
2. Ramesh Bangia, “PC Software Made Easy – The PC Course Kit”, Khanna Publishing House.
3. Online Resources, Linux man pages, Wikipedia
4. Mokhtar Ebrahim and Andrew Mallett, “Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming”.
5. Vikas Gupta, “Comdex Hardware and Networking Course Kit” Dream Tech press, New Delhi, 2008.
6. Sumitabha Das, “UNIX concepts and applications” Tata McGraw Hill, New Delhi, 2008, Fourth Edition.

SUGGESTED WEBSITES

1. https://nptel.ac.in/courses/106/106/106106222/ - NPTEL Course on Modern Application Development
2. https://onlinecourses.swayam2.ac.in/aic19_de01/preview -
3. https://spoken-tutorial.org/ - Tutorials on Introduction to Computers, HTML, LibreOffice Tools, etc.
4. NOTEPAD++
5. https://tms-outsource.com/blog/posts/web-development-ide/

INSTRUCTIONAL STRATEGY

This is a skill based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weight age.

1.6 ENGINEERING GRAPHICS

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RATIONALE

Drawing is the language of engineers and technicians. Reading and interpreting engineering drawings is their day to day responsibility. The subject is aimed at developing basic graphic skills in the students so as to enable them to use these skills in preparation of engineering drawings, their reading and interpretation. The emphasis, while imparting instructions, should be to develop conceptual skills in the students following BIS SP 46 – 1988.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:

CO1: Draw Orthographic views of different objects viewed from different angles.

CO2: Draw and interpret sectional views of an object which are otherwise not visible in normal view.

CO3: Draw Isometric views of different solids and develop their surfaces.

CO4: Identify conventions for different engineering materials, symbols, sections of regular objects and general fittings used in Civil and Electrical household appliances /fittings.

CO5: Draw orthographic views of different objects by using basic commands of AutoCAD.

DETAILED CONTENTS

UNIT I

1. Introduction to Engineering Drawing and Graphics

1.1 Introduction to use and care of drawing instruments, drawing materials, layout and sizes of drawing sheets and drawing boards.

1.2 Symbols and conventions-

a) Conventions of Engineering Materials, Sectional Breaks and Conventional lines.

b) Civil Engineering Sanitary fitting symbols

c) Electrical fitting symbols for domestic interior installations.

1.3 Geometrical construction-geometrical figures such as triangles, rectangles, circles, ellipses and curves, hexagons, pentagons bisecting a line and arc , division of line and circle with the help of drawing instruments.

2. Technical Lettering of Alphabet and Numerals

Definition and classification of lettering, Free hand (of height of 5,8,12 mm) and instrumental lettering (of height 20 to 35 mm) : upper case and lower case, single and double stroke, vertical and inclined (Gothic lettering) at 75 degree to horizontal and with suitable height to width ratio 7:4.

3. Dimensioning

3.1 Necessity of dimensioning, method and principles of dimensioning (mainly theoretical instructions).

3.2 Dimensioning of overall sizes, circles, threaded holes, chamfered surfaces, angles, tapered surfaces, holes, equally spaced on P.C.D., countersunk holes, counter bored holes, cylindrical parts, narrow spaces and gaps, radii, curves and arches.

4. Scales

4.1 Scales –Needs and importance (theoretical instructions), Type of scales, Definition of Representative Fraction (R.F.) and Length of Scale.

4.2 To draw/construct plain and diagonal scales.

UNIT II

1. Orthographic Projections

1.1 Theory of orthographic projections (Elaborate theoretical instructions).

1.2 Three views of orthographic projections of different objects of given pictorial view of a block in 1st and 3rd angle.

1.3 Projection of Points in different quadrant

1.4 Projection of Straight Line (1^{st} angle)

i. Line parallel to both the planes.

ii. Line perpendicular to any one of the reference plane and parallel to others

iii. Line inclined to any one of the references and parallel to another plane.

1.5 Projection of Plane – Different lamina like square rectangular, triangular, circle and Hexagonal pentagon. Trace of planes (HT and VT).

1.6 Identification of surfaces.

2. Sectioning

2.1 Importance and salient features

2.2 Drawing of full section, half section, partial or broken out sections, Offset sections, revolved sections and removed sections (theoretical only).

2.3 Orthographic sectional views of different objects.

UNIT III

1. Introduction of projection of right solids such as prism & pyramid (square, Pentagon, Hexagonal) cube, cone & cylinder (Axes perpendicular to H.P and parallel to V.P.)
2. Introduction of sections of right solids - Section planes, Sections of Hexagonal prism, pentagon pyramid, cylinder and cone (Section plane parallel to anyone reference planes and perpendicular to V.P. and inclined to H.P.)
3. Development of Surfaces – Development of lateral surfaces of right solids like cone, cylinder, pentagonal prism, pyramid and hexagonal pyramid (Simple problems)

UNIT IV

Isometric Views

1. Fundamentals of isometric projections and isometric scale.
2. Isometric views of different laminas like circle, pentagon and hexagon.
3. Isometric views of different regular solids like cylinder, cone, cube, cuboid, pyramid and prism.
4. Isometric views from given different orthographic projections(front, side and top view)

UNIT V

Introduction to AutoCAD

Basic introduction and operational instructions of various commands in AutoCAD. At least two sheets of different objects on AutoCAD (given pictorial/isometric view of a block). AutoCAD skill of student is evaluated in internal assessment only not in external exam.

RECOMMENDED BOOKS

1. A Text Book of Engineering Drawing by Surjit Singh; Dhanpat Rai & Co.,Delhi
2. Engineering Drawing by PS Gill; SK Kataria & Sons, NewDelhi
3. Elementary Engineering Drawing in First Angle Projection by ND Bhatt;Charotar Publishing House Pvt. Ltd.,Anands
4. Engineering Drawing and Graphics using AutoCAD by T. Jeyapoovan,Vikas Publishing House Pvt, Ltd Noida.
5. A Text Book of Engineering Drawing by S.R.Singhal and O.P.Saxena, Asian Publisher, Delhi
6. Engineering Drawing by RB Gupta, Satya Prakashan, New Delhi

SUGGESTED WEBSITES

1. http://swayam.gov.in

INSTRUCTIONAL STRATEGY

Teacher should show model of realia of the component/part whose drawing is to be made. Emphasis should be given on cleanliness, dimensioning and layout of sheet. Focus should be on proper selection of drawing instruments and their proper use. First angle projection is to be followed. Minimum of 20 sheets to be prepared and at least 2 sheets on AutoCAD**.** Instructions relevant to various drawings may be given along with appropriate demonstrations, before assigning drawing practice to students. This subject contains five units of equal weight age.

SECOND SEMESTER

2.1 APPLIED MATHEMATICS – II

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4	-

RATIONALE

Applied mathematics forms the backbone of engineering students. Basic elements of Differential calculus, Integral calculus and Differential Equations have been included in this course. This will develop analytical abilities to apply in engineering field and will provide continuing educational base to the students.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:

CO1: Formulate the engineering problems into mathematical format with the use of differential equations and differential

C02: Use the differentiation and Integration in solving various Mathematical and Engineering problems.

CO3: Calculate the approximate area under a curve by applying integration and numerical methods.

CO4: Discuss the purposes of measures of central tendency and calculate the measures of central tendency (mode, median, mean) for a set of data.

CO5: Learn about basic fundamentals about MATLAB/ SciLab and mathematical calculation with MATLAB/ SciLab software.

DETAILED CONTENTS

UNIT I

Differential Calculus

1.1 Definition of function; Concept of limits (Introduction only) and problems related to four standard limits only.

1.2 Differentiation of x^n, sin x, cos x, e^x by first principle.

1.3 Differentiation of sum, product and quotient of functions.

UNIT II

Differential Calculus and Its Applications

2.1 Differentiation of trigonometric functions, inverse trigonometric functions. Logarithmic differentiation, successive differentiation (upto 2nd order)

2.2 Application of differential calculus in:

(a) Rate measures (b) Maxima and minima

UNIT III

Integral Calculus

3.1 Integration as inverse operation of differentiation with simple examples.

3.2 Simple standard integrals and related problems, Integration by Substitution method and Integration by parts.

3.3 Evaluation of definite integrals with given limits.

Evaluation of $\int_0^{\pi/2} \sin^n x.\, dx$, $\int_0^{\pi/2} \cos^n x\, dx$, $\int_0^{\pi/2} \sin^m x\, \cos^n x\, dx$

using formulae without proof (m and n being positive integers only) using pre-existing mathematical models.

UNIT IV

Application of Integration, Numerical Integration and Differential Equations

4.1 Applications of integration: for evaluation of area under a curve and axes (Simple problems).

4.2 Numerical integration by Trapezoidal Rule and Simpson's $1/3^{rd}$ Rule using pre-existing mathematical models.

Differential Equations

4.3 Definition, order, degree, Type of differential Equations, linearity, Formulation of ordinary differential equation (up to 1^{st} order), solution of ODE (1^{st} order) by variable separation method.

UNIT V

Statistics and Software

Statistics

5.1 Measures of Central Tendency: Mean, Median, Mode

5.2 Measures of Dispersion: Mean deviation, Standard deviation

Software

5.3 SciLab software – Theoretical Introduction.

5.4 Basic difference between MATLAB and SciLab software,

5.5 Calculations with MATLAB or ScilLab - (a) Representation of matrix (2×2 order), (b) Addition, Subtraction of matrices (2×2 order) in MATLAB or SciLab

RECOMMENDED BOOKS

1. R. D. Sharma, "Applied Mathematics – I & II for Diploma Courses", Dhanpat Rai Publications.
2. "Mathematics for Class XI", NCERT Publication, New Delhi.

3. "Mathematics for Class XII", NCERT Publication, New Delhi.
4. H. K Dass, "Applied Mathematics for Polytechnics", CBS Publishers & Distributers.
5. A Ganesh and G Balasubramanian, "Textbook of Engineering Mathematics –I", CBS Publisher, New Delhi.
6. A Ganesh and G Balasubramanian, "Textbook of Engineering Mathematics –II", CBS Publisher, New Delhi.
7. G. B. Thomas, R. L. Finney, "Calculus and Analytic Geometry", Addison Wesley, Ninth Edition.
8. B S Grewal, "Elementary Engineering Mathematics", Khanna Publishers, Delhi, Thirty-Fifth Edition.
9. R.K. Jain and S.R.K. Iyengar, "Advanced Engineering Mathematics" Narosa Publishing House, New Delhi, Second Edition, 2003.
10. SS Sabharwal & Dr Sunita Jain, "Applied Mathematics Vol. I & II", Eagle Parkashan, Jalandhar.
11. S Kohli, "Engineering Mathematics Vol. I & II", IPH, Jalandhar.
12. Reena Garg & Chandrika Prasad, "Advanced Engineering Mathematics", Khanna Publishing House, New Delhi.
13. R. Pratap, "Getting Started with MATLAB 7", Oxford University Press, Seventh Edition.
14. E-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

SUGGESTED WEBSITES

1. https://www.scilab.org
2. http://swayam.gov.in

INSTRUCTIONAL STRATEGY

This is theoretical subject and contains five units of equal weight age.

Basic elements of Differential Calculus, Integral Calculus, and Differential Equations can be taught in the light of their applications in the field of engineering and technology. By laying more stress on applied part, teachers can also help in providing continuing education base to the students. Students need to be taught the skills needed to use software tools built by experts through multiple problem solving based on the topics that the industry requires. For example they need to know how to use mathematical models that use integration as opposed to learning how integration can be used. Useful authenticated software MATLAB or open source software SciLab can be taught theoretically by books/online literatures and basic operations can be shown practically with practical software laboratory or small mobile apps of these software or authentic Trial version of MATLAB/ SciLab software. Diploma students need to know which tools to use and how to do the job.

2.2 APPLIED PHYSICS-II

L	P
2	2

RATIONALE

Applied physics includes the study of a large number of diverse topics all related to things that go on in the world around us. It aims to give an understanding of this world both by observation and by prediction of the way in which objects will behave. Concrete use of physical principles and analysis in various fields of engineering and technology are given prominence in the course content to prepare students for various engineering applications.

COURSE OUTCOMES

At the end of this subject, the students will be able to:

CO1: Differentiate between types of waves and their motion.
CO2: Illustrate laws of reflection and refraction of light.
CO3: Demonstrate competency in phenomena of electrostatics and electricity.
CO4: Characterize properties of material to prepare new materials for various engineering applications.
CO5: Demonstrate a strong foundation on Modern Physics to use at various technical and engineering applications

DETAILED CONTENTS

UNIT I

Wave Motion and its Applications

1.1 Waves: definition, types (mechanical and electromagnetic wave)
1.2 Wave motion- transverse and longitudinal with examples, terms used in wave motion like displacement, amplitude, time period, frequency, wavelength, wave velocity; relationship among wave velocity, frequency and wave length
1.3 Simple harmonic motion (SHM): definition, examples
1.4 Cantilever: definition, formula of time period (without derivation)
1.5 Free, forced and resonant vibrations with examples
1.6 Sound waves: types (infrasonic, audible, ultrasonic) on the basis of frequency, noise, coefficient of absorption of sound, echo

UNIT II

Optics

2.1 Reflection and refraction of light with laws, refractive index

2.2 Lens: introduction, lens formulae (no derivation), power of lens and simple numerical problems

2.3 Total internal reflection and its applications, critical angle and conditions for total internal reflection

2.4 Superposition of waves (concept only), definition of Interference, Diffraction and Polarization of waves

2.5 Introduction to Microscope, Telescope and their applications

UNIT III

Electrostatics and Electricity

3.1 Electric charge, unit of charge, conservation of charge

3.2 Coulomb's law of electrostatics

3.3 Electric field, electric lines of force (definition and properties), electric field intensity due to a point charge

3.4 Definition of electric flux, Gauss law (statement and formula)

3.5 Capacitor and capacitance (with formula and unit)

3.6 Electric current and its SI Unit, direct and alternating current

3.7 Resistance, conductance (definition and unit)

3.8 Series and parallel combination of resistances

3.9 Ohm's law (statement and formula)

UNIT IV

Classification of Materials and their Properties

4.1 Definition of energy level, energy bands

4.2 Types of materials (conductor, semiconductor, insulator and dielectric) with examples, intrinsic and extrinsic semiconductors (introduction only)

4.3 Introduction to magnetism, type of magnetic materials: diamagnetic, paramagnetic and ferromagnetic materials with examples

4.4 Magnetic field, magnetic lines of force, magnetic flux

4.5 Electromagnetic induction (definition)

UNIT V

Modern Physics

5.1 Laser: introduction, principle, absorption, spontaneous emission, stimulated emission, population inversion

5.2 Engineering and medical applications of laser

5.3 Fibre optics**:** introduction to optical fibers (definition, principle and parts), light propagation, fiber types (mono-mode, multi-mode), applications in medical, telecommunication and sensors

5.4 Nanotechnology: introduction, definition of nanomaterials with examples, properties at nanoscale, applications of nanotechnology (brief)

PRACTICAL EXERCISES

1. Familiarization with apparatus (resistor, rheostat, key, ammeter, voltmeter, telescope, microscope etc.)
2. To find the time period of a simple pendulum.
3. To study variation of time period of a simple pendulum with change in length of pendulum.
4. To determine and verify the time period of Cantilever.
5. To verify Ohm's laws by plotting a graph between voltage and current.
6. To study colour coding scheme of resistance.
7. To verify laws of resistances in series combination.
8. To verify laws of resistance in parallel combination.
9. To find resistance of galvanometer by half deflection method.
10. To verify laws of reflection of light using mirror.
11. To verify laws of refraction using glass slab.
12. To find the focal length of a concave lens, using a convex lens.

RECOMMENDED BOOKS

1. "Text Book of Physics for Class XII (Part-I, Part-II)", N.C.E.R.T., Delhi.
2. Dr. HH Lal, "Applied Physics, Vol. I & II", TTTI Publications, Tata McGraw Hill, Delhi.
3. AS Vasudeva, "Applied Physics –II", Modern Publishers, Jalandhar.
4. R A Banwait, "Applied Physics – II", Eagle Prakashan, Jalandhar.
5. N Subrahmanyam, Brij Lal and Avadhanulu, "A text book of OPTICS", S Chand Publishing, New Delhi.
6. E-books/e-tools/relevant software to be used as recommended by AICTE/ HSBTE/ NITTTR.
7. M H Fulekar, "Nanotechnology: Importance and Applications", IK International Publishing House (P) Ltd., New Delhi.
8. C. L. Arora, "Practical Physics", S Chand Publication.

SUGGESTED WEBSITES

1. http://swayam.gov.in

INSTRUCTIONAL STATREGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

Teacher may use various teaching aids like models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. Students need to be exposed to use of different sets of units and conversion from one unit type to another. Software may be used to solve problems involving conversion of units. The teacher should explain about field applications before teaching the basics of mechanics, work, power and energy, rotational motion, properties of matter etc. to develop proper understanding of the physical phenomenon. Use of demonstration can make the subject interesting and develop scientific temper in the students.

Teachers should give examples of engineering/technology applications of various concepts and principles in each topic so that students are able to appreciate learning of these concepts and principles. In all contents, SI units should be followed. Working in different sets of units can be taught through relevant software.

2.3 FUNDAMENTALS OF MEDICAL ELECTRONICS

L	P
3	4

RATIONALE

This subjects aims to impart understanding of basic medical instrumentation & physical principles which govern the measurement of a biological variable. The subject also illustrate biomedical sensors, biomedical amplifiers & biomedical recorders.

COURSE OUTCOMES

At the end of this subject, the students will be able to:

CO1: Detail basic concepts of biomedical instrumentation and their applications.
CO2: Familiarize with the various bioelectric signals & theirs measurements.
CO3: Elaborate basic theory behind biomedical recorders & their classification.
CO4: Comprehend the functioning of various bio potential electrodes.
CO5: Describe the basic characteristics of transducer & their classification.

DETAILED CONTENTS

UNIT I

Overview of Medical Instrumentation

1.1 A perspective of Biomedical Engineering & career opportunities in it.
1.2 Classification of Hospital Equipments.
1.3 Classification of Hospital Departments & their functions
1.4 Explain basic Medical Instrumentation system with block diagram & their functions.
1.5 Performance Requirements of a Medical Instrumentation System.
1.6 PC based Medical Instrumentation system.
1.7 Biomedical Organizations.

UNIT II

Bioelectric Signals & Bioelectric Amplifiers

2.1 Signals & their classifications.
2.2 Signal distortion and noise with their types
2.3 Noise Parameters
2.4 Origin of Bioelectric Signals.
2.5 Enlist different Bio potential signals generated in human body.
2.6 Motion Artefacts
2.7 Special Features of bioelectric amplifiers

UNIT III

Biomedical Recording System

3.1 Basic Recording system

3.2 General consideration for signal conditioners , Preamplifiers & Differential amplifiers

3.3 Introduction to Biomedical Recorders:-

i. Electrocardiograph (ECG)

ii. Electroencephalograph (EEG)

iii. Electromyograph (EMG)

3.4 Biomedical signals processing with basic block diagram of Digital signal Processing (DSP) System.

3.5 Writing Recorders (Direct Writing Recorders & Ink-Jet Recorders), Introduction to Digital Recorders.

UNIT IV

Bio-Potential Electrodes

4.1 Theory of Biomedical Electrodes

4.2 Model of a Biomedical Electrode

4.3 Classification of Electrodes.

4.4 Describe microelectrodes & its properties

4.5 Needle electrodes and skin surface electrodes.

4.6 Electrodes , Electrode-Electrolyte Interface , Electrode-Tissue Interface

UNIT V

Biomedical Transducers & Sensors

5.1 Transducers & their classifications with examples.

5.2 Describe principle of active transducers & passive transducers

5.3 Temperature transducers (Resistance Temperature Detector (RTD), Thermistor, Thermocouple) Pressure Transducers

5.4 Principle of LVDT, State merits and demerits of LVDT.

5.5 Principle of Piezo-electric transducer

5.6 Basic idea about Biosensors & Smart sensors.

5.7 Optical fibre sensors & their advantages.

PRACTICAL EXERCISES

1. Identification of different Medical Equipments as per their utilization in different Hospital departments.
2. Identification of different medical organization and their products.
3. Demonstration about a basic medical instrumentation system & it's working.

