SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
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DEPARTMENT OF BIOMEDICAL ENGINEERING

BOARD OF STUDIES - 2020

Minutes of the Meeting

26-06-2020

1. As per discussion with the BOS members the new subject Industry 4.0 introduced in the fourth semester for