4. Demonstration about different types of signals and their characteristics.
5. To understand about different bioelectric signals and their characteristics
6. To understand the concept of motion artefacts in bioelectric signals & their effects.
7. To study about different types of ECG Electrodes and technique to apply them.
8. To study about different types of EEG Electrodes and technique to apply them.
9. To study about different types of EMG Electrodes and technique to apply them.
10. To study about Piezoelectric Transducer.
11. To study about Resistive temperature detector (RTD).
12. Measure the body temperature through transducers (Thermistor and Thermocouple).
13. Use LVDT Transducer.
14. To study Piezo-electric Transducer
15. To study Optical fibre sensors

RECOMMENDED BOOKS

1. Joseph J Carr, John M Brown, "Introduction to Biomedical Equipment Technology".
2. Shakti Chhaterjee, Aubert, "Miller Biomedical Instrumentation Systems", Delmar Cengage Learning, First Edition, 2010.
3. R.S.Khandpur, "Biomedical Instrumentation", McGraw-Hill Publications, Third Edition, 2014.
4. O.N. Pandey, "Fundamentals of Biomedical Instrumentation" S.K. Kataria & sons, First Edition, 2013.
5. G.S. Sawhney, "Biomedical Electronics and Instrumentation" I.K. International Publishing House, First Edition, 2011.

SUGGESTED WEBSITES

1. www.efymag.com
2. www.electronicsforu.com

INSTRUCTIONAL STRATEGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage. The teacher should also organize for the students various Webinars/Online lectures from experts, Hospital Visits, Open Online MOOC Courses for special topics.

2.4 ANALOGUE & DIGITAL ELECTRONICS

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RATIONALE

This subject gives the knowledge of fundamental concepts and principles of basic electronics and aims at providing the students with basic understanding of various types of materials based on their conductivity. Students will study p-n junction, rectifiers and their significance, filters, basic structure and working principle of transistors in various configurations. This course also gives the knowledge to make the students know about the fundamental principles of digital electronics and gain familiarity with the available IC chips.

COURSE OUTCOMES

After completing this subject, student will be able to:

CO1: Describe different Semiconductor devices and explain their characteristics

CO2: Acquire the knowledge of transistor in CB and CE mode and demonstrate the working of transistor as an amplifier.

CO3: Explain the fundamentals of FETs & MOSFETs and their applications.

CO4: Evaluate and realize the various digital circuits.

CO5: Analyze sequential and combinational digital circuits.

DETAILED CONTENTS

UNIT I

Semiconductor devices

1.1 Concept of insulators, conductors and semi conductors, doping, minority and majority charge carriers.

1.2 P and N type semiconductors , PN junction diode, mechanism of current flow in PN junction, forward and reverse biased PN junction, potential barrier, drift and diffusion currents, depletion layer. V-I characteristics of diodes.

1.3 Concept of junction capacitance in forward and reverse biased condition. Characteristics and applications of Zener diodes. Zener and avalanche breakdown.

1.4 Diode as rectifier:-Diode as half-wave, full wave and bridge rectifiers. Peak Inverse Voltage, rectification efficiencies and ripple factor calculations, Concept of filters

UNIT II

Introduction to Bipolar Transistors

2.1 Concept of a bipolar transistor, its structure, PNP and NPN transistors, their symbols, Concept of leakage current.

2.2 CB, CE, CC configurations of a transistor; Input and output characteristics in CB and CE configurations.

2.3 Transistor as an amplifier in CE Configuration, Current amplification factors, relation b/w α, β and γ, Comparison of CB, CE and CC Configurations.

UNIT III

Field Effect Transistors

3.1 Construction, operation and characteristics of FETs, FET as an amplifier

3.2 Construction, operation and characteristics of a MOSFET and its applications.

3.3 Comparison of JFET, MOSFET and BJT.

UNIT IV

Digital Electronics

4.1 Distinction between analog and digital signal.

4.2 Number system Decimal, Binary, octal and hexadecimal number system: conversion from decimal and hexadecimal to binary and vice-versa. Binary addition and subtraction.

4.3 Logic gates-Definition, symbols and truth tables of NOT, AND, OR, NAND, NOR, EXOR Gates, NAND and NOR as universal gates.

4.4 Gate realization with CMOS

UNIT V

Sequential and Combinational Circuit

5.1 Sequential Circuits: Half adder, Full adder, Mux, De-Mux, Encoder and Decoder.

5.2 Combinational Circuits: Concept of latch, Flip Flops (S-R, D, J-K, T types) Basic concept of shift registers and counters.

5.3 A/D and D/A Converters: Basic concept of A/D and D/A converters, Applications

PRACTICAL EXERCISES

1. To Plot V-I characteristics of a PN junction diode on bread board.
2. To Plot V-I characteristics of a Zener diode on bread board.
3. Observe the output of waveform using bread board:

a. Half-wave rectifier circuit using one diode

b. Full-wave rectifier circuit using two diodes

4. Bridge-rectifier circuit using four diodes

5. Plotting of input and output characteristics and calculation of parameters of transistors in CE configuration.
6. Plotting of input and output characteristics and calculation of parameters of transistors in CB configuration.
7. Plotting of V-I characteristics of a FET.
8. Basic logic operations AND, OR, NOT gates on bread board.
9. Verification of truth tables for NAND, NOR and Exclusive OR (EX-OR) and Exclusive NOR (EX-NOR) gates on bread board.
10. Realization of logic functions with the help of NAND or NOR gates.
11. To design a half adder using XOR and NAND gates and verification of its operations.
12. Construction of a full adder circuit using XOR and NAND gates and verify its operation
13. Verification of truth table for IC flip-flops (At least one IC each of D latch, D flip-flop, JK flip-flops).
14. Verification of truth table for encoder and decoder ICs,
15. Verification of truth table for Mux and De-Mux.

RECOMMENDED BOOKS

1. Kulshreshta and SC Gupta, “Basic Electronics and Linear Circuit” byTata McGraw Hill Education Pvt Ltd., New Delhi.
2. VK Mehta, “Principles of Electrical and Electronics Engineering” by S Chand and Co., New Delhi
3. Millman and Halkias, “Electronics Devices and Circuits” by McGraw Hill.
4. Albert Paul Malvino, “Principles of Electronics” by Tata McGraw Hill Education Pvt Ltd.
5. SK Sahdev, “Electronic Principles” by Dhanpat Rai& Co., New Delhi
6. JB Gupta, “Basic Electronics” BY SK Kataria and Sons, New Delhi
7. Schultz, “Grob’s Basic Electronics- A text Lab Manual” (Special Indian Edition) by Tata McGraw Hill Education Pvt Ltd, New Delhi.
8. Anand Kumar “Fundamentals of Digital Circuits” PHI
9. Anil K. Maini “Digital Electronics: Principles And Integrated Circuit”, Wiley Publications
10. R P Jain- “Modern Digital Electronics”-Tata McGraw Hill.
11. E-books/e-tools/relevant software to be used as recommended by ICTE/HSBTE/NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. www.efymag.com
3. www.electronicsforu.com

INSTRUCTIONAL STRATEGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage. The teacher should also organize for the students various Webinars/Online lectures from experts, Open Online MOOC Courses for special topics.

2.5 ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT

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2	-

RATIONALE

A diploma holder must have knowledge of different types of pollution caused due to industrial and construction activities so that he/she may help in balancing the ecosystem and controlling pollution by various control measures. The course is intended to provide a general concept in the dimensions of environmental pollution and disasters caused by nature beyond the human control as well as the disasters and environmental hazards induced by human activities with emphasis on disaster preparedness, response and recovery.

COURSE OUTCOMES

After undergoing the subject, the student will be able to:

CO1: Comprehend the importance of sustainable ecosystem.
CO2: Clarify interdisciplinary nature of environmental issues.
CO3: Describe corrective measures for the abatement of pollution.
CO4: Identify the role of non-conventional energy resources in environmental protection.
CO5: Recognize various types of disasters.

DETAILED CONTENTS

UNIT I

Introduction

1.1 Basics of ecology, eco system- concept, and sustainable development, Sources, advantages, disadvantages of renewable and nonrenewable energy.
1.2 Rain water harvesting
1.3 Deforestation – its effects & control measures

UNIT II

Air and Noise Pollution

2.1 Air Pollution: Source of air pollution. Effect of air pollution on human health, economy, Air pollution control methods.
2.2 Noise Pollution: Source of noise pollution, Unit of noise, Effect of noise pollution, Acceptable noise level, Different method of minimizing noise pollution.

UNIT III

Water and Soil Pollution

3.1 Water Pollution: Impurities in water, Cause of water pollution, Source of water pollution. Effect of water pollution on human health, Concept of DO, BOD, COD. Prevention of water pollution- Water treatment processes, Sewage treatment. Water quality standard.

3.2 Soil Pollution :Sources of soil pollution, Effects and Control of soil pollution, Types of Solid waste- House hold, Industrial, Agricultural, Biomedical, Disposal of solid waste, Solid waste management E-waste, E – waste management

UNIT IV

Impact of Energy Usage on Environment

Global Warming, Green House Effect, Depletion of Ozone Layer, Acid Rain. Eco-friendly Material, Recycling of Material, Concept of Green Buildings, Concept of Carbon Credit & Carbon footprint.

UNIT V

Disaster Management

A. Different Types of Disaster:

Natural Disaster: such as Flood, Cyclone, Earthquakes and Landslides etc.

Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea Rail & Road), Structural failures(Building and Bridge), War & Terrorism etc.

B. Disaster Preparedness:

Disaster Preparedness Plan

Prediction, Early Warnings and Safety Measures of Disaster

Psychological response and Management (Trauma, Stress, Rumour and Panic)

RECOMMENDED BOOKS

1. S.C. Sharma & M.P. Poonia, “Environmental Studies”, Khanna Publishing House, New Delhi.
2. BR Sharma, “Environmental and Pollution Awareness”, Satya Prakashan, New Delhi.
3. Dr. RK Khitoliya, “Environmental Pollution”, S Chand Publishing, New Delhi.
4. Erach Bharucha, “Environmental Studies”, University Press (India) Private Ltd., Hyderabad.
5. Suresh K Dhamija, “Environmental Engineering and Management”, S K Kataria and Sons, New Delhi.
6. E-books/e-tools/relevant software to be used as recommended by AICTE/BTE/NITTTR, Chandigarh.

7. Dr. Mrinalini Pandey, “Disaster Management”, Wiley India Pvt. Ltd.
8. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill Education (India) Pvt. Ltd.

INSTRUCTIONAL STRATEGY

In addition to theoretical instructions, different activities pertaining to Environmental Studies and Disaster Management like expert lectures, seminars, visits etc. may also be organized This subject contains five units of equal weightage.

2.6 ELECTRONICS WORKSHOP

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RATIONALE

Electronic practice is the backbones of the real work situation, which helps in development and enhancement of relevant skill required in engineering. The main objective of this course is to impart knowledge of different electronics components used in electronic circuits and develop the ability to understand datasheets. The course also describes various electronic components for different applications.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:

CO1: Identify electronics components like resistors, capacitors, diodes, transistors etc.
CO2: Implement soldering and de-soldering on electronic circuit interconnections.
CO3: Identify different active electronic components and assemble circuits on breadboard.
CO4: Use measuring instruments like Multimeter, Function generator, Power Supply & DSO.
CO5: Able to test various electronic circuitry and batteries.

PRACTICAL EXERCISES

UNIT I

Basic Electronic Components

1.1 Concept of Resistors, Color Coding, Tolerance, Maximum power rating, Application of LDR.
1.2 Classification of Capacitors, Coding of capacitors-using numerals, directly printed values on capacitors, Ceramic capacitor and Electrolytic capacitor.
1.3 Concept of Inductors
1.4 Testing of components using Multi meter/LCR Q-meter

UNIT II

Soldering & De-soldering

2.1 Identify different types of soldering guns and practice soldering of different electronic active and passive components and IC bases on lug boards and PCBs.
2.2 Join the broken PCB track and test
2.3 Practice de-soldering using pump and wick
2.4 Prepare component for soldering.
2.5 Demonstrate soldering and de-soldering using soldering and de-soldering stations.

UNIT III

Active Electronic Components

3.1 Identify different types of mains transformers and their testing.
3.2 Identify the primary and secondary transformer windings and test the polarity.
3.3 Identify different sizes, shapes of cores used in low capacity transformers.
3.4 Measure the primary and secondary voltage of different transformers.
3.5 PN junction diode: Terminal Identification, setting on bread board and testing.
3.6 Zener diode: Terminal Identification, setting on bread board and testing.
3.7 LED, Photo diode :Terminal Identification, setting on bread board and testing.
3.8 Integrated Circuits (ICs) like 7404, 7408, 7432, 7805, 555, 741: Pin diagram, Identification, setting on bread board and testing.
3.9 Switches, Application of Toggle, Rotary, push to on & push to off
3.10 Relays and application of General purpose relay

UNIT IV

Electronic Testing Equipments

4.1 Power Supply, DC power supply, Concept of Dual power supply
4.2 Cathode Ray Oscilloscope (CRO), CRO probes, Front panel controls, AC/DC voltage measurement, Frequency measurement, wave form generation.
4.3 Function Generator, Front panel controls, Functions: sine wave, square wave, triangular wave and Amplitude measurement.
4.4 Digital Multi Meter, Front panel controls of DMM
4.5 Study of AC and DC Waveforms
4.6 Construction of various electronic circuits on breadboard Circuits like: rectifiers, filter circuits, clipper, clamper, transistor amplifiers, logic gates, LED driver circuit, power supply, etc
4.7 Testing of outputs of various electronic circuits using test Equipment.

UNIT V

AC and Electrical Cables

5.1 Identify the Phase, Neutral and Earth on power Socket.
5.2 Construct a test lamp and use it to check mains.
5.3 Use a Tester to monitor AC power.
5.4 Measure the voltage between phase and ground and rectify earthing.
5.5 Identify and test different AC mains cables.
5.6 Skin the electrical wires /cables using the wire stripper and cutter. .
5.7 Prepare the mains cable for termination.
5.8 Measure AC and DC voltages using multi meter
5.9 Replace the fuse, battery for the given multimeter

RECOMMENDED BOOKS

1. Prof. D.Chhatopadhyay & Prof. P.C Rakshit, "Basic Electronics" New Age International (P) Ltd. Publishers, 2010.
2. Zber, "Basic Electronics Lab Manual", Mc Graw Hill India, Seventh Edition, 2001.
3. Stan Gibilisco & Simon Monk, "Electricity & Electronics", Mc Graw Hill Education Sixth Edition, 2016.
4. Marc De Vinck "Getting Started with Soldering", Shroff/Maker Media, First Edition, 2018.

SUGGESTED WEBSITES

1. www.electronics.wisc-online.com
2. www.electronicsforu.com
3. https://www.electronics-tutorials.ws/design

INSTRUCTIONAL STRATEGY

This is hands-on practice based workshop for development of required skills in the students. There are five units of equal weightage. The teacher should also engage the students for various Hands on Practice/Training of Students during Educational Tour, Seminar/ Assignment Event, Students Quiz.

SECOND YEAR

NSQF LEVEL - 4

12. STUDY AND EVALUATION SCHEME

THIRD SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits L+P= C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Total	Th	Pr	Total	
3.1	Industrial/In-HouseTraining - I	-	2	**0+1 =1**	-	40	40	-	60	60	100
3.2	Human Anatomy & Physiology	3	4	**3+2=5**	40	40	80	60	60	120	200
3.3	**Measurement and Instrumentation	3	2	**3+1=4**	40	40	80	60	60	120	200
3.4	Bio-Mechanics and Bio Materials	4	-	**4+0=4**	40	-	40	60	-	60	100
3.5	Biomedical Instrumentation-I	4	6	**4+3=7**	40	40	80	60	60	120	200
3.6	Open Elective (MOOCs+/Offline)	2	-	**2+0=2**	40	-	40	60	-	60	100
# Student Centered Activities (SCA)		-	5	-	-	-	-	-	-	-	-
Total		**16**	**19**	**23**	**200**	**160**	**360**	**300**	**240**	**540**	**900**

\+ Assessment of Open Elective through MOOCs shall be based on assignments out of 100 marks.

** Common with Diploma in Instrumentation & Control Engineering programme

Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Electoral Literacy, Motor Vehicles (Driving) Regulations 2017 etc., games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

FOURTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L + P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Total	Th	Pr	Total	
4.1	*English and Communication Skills - II	2	2	**2+1=3**	40	40	80	60	60	120	200
4.2	Medical Imaging Techniques	3	4	**3+2=5**	40	40	80	60	60	120	200
4.3	*Entrepreneurship Development & Management	3	-	**3+0=3**	40	-	40	60	-	60	100
4.4	Programme Elective-I	3	-	**3+0=3**	40	-	40	60	-	60	100
4.5	Biomedical Instrumentation-II	3	4	**3+2=5**	40	40	80	60	60	120	200
4.6	Minor Project	-	6	**0+3=3**	-	40	40	-	60	60	100
# Student Centered Activities (SCA)		-	5	-	-	-	-	-	-	-	-
Total		**14**	**21**	**22**	**200**	**160**	**360**	**300**	**240**	**540**	**900**

* Common with other diploma programmes

Programme Elective-I 4.4.1 Telemetry and Telemedicine. 4.4.2 Laser and Fiber Optics in Medicine 4.4.3 Advance Medical Imaging Techniques

Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Electoral Literacy, Motor Vehicles (Driving) Regulations 2017 etc., games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

Industrial Training: After 4th Semester, students shall undergo Industrial Training of 4 Week.

13. HORIZONTAL AND VERTICAL SUBJECTS ORGANISATION

Sr. No.	Subjects/Areas	Hours Per Week	
		Third Semester	Fourth Semester
1.	Industrial/In-House Training - I	2	-
2.	Human Anatomy & Physiology	7	-
3.	Measurement and Instrumentation	5	-
4.	Bio-Mechanics and Bio Materials	4	-
5.	Biomedical Instrumentation-I	10	-
6.	Open Elective (MOOCs^{+}/Offline)	2	-
7.	English and Communication Skills - II	-	4
8.	Medical Imaging Techniques	-	7
9.	Entrepreneurship Development & Management	-	3
10.	Programme Elective-I	-	3
11.	Biomedical Instrumentation-II	-	7
12.	Minor Project	-	6
13.	Student Centered Activities	5	5
	Total	**35**	**35**

14. COMPETENCY PROFILE & EMPLOYMENT OPPORTUNITIES

Industry and government sector pertaining to **Medical Electronics** require **skilled workers** to work in familiar, predictable, routine situations of clear choice. They should be able to communicate in writing and speaking with required clarity and fluency. Students after passing level 4 shall have understanding of basic arithmetic, algebraic principles along with basic understanding of social and natural environment. They are expected to recall and demonstrate quality skill in narrow range of applications using appropriate rules and tools. Students having the diploma in **Medical Electronics** experience and expansive skill set needed to design and operate electrical systems.

Medical electronics is a very important subject since the growth of biomedical industry depends upon electronics to a great extent. Medical electronics provides the ideas and the basic knowledge of human anatomy, physiology and the need of electronics principle and applications of equipments used in the medical field as well as introduce the concept of safety aspects for medical instruments. Medical Electronics is an integration of Environmental Science and Medicine with Engineering theories and Practices.

Skilled workers will be responsible for carrying out a range of jobs, some of which will require them to make choices about the approaches they adopt. They will be expected to learn and improve their practice on the job. They should know what constitutes quality in the occupation and should distinguish between good and bad quality in the context of their job roles. Skilled worker at this level will be expected to carry out their work safely and securely and take full account of the health and safety on colleagues and customers. They should work hygienically and in ways which show an understanding of environmental issues. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social and political environment.

NSQF Level – 4 pass out students are expected to recall and demonstrate practical routine and repetitive skills, in Medical Electronics. In government and private sectors related to Medical Electronics, “Skilled workers” are required to carry out a limited range of predictable tasks under close supervision. This role often requires hands-on work, and need to have a strong understanding of instrumentation principles and safety standards. This role also requires a high level of attention to detail and a strong understanding of measurement principles. Skills acquired through course will help the student to troubleshoot medical equipments. The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency

They have wide scope as Service Engineer – in Electronics / ECE / Instrumentation), Field Service Engineer, Engineer - Field Service, Sales/Service Engineer.

Bio-Medical Equipment Technician; Electronics Technician; Biomedical Engineering Technician, Medical Equipment Technician; Biomedical Electronics Technician, and Biomedical Engineering Technician (BMET). Medical Laboratory Technician; (MLT) Medical Laboratory Scientists. Medical Electronics Fitter, Technician Medical Electronics Medical Electronics Mechanic; Medical Electronic Equipment Mechanic ECG Technician.

15. PROGRAMME OUTCOMES

The program outcomes are derived from five domains of NSQF Level – 4 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this level, the student will be able to:

PO1: Perform out task in familiar, predictable, routine situation of clear choice related to the medical electronics.

PO2: Acquire factual knowledge in the field of Medical Electronics for sustainability and employment.

PO3: Demonstrate quality skills in routine and repetitive in narrow range of Medical Electronics applications.

PO4: Communicate in writing and speaking with required clarity and demonstrate professional behavior.

PO5: Adopt self-study learning and acquire knowledge aiming towards holistic development of learners through MOOCs.

16. ASSESSMENT OF PROGRAMME AND COURSE OUTCOMES

Programme Outcomes to be assessed	Assessment criteria for the Course Outcomes
PO1: Perform out task in familiar, predictable, routine situation of clear choice related to the medical electronics.	• Learn about present and future requirement of industries. • Explain different anatomical terms, Cell structure and Tissue with their classifications. • Comprehend Muscles physiology and Nervous sytem & its functions. • Handle properly, operate and maintain instruments used in industries. • Measure various electrical quantities with the help of different instruments. • Operate various instruments and measure the physical quantities. • Demonstrate usage of C.R.O. and D.S.O in the lab. • Comprehend various monitoring medical instruments and their importance. • Handle critical care instruments used in hospitals in various departments. • Familiarize with dialysis machine, Lithotripsy and sterilization in healthcare. • State the basic concepts and principles about the subject of interest. • Familarize magnetic resonance imaging and its importance. • Comprehend the importance of entrepreneurship and its role in nation's development. • Explain different cardiac care instruments and their importance in details. • Handle various medical instruments used in operation theatres and their importance.

PO2: Acquire factual knowledge in the field of Medical Electronics for sustainability and employment.	• Develop required competencies and skills for relevant industries. • Explain different anatomical terms, Cell structure and Tissue with their classifications. • Comprehend Muscles physiology and Nervous sytem & its functions. • Detail blood physiology and anatomy and physiology of cardiovascular system. • Describe various Electrical and Electronic Instruments. • Handle properly, operate and maintain instruments used in industries. • Measure various electrical quantities with the help of different instruments. • Explain different biomedical signals and their recorders like in details. • Comprehend various monitoring medical instruments and their importance. • Handle critical care instruments used in hospitals in various departments. • Familiarize with dialysis machine, Lithotripsy and sterilization in healthcare. • State the basic concepts and principles about the subject of interest. • Comprehend generation and detection of X-rays and construction principle behind X-Ray machine in details. • Discuss advancement of x-ray technique in computed tomography techniques. • Familarize magnetic resonance imaging and its importance. • Explain different cardiac care instruments and their importance in details. • Handle various medical instruments used in

	operation theatres and their importance. • Understand the properties of optics fibers and relate with tissues. • Evaluate the safety procedure of using laser • Explain the different components and classifications of transmitters and receivers. • Demonstrate the types of communication and network systems used in tele health technology.
PO3: Demonstrate quality skills in routine and repetitive in narrow range of Medical Electronics applications.	• Develop required competencies and skills for relevant industries. • Comprehend Muscles physiology and Nervous sytem & its functions. • Detail blood physiology and anatomy and physiology of cardiovascular system. • Illustrate anatomy and physiology of Digestive and respiratory system. • Handle properly, operate and maintain instruments used in industries. • Measure various electrical quantities with the help of different instruments. • Operate various instruments and measure the physical quantities. • Comprehend biomechanics and details about bone, joint and tissue biomechanics. • Explain Cardiac and respiratory biomechanics and their importance. • Illustrate biomaterials and their compatibility with Hard and soft tissue replacement implants. • Apply various sterilization process and their effects on biomaterials used in healthcare. • Explain different biomedical signals and their recorders like in details.

	• Comprehend various monitoring medical instruments and their importance. • Handle critical care instruments used in hospitals in various departments. • Familiarize with dialysis machine, Lithotripsy and sterilization in healthcare. • Comprehend generation and detection of X-rays and construction principle behind X-Ray machine in details. • Discuss advancement of x-ray technique in computed tomography techniques. • Familarize magnetic resonance imaging and its importance. • Apply ultrasonic waves in ultrasound machine with different modes. • Explain different cardiac care instruments and their importance in details. • Handle various medical instruments used in operation theatres and their importance. • Detail Life supporting instruments used in hospitals in various departments. • Illustrate exercise stress testing, endoscopy etc. • Apply concepts, principles and practices taught in the classroom in solving field / industrial problems. • Understand the properties of optics fibers and relate with tissues. • Apply the concepts of fibre optic lasers in clinical application. • Analyse the fiber optic techniques with medical applications. • Explain the different components and classifications of transmitters and receivers.

PO4: Communicate in writing and speaking with required clarity and demonstrate professional behavior.	• Comprehend the working environment of industries. • Work in team for solving industrial problems. • Develop required competencies and skills for relevant industries. • Develop required competencies for effective communication and presentation. • Handle critical care instruments used in hospitals in various departments. • State the basic concepts and principles about the subject of interest. • Perform in a better way in the professional world. • Select and learn the subject related to own interest. • Explore latest developments in the field of interest. • Develop the habit of self-learning through online courses. • Communicate effectively with an increased confidence; read, write and speak in English language fluently. • Comprehend special features of format and style of formal communication through various modes. • Write a Report, Resume, make a Presentation, Participate in GDs and Face Interviews • Illustrate use of communication to build a positive self-image through self-expression and develop more productive interpersonal relationships.
PO5: Adopt self-study learning and acquire knowledge aiming towards holistic development of learners through MOOCs.	• Work in team for solving industrial problems. • Develop required competencies and skills for relevant industries. • Develop required competencies for effective communication and presentation. • Familiarize with dialysis machine, Lithotripsy and sterilization in healthcare. • State the basic concepts and principles about the subject of interest. • Perform in a better way in the professional world.

	• Select and learn the subject related to own interest. • Explore latest developments in the field of interest. • Develop the habit of self-learning through online courses. • Communicate effectively with an increased confidence; read, write and speak in English language fluently. • Comprehend special features of format and style of formal communication through various modes. • Write a Report, Resume, make a Presentation, Participate in GDs and Face Interviews • Illustrate use of communication to build a positive self-image through self-expression and develop more productive interpersonal relationships. • Comprehend generation and detection of X-rays and construction principle behind X-Ray machine in details. • Discuss advancement of x-ray technique in computed tomography techniques. • Familarize magnetic resonance imaging and its importance. • Apply ultrasonic waves in ultrasound machine with different modes. • Classify the various types of business and business organizations. • Identify the various resources / sources and / or schemes for starting a new venture. • Work as a team member for successful completion of minor project. • Acquire Life Long Learning skills. • Write the minor project report effectively and present through ppt. • Understand the properties of optics fibers and relate with tissues. • Apply the concepts of fibre optic lasers in clinical application

17. SUBJECTS & CONTENTS

(SECOND YEAR)

THIRD SEMESTER

3.1 INDUSTRIAL/IN-HOUSE TRAINING- I

L	P
-	2

RATIONALE

Industrial training /In–house training will help the students to understand the working environment of relevant industries. The student will learn to work in team to solve the industrial problems. It will also give exposure about the present and future requirements of the relevant industries. This training is very important for development of required competencies and skills for employment and start – ups.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:

CO1: Understand the working environment of industries.
CO2: Take necessary safety precautions and measures.
CO3: Learn about present and future requirement of industries.
CO4: Work in team for solving industrial problems.
CO5: Develop competencies and skills required by relevant industries.
CO6: Develop writing, speaking and presentations skills.

PRACTICAL EXERCISES

1. Report writing based on industrial training.
2. Preparation of Power Point Slides based on industrial training and presentation by the candidate.
3. Internal Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries.
4. External Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries.

GUIDELINES

Students will be evaluated based on Industrial training / In – house training report and their presentation using Power Point about the knowledge and skills gained during the training. The Head of the Department will depute faculty coordinators by assigning a group of students to each. The coordinators will mentor and guide the students in preparing the PPTs for final

presentation. The following performance parameters are to be considered for assessment of the students out of 100 marks:

	Parameter	**Weightage**
i	Industrial / In-house assessment of the candidate by the trainer	40%
ii	Report Writing	20%
iii	Power Point Presentation	20%
iv	Viva-voce	20%

3.2 HUMAN ANATOMY & PHYSIOLOGY

L	P
3	4

RATIONALE

The diploma holders of Medical Electronics course have not only to maintain and keep up various biomedical instruments/equipment, they must also be able to use these instruments/equipment to check/monitor the health of the patients. In order to perform this function efficiently, they must have adequate knowledge of location, functions of various body systems, organs, their diseases and diagnostic parameters to be monitored.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:

CO1: Explain different anatomical terms, Cell structure and Tissue with their classifications.
CO2: Comprehend Muscles physiology and Nervous sytem & its functions.
CO3: Detail blood physiology and anatomy and physiology of cardiovascular system.
CO4: Illustrate anatomy and physiology of Digestive and respiratory system.

DETAILED CONTENTS

UNIT I

Introduction to human body

1.1. Anatomical Terms & Anatomical Planes
1.2. Human Cell Structure and its brief description
1.3. Tissue and their classifications
1.4. Body organs & their location within body ,
1.5. Various systems within the body.

UNIT II

Muscular and skeletal systems

2.1. Structure of muscle,
2.2. Classification & Functions of muscles
2.3. Neuromuscular Junction
2.4. Bones- Types & Structure
2.5. Axial and Appendicular skeleton
2.6. Joints – Classification and Structure.

UNIT III

Blood & its Constituents

3.1. Composition and function of blood, plasma, proteins

3.2. RBC, WBC, Platelets and their structure and function

3.3. Blood groups

UNIT IV

Cardiovascular system

4.1. Structure and function of heart

4.2. Structure of blood vessels- Arterial & Venous System

4.3. Blood Circulation through the Heart

4.4. Cardiac Cycle with description

4.5. Blood pressure systolic, diastolic; pulse and heart rate

4.6. Heart sounds

4.7. Conduction system of Heart

UNIT V

Respiratory system & Digestive System

5.1 Anatomy of Lungs & other respiratory organs

5.2 Respiratory Muscles

5.3 Mechanics of Breathing

5.4 Structure of Alimentary tract and accessory organs of digestion

5.5 Movement of digestive system, Mechanisms and control of digestive secretions

5.6 Liver and Gall bladder their functions.

PRACTICAL EXERCISES

1. Study of various parts of body through demonstration.
2. Study about different parts and working of a compound Microscope.
3. Study of Cell structure using compound microscope.
4. Study of various tissues of body through demonstration
5. Study of various axial and appendicular bones and joints through demonstration.
6. Study of Blood constituents using compound microscope.
7. Determination of Individual Blood Group.
8. Estimation of Hemoglobin by Sahali's Method.
9. Study of parts of Nervous system through demonstration from anatomical chart and model

10. Study of parts of digestive & respiratory system through demonstration from Model.
11. Study of parts of Respiratory system through demonstration from anatomical chart and model.
12. Study of parts of Respiratory system through demonstration from anatomical chart and model.

RECOMMENDED BOOKS

1. N Murugesh, "Basic Anatomy and Physiology", Sathya Publishers, Madurai.
2. Anne Waugh and Kathleen JW Wilson, "Ross and Wilson Anatomy and Physiology", Curchill Living Stone, London.
3. Pears, "Anatomy and Physiology", JP Brothers, New Delhi.
4. Sears, "Anatomy and Physiology", ELBS, London.

SUGGESTED WEBISTES

1. www.Teachmeanatomy.com
2. www.Openmd.com

INSTRUCTIONAL STARTEGY

While teaching this course the teacher should give demonstration in working models of human physiology pertaining to relevant topics in the class. A visit to medical laboratory/ clinic should also be organized in order to reinforce the classroom teaching and substantiating the course fundamentals. Webinars/Online Lectures from Medical Experts should be arranged with Educational Tour at Anatomy Lab of Medical institute. This subject contains five units of equal weightage.

3.3 MEASUREMENT AND INSTRUMENTATION

L	P
3	2

RATIONALE

Instrumentation and control engineering diploma holders are normally placed in process and manufacturing industries and service sector. This course provides a starting background to the students of diploma program in Instrumentation and Control acquainting him/her with various electrical and electronic instruments for their principle, operation, testing, calibration and applications. Proper understanding of the measuring techniques, construction and working principles of various instruments will help the students in proper handling, operation and maintenance of industrial plants, control circuits and panels etc.

COURSE OUTCOMES

After undergoing the subject, student will be able to**:**

CO1: Describe various Electrical and Electronic Instruments.
CO2: Handle properly, operate and maintain instruments used in industries.
CO3: Measure various electrical quantities with the help of different instruments.
CO4: Operate various instruments and measure the physical quantities.
CO5: Demonstrate usage of C.R.O. and D.S.O in the lab.

DETAILED CONTENTS

UNIT I

Measurement of Resistance, Inductance and Capacitance

1.1 Measurement of Resistance:
1.1.1 Wheatstone Bridge
1.1.2 Potentiometer method
1.2 Measurement of Inductance
1.2.1 Hay’s bridge
1.2.2 Maxwell Bridge
1.3 Measurement of capacitance
1.3.1 De Sauty’s bridge

UNIT II

Ammeter, Voltmeter and Multimeter

2.1. Construction and working principle, applications of Ammeter and voltmeter
2.2. Moving Iron
2.3. Permanent Magnet Moving Coil Meters
2.4. Thermocouple type
2.5. Electrostatic type
2.6. Rectifier type

UNIT III

Power and Energy Measurement

3.1 Introduction to single-phase and three-phase system.
3.2 Comparison between three-phase and single-phase system.
3.3 Working principle of dynamometer type watt meter
3.4 Power measurement using 2 watt meter or 3 watt meter methods
3.5 Working principle, construction and applications of energy meter

UNIT IV

Frequency Measurement

Working Principle and applications of

4.1 Stroboscopes
4.2 Digital frequency meters

UNIT V

Cathode Ray Oscilloscope

5.1 Construction and working of Cathode Ray Tube (CRT)
5.2 Block diagram and working principle of a basic CRO
5.3 Digital storage oscilloscope (DSO): block diagram and working principle.

PRACTICAL EXERCISES

1 To identify and study of indicating, integrating and recording instruments.
2 Extension of range of a given voltmeter and an ammeter.
3 Use of analog and digital multimeter for measurement of voltage, current (a.c/d.c) and resistance
4 Study the constructional details, working and calibration of an ammeter (moving
5 Coil and moving iron type)
6 To measure power, power factor in a 1-phase circuit, using wattmeter and power factor meter and verify results with calculations.
7 Study the constructional details, working of a Meggar and measurement of Insulation resistance of a given motor.

8 To measure the value of earth resistance using earth tester.
9 To measure unknown resistance with wheat-stone bridge.
10 To measure frequency, power, power factor in a single-phase circuit, using digital frequency meter, wattmeter and power factor meter and to verify results with calculations.
11 Measurement of power and power factor of a three-phase balanced load by two wattmeter method.
12 Use of LCR meter for measuring inductance, capacitance, Q-factor and resistance.
13 Measurement of voltage, frequency, time period, phase using CRO.
14 Measurement of voltage, frequency, time period, phase using digital CRO.

RECOMMENDED BOOKS

1. AK Sawhney, "A Course in Electrical Measurement and Measuring Instruments", Dhanpat Rai and Sons, New Delhi.
2. SK Sahdev, "Electrical Measurements and Measuring Instruments", Unique International Publications, Jalandhar.
3. SK Bhattacharya and KM Rastogi, "Experiments in Basic Electrical Engineering", New Age International (P) Ltd., Publishers, New Delhi.
4. Malvino, "Electronic, Instrumentation Fundamentals".
5. DR Nagpal, "Electrical Measurement".
6. D. Cooper, "Electric Instruments", Prentice Hall of India, New Delhi.
7. JB Gupta, "Electronics Instrumentation", Satya Prakashan, New Delhi.
8. Cooper, "Modern Electronic Instrumentation and Measurement Techniques".
9.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. http://nptel.ac.in

INSTRUCTIONAL STRATEGY

While teaching this course the teacher should give demonstration in working and calibration of the instruments pertaining to relevant topics in the class. A visit to power plant or industry can also be organized in order to reinforce the classroom teaching and substantiating the course fundamentals. The students may be given exposure in process industry and shown various controls. This subject contains five units of equal weightage.

3.4 BIO-MECHANICS AND BIO MATERIALS

L	P
4	-

RATIONALE

Biomaterials in the form of implants like sutures, bone plates, joint replacements and medical devices i.e. pacemakers, artificial cardiac valves, blood tubes are widely used to replace and restore the function of traumatized or degenerated tissues or organs, and thus improve the quality of life of the patients. This course curriculum is important for a diploma biomedical engineer to develop an understanding of the concepts underlying the design and selection of materials for use in prostheses and implants and develop relevant skills to work effectively in health care industries.

COURSE OUTCOMES

After undergoing the subject, student will be able to**:**

CO1: Comprehend biomechanics and details about bone, joint and tissue biomechanics.
CO2: Explain Cardiac and respiratory biomechanics and their importance.
CO3: Illustrate biomaterials and their compatibility with Hard and soft tissue replacement implants.
CO4: Apply various sterilization process and their effects on biomaterials used in healthcare.

DETAIL ED CONTENTS

UNIT I

Biomechanics & Materials in Medical Devices

1.1. Biomechanics
1.2. Newton’s laws of motion.
1.3. Viscoelasticity
1.4. Medical application of blood rhelogy.
1.5. Metals:Stainless steel, Cobalt-chromium alloys, Titanium based alloys, Nitinol
1.6. Ceramics: Bio-ceramics, Some common bio-ceramics (Aluminum oxide, Glass ceramics)
1.7. Polymers: Polymerization, Polymers and their classification

UNIT II

Tissue and Joint Biomechanics

2.1. Bone structure & composition
2.2. Mechanical properties of bone

2.3. Biomechanics of fracture healing
2.4. Bone Implants and materials.
2.5. Structure and functions of Soft Tissues: Cartilage, Tendon, Ligament, and Muscle
2.6. Joints Biomechanics: Skeletal joints, forces and stresses in human joints
2.7. Classifications of joint
2.8. Biomechanical analysis of elbow, shoulder, hip, knee and ankle.

UNIT III

Cardiac & Respiratory Mechanics

3.1. Cardiovascular system
3.2. Mechanical properties of blood vessels: arteries, arterioles, capillaries, and veins.
3.3. Artificial heart valves, biological and mechanical valves development, testing of valves.
3.4. Alveoli mechanics, Interaction of blood and lung
3.5. P-V curve of lung
3.6. Breathing mechanism, Airway resistance

UNIT IV

Biomaterials and Implants

4.1. Biomaterials & their impact.
4.2. Requirements of biomaterials.
4.3. Classification of biomaterials.
4.4. Properties of some common biomaterials.
4.5. Various Applications of Biomaterials.
4.6. Performance and Tissue response to implants.
4.7. Bio-compatibility
4.8. Hard Tissue replacement implants : Orthopaedic & Dental Implants
4.9. Soft Tissue replacement implants : Vascular Implants, Grafts and Stents.

UNIT V

Sterilization Techniques

5.1 Concept of Sterilization.
5.2 Classification of Sterilization (Autoclaving, ETO, Gamma Radiation).
5.3 Effect of sterilization on properties of biomaterials.

Recommended Books

1. Y.C.Fung , “Biomechanics- Circulation” Springer Verlang , 2nd Edition
2. Duane Knudson, “ Fundamentals of Biomechanics”.
3. Sushan J.Hall, “Basic Biomechanics”.

SUGGESTED WEBISTES

1. www.Teachnicalsymposium.com
2. http://swayam.gov.in
3. http://nptel.ac.in

INSTRUCTIONAL STARTEGY

While teaching this course the teacher should give demonstration in working models of human physiology pertaining to relevant topics in the class. A visit to medical laboratory/ clinic should also be organized in order to reinforce the classroom teaching and substantiating the course fundamentals. Webinars/Online Lectures from Medical Experts should be arranged with Educational Tour at Biomedical Training Institute like AMTZ Vizag, CSIO Chandigarh etc. This subject contains five units of equal weightage.

3.5 BIOMEDICAL INSTRUMENTATION-I

L	P
4	6

RATIONALE

Biomedical instruments play a major role in the field of health care in providing information about the disease. This course will enable the students to understand functioning and constructional features of different diagnostic medical instruments used in biomedical engineering for sensing various parameters of human body. Biomedical engineers should be able to operate, calibrate and maintain these instruments/ equipment. And hence this course is a key course for biomedical engineers.

COURSE OUTCOMES

After undergoing the subject, student will be able to**:**

CO1: Explain different biomedical signals and their recorders like in details.
CO2: Comprehend various monitoring medical instruments and their importance.
CO3: Handle critical care instruments used in hospitals in various departments.
CO4: Familiarize with dialysis machine, Lithotripsy and sterilization in healthcare.

DETAILED CONTENTS

UNIT I

Biomedical Recorders

1.1 Introduction to different biomedical signals and their sources of generation.

1.2 Electrocardiograph (ECG):-

i) Human Heart cardiac system and its working
ii) ECG Electrodes, cables & Accessories
iii) ECG Leads (Bipolar & Unipolar) combinations
iv) Einthoven's Triangle
v) Block Diagram description of ECG Machine.
vi) Effects of Artefacts in ECG measurement
vii) ECG simulator

1.3 Electroencephalograph (EEG):-

i) Human Nervous system and its functions
ii) EEG Electrodes, cables & Accessories
iii) Brain waves
iv) Block Diagram description of EEG Machine.
vi) 10/20 Montage Electrode Placement system

1.4 Electromyograph (EMG):-

i) Muscular system & its types & functions
ii) Neuromuscular Junction
iii) Electromyogram (EMG) Machine with diagram
iv) EMG electrodes.

UNIT II

Patient Monitoring Instrumentation systems

2.1 Blood Pressure Measurement
Direct method, Indirect method such as korotkoff Method and Palpatory Method (Manual (Sphygmomanometer) & Automatic BP Instrument.

2.2 Blood Glucose Measurement
Principle, working of a blood glucose meter, Significance of Measurement.

2.3 Pulse Oximeter: Principle & working of Pulse Oximeter, Measurement of Oxygen Saturation.

2.4 Multi Parameter/Bed-side Monitor with block diagram description

2.5 Central Monitoring system with block diagram description

2.6 Intravenous Cannulae, IV Set

UNIT III

Critical Care Instrumentation system

3.1 Introduction to critical care instrumentation & basic concepts behind ICU, NICU, ICCU

3.2 Syringe Pump (Construction & working)

3.3 Infusion Pump (Construction & working)

3.4 Oxygen Concentrator (construction and working principle with block diagram description)

3.5 Radiant warmer with block diagram description.

UNIT IV

Miscellaneous Equipments

4.1 Dialysis machine with construction, working and block diagram description.

4.2 Ambulatory Monitoring system (Cardiac Arrhythmia, Arrhythmia Monitor)

4.3 Introduction to Lithotripter with block diagram description.

4.4 Autoclave/sterilization system in hospital with block diagram description.

PRACTICAL EXERCISES

1) Identification and understanding about different types of Biomedical Electrodes.
2) Demonstration of ECG machine and measurements techniques
3) Demonstration and hands on measurement techniques using ECG simulator

4) Demonstration of EMG machine and measurement techniques.
5) Demonstration and hands on Manual Blood Pressure Monitor & Digital Blood Pressure Monitor.
6) Measurement of Blood pressure using Kortokoff and Palpatory Method.
7) To measure Blood Glucose level using Glucometer
8) Demonstration and measurement on Pulse Oximeter and procedure to measure SpO2 %.
9) Demonstration and hands on Multi Parameter Monitor in details.
10) Demonstration and hands on about Intravenous (IV) set and its working.
11) Demonstration and hands on about Syringe/Infusion Pump and its working.
12) Demonstration and hands on about Oxygen Concentrator and its working.
13) Demonstration about Autoclave sterilization and its working

*Virtual Lab platform can be installed and students can be made to practice.

RECOMMENDED BOOKS

1 John G.Webster, "Medical instrumentation application design".
2 RS Khandpur, " Handbook of biomedical Instrumentation".
3 P Cromwell Weibel, "Biomedical instrumentation Measurements".
4 A.G Patil, "Medical Electronics"
5 Carr Joseph Brown, "Introduction to Biomedical equipment technology".

SUGGESTED WEBISTES

1. www.efymag.com
2. www.electronicsforu.com
3. http://swayam.gov.in
4. http://nptel.ac.in

INSTRUCTIONAL STARTEGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. The teacher should also organize for the students various Webinars/Online lectures from experts, Hospital Visits, Open Online MOOC Courses for special topics.
A visit to medical laboratory/ clinic should also be organized in order to reinforce the classroom teaching and substantiating the course fundamentals. Webinars/Online Lectures from Medical Experts should be arranged with Educational Tour at Anatomy Lab of Medical institute. This subject contains five units of equal weightage.

3.6 OPEN ELECTIVE

L	P
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RATIONALE

Open electives are very important and play major role in implementation of National Education Policy. These subjects provide greater autonomy to the students in the curriculum, giving them the opportunity to customize it to reflect their passions and interests. The system of open electives also encourages cross learning, as students pick and choose subjects from the differentstreams.

COURSE OUTCOMES

At the end of the open elective, the students will be able to:

CO1: State the basic concepts and principles about the subject of interest.
CO2: Perform in a better way in the professional world.
CO3: Select and learn the subject related to own interest.
CO4: Explore latest developments in the field of interest.
CO5: Develop the habit of self-learning through online courses.

LIST OF OPEN ELECTIVES

(The list is indicative and not exhaustive)

1. Computer Application in Business
2. Introduction to NGO Management
3. Basics of Event Management
4. Event Planning
5. Administrative Law
6. Introduction to Advertising
7. Moodle Learning Management System
8. Linux Operating System
9. E-Commerce Technologies
10. NCC
11. Marketing and Sales
12. Graphics and Animations
13. Digital Marketing
14. Human Resource Management
15. Supply Chain Management
16. TQM

GUIDELINES

Open Elective shall be offered preferably in online mode. Online mode open elective shall preferably be through Massive Open Online Courses (MOOCs) from Swayam, NPTEL, Upgrad, Udemy, KhanAcademy or any other online portal to promote self-learning. A flexible basket of large number of open electives is suggested which can be modified depending upon the availability of courses at suggested portals and requirements. For online open electives, department coordinators shall be assigned to monitor and guide the group of students for selection of minimum 20 hours duration online course of their choice. For offline open electives, a suitable relevant subject shall be offered by the respective department to the students with minimum 40% of the total class strength as per present and future requirements.

Assessment of MOOCs open elective shall be based on continuous evaluation by the respective coordinator. The coordinator shall consider the submitted assignments by the students from time to time during the conduct of MOOCs. The MOOCs assessment shall be conducted by the coordinator along with one external expert by considering submitted assignments out of 100 marks.

In case, no suitable open elective is available online, only then the course may be conducted in offline mode. The assessment of offline open elective shall be internal and external. The offline open elective internal assessment of 40 marks shall be based on internal sessional tests; assignments etc. and external assessment of 60 marks shall be based on external examination at institute level.

NOTE

The students enrolled under NCC will compulsorily undertake NCC as an open elective subject.

SUGGESTED WEBSITES

1. https://swayam.gov.in/
2. https://www.udemy.com/
3. https://www.upgrad.com/
4. https://www.khanacademy.org/

FOURTH SEMESTER

4.1 ENGLISH AND COMMUNICATION SKILL - II

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2	2

RATIONALE

Communication II moves a step further from Communication Skills I and is aimed at enhancing the linguistic competency of the students. Language as the most commonly used medium of self-expression remains indispensable in all spheres of human life – personal, social and professional. This course is intended to make fresh ground in teaching of Communicative English as per the requirements of National Skill Quality Framework.

COURSE OUTCOMES

After undergoing this course, the learners will be able to:

CO1: Communicate effectively with an increased confidence; read, write and speak in English language fluently.

CO2: Comprehend special features of format and style of formal communication through various modes.

CO3: Write a Report, Resume, make a Presentation, Participate in GDs and Face Interviews

CO4: Illustrate use of communication to build a positive self-image through self-expression and develop more productive interpersonal relationships.

DETAILED CONTENTS

UNIT I

Reading

1.1 Portrait of a Lady - Khushwant Singh

1.2 The Doctor's Word by R K Narayan

1.3 Speech by Dr Kiran Bedi at IIM Indore2007 Leadership Concepts

1.4 The Bet - by Anton Chekov

UNIT II

Effective Communication Skills

2.1 Modern means of Communication (Video Conferencing, e- mail, Teleconferencing)

2.2 Effective Communication Skills: 7 C's of Communication

2.3 Non-verbal Communication – Significance, Types and Techniques for Effective Communication

2.4 Barriers and Effectiveness in Listening Skills

2.5 Barriers and Effectiveness in Speaking Skills

Unit III

Professional Writing

3.1 Correspondence: Enquiry letters, placing orders, complaint letters

3.2 Report Writing

3.3 Memos

3.4 Circulars

3.5 Press Release

3.6 Inspection Notes and tips for Note-taking

3.7 Corrigendum writing

3.8 Cover Letter

UNIT IV

Grammar and Vocabulary

4.1 Prepositions

4.2 Conjunctions

4.3 Punctuation

4.4 Idioms and Phrases: A bird of ill omen, A bird's eye view, A burning question, A child's play, A cat and dog life, A feather in one's cap, A fish out of water, A shark, A snail's pace, A snake in the grass, A wild goose chase, As busy as a bee, As faithful as dog, Apple of One's eye, Behind one's back, Breath one's last, Below the belt, Beat about the bush, Birds of a feather flock together, Black Sheep, Blue blood, By hook or crook, Chicken hearted, Cut a sorry figure ,Hand in glove, In black and white, In the twinkling, In full swing ,Is blind as a bat, No rose without a thorn, Once in a blue moon, Out of the frying pan in to the fire, know no bounds ,To back out, To bell the cat, To blow one's trumpet, To call a spade a spade, To cut one's coat according to one's cloth, To eat humble pie, To give ear to, To have a thing on one's finger tips, To have one's foot in the grave, To hold one's tongue, To kill two birds with one stone, To make an ass of oneself, To put two and two together, To the back bone, Turn coat, ups and downs.

4.5 Pairs of words commonly misused and confused: Accept-except, Access-excess, Affect-effect, Artificial- artful, Aspire-expire, Bail-bale, Bare-bear, Berth-birth, Beside-besides, Break-brake, Canvas-canvass, Course- coarse, Casual-causal, Council-counsel, Continual-continuous, Coma-comma, Cue- queue, Corpse- corps-core, Dairy-diary, Desert-dessert, Dual-duel, Dew- due, Die-dye, Draft- draught-drought, Device-devise, Doze-dose, Eligible-illegible, Emigrant- immigrant, Envelop-envelope, Farther-further, Gate-gait, Goal-goal, Human-humane, Honorable-honorary, Hail-hale, Hair-heir-hare, Industrial-industrious, Impossible- impassable, Idle-idol-ideal, Lose-loose, Later-latter, Lesson-lessen, Main-Mane, Mental-mantle, Metal-mettle, Meter-metre, Oar-ore, Pray-prey, Plain-plan, Principal - principle, Personal- personnel, Roll- role, Route-rout- roote,

Stationary-stationery, Union- unity, Urban- urbane, Vocation- vacation, Vain- vein-vane, Vary- very.

4.6 Translation of Administrative and Technical Terms in Hindi or Mother tongue: Academy, Abandon, Acting in official capacity, Administrator, Admission, Aforesaid, Affidavit, Agenda, Alma Master, Ambiguous, Appointing Authority, Apprentice, Additional, Advertisement, Assistant, Assumption of charge, Assurance, Attested copy, Bonafide, Bond, Cashier, Chief Minister, Chief Justice Clerical error, Commanding ,Officer, Consent, Contractor, corruption, Craftsman, Compensation, Code, Compensatory allowance, Compile, Confidential letter, Daily Wager, Data, Dearness allowance, Death - Cum Retirement, Dispatch, Dispatch Register, Disciplinary, Disciplinary Action, Disparity Department, Dictionary, Director, Director of Technical Education, Earned Leave, Efficiency Bar, Estate, Exemption, Executive Engineer, Extraordinary, Employment Exchange, Flying Squad, General Body, Head Clerk, Head Office, High Commission, Inconvenience, Income Tax, Indian Assembly Service, Justify, Legislative Assembly, Negligence, Officiating ,Office Record, Office Discipline, On Probation, Part Time, Performance, Polytechnic, Proof Reader Precautionary, Provisional, Qualified, Regret, Responsibility, Self-Sufficient, Senior, Simultaneous ,Staff, Stenography ,Superior, Slate, Takeover, Target Data Technical Approval, Tenure, Temporary, Timely Compliance, Under Investigation, Under Consideration, Verification, Viva-voce, Write off, Working Committee, Warning, Yours Faithfully , Zero Hour.

UNIT V

Employability Skills

5.1 Presentation Skills: How to prepare and deliver a good presentation

5.2 Telephone Etiquettes

5.3 Importance of developing employable and soft skills

5.4 Resume Writing: Definition, Kinds of Resume, Difference between Bio-data and Curriculum Vitae and Preparing a Resume for Job/ Internship

5.5 Group discussions: Concept and fundamentals of GD, and learning Group Dynamics.

5.6 Case Studies and Role Plays

PRACTICAL EXERCISES

1. Reading Practice of the above lessons in the Lab Activity classes.
2. Comprehension exercises of unseen passages along with the given lessons.
3. Vocabulary enrichment and grammar exercises based on the above selective readings.
4. Situational Conversation: Requesting and responding to requests; Expressing sympathy and condolence.
5. Warning; Asking and giving information.
6. Getting and giving permission.

7. Asking for and giving opinions.
8. A small formal and informal speech.
9. Seminar.
10. Debate.
11. Interview Skills: Preparing for the Interview and guidelines for success in the Interview and significance of acceptable body-language during the Interview.
12. Written Drills will be undertaken in the class to facilitate a holistic linguistic competency among learners.
13. Participation in a GD, Functional and Non-functional roles in GD, Case Studies and Role Plays
14. Presentations, using audio-visual aids (including power-point).
15. Telephonic interviews, face to face interviews.
16. Presentations as Mode of Communication: Persuasive Presentations using multi-media aids.
17. Practice of idioms and phrases on: Above board , Apple of One's eye , At sea, At random, At large, A burning question, A child's play, A wolf in sheep's clothing, A deal, Breath one's last, Bid fair to, Beat about the bush, Blue Blood, Big Gun, Bring to Book, Cut a sorry figure, Call names, Carry weight, Dark Horse, Eat Humble pie, Feel small, French leave, Grease the palm, Go against the grains, Get One's nerves, Hard and Fast, Hue and Cry, Head and ears, In full swing, Jack of all trades, know no bounds, kiss the dust, Keep an eye on, Lion's share, learn by rote, Null and void, on the cards, Pull a long face, Run amuck, Right and Left, Rain on Shine, Small talk, Take to one's heels, Tooth and nail, to take by storm, , Wet blanket, Yearn for.

RECOMMENDED BOOKS

1. Alvinder Dhillon and Parmod Kumar Singla, "Text Book of English and Communication Skills Vol – 1, 2", M/s Abhishek Publications, Chandigarh.
2. J Sethi, Kamlesh Sadanand & DV Jindal, "Course in English Pronunciation", PHI Learning Pvt. Ltd., New Delhi.
3. Wren and Martin, "High School English Grammar and Composition" .
4. NK Aggarwal and FT Wood, "English Grammar, Composition and Usage", Macmillan Publishers India Ltd., New Delhi.
5. RC Sharma, and Krishna Mohan, "Business Correspondence & Report Writing", (4^{th} Edition), by Tata MC Graw Hills, New Delhi.
6. Varinder Kumar, Bodh Raj & NP Manocha, "Business Communication Skills", Kalyani Publisher, New Delhi.
7. Kavita Tyagi & Padma Misra, "Professional Communication", PHI Learning Pvt. Ltd., New Delhi.

8. Nira Konar, “Communication Skills for Professionals”, PHI Learning Pvt. Ltd., New Delhi.
9. Krishna Mohan & Meera Banerji, “Developing Communication Skills”, (2nd Edition), Macmillan Publishers India Ltd., New Delhi.
10. M. Ashraf Rizwi, “Effective Technical Communication”, Tata MC Graw Hills, New Delhi.
11. Andrea J Rutherford, “Basic Communication Skills for Technology”, Pearson Education, New Delhi.

INSTRUCTIONAL STRATEGY

This is practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required communication skills in the students. Emphasis should be given on practicing of communication skills. This subject contains five unit of equal weight age.

4.2 MEDICAL IMAGING TECHNIQUES

L	P
3	4

RATIONALE

This subject will provide the understanding of medical imaging techniques and related modalities in health care system. The subject includes the fundamental principle and working of the advanced medical imaging systems involved in the diagnosis of healthcare. The students will know the advanced instruments and latest techniques used for visualizing various sections of the body

COURSE OUTCOMES

CO1: Comprehend generation and detection of X-rays and construction principle behind X-Ray machine.
CO2: Discuss advancement of x-ray technique in computed tomography techniques.
CO3: Familarize magnetic resonance imaging and its importance.
CO4: Apply ultrasonic waves in ultrasound machine with different modes.

DETAILED CONTENTS

UNIT I

X-ray Equipment

1.1. Electromagnetic radiation with its spectrum, Explain various interactions between X-rays and matter: coherent scattering, photoelectric effect, Compton scattering.
1.2. Properties of X rays, Visualization of X rays: X ray Films, Fluorescent Screens, X ray Image Intensifier Television System
1.3. Applications of X rays
1.4. Biological effects of Ionizing radiation
1.5. Explain construction of intensifying screens, Explain image intensifiers, Explain X-ray films Explain construction of X-ray machine

UNIT II

X-ray Machine

2.1. X-RAY machine: Technical specifications and block diagram, Short Description of part/components
2.2. X ray Tube: Stationary node Tube with diagram, Rotating node Tube with diagram

2.3. Portable X ray Units, Mobile X ray Units, Dental X ray Machine , Mammography Describe the Biological effects of Ionizing radiation

2.4. Digital Radiography, Angiography

UNIT III

Computed Tomography imaging

3.1. Limitations of using Conventional X-Rays

3.2. Introduction to Computed Tomography

3.3. System Components: Block Diagram, Short description of part/components

3.4. Generations of CT Scanners, Applications of CT

3.5. Patient Dose in CT Scanners

UNIT IV

Magnetic Resonance Imaging (MRI)

4.1. Fundamentals of NMR: Magnetic moment, Free Induction Decay (FID), Excitation, Emission

4.2. NMR system : Block Diagram, Short description of part/components

4.3. Types of Scanners: On the basis of types of Magnets used: Permanent magnets Scanners, Resistive scanners, Superconductive Magnet Scanners

4.4. On the basis of Magnet arrangement/Shape: Closed Scanners, Open Scanners Standing or Sitting Scanners

4.5. Magnets: Super Conducting Magnets, Permanent Magnets

4.6. NMR Coils - Definition and Types, Biological effects of NMR Imaging System, Advantages of NMR Imaging System.

UNIT V

Ultrasound Imaging

5.1 Introduction, properties of ultrasound & its limitations

5.2 Ultrasound transducer, Generation and Detection of Ultrasound

5.3 Basic Components of Ultrasonic imaging System: Block Diagram, Description of part/components

5.4 Transducer array arrangement: Linear Sequential Arrays, Curvi-linear array, Linear phased array, Phased array

5.5 Ultrasound imaging: - A-scan, B-scan, Doppler method

5.6 Biological Effect of Ultrasound.

PRACTICAL EXERCISES

1 Identify various front panel controls of X-Ray machine.
2 Demonstration of X-Ray machine.
3 Demonstration of CT-Scan at Hospital.
4 Demonstration of MRI Machine at diagnostic centre/Hospital.
5 Demonstration of Ultrasound Machine at Diagnostic centre/Hospital.

RECOMMENDED BOOKS

1 Christen Thomas, and Curry Dowdey, "Introduction to Physics of Diagnostic Radiology".
2 Carr & Brown, "Introduction to Biomedical Equipment Technology" Pearson Education, Asia.
3 Robert E Molleoy, "Medical Electrical Equipment".
4 RS Khandpur, "Handbook of Biomedical Instrumentation".
5 Peter Carter, Audry Patarson, and Andrew Hyatt, "Medical Instrumentation".

SUGGESTED WEBISTES

1. www.learningradilogy.com
2. www.teachmemedicine.org
3. http://swayam.gov.in
4. http://nptel.ac.in

INSTRUCTIONAL STARTEGY

While teaching this course the teacher should give demonstration in working models of human physiology pertaining to relevant topics in the class. A visit to medical laboratory/ clinic should also be organized in order to reinforce the classroom teaching and substantiating the course fundamentals. Webinars/Online Lectures from Medical Experts should be arranged with Educational Tour at Radiology Diagnostic centre. This subject contains five units of equal weightage.

4.3 ENTREPRENEURSHIP DEVELOPMENT & MANAGEMENT

L	P
3	-

RATIONALE

In the present day scenario, it has become imperative to impart entrepreneurship and management concepts to students so that a significant percentage of them can be directed towards setting up and managing their own small enterprises. This subject focuses on imparting the necessary competencies and skills of enterprise set up and its management.

COURSE OUTCOMES

After undergoing this course, the learners will be able to:

CO1: Comprehend the importance of entrepreneurship and its role in nation's development.
CO2: Classify the various types of business and business organizations.
CO3: Identify the various resources / sources and / or schemes for starting a new venture.

DETAILED CONTENTS

UNIT I

Entrepreneurship: Concept and definitions, classification and types of entrepreneurs, entrepreneurial competencies, Traits / Qualities of entrepreneurs, manager v/s entrepreneur, role of Entrepreneur, barriers in entrepreneurship, Sole proprietorship and partnership forms of business organisations, small business vs startup, critical components for establishing a start-up, Leadership: Definition and Need, Manager Vs leader, Types of leadership

UNIT II

Definition of MSME (micro, small and medium enterprises), significant provisions of MSME Act, importance of feasibility studies, technical, marketing and finance related problems faced by new enterprises, major labor issues in MSMEs and its related laws, Obtaining financial assistance through various government schemes like Prime Minister Employment Generation Program (PMEGP) Pradhan Mantri Mudra Yogna (PMMY) , Make in India, Start up India, Stand up India , National Urban Livelihood Mission (NULM); Schemes of assistance by entrepreneurial support agencies at National, State, District level: NSIC, NRDC, DC:MSME, SIDBI, NABARD, Commercial Banks, SFC's TCO, KVIB, DIC, Technology Business Incubator (TBI) and Science and Technology Entrepreneur Parks (STEP).

UNIT III

Nature and Functions of Management: Definition, Nature of Management, Management as a Process, Management as Science and Art, Management Functions, Management and Administration, Managerial Skills, Levels of Management; Leadership.

PLANNING AND DECISION MAKING: Planning and Forecasting - Meaning and definition, Features, Steps in Planning Process, Approaches, Principles, Importance, Advantages and Disadvantages of Planning, Types of Plans, Types of Planning, Management by Objective. Decision Making-Meaning, Characteristics.

UNIT IV

Organising and Organisation Structure: Organising Process - Meaning and Definition, Characteristics Process, Need and Importance, Principles, Span of Management, Organisational Chart - Types, Contents, Uses, Limitations, Factors Affecting Organisational Chart.

STAFFING: Meaning, Nature, Importance, Staffing process. Manpower Planning, Recruitment, Selection, Orientation and Placement, Training, Remuneration.

CONTROLLING AND CO-ORDINATION Controlling - Meaning, Features, Importance, Control Process, Characteristics of an effective control system, Types of Control. Co-ordination - characteristics, essentials.

UNIT V

Market Survey and Opportunity Identification, Scanning of business environment, Assessment of demand and supply in potential areas of growth, Project report Preparation, Detailed project report including technical, economic and market feasibility, Common errors in project report preparations, Exercises on preparation of project report.

RECOMMENDED BOOKS

1. BS Rathore and Dr JS Saini, “A Handbook of Entrepreneurship”, Aapga Publications, Panchkula (Haryana).
2. Entrepreneurship Development, Tata McGraw Hill Publishing Company Ltd., New Delhi.
3. CB Gupta and P Srinivasan, “Entrepreneurship Development in India”, Sultan Chand and Sons, New Delhi.
4. Poornima M Charantimath, “Entrepreneurship Development - Small Business Enterprises”, Pearson Education, New Delhi.
5. David H Holt, “Entrepreneurship: New Venture Creation”, Prentice Hall of India Pvt. Ltd., New Delhi.
6. L M Prasad, “Principles and Practice of Management”, Sultan Chand & Sons, New Delhi.

SUGGESTED WEBSITES

1. https://ipindia.gov.in/

INSTRUCTIONAL STRATEGY

Some of the topics may be taught using question/answer, assignment or seminar method. The teacher will discuss stories and case studies with students, which in turn will develop appropriate managerial and entrepreneurial qualities in the students. In addition, expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organisations on visit. Approach extracted reading and handouts may be provided. In addition, different activities like conduct of entrepreneurship awareness camp extension lecturers by outside experts, interactions sessions with entrepreneurs and industrial visits may also be organised. This subject contains five units of equal weightage.

4.4 PROGRAMME ELECTIVE - I
4.4.1 TELEMETRY AND TELEMEDICINE

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3	-

RATIONALE

This course provides the basics of electronic communication systems including transmitters and receivers. In addition, the students will learn the basics of satellite communication. Biomedical Telemetry i.e., wireless telemetry, modulation techniques used in telemetry and interfacing Bio-analog signal to computers for interpretation and diagnostic and monitoring purpose. This course will provide the students with perspectives of different communication systems and a brief information about Tele-Medicine.

COURSE OUTCOMES

At the end of the course, students should able to:

CO1: Explain the different components and classifications of transmitters and receivers.
CO2: Understand the biotelemetry and tele Medicine system.
CO3: Demonstrate the types of communication and network systems used in tele health technology.
CO4: To provide the understanding of Single channel and multi-channel telemetry system

DETAILED CONTENTS

UNIT I
Single channel telemetry system

1.1 ECG telemetry systems, Block diagram, Short description of Parts/ components
1.2 Telemetry Transmitter, Block diagram, Short description of Parts/ components
1.3 Telemetry Receiver: Block diagram, Short description of Parts/ components
1.4 Temperature Telemetry System: Short Description

UNIT II
Multi-channel telemetry system

2.1 Multiplexing- Frequency–division multiplexing, Time–division multiplexing
2.2 Telemetry of ECG and respiration: Schematic diagram, Working/ Operation
4.3 Obstetrical telemetry system
4.4 Telemetry in operating rooms
4.5 Telemetry in Sports

UNIT III
Telemedicine

3.1 Introduction
3.2 Telemedicine applications
3.3 Block diagram of a telemedicine system
3.4 Transmission of Medical Images
3.5 Transmission of Video Images
3.6 Transmission of Digital Audio

UNIT IV
Communication services

4.1 Digital communication services
4.1.1 POTS
4.1.2 DDS
4.1.3 ISDN
4.1.4 ATM
4.2 Using Mobile Communication
4.3 Internet resource

UNIT V
Satellite Communications

5.1 Basic idea, Passive , Active satellites
5.2 Meaning of the terms, Orbit, Apogee, Perigee
5.3 Geo-stationary satellite, Introduction , Its need
5.4 Satellite communication Link, Block diagram and Explanation.

SUGGESTED WEBISTES

1. http://swayam.gov.in
2. http://nptel.ac.in
3. www.Teachnicalsymposium.com

RECOMMENDED BOOKS

1 George Kennedy, “Communication Systems” Tata McGraw Hill Education Pvt Ltd, New Delhi.
2 K.S. Jamwal, “Electronic Communication Systems” Dhanpat Rai and Sons, New Delhi.

3 Roddy and Coolen, “Electronic Communication System” Prentice Hall of India, New Delhi.

4 S. Poornachandra Rao, and B Sasikala, “ Handbook of Experiments in Electronics and Communication Engineering “ Vikas Publishing House Pvt Ltd, Jangpura, New Delhi.

5 R.S.Khandpur, “ Handbook of Bio-Medical Instrumentation,” 2ndEd.TMH

6 R.S.Khandpur, “ Telemedicine-Technology and Applications”, PHI Learning Pvt. Ltd.,New Delhi, 2017

INSTRUCTIONAL STRATEGY

While teaching this course the teacher should give demonstration in working models of human physiology pertaining to relevant topics in the class. A visit to medical laboratory/ clinic should also be organized in order to reinforce the classroom teaching and substantiating the course fundamentals. Webinars/Online Lectures from Medical Experts should be arranged with Educational Tour at Medical institute. This subject contains five units of equal weightage.

4.4.2 LASER AND FIBER OPTICS IN MEDICINE

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RATIONALE

Fiber optics and LASER have been used in the medical industry for years. Laser medicine consists in the use of lasers in medical diagnosis, treatments, or therapies, such as laser photodynamic therapy, photo rejuvenation, and laser surgery. In this course students will learn optical properties of the tissues and the applications of laser in diagnosis and therapy. They get knowledge about instrumentation in photonics and understand the safety usage of laser.

COURSE OUTCOMES

After undergoing this course, the learners will be able to:

CO1: Understand the properties of optics fibers and relate with tissues.

CO2: Apply the concepts of fibre optic lasers in clinical application.

CO3: Analyse the fiber optic techniques with medical applications.

CO4: Evaluate the safety procedure of using laser

DETAILED CONTENTS

Unit I
Overview of Optical Fiber Communication

Nature of Light , Basic Optical Law , Optical Fiber mode , Mechanical properties of fiber , Fiber optics cable , Fiber material and connections .

Unit II
Transmission Characteristics of Optical Fibers

Attenuation , Absorption , Scattering Losses , Bending Losses , Core and Cladding Losses , Single distortion in Fibers , Polarization Mode dispersion

Unit III
Optical Sources and Detectors

Introduction, LED's, LASER Diode , Photo Detectors ,Response Time , Comparison of Photo Detectors.

Unit IV
Laser Fundamentals

Fundamental Characteristics of Laser , Laser Properties ,Principle of Operations , Laser interactions with Tissues, Types of Lasers (Gas Lasers , Solid Lasers , Liquid Lasers , Semiconductor Lasers)

Unit V
Medical applications of Laser & Fiber Optics & their safety standards

Introduction to Endoscopic imaging systems, Fundamental Principles of imaging techniques, Endoscopic diagnostic and therapeutic techniques. Laser Instruments for surgery, Laser Application in surgery, Laser and fiber optics standards Potential Hazards of Laser , Safety Regulation and precaution.

RECOMMENDED BOOKS

1 Optical Communication by V S Bhagad .

2 Handbook of biomedical Instrumentation by RS Khandpur

3 Laser and fiber optics in Medicine by P Abraham Katzir

SUGGESTED WEBISTES

1. http://swayam.gov.in
2. http://nptel.ac.in
3. www.Teachnicalsymposium.com

INSTRUCTIONAL STARTEGY

While teaching this course the teacher should give demonstration in working models of human physiology pertaining to relevant topics in the class. A visit to medical laboratory/ clinic should also be organized in order to reinforce the classroom teaching and substantiating the course fundamentals. Webinars/Online Lectures from Medical Experts should be arranged with Educational Tour at Medical institute. This subject contains five units of equal weightage.

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4.4.3 ADVANCE MEDICAL IMAGING TECHNIQUES

L	P
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RATIONALE

This subject will impart the understanding of versatile advanced imaging techniques and related modalities in health care system. The subject includes the fundamental principle and working of the advanced medical imaging systems involved in the diagnosis of healthcare. The students will know the advanced instruments and latest techniques used for visualizing various sections of the body

COURSE OUTCOMES

At the end of the course, students should able to:
CO1: Demonstrate the advanced imaging instruments.
CO2: Justify the utility of advanced imaging system and explain the principles of working.
CO3: Compare and analyze the latest techniques used for medical imaging.
CO4: Plan and minimize the risks and health hazards.

DETAILED CONTENTS

UNIT I
Digital Radiography (DR)

1.1 Principle of Digital Radiography
1.2 Components of Digital Radiography System
1.3 Angiography Procedure
1.4 Digital Subtraction Angiogram (DSA)
1.4.1 Block Diagram
1.4.2 Operation
1.4.3 Advantages of DSA

1.5 Maintenance of X ray Machine

UNIT II
Advancement in CT Scanners

2.1 Spiral /Helical Scanning
2.2 Use of Slip Rings
2.3 Detectors
2.3.1 Scintillation crystal and photomultiplier
2.3.2 Xenon
2.3.3 Scintillarc
2.4 Electron beam tomography (EBT) scanner

UNIT III
Nuclear Medical Imaging System

3.1 Radioactivity, Radio Active Particle
3.2 Radioactive emissions
  3.2.1 Alpha Emissions
  3.2.2 Beta Emissions
  3.2.3 Gamma Emissions
3.3 Radioactive decay
  3.3.1 Positron Decay
  3.3.2 Negatron
  3.3.3 Electron Capture
  3.3.4 Isomeric Transition
3.4 Gamma camera
  3.4.1 Block Diagram
  3.4.2 Short description of parts/ Components
  3.4.3 Application of Gamma Camera
3.5 Single Photon Emission Computed Tomography (SPECT)
3.6 Positron Emission Tomography

UNIT IV
Thermal Imaging System

4.1 Infrared Radiations
4.2 Physical factors affecting Infrared Radiation emission from body
  4.2.1 Emissivity
  4.2.2 Reflectivity
  4.2.3 Transmittance or absorption.
4.3 Medical Thermograph
4.4 Thermographic Equipment
  4.4.1 Block Diagram
  4.4.2 Operation
4.5 Pyroelectric Vidicon
  4.5.1 Block Diagram
  4.5.2 Operation

UNIT V
Radiation Safety

5.1 Radiation Protection
5.2 Ionizing and non-Ionizing Radiation

5.3 Stochastic and non-stochastic effects
5.4 Safety Limits
5.5 Risk Factors
5.6 Principles of radiation dosimetry

RECOMMENDED BOOKS

1. Carr & Brown, "Introduction to Biomedical Equipment Technology" Pearson Education, Asia.
2. R. S. Khandpur, "Handbook of Bio-Medical Instrumentation", Tata McGraw Hill.
3. J.Webster, "Bioinstrumentation", Wiley & Sons
4. Dowsett, Kenny & Johnston, "The Physics of Diagnostic Imaging", Chapman & Hall Medical, Madras/London.
5. Brown, Smallwood, Barber, Lawford& Hose, "Medical Physics and Biomedical Engineering", Institute of Physics Publishing, Bristol.
6. Massey & Meredith, "Fundamental Physics of Radiology", John Wright & Sons.
7. S. Webb, "The Physics of Medical Imaging", Ada m Hilger, Bristol.
8. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements", Prentice-Hall of India, 2nd Edition, 1997.
9. Wolfgang Drexler James G.Fijimoto "Optical coherence tomography technology and applications", Springer, First edition, 2008
10. P Raghunathan, "Magnetic Resonance Imaging & Spectroscopy in Medicine- Concept and Techniques" Orient Longman Pvt. Ltd., 2006.

SUGGESTED WEBISTES

1. http://swayam.gov.in
2. http://nptel.ac.in
3. www.Teachnicalsymposium.com

INSTRUCTIONAL STARTEGY

While teaching this course the teacher should give demonstration in working models of human physiology pertaining to relevant topics in the class. A visit to medical laboratory/ clinic should also be organized in order to reinforce the classroom teaching and substantiating the course fundamentals. Webinars/Online Lectures from Medical Experts should be arranged with Educational Tour of Medical institute. This subject contains five units of equal weightage.

4.5 BIOMEDICAL INSTRUMENTATION-II

L	P
3	4

RATIONALE

Biomedical Engineering profession requires broad knowledge of biomedical instrumentation systems. Necessary knowledge includes system usage, maintenance responsibilities, and ways to obtain data on an extensive range of monitoring, diagnostic, therapeutic, and surgical instrumentation. This course will enable the students to understand functioning and constructional features of different operation theatre & Life saving instruments medical instruments used in biomedical engineering Biomedical engineers should be able to operate, calibrate and maintain these instruments/ equipment.

COURSE OUTCOMES

After undergoing this course, the learners will be able to:

CO1: Explain different cardiac care instruments and their importance in details.
CO2: Handle various medical instruments used in operation theatres and their importance.
CO3: Detail Life supporting instruments used in hospitals in various departments.
CO4: Illustrate exercise stress testing, endoscopy etc.

DETAILED CONTENTS

UNIT I
Cardiac care Instrumentation systems

1.1. **Defibrillator** -Ventricular fibrillation, DC defibrillator, Defibrillator electrodes, Types of Defibrillator based on mode of application i.e. AED and Implantable defibrillators
1.2. **Pacemaker** - Cardiac arrthymia, Need & Classification such as external pacemaker based on pulses and output waveform implantable pacemaker and leads,
1.3. Cardiac care Catheterization Instruments, Catheterization lab layout in hospital, Vascular Stents & its types
1.4. Intra-Aortic Balloon Pump (IABP)
1.5. Heart – Lung Machine with its block diagram working description.

UNIT II

Operation Theatre Instrumentation system

2.1. Operating Room suite plan, Operating Room Instrumentation
2.2. Electrosurgical machine with block diagram description, Precautions & techniques used
a. in electro-surgery
2.3. Construction, working & Application of Suction Pump in operation theatre.
2.4. Operation Theatre Table
2.5. Operation theatre/ Surgical lights

UNIT III

Life Supporting Instrumentation systems

3.1. **Ventilator** - Mechanics of ventilation, Need of Artificial Ventilation, Respiratory volumes & Capacities, Classifications of Ventilator, High Frequency Modern Ventilators, Conventional mechanical ventilation, Positive End Expiratory Pressure (PEEP), Ventilator Modes, Continuous Positive Airway Pressure (CPAP), Resuscitator or AMBU. Gas Pipe lines & Vacuum system in Hospitals, Gas flow meters of various types, Oxygen Gas Cylinders, Gas Regulators & Pressure gauges.
3.2. **Anaesthesia Workstation** - Basics of Anaesthesia, Anaesthesia machine-Gas supply and delivery, vapour delivery, patient breathing circuit, Vaporizers & Humidifiers, Scavenging system

UNIT IV

Miscellaneous Equipments

4.1. Exercise stress testing (Tread Mill Test (TMT), Bicycle Test
4.2. Endoscope
4.3. Ophthalmoscope
4.4. Audiometer & Hearing aid with its types

PRACTICAL EXERCISES

1. Identification and understanding about different Cardiac care Instruments & their application.
2. Demonstration of Cardiac Defibrillator & its electrodes used.
3. Demonstration of external cardiac pacemaker.
4. Identification and understanding about cardiac catheterization instrumentation system.
5. Demonstration of Heart lung machine working.

6. Identification and understanding about different Operation Theatre Instruments & their application.
7. Demonstration of Suction pump working.
8. Demonstration about Electro-surgical Unit.
9. Demonstration about Operation theatre table.
10. Identification and understanding about different Gas Pipe lines, Vacuum system and Gas flow meters of various types in Hospitals.
11. Demonstration about Intensive care Ventilator and its working in different modes.
12. Demonstration about Anaesthesia workstation ad its components.
13. Demonstration about Tread mill Test machine.
14. Demonstration about Audiometer & its working.
15. An educational visit to nearby hospital is proposed for more practical exposure.

RECOMMENDED BOOKS

1 John G.Webster, "Medical Instrumentation Application Design".
2 RS Khandpur, "Handbook of Biomedical Instrumentation".
3 P Cromwell, Weibell, "Biomedical Instrumentation Measurements".
4 A.G Patil, "Medical Electronics".
5 Carr Joseph Brown, "Introduction to Biomedical Equipment Technology".

SUGGESTED WEBSITES

1 http://swayam.gov.in
2 http://nptel.ac.in
3 www. Teachnicalsymposium.com

INSTRUCTIONAL STARTEGY

While teaching this course the teacher should give demonstration in working models of human physiology pertaining to relevant topics in the class. A visit to medical laboratory/ clinic should also be organized in order to reinforce the classroom teaching and substantiating the course fundamentals. Webinars/Online Lectures from Medical Experts should be arranged with Educational Tour at Biomedical Training Institute like AMTZ Vizag etc and Medical institute. This subject contains four units of equal weightage.

4.6 MINOR PROJECT

L	P
-	6

RATIONALE

Minor project work will help in developing the relevant skills among the students as per National Skill Qualification Framework. It aims at exposing the students to the present and future needs of various relevant industries. It is expected from the students to get familiar with industrial environment. For this purpose, students are required to be involved in Minor Project Work in different establishments.

COURSE OUTCOMES

At the end of the open elective, the students will be able to:

CO1: Define the problem statement of the minor project according to the need of industry.
CO2: Work as a team member for successful completion of minor project.
CO3: Write the minor project report effectively.
CO4: Present the minor project report using PPT.

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GUIDELINES

Depending upon the interest of the students, they can develop minor projects as per present and future demand of the industry. The supervisors may guide the students to identify their minor project work and chalk out their plan of action well in advance. As a minor project activity each student is supposed to study the operations at site and prepare a detailed project report of the observations/processes/activities. The supervisor may create a group of 4-5 students as per their interest to work as a team for successful completion of the minor project.

The supervisor shall evaluate the students along with one external expert by considering the following parameters:

	Parameter	Weightage
i	Defining problem statement, focus and approach	20%
ii	Innovation / creativity	20%
iii	Report Writing	20%
iv	Power Point Presentation	20%
v	Viva - voce	20%

THIRD YEAR

NSQF LEVEL - 5

18. DIPLOMA PROGRAMME STUDY AND EVALUATION SCHEME

FIFTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
5.1	Industrial Training - II	-	2	**0+1 =1**	-	40	40	-	60	60	100
5.2	Therapeutic Medical Instrumentation	4	4	**4+2=6**	40	40	80	60	60	120	200
5.3	Medical Laboratory Instruments	4	4	**4+2=6**	40	40	80	60	60	120	200
5.4	Troubleshooting and Maintenance of Bio medical Equipment	4	4	**4+2=6**	40	40	80	60	60	120	200
5.5	Programme Elective-II	3	-	**3+0=3**	40	-	40	60	-	60	100
5.6	Multidisciplinary Elective(MOOCs+/Offline)	2	-	**2+0=2**	40	-	40	60	-	60	100
# Student Centered Activities (SCA)		-	4	-	-	-	-	-	-	-	-
Total		**17**	**18**	**24**	**200**	**160**	**360**	**300**	**240**	**540**	**900**

\+ Assessment of Open Elective through MOOCs shall be based on assignments out of 100 marks.

Programme Elective-II: 5.5.1 Rehabilitation Engineering. 5.5.2 Medical Devices Regulations & Hospital Management

Student Centred Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Games, Yoga, Human Values & Ethics, Knowledge of Indian System, Hobby Clubs e.g. Photography etc., Seminars, Declamation Contests, Educational Field Visits, NCC, NSS, Cultural Activities and Self-study etc.

SIXTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) (L+P=C)	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
6.1	Professional Industrial/Hospital Training	-	35	**0+17=17**	-	200	200		300	300	500
	Total	-	**35**	**17**	**-**	**200**	**200**	**-**	**300**	**300**	**500**

19. HORIZONTAL AND VERTICAL SUBJECTS ORGANISATION

Sr. No.	Subjects/Areas	Hours Per Week	
		Fifth Semester	Sixth Semester
1.	Industrial Training - II	2	-
2.	Therapeutic Medical Equipment	8	-
3.	Medical Laboratory Instruments	8	-
4.	Troubleshooting and Maintenance of Bio medical Equipment	8	-
5.	Programme Elective-II	3	-
6.	Multidisciplinary Elective	2	-
7.	Professional Industrial/Hospital Training	-	35
8.	Student Centered Activities	4	
	Total	**35**	**35**

20.COMPETENCY PROFILE & EMPLOYMENT OPPORTUNITIES

Government and private sectors related to **Medical Electronics** require **supervisors** having well developed skills with clear choice of procedures. They are expected to have complete knowledge and practical skills related to their field. They shall be able to communicate clearly with others. Diploma holders after passing level 5 shall haveunderstanding of desired mathematical skills and understanding of social and natural environment. They are expected to collect, organize and communicate information effectively. They are expected to have good exposure of humanities, life skills, entrepreneur development and management to establish small start-ups.

Medical Electronics is an integration of Medicine with Engineering theories and Practices. All medical electronics professionals should be educated to deliver patient-centered care as members of an interdisciplinary team, emphasizing evidence-based practice, quality improvement approaches, and informatics. The professionals should be able to apply the kowledge to applications in biomedical equipment technology, electronics, information technology, physics, and chemistry.

Work requiring knowledge, skills and aptitudes at level 5 will also be carried out in familiar situations, but also ones where problems may arise. Job holders will be able to make choices about the best procedures to adopt to address problems where the choices are clear. Individuals in jobs which require level 5 qualifications will normally be responsible for the completion of their own work and expected to learn and improve their performance on the job. They will require well developed practical and cognitive skills to complete their work. They may also have some responsibility for others' work and learning. They should develop secretarial skills by using modern office equipment and necessary expertise in handling clients and appreciation of value of better inter-personal relations for growth and development of the organization

They have wide scope as Service Engineer – in Electronics / ECE / Instrumentation), Field Service Engineer, Engineer - Field Service, Sales/Service Engineer.Bio-Medical Equipment Technician; Electronics Technician; Biomedical Engineering Technician, Medical Equipment Technician; Biomedical Electronics Technician, and Biomedical Engineering Technician (BMET). Medical Laboratory Technician; (MLT) Medical Laboratory Scientists. Medical Electronics Fitter, Technician Medical Electronics Medical Electronics Mechanic; Medical Electronic Equipment Mechanic ECG Technician.

21. PROGRAMME OUTCOMES

The program outcomes are derived from five domains of NSQF Level – 5 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this level, the student will be able to:

PO1: Perform task that require well developed skills of Medical Electronics Engineer with clear choice of procedures.

PO2: Acquire knowledge of facts, principles and processes related to Medical Electronics.

PO3: Demonstrate cognitive and practical skills of Medical Electronics Engineer to solve problems

PO4: Develop skills to collect, organize and communicate information.

PO5: Accomplish Medical Electronics Engineer and supervise other's work.

PO6: Select online multidisciplinary electives of own interest to promote self-learning.

22. ASSESSMENT OF PROGRAM AND COURSE OUTCOMES

Programme Outcomes to be assessed	Assessment criteria for the Course Outcomes
PO1: Perform task that require well developed skills of Medical Electronics Engineer with clear choice of procedures.	• Develop competencies and skills required by relevant industries. • Comprehend and explain working principle of various electric stimulators. • Illustrate working principle of neonatal therapy equipment. • Illustrate working principle of different pathological instruments with their applications • Identify the reasons of equipment failure and troubleshooting methods. • Formulate methods to solve critical problems & compare various standards. • Identify general fault finding in medical equipment in healthcare. • Comprehend the construction of manual and powered wheel chair. • Select proper sensory augmentation and substitution devices for different disabilities. • Demonstrate the competence to apply knowledge and skills learnt earlier in the context of the project.
PO2: Acquire knowledge of facts, principles and processes related to Medical Electronics.	• Comprehend and explain working principle of various electric stimulators. • Detail working principle of physiotherapy & electrotherapy instruments. • Illustrate working principle of neonatal therapy equipment. • Comprehend and explain the working principle of various clinical instruments. • Illustrate working principle of different pathological instruments with their applications

	• Illustrate different methods of orthopaedic prosthetics & orthotics for rehabilitation • Comprehend the construction of manual and powered wheel chair. • Select proper sensory augmentation and substitution devices for different disabilities. • Demonstrate the knowledge of proper handling of orthotic & prosthetic waste
PO3: Demonstrate cognitive and practical skills of Medical Electronics Engineer to solve problems	• Familiarize with the working environment of industries • Comprehend about present and future requirement of industries. • Develop competencies and skills required by relevant industries. • Develop competencies to explain working principle of different diathermy units. • Illustrate working principle of neonatal therapy equipment. • Illustrate working principle of different pathological instruments with their applications • Interpret the need of grounding aspects, maintenance and troubleshooting. • Formulate methods to solve critical problems & compare various standards. • Illustrate different methods of orthopaedic prosthetics & orthotics for rehabilitation • Demonstrate the knowledge of proper handling of orthotic & prosthetic waste • Illustrate different medical standards & safety aspects in healthcare. • Demonstrate the knowledge about various hospital services department & their functions • Develop the competency as biomedical engineers in hospital • Apply various techniques used in waste management

PO4: Develop skills to collect, organize and communicate information.	• Familiarize with the working environment of industries • Develop writing, speaking and presentations skills. • Select proper sensory augmentation and substitution devices for different disabilities. • Illustrate different medical standards & safety aspects in healthcare. • Define the problem statement of the Industrial training as per industry need. • Apply the communication skills in writing and presenting the technical report.
PO5: Accomplish Medical Electronics Engineer and supervise other's work.	• Familiarize with the working environment of industries • Apply necessary safety precautions and measures. • Comprehend about present and future requirement of industries. • Work in team for solving industrial problems • Illustrate working principle of neonatal therapy equipment. • Develop competencies to explain working principle of auto-analyzer & blood cell counting techniques. • Interpret the need of grounding aspects, maintenance and troubleshooting. • Identify the reasons of equipment failure and troubleshooting methods. • Formulate methods to solve critical problems & compare various standards. • Identify general fault finding in medical equipment in healthcare. • Demonstrate the knowledge of proper handling of orthotic & prosthetic waste. • Illustrate different medical standards & safety aspects in healthcare. • Demonstrate the knowledge about various hospital

	services department & their functions • Develop the competency as biomedical engineers in hospital • Apply various techniques used in waste management • Define the problem statement of the Industrial training as per industry need. • Develop the problem-solving skills in finding solutions to the problems in the world of work. • Acquire interpersonal skills and work as a team member.
PO6: Select online multidisciplinary electives of own interest to promote self-learning	• Apply critical thinking in problem solving. • Demonstrate self and time management. • Display analytical and research abilities. • Integrate multiple knowledge domains. • Enhance the scope and depth of learning.

23. SUBJECTS & CONTENTS

(THIRD YEAR)

FIFTH SEMESTER

5.1 INDUSTRIAL TRAINING-II

L	P
-	2

RATIONALE

Industrial training will help the students to understand the working environmentof relevant industries. The student will learn to work in team to solve the industrial problems. It willalso give exposure about the present and future requirements of the relevant industries. This trainingis very important for development of required competencies and skills for employment and start– ups.

COURSE OUTCOMES

After undergoing the training, the students will be able to:

CO1: Familiarize with the working environment of industries
CO2: Apply necessary safety precautions and measures.
CO3: Comprehend about present and future requirement of industries.
CO4: Work in team for solving industrial problems
CO5: Develop competencies and skills required by relevant industries.
CO6: Develop writing, speaking and presentations skills.

PRACTICAL EXERCISES

1. Report writing based on industrial training.
2. Preparation of Power Point Slides based on industrial training and presentation by the candidate.
3. Internal Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries.
4. External Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries.

GUIDELINES

Students will be evaluated based on Industrial training report and their presentation using Power Point about the knowledge and skills gained during the training. The Headof the Department will depute faculty coordinators by assigning a group of students to each. The coordinators will mentor and guide the students in preparing the PPTs for final presentation. The following performance parameters are to be considered for assessment of the students out of 100 marks:

	Parameter	**Weightage**
i	Industrial assessment of the candidate by the trainer	40%
ii	Report Writing	20%
iii	Power Point Presentation	20%
iv	Viva-voce	20%

5.2 THERAPEUTIC MEDICAL INSTRUMENTATION

L	P
4	4

RATIONALE

This subject includes an exposure to therapeutic & physiotherapy equipment used in healthcare. This course will develop the assembling & operational understanding of physiotherapy and diathermy equipment to students.

COURSE OUTCOMES

After undergoing the training, the students will be able to:

CO1: Comprehend and explain working principle of various electric stimulators.

CO2: Detail working principle of physiotherapy & electrotherapy instruments.

CO3: Develop competencies to explain working principle of different diathermy units.

CO4: Illustrate working principle of neonatal therapy equipment.

DETAILED CONTENTS

UNIT I
Introduction

1.1 Electromagnetic spectrum
1.2 Principle of High frequency current therapy
1.3 Advantages of high frequency thermo-therapy
1.4 Safety issues related to using therapeutic equipment
1.5 Muscle & Nerve response to electric stimulation – Polarization, Depolarization & propagation of impulse

UNIT II
Physiotherapy Stimulators

2.1 Neuromuscular electric stimulation & its classification
2.2 Electric stimulation techniques- electrode types, electrode placement, stimulating points, reducing of skin electrode resistance
2.3 Ultrasonic simulator
2.4 Transcutaneous Electric Nerve stimulator (TENS)
2.5 Magnetic stimulator
2.6 Pain relief through electric simulation

UNIT III
Electrotherapy Equipment

3.1 Electrotherapy & different waveform used, Electrode system
3.2 Shortwave Diathermy (SWD)
3.3 Microwave Diathermy (MWD)
3.4 Ultrasonic Diathermy
3.5 Infra-red Diathermy (IRD)
3.6 Physiological effect of therapeutic instruments.
3.7 Phonophoresis

UNIT IV
Advanced Electrotherapy techniques

4.1 Hydrocollator unit
4.2 Iontophoresis
4.3 Inter-ferential Therapy (IFT)
4.4 Continuous Passive Motion (CPM) Therapy
4.5 Traction Unit
4.6 Fluidotherapy
4.7 Cryotherapy
4.8 Wax therapy unit

UNIT V

Electro—diagnosis & neonatal therapy

5.1 Phototherapy unit
5.2 Infant Incubator
5.3 Radiant warmer
5.4 Solid state electro-surgery circuits
5.5 Electro-diagnosis
5.6 Intensity-time curve
5.7 Different waveform used in Electro-diagnosis

PRACTICAL EXERCISES

1. Demonstration about Transcutaneous Electric Nerve stimulator (TENS)
2. Demonstration about Shortwave Diathermy (SWD)
3. Demonstration about Microwave Diathermy (MWD)
4. Demonstration about Ultrasonic Diathermy
5. Demonstration about Hydrocollator unit
6. Demonstration about Inter-ferential Therapy (IFT)
7. Demonstration about Continuous Passive Motion (CPM) Therapy
8. Demonstration about Phototherapy unit
9. Demonstration about Radiant warmer
10. Demonstration about Solid state electro-surgery circuits
11. Demonstration about Traction Unit
12. Visit to a nearby physiotherapy centre and make a report.

RECOMMENDED BOOKS

1. Introduction to Biomedical Equipment Technology by Carr & Brown, Pearson Education, Asia
2. RS Khandpur, Handbook of Biomedical instrumentation, TMH
3. Physiotherapy Equipment's by RKV Murugan , Notion Press .
4. Textbook of physiotherapy by Basanta Kumar Nanda, Jaypee Brothers Medical Publishers.
5. E-books / e-tools /relevant software to be used as recommended by AICTE /HSBTE / NITTTR.

SUGGESTED WEBISTES

1. www.learningradilogy.com
2. www.teachmemedicine.org
3. http://swayam.gov.in
4. http://nptel.ac.in

INSTRUCTIONAL STRATEGY

The teachers may encourage students to perform practical simultaneously for better understanding of the subjects and verification of theoretical concepts. The various components must be shown to the students for identification and also tested. Practical applications of the various circuits and devices should be discussed in the class. This subject contains five units each having equal weightage in terms of contact hours and marks distribution.

5.3 MEDICAL LABORATORY INSTRUMENTS

L	P
4	4

RATIONALE

This subject includes exposure to clinical laboratory equipment/instruments and various principles used in analytical instruments. This will enable the participants to make use of pathological equipment and to carry out preventive maintenance of these equipment

COURSE OUTCOMES

After undergoing the training, the students will be able to:

CO1: Comprehend and explain the working principle of various clinical instruments.
CO2: Develop competencies to work on auto-analyzer & blood cell counting techniques.
CO3: Illustrate working principle of different pathological instruments with their applications
CO4: Handel various medical instruments effectively.

DETAILED CONTENTS

UNIT I
Introduction

1.1 General overview & structure of Medical Laboratory
1.2 Role of Medical laboratory services in healthcare
1.3 Classification of Medical Laboratories
1.4 Professional laws & ethics for medical laboratory
1.5 Laboratory hazards and accidents
1.6 General precautions for avoidance of laboratory accidents.

UNIT II

Clinical Instruments

2.1 Photo colorimeter: - Working principle, Block diagram description, Light sources used in photo-colorimeter, Optical Filters, Monochromators & their classification, Photo colorimeter applications

2.2 Spectrophotometer: - Working principle, Block diagram description, Light sources used in spectrophotometry, Photosensitive detectors, Applications of spectrophotometer.

2.3 Flame Photometer: - Working principle, Block diagram description, Light sources used in flame-photometer, Atomizer, Applications of Flame photometer.

UNIT III

Blood Analyzer & Digital pH

Digital pH

3.1 Working principle

3.2 Block diagram & parts description of a Digital pH meter

3.3 pH electrodes - Glass electrode, Reference electrode, Gel electrode.

3.4 Acid base balance

3.5 Significance of pH measurement w.r.t. blood.

3.6 Applications of pH meter

3.7 Effect of Blood on Electrodes

3.8 Buffer Solutions

Blood Analyzer & its types

3.9 Introduction to Analyzers

3.10 Classification of Analyzers - Semi-Automatic Analyzer , Fully Automatic Analyzer , Difference between the Semi and Fully Automatic Analyzers

3.11 Block-diagram of Fully Automatic Analyzer with descriptions – Sampler , Pumps, Heater , Dialyzer , colorimeter , Recorder, Digital Printer

3.12 Classification of Fully Automatic Analyzer- Continuous flow analyzer, Discrete automatic analyzer, Centrifugal automatic analyzer, Dry chemical automatic analyzer

3.13 Applications of Fully Automatic Analyzer.

UNIT IV

Blood Cell Measurement Techniques

4.1 Blood cells & its types
4.2 Different methods of blood cell counting
4.3 Microscopic method
4.4 Automated optical method
4.5 Electrical conductivity method
4.6 Blood Cell Counters (Coulter Counters) – working principle , system components
4.7 Types of Blood Cell Counters.

UNIT V

Pathology Instruments

5.1 Haemoglobinometer- Working Principle, Block diagram description & its application
5.2 Electric Centrifuge - Working Principle, Block diagram description & its application
5.3 Microscope – Components, Operating procedure & its applications
5.4 Polymerase Chain Reaction (PCR) Machine
5.5 Microtome
5.6 Electrophoresis
5.7 ELIZA Reader
5.8 Chromatography & its applications

PRACTICAL EXERCISES

1. To operate, familiarize with external control panel of photo-colorimeter and calibrate the equipment.
2. To operate, familiarize with its external control and to calibrate the flame photometer.
3. To find out the concentration, Optical density and transmittance of unknown sample in spectrophotometer machine.
4. To operate the pH meter, familiarize with various sections and to calibrate.
5. To measure the pH of unknown sample.
6. To operate and to calibrate the Auto-analyzer. To find out various parameters of blood sample. To open the equipment and familiarize with various sections.
7. To operate and to calibrate different types of Blood cell counter. To open the equipment and familiarize with various sections

8. To operate and to calibrate Haemoglobinometer. To open the equipment and familiarize with various sections
9. To operate & familiarize with various sections the electric centrifuge machine.
10. To operate & familiarize with various sections of Microscope.

RECOMMENDED BOOKS

1. Biomedical Instrumentation – R.S. Khandpur.
2. Introduction to Biomedical Equipment – Joseph Carrt Brown
3. Analytical Instrumentation by RS Khandpur
4. Biomedical Instrumentation and Measurements by Cromwell
5. Biomedical Electronics and Instrumentation Made Easy by G. S. Sawhney
6. Medical Laboratory Technology (Volume III): Procedure Manual for Routine Diagnostic Tests by L Mukherjee, Kanai

SUGGESTED WEBISTES

1. www.learningradilogy.com
2. www.teachmemedicine.org
3. http://swayam.gov.in
4. http://nptel.ac.in

INSTRUCTIONAL STRATEGY

The teachers may encourage students to perform practical simultaneously for better understanding of the subjects and verification of theoretical concepts. The various components must be shown to the students for identification and also tested. Practical applications of the various circuits and devices should be discussed in the class. This subject contains five units each having equal weightage in terms of contact hours and marks distribution.

5.4 TROUBLESHOOTING AND MAINTENANCE OF BIO - MEDICAL EQUIPMENT

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RATIONALE

This subject intends to guide the students with relevant concepts and principles of installation, maintenance of biomedical equipment. The subject includes an exposure to testing of electrical installation keeping in view the equipment as well as patient's safety. The students will carry out preventive/breakdown maintenance as well as troubleshoot faults in various bio-medical equipment/machines in addition to preparing maintenance schedule of machines.

COURSE OUTCOMES

After undergoing the training, the students will be able to:

CO1: Interpret the need of grounding aspects, maintenance and troubleshooting.
CO2: Identify the reasons of equipment failure and troubleshooting methods.
CO3: Formulate methods to solve critical problems & compare various standards.
CO4: Identify general fault finding in medical equipment in healthcare.

DETAILED CONTENTS

UNIT I
Testing of Electrical Equipment

1.1 AC/DC Power Supply Inspection
1.2 Grounding System inspection
1.3 Insulation Testing, Insulation resistance measurement
1.4 Circuit Breakers & its types, Testing of circuit breakers.
1.5 Precautionary measurement for installation of any medical equipment.
1.6 Space for Handling of Medical Equipment.
1.7 Earthing mechanism for installation of medical equipment.

UNIT II
Testing of Electronics Equipment

2.1 **Cables**: - Compare various types of cables (Flexibility, current carrying, capacity), Types of cables, Construction and application of coaxial cable

2.2 **Connectors:** - Compare various types of connectors (Flexibility, current carrying, capacity), Types of connectors (BNC, Audio, Video, Printer, FRC, RJ45,)

2.3 **Fuses**: - Compare various types of Fuses (Glass, ceramic, shunt, HRC)

2.4 Current Transformer (CT), Potential Transformer (PT), Transformer testing

2.5 Switch Mode Power Supply

2.6 Uninterruptable Power Supply

2.7 Constant Voltage Transformer

UNIT III
Maintenance of Medical Equipment

3.1 Biomedical Engineering operations for maintenance

3.2 Preventive Maintenance System

3.3 Comprehensive Maintenance System

3.4 Annual Maintenance Contract

3.5 Radiation safety instrumentation

3.6 Physiological effects due to 50 Hz current passage

3.7 Micro-shock and macro-shock hazards of medical instruments

3.8 Leakage current

3.9 Biological effect of UV Radiation

UNIT IV
Maintenance & troubleshooting of ICU Equipment

4.1 ECG Machine

4.2 Pulse Oximeter

4.3 Multi Parameter Monitor

4.4 Syringe pump

4.5 Oxygen Cylinder & Flow meters

UNIT V

Maintenance & troubleshooting of OT Equipment

5.1 Ventilator
5.2 Anaesthesia Workstation
5.3 OT Table
5.4 OT Light
5.5 Suction Machine

PRACTICAL EXERCISES

1 Identify & testing of different types of connectors and their applications.
2 Identify & testing of different types of Fuses.
3 Prepare a preventive Maintenance schedule for different equipment in institute lab
4 Testing of electrical installation in the institute from electrical power meter output to the electrical output points.
5 To analyse the general troubleshooting in ECG measurement & their corrective action
6 To analyse the general troubleshooting in sPo_2 measurement & their corrective action
7 To analyse the general troubleshooting in patient monitoring system & their corrective action
8 To analyse the general troubleshooting in syringe pump & their corrective action
9 To analyse the general troubleshooting in ventilation system & their corrective action
10 To analyse the general troubleshooting in Anaesthesia workstation & their corrective action
11 To analyse the general troubleshooting in suction unit & their corrective action.

RECOMMENDED BOOKS

1. Shakti Chatterjee , Aubert Miller ," Biomedical Equipment Repair " ,Cengage learning Technology & engineering , 2010.
2. Joseph J.Carr, John M Brown , Introdiction to Biomedical equipment Technology , New York 2010.
3. Medical Equipment Maintenance Manual , Ministry of Health & family welfare , New Delhi 2010.
4. L.Nokes , B.Turton , D.Jennings , T.Flint " Introduction to Medical Electronics Application" A Butterworth Heinemann Title , 1995.

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INSTRUCTIONAL STRATEGY

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5.5PROGRAMME ELCTIVE –II

5.5.1 REHABILITATION ENGINEERING

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RATIONALE

This subject intends to provide knowledge on design, analysis, control & working principle of assistive devices & technologies to meet the specific need of people with physical or sensory impairments. It is a specialized field that integrates the engineering principles to enhance the lives of induvial with disabilities.

COURSE OUTCOMES

After undergoing the subject, students will be able to:

CO1: Illustrate different methods of orthopaedic prosthetics & orthotics for rehabilitation

CO2: Comprehend the construction of manual and powered wheel chair.

CO3: Select proper sensory augmentation and substitution devices for different disabilities.

CO4: Demonstrate the knowledge of proper handling of orthotic & prosthetic waste

DETAILED CONTENTS

UNIT I

Introduction

1.1 Rehabilitation concepts
1.2 Preventive rehabilitation
1.3 Engineering concept in sensory rehabilitation
1.4 Engineering concept in motor rehabilitation
1.5 Diagnosis of disability
1.6 Rehabilitation tea
1.7 Future of Rehabilitation Engineering

UNIT II

Biomechanics concepts – kinematics and kinetics

2.1 Motion – Types, Magnitude & Location
2.2 Concurrent force systems
2.3 Parallel force system
2.4 Joint structure & functions
2.5 Human joint design
2.6 General properties of connective tissues
2.7 Biomechanics of foot & ankle

UNIT III

Sensory Augmentation & Substitution

3.1 Visual Augmentation
3.2 Tactual vision substitution
3.3 Auditory vision substitution
3.4 Electronic speech synthesizers
3.5 Optical character recognition (OCR)
3.6 Auditory Augmentation – Hearing aid, Cochlear implant
3.7 Visual Auditory substitution
3.8 Tactual substitution

UNIT IV

Assistive Technology- Wheeled Mobility

4.1 Wheelchair Structure and component design
4.2 Features & categories of a Wheelchair
4.3 Wheels & casters
4.4 Performance factors of wheels
4.5 User interface & integrated controls of powered wheelchair
4.6 Maintenance procedure of powered wheelchair

UNIT V

Prosthetics and orthotics in Rehabilitation

5.1 Computer application in rehabilitation engineering
5.2 Prosthetic knee
5.3 Controlled Prosthetic hand
5.4 Orthotic knee joint
5.5 Functional electrical stimulation & restoration of hand functions
5.6 FES System & it's working principle.
5.7 Hybrid assistive system (HAS) for walking
5.8 Myoelectric hand & its features
5.9 Externally controlled Transfemoral prosthesis
5.10 Material used in orthotics & prosthetics
5.11 Management of orthotics & prosthetic waste

RECOMMENDED BOOKS

1. Principles of Hospital administration & planning by Dr.B M Sakhharkar, JP Brothers publication
2. Biomedical waste disposal by Anantpreet singh & Sukhjit kumar , JP Brothers publication.
3. Healthcare Information system by Karen A.Wager & John P Glacer , Jossey Bass publications
4. RS Khandpur , Handbook of Biomedical instrumentation , TMH
5. Medical Equipment Maintenance Manual , Ministry of Health & family welfare , New Delhi 2010.
6. L.Nokes , B.Turton , D.Jennings , T.Flint " Introduction to Medical Electronics Application" A Butterworth Heinemann Title , 1995.

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INSTRUCTIONAL STRATEGY

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5.5.2 MEDICAL DEVICES REGULATIONS & HOSPITAL MANAGEMENT

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RATIONALE

This subject intends to guide the students to learn the quality standards and safety aspects in hospitals. The subject includes fundamentals of Hospital administration & management with market related research process. The students will gain knowledge about various waste management techniques.

COURSE OUTCOMES

After undergoing the subject, students will be able to:

CO1: Illustrate different medical standards & safety aspects in healthcare.
CO2: Demonstrate the knowledge about various hospital services department & their functions
CO3: Develop the competency as biomedical engineers in hospital
CO4: Apply various techniques used in waste management

DETAILED CONTENTS

UNIT I
Quality Standards & safety aspects in Hospitals

1.1 Need for standardization & Quality management
1.2 Patient safety organization – Government & independent
1.3 TQM in healthcare organization
1.4 Measuring quality care – Evaluation of hospital services, six sigma way
1.5 Quality assurance methods
1.6 Diagnostic services – classification of equipment

UNIT II

Regulatory Requirement & safety aspects for Healthcare

2.1 Quality Auditing – Need for accreditation of hospitals.
2.2 Accreditation of Hospitals – NABH , NABL , JCI
2.3 Other Regulatory bodies of India – MCI , PCI
2.4 Indian Medical device rules & regulations - 2017
2.5 International standards ISO 9000
2.6 Medical ethics, safety rules , Alarm system , Fire safety , Labor laws applicable in hospital
2.7 Hospital electrical system design

UNIT III

Hospital & its services department

3.1 Role of Hospital in medical care
3.2 Hospital classification & factor influencing hospital utilization
3.3 Outpatient services- Outpatient department & its flowchart, Emergency department, Common problems associated with OPD services
3.4 Nursing services & its role in healthcare
3.5 Role & functions of Intensive care unit (ICU)
3.6 Layout & types of ICU.
3.7 Ambulatory services

UNIT IV

Procurement Maintenance and disposal of Medical Equipment

4.1 Biomedical Equipment Procurement Procedure (Purchase/Contract)
4.2 Installation, testing & Calibration of Medical Equipment
4.3 Training, operating & precautionary instructions to Hospital staff.
4.4 Planned Preventive Maintenance system.
4.5 Computerized inter-departmental medical record evaluation.
4.6 Medical Equipment Audit
4.7 Condemnation & disposal of medical equipment.
4.8 Computer based information management in hospitals.
4.9 Administration/discharge record of patients
4.10 Maintenance of inventory of medicines and drug purchase
4.11 Hospital Information system

UNIT V

Biomedical waste management

5.1 General & Hazardous health care waste
5.2 Biomedical waste categories & their colour coding
5.3 Collection, segregation & disposal of waste
5.4 Infection control
5.5 HVAC System
5.6 Protective devices-Bioethics & handling of waste management
5.7 Role of central sterilization department in waste management

RECOMMENDED BOOKS

1. Principles of Hospital administration & planning by Dr.B M Sakhharkar, JP Brothers publication
2. Biomedical waste disposal by Anantpreet singh & Sukhjit kumar , JP Brothers publication.
3. Healthcare Information system by Karen A.Wager & John P Glacer , Jossey Bass publications
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INSTRUCTIONAL STRATEGY

The teachers may encourage students to perform practical simultaneously for better understanding of the subjects and verification of theoretical concepts. The various components must be shown to the students for identification and also tested. Practical applications of the various circuits and devices should be discussed in the class. This subject contains five units each having equal weightage in terms of contact hours and marks distribution.

5.6 MULTI-DISCIPLINARY ELECTIVE

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RATIONALE

Multidisciplinary electives are very important and play major role in implementation of National Education Policy. Multidisciplinary is a subject which is useful for two or more disciplines in which students are asked to understand the concept of multidisciplinary or interdisciplinary. It will help the students to gain an arsenal of skills that are easily transferable across work environments.

COURSE OUTCOMES

At the end of the multidisciplinary elective, the students will be able to:

CO1: Apply critical thinking in problem solving.
CO2: Demonstrate self and time management.
CO3: Display analytical and research abilities.
CO4: Integrate multiple knowledge domains.
CO5: Enhance the scope and depth of learning.

LIST OF MULTIDISCIPLINARY ELECTIVES

(The list is indicative and not exhaustive)

1. Introduction to Internet of Things
2. Introduction to Robotics
3. Introduction to Embedded System Design
4. Fundamentals of Artificial Intelligence
5. Digital Image Processing
6. Introduction to Machine Learning
7. Block Chain
8. The Joy of Computing Using Python

9. Cloud Computing
10. Introduction to Industry 4.0
11. Industrial Internet of Things
12. Object Oriented System Development using UML, Java and Patterns

GUIDELINES

Multidisciplinary Elective shall be offered preferably in online mode. Online mode multidisciplinary elective shall preferably be through Massive Open Online Courses (MOOCs) from Swayam, NPTEL, Upgrad, Udemy, KhanAcademy or any other online portal to promote self-learning. A flexible basket of large number of multidisciplinary electives is suggested which can be modified depending upon the availability of courses at suggested portals and requirements. For online multidisciplinary electives, department coordinators shall be assigned to monitor and guide the group of students for selection of minimum 20 hours duration online course of their choice. For offline multidisciplinary electives, a suitable relevant subject shall be offered by the respective department to the students with minimum 40% of the total class strength as per present and future requirements.

Assessment of MOOCs multidisciplinary elective shall be based on continuous evaluation by the respective coordinator. The coordinator shall consider the submitted assignments by the students from time to time during the conduct of MOOCs. The MOOCs assessment shall be conducted by the coordinator along with one external expert by considering submitted assignments out of 100 marks.

In case, no suitable multidisciplinary elective is available online, only then the course may be conducted in offlinemode. The assessment of offline multidisciplinary elective shall be internal and external. The offline multidisciplinary elective internal assessment of 40 marks shall be based on internal sessional tests, assignments etc. and external assessment of 60 marks shall be based on external examination at institute level.

SUGGESTED WEBSITES

1. https://swayam.gov.in/
2. https://www.udemy.com/
3. https://www.upgrad.com/
4. https://www.khanacademy.org/

SIXTH SEMESTER

6.1 PROFESSIONAL INDUSTRIAL/HOSPITAL TRAINING

L	P
-	35

RATIONALE

The rise in global competition as prompted organization to devise strategies to have innovative work force to gain a competitive edge. Developing an industrial/hospital training is a fruitful way for creating a future talent pools for healthcare industry. The main aim of the course to enhance the employability skills of the students. This course has been designed to fulfil need of industrial exposure, where they get an experience of industrial environment.

COURSE OUTCOMES

After undergoing this course, the students will be able to:

CO1: Define the problem statement of the Industrial training as per industry need.
CO2: Develop the problem-solving skills in finding solutions to the problems in the world of work.
CO3: Acquire interpersonal skills and work as a team member.
CO4: Demonstrate the competence to apply knowledge and skills learnt earlier in the context of the project.
CO5: Apply the communication skills in writing and presenting the technical report.

Guidelines for the Institute/TPO Cell/ Department -

- The TPO cell/ concerned department have to send training request letter to various industries/hospitals well in advance.
- The concerned HOD will assign each departmental faculty as Faculty Mentor for minimum 10-15 students or 3-5 student groups.
- Each student group will consist of minimum **3-5 students.** For each student group, teaching workload of **04 hrs. /week** will be considered for each Faculty Mentor
- Department will issue a Relieving order letter to industry/hospital for the Industrial/Hospital Training mentioning name and institute registration number of student.

- Before relieving students for Industrial/Hospital Training TPO/HOD Faculty Mentor should address students about industrial/hospital safety norms, rules, safety precautions & discipline to be maintained during Industrial/Hospital Training.
- Institute has to prepare time table of the staff in such a manner that one faculty must be remain free for one whole day for industrial visit/counseling of the trainee. Trainee should be distributed equally among the faculty involved and the faculty will be considered Faculty Mentor for those students. Progressive assessment will be carried out by that faculty Mentor.
- The concerned HOD will prepare a schedule for follow up of Industrial/Hospital Training & according to it will send the faculty mentors to training industries/hospitals.
- Faculty member will be working as Mentor/Guide to the assigned group and will be responsible for handling all the documents regarding Industrial/Hospital Training.
- Faculty Mentor will monitor & evaluate (online) the progress of the student on weekly basis as per his/her weekly diary, attendance report, discipline & feedback from training in-charge and collect all the documents. However minimum 2-3 industrial/hospital visits at training centers by concerned Faculty Mentor is proposed for Industrial/Hospital Training. In cases, where students join industry/hospital far away from the institute then Faculty Mentor may make evaluation in online mod & collect documents through online E-mail/Post.
- Faculty Mentor will award for internal **Assessment-I** (after completion of 4 weeks of training, internal **Assessment-II** (after completion of 8 weeks of training) & internal **Assessment-III** (after completion of 12 weeks of training) of concerned students as per Student Attendance Record, Weekly Diary Report, Training Visit Feedback Report.
- Final External Assessment will be done as per HSBTE academic calendar schedule after successfully completion of Industrial/Hospital Training.
- A Training evaluation committee for final assessment will be constituted by Principal/TPO of institute.
- Training evaluation committee will be comprised of HOD of concerned department, concerned faculty mentor & One Expert Examiner from Biomedical Industry /Biomedical Engineer from Govt./Private hospital /any other institute faculty from concerned/relevant course.
- This assessment will be done on basis of Student Training Report, PPT Seminar representation by student on any one medical equipment & viva-voce.
- Faculty mentor should maintain good industry interaction by keeping contact with industry/hospital coordinator.
- Any other relevant or required documentation should be prepared by Faculty mentor.

Role of Industry/Hospital

- Industry/Hospital will confirm training slot and seat allocated for Industrial/Hospital Training.
- Industry/hospital will provide opportunity for effective learning to the students for improving their practical knowledge.
- Industry/hospital is requested to assign student/group of students under training to technical executive for guidance.
- Industry/hospital Coordinator is requested to instruct the students about safety procedures & rules of industry to be followed.
- Industry/hospital coordinator is requested to sign weekly diary with remarks as per performance in the week.
- Industry/hospital coordinator is requested to provide desired information to students for preparing Industry/hospital training report.
- Industry/hospital Coordinator is requested to maintain student attendance under training & report any irregularity of student to institute.
- Industry/hospital is also requested to issue a Industry/hospital training certificate in their letter head with remarks.

Responsibility of students

- Students will interact with their concerned Faculty Mentor in department for Industrial/Hospital Training.
- All students will be required to submit training application letter to their concerned faculty mentor.
- Students on joining training at concerned Industry/Hospital will submit joining letter/ report to concerned Faculty Mentor.
- Students would carry with him/her Institute Identity card during Training period.
- Before proceeding for Industrial/Hospital Training, a Student will get all the required training formats from their concerned faculty Mentor.
- Each Student will prepare a Final training report duly signed from Training Coordinator for submitting in the department at the time of viva & presentation.
- Each student will prepare a power point presentation about the industry/hospital & their learning during training period.

A criteria for assessing student performance by the internal examiner (personnel from industry and supervisor) and external examiner (teachers and experts) are given in table below:

S. No.	Performance criteria for Internal Assessment	Weightage of marks (in %age)
1.	Punctuality and regularity	10%
2.	Initiatives taken by the student in learning at training workplace	10%
3.	Defining problem statement, approach and schedule (Planning)	20%
4.	Level /proficiency of new practical skills acquired	20%
5.	Preliminary Action Plan and Report	40%
TOTAL		**100**

S. No.	Performance criteria for External Assessment	Weightage of marks (in %age)
1.	Project Report	60%
2.	Presentation & Viva voce	40%
Total marks		**100**

24. ASSESMENT TOOLS AND CRITERION

The assessment is carried out by conducting:

1. Formative assessments
2. Summative assessments

1. FORMATIVE ASSESSEMENT

The **formative assessment** will be evaluated on the basis of the internal assessments for theory subjects and practical by the concerned teachers for evaluating the knowledge and skill acquired by students and the behavioral transformation of the students. This **internal assessment** is primarily carried out by collecting evidence of competence gained by the students by evaluating them at work based on assessment criteria, asking questions and initiating formative discussions to assess understanding and by evaluating records and reports, and sessional marks are awarded to them.

2. SUMMATIVE ASSESSMENT

The **summative assessment** will include end semester examination for theory part for each candidate and practical examination with viva voice. Each Performance Criteria will be assigned marks proportional to its importance and proportion of marks for Theory and Skills Practical for each subject should be laid down.

The following assessment tools are used for effective student evaluation:

1. Theory Examinations
2. Practical Work
3. Internships
4. Professional Industrial Training
5. Project Work (Minor & Major)
6. MOOC Courses
7. Viva Voce
8. Case Studies

1. Theory

Evaluation in theory aims at assessing students' understanding of concepts, principles and procedures related to a course/subject, and their ability to apply learnt principles and solve problems.

The **formative evaluation** for theory subjects may be caused through

i. Sessional /class-tests,
ii. Quizzes,
iii. Assignments,
iv. Seminars/ Presentations
v. Attendance
vi. Case Studies

For **Summative evaluation** of theory, the question paper may comprise of three sections.

i. It should contain objective type question and multiple choice questions. The objective type items should be used to evaluate students' performance in knowledge, comprehension and at the most application domains only.
ii. It should contain short answer questions.
iii. Descriptive type questions , with some internal choice of the questions set may be given in this section

2. Practical Assessment

Evaluation of students performance in practical work (Laboratory experiments, Workshop practical /field exercises) aims at assessing students ability to apply or practice the concepts, principles and procedures, manipulative skills, ability to observe and record, ability to interpret and draw conclusions and work related attitudes. This will comprise of a creation of mock environment, wherever applicable in the skill lab which is equipped with all required equipment for development of desired skills. Candidate's soft skills, communication, aptitude, safety consciousness, quality consciousness etc. will be ascertained by observation and will be marked in observation checklist along with the assessment of Job carried out in labs and maintenance of Lab Record files.

Formative and summative evaluation may comprise of weightages to performance on task, quality of product, general behavior and it should be followed by viva-voce of the relevant subject. The end product will be measured against the specified dimensions and standards to gauge the level of his skill achievements

3. Internship

The two mandatory internships after I Year and II Year of the programme are to be assessed in 3rd and 5th semester subsequently. The internships should be preferably done in the field/ in the industry, can be in house depending upon the stream and availability of resources in and around the institute.

Every faculty should be assigned the students and made responsible for the evaluation and assessment of the internship. Formative assessment should be taken from the industry/institute/ department on the basis of performance, behavior and learning capabilities. Summative evaluation may comprise of weightages on the basis of report submission/ presentation followed by viva-voce of the relevant subject.

4. Professional Industrial Training

Evaluation of professional industrial training report and viva-voce/ presentation aims at assessing students' understanding of industrial processes, practices in the industry/field and their ability to engage in activities related to problem-solving in industrial setting as well as understanding of application of learnt knowledge and skills in real life situation. Formative and summative evaluation may comprise of weightages to performance on task, quality of product, general behavior and it should be followed by viva-voce of the relevant subject.

The formative assessment should include the evaluation from the employer where the student is doing his training or Project work in the ratio of 40:60. The final assessment will be the combination of the employer assessment and evaluation by the faculty of the institute which shall include report submission/ presentation/ seminar followed by viva-voce of the relevant subject.

5. Project Work Assessment

The purpose of evaluation of project work is to assess student's ability to apply, in an integrated manner, knowledge and skills in solving real life problems, manipulative skills, ability to observe, record, creativity and communication skills. The project work assigned should be of

relevance to the core skill, state of the art topics and the project areas that are pertaining to enhance job skill and enhance occupational opportunities. For both, minor and major project, Formative and summative evaluation may comprise of weightages to performance on task, quality of product, nature and relevance of project and general behavior.
The formative assessment should include the continuous assessment based on the work allocated and mid semester viva voice or presentation. The final assessment will be the combination of the project undertaken, report submission and should be followed by viva-voce of the relevant subject.

In case of the assessment of this component, the team of examiners should be constituted on 50 – 50 % basis. i.e. half of the examiners in the team should be invited from outside the institute conducting examination.

6. MOOC COURSES (Open Elective and Multi-Disciplinary Elective)

Massive Open Online Courses (MOOCs) platforms promise open, online courses to massive numbers of students as they are free to join, they provide a wide range of courses, they allow for space and time flexibility and their participants can benefit from various online communication tools and access to quality content.

The coordinating Department/Centre/Office shall monitor every student to adopt the courses online of their choice and preference on Swayam portal. The duration of courses will vary depending on the level and credit points. Courses offered in the duration of 4-10 weeks for 2 to 3 credits at diploma level are to be opted. Students, after they have registered, can get a certificate after attending the classes and submitting the assignments/quizzes and qualifying nationwide exam conducted written exam at the institute close to the one where the student is enrolled.

On successful completion of each course, the institution offering the MOOCs course would issue the certificate, along with the number of credits and grades, through which the student can get credits transferred into his marks certificate issued by his parent institution. Guidelines for credit sharing will be issued by concerned Regulators such as UGC, AICTE, etc. for consideration by various Institutes. There may be standard norms for the host Institution to conduct the course that may include continuous evaluation through assignments, online quizzes, case studies, online writing exercises, term examinations, student feedback, online forum management, etc.

The coordinating Department/Centre/Office of the respective department shall monitor every student and submit to the Office of Examinations, a score sheet (marks card) during the last 10 days prior to the close of the even semester.

7. Viva Voce

This tool will be used to assess the conceptual understanding and the behavioral aspects as regards the job role and the specific task at hand. It will also include questions on safety, quality, environment and equipment's etc. Ask questions on non-prescribed tasks to ensure that the learners have complete knowledge on the assessment

Computation of SGPA and CGPA

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

i. The SGPA is the ratio of sum of the product of the number of credits with the marks scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

$$SGPA\ (Si) = \sum(Ci \times Gi) / \sum Ci$$

where Ci is the number of credits of the ith course and Gi is the marks scored by the student in the ith course.

ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$CGPA = \sum(Ci \times Si) / \sum Ci$$

where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

25. TEACHING LEARNING TOOLS FOR EFFECTIVE IMPLEMENTATION

For effective implementation of curriculum, the faculty and staff of institutions have to play a vital role in planning instructional experiences for the courses in four different environments viz. class-room, laboratory, library and field and execute them in right perspective. It is emphasized that only a proper mix of different teaching methods in all these places of instruction can bring the changes in students behavior as stipulated in the curriculum document. It is important to understand curriculum document holistically and further be aware of intricacies of Teaching-Learning Tools for achieving curriculum objectives. Given below are certain recommendations which may help in carrying out teaching-learning effectively:

PROGRAMME LEVEL RECOMMENDATIONS

1. Curriculum implementation takes place at programme, course and class-room level respectively and synchronization among them is required for its success. The first step towards achieving synchronization is to read curriculum document holistically and understand its rationale and philosophy.

2. An academic plan needs to be prepared at institute level. The Head of the institute have a great role to play in its dissemination and percolation up to grass-root level.

3. Head of Department are required to prepare academic plan at department level referring to institutional academic plan.

COURSE LEVEL RECOMMENDATIONS

Teachers are educational managers at class room level and their success in achieving course level objectives lies in using course plan and their judicious execution which is very important for the success of programme by achieving its objectives. Teachers are required to plan various instructional experiences viz. theory lecture, expert lectures, lab/workshop practicals, guided library exercises, field visits, study tours, camps etc. In addition, they have to carry out progressive assessment of theory, assignments, library, practicals and field experiences. Teachers are also required to do all these activities within a stipulated period which is made available to them in the academic plan at Board level. With the amount of time to their credit, it is essential for them to use it judiciously by planning all above activities properly and ensure execution of

the plan effectively. Following is the gist of suggestions for subject teachers for effective utilization of Teaching Learning Tools to achieve the course objectives:

1. Teachers need to ensure attainment of course outcomes so as to help the students achieve program outcomes and also meet the desired learning outcomes in five domains of NSQF i.e. Process, Professional knowledge, Professional skills, Core skills and Responsibility.

2. Teachers are required to prepare a course plan, taking into account number of weeks available and courses to be taught.

3. Teachers are required to prepare lesson plan for every theory class. This plan may comprise of contents to be covered, learning material for execution of a lesson plan.

4. Teachers are required to plan for expert lectures from field/industry. For this, necessary steps need to be taken such as planning in advance, identifying field experts, making correspondence to invite them, taking necessary budgetary approval etc.

5. Teachers are required to plan for guided library exercises by identification of course specific experience requirement, setting time, assessment, etc. The assignments and seminars can be thought of as terminal outcome of library experiences.

6. Concept based industrial/field visits may be planned and executed for such contents of course which are abstract in nature and no other requisite resources are readily available in institute to impart them effectively.

7. Lot of focus needs to be laid on skill development. There is need for planning practical experiences in right perspective. These slots in a course are the avenues to use problem based learning and experiential learning effectively. The development and use of lab manuals will enable the institutes to provide lab experiences effectively.

8. Emphasis should to lay on developing soft skills like communication skills, personality Development, self-learning, inter personal skills, problem solving, and creativity etc.

9. Where ever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time. While teaching, the teacher should make extensive use of audio visual aids such as video films, power point presentations and IT tools.

10. Teachers may take initiative in establishing liaison with industries and field organizations for imparting field experiences to their students.

11. Students be made aware about issues related to ecology and environment, safety, concern for wastage of energy and other resources etc.

12. To enhance digital learning, open electives and multi-disciplinary electives have been provided in the curriculum to be taken up in the form of MOOCs. For Open electives, some courses may be identified out of the prescribed list given in the curriculum keeping in mind the interest of students. Similarly, for multi-disciplinary electives, courses to be o offered may be identified by considering their relevance and utility. Every year SWAYAM is notifying the list of courses which are going to be offered in forthcoming even and odd semester. The institute needs to select the courses that are offered on SWAYAM platform or any other online platform.

13. For effective implementation of Massive Open Online Courses (MOOCs), a faculty member in the department may be identified and given the responsibility to coordinate various activities related to MOOCs. The concerned faculty member will facilitate in registration of students for MOOCs. The faculty member will also be responsible for compiling the result of students on the completion of MOOCs and pass on the information to the concerned authority.

14. Flexibility has been provided in the curriculum for the students to choose a course related to the discipline as per their interest. For effective implementation of discipline-specific electives, the institute should identify some courses from the list of courses prescribed in the curriculum. The courses should be selected and offered keeping in mind the interest of students, infrastructure and expertise available in and around the institute related to the courses. Option for discipline-specific elective may be taken from students through a form and a course, with more than 10 students opting for it, may be run.

15. Where ever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time. While teaching, the teacher should make extensive use of audio visual aids such as video films, power point presentations and IT tools.

16. Teachers may take initiative in establishing liaison with industries and field organizations for imparting field experiences to their students.

17. Students be made aware about issues related to ecology and environment, safety, concern for wastage of energy and other resources etc.

18. To enhance digital learning, open electives and multi-disciplinary electives have been provided in the curriculum to be taken up in the form of MOOCs. For Open electives, some courses may be identified out of the prescribed list given in the curriculum keeping in mind the interest of students. Similarly, for multi-disciplinary electives, courses to be offered may be identified by considering their relevance and utility. Every year SWAYAM is notifying the list of courses which are going to be offered in forthcoming even and odd semester. The institute needs to select the courses that are offered on SWAYAM platform or any other online platform.

26. LIST OF EXPERTS

1. Controller of Examination, Haryana State Board of Technical Education, Panchkula.
2. Controller of Finance, Haryana State Board of Technical Education, Panchkula.
3. Joint Secretary, Haryana State Board of Technical Education, Panchkula.
4. Deputy Secretary Training & Placement Haryana State Board of Technical Education, Panchkula,
5. Deputy Secretary (Examination), Haryana State Board of Technical Education, Panchkula,
6. Deputy Secretary (Acd.), Haryana State Board of Technical Education, Panchkula.
7. Assistant Secretary, Academic, Haryana State Board of Technical Education, Panchkula.
8. Sh. Naresh Kumar, Senior Lecturer, Medical Electronics Department, Government Polytechnic, Hisar, Haryana.
9. Sh. Satish Kumar, Lecturer, Medical Electronics Department, Government Polytechnic, Hisar, Haryana.
10. Sh. Sidharth Sharma, Lecturer, Medical Electronics Department, Government Polytechnic, Hisar, Haryana.
11. Dr. Balwinder Singh, Joint Director, Centre for Development of Advanced Computing, Mohali.
12. Sh. Jatin Kumar, Consultant, Biomedical Engineer, Rajasthan Medical Service Corporation, Jaipur.
13. Dr. Jaimala Jindal, Associate Professor, EE, Punjab Engineering College, Chandigarh.
14. Dr. Manish Kumar Jindal, CEO, Quality Control of India, NABET, Delhi.
15. Er. Kapil Kalra, Senior Biomedical Engineer, Fortis Hospital, Vasant Kunj, New Delhi.
16. Smt. Pushpa Rani, Senior Lecturer, Applied Science Department, Government Polytechnic, Sonipat, Haryana.
17. Smt. Krishna Bhoria, Lecturer, Applied Science Department, Government Polytechnic, Ambala, Haryana.

18. Smt. Preetpal Kaur, Guest Faculty, Applied Science Department, Government Polytechnic, Ambala, Haryana.
19. Ms. Monika, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla, Haryana.
20. Dr. Neena Sharma, English Department, MCM College, Chandigarh.
21. Dr. Bhajan Lal, Lecturer, Applied Science Department, Government Polytechnic, Sirsa, Haryana.
22. Sh. Anil Nain, Lecturer, Applied Science Department, Government Polytechnic, Hisar, Haryana.
23. Dr. Sarita Mann, Lecturer, Applied Science Department, Government Polytechnic, Ambala, Haryana.
24. Smt. Bindu Verma, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla, Haryana.
25. Dr. Pankaj Sharma, Professor, Applied Science Department, NITTTR, Chandigarh.
26. Dr. Ashok Kumar, Associate Professor, Applied Science Department, NITTTR, Chandigarh.
27. Mr. Satyawan Dhaka, Senior Lecturer, Applied Science Department, Government Polytechnic, Nilokheri.
28. Mrs. Sapna Sang, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla, Haryana.
29. Mr. Ravi Bansal, Lecturer, Applied Science Department, Government Polytechnic, Manesar, Haryana.
30. Mrs. Kiran, Lecturer, Applied Science Department, Government Polytechnic, Sonepat, Haryana.
31. Dr. Naveen Jha, Assistant Professor, Department of Mathematics, Government Engineering College, Bharatpur, Haryana.
32. Dr. KC Lachhwani, Assistant Professor, Applied Science, NITTTR, Chandigarh.
33. Dr. KG Srinivasa, Professor, Information Management & Emerging Engineering, NITTTR, Chandigarh.
34. Dr. Vidhi Grover, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla, Haryana.

35. Mr. Tavinder Singh, Lecturer, Applied Science Department, Government Polytechnic, Sirsa, Haryana.
36. Ms. Sunita Rani, Lecturer, Applied Science Department, Government Polytechnic, Ambala, Haryana.
37. Mr. Subhash Chandra Bhoria, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Hisar, Haryana.
38. Mr. Jagjit Singh Narang, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Ambala, Haryana.
39. Mr. Pardeep Kumar, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Nilokheri, Haryana.
40. Dr. Balwinder Singh Dhaliwal, Associate Professor, Electronics and Communication Department, NITTTR, Chandigarh.
41. Dr. Rajesh Mehra, Professor and Head, Curriculum Development Centre, NITTTR, Chandigarh.
42. Dr. AB Gupta, Professor and head, Education & Educational Management Department, , NITTTR, Chandigarh.
43. Er. PK Singla, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.
44. Dr. SK Gupta, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.
45. Dr. Meenakshi Sood, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.

Coordinator

27. APPENDIX

Sr.No.	LIST OF EQUIPMENT
1	Human skeleton Model (Articulated)
2	Compound Microscope
3	Anatomical Models for Human Cardiovascular system
4	Anatomical Models for Human Respiratory system
5	Anatomical Models for Human Digestive system
6	Anatomical Models for Human Excretory system
7	Anatomical Models for Human Nervous system
7	Human skeleton Model (Articulated)
8	Human skeleton Model (Disarticulated)
9	Binocular Compound Microscope
10	Multichannel ECG machine with its accessories
11	12 Lead ECG Simulator
12	12 Lead ECG Simulator Trainer kit
13	ECG cum Heart rate Monitor Trainer kit
14	EEG simulator Trainer kit
15	Heart rate measurement Trainer kit
15	Blood Pressure Measurement Trainer kit
17	Blood Pressure Monitor (Manual)
18	Blood Pressure Monitor (Digital)
19	Digital Glucometer
20	Finer-tip Pulse oximeter
21	Table top pulse oximeter
22	Multi Parameter Monitor
23	Multi Parameter Monitor Trainer kit
24	EMG Trainer kit
25	Cardiac Pacemaker simulator Trainer kit
26	Syringe Pump
27	Infusion Pump
28	Oxygen concentrator

29	Autoclave
30	Demo X-ray machine
31	Cardiac defibrillator & its accessories
32	Defibrillator electrodes
33	Suction Machine
34	Operation theatre Table
35	Operation theatre Table
36	Intensive care ICU Ventilator & its accessories
37	Anesthesia workstation
38	Tread Mill Testing machine
39	Photo-colorimeter
40	Spectrophotometer
41	Flame photometer
42	Auto Analayzer
43	Digital pH Meter
44	Blood cell counter
45	IV Stand
46	Haemoglobinometer
47	Electric centrifuge
48	TENS machine
49	Shortwave Diathermy unit
50	Microwave Diathermy unit
51	Ultrasonic Diathermy unit
52	Hydrocollator Unit
53	CPM traction machine
54	Inter-ferential Therapy (IFT) Unit
55	Electrosurgical Unit
56	Radiant warmer


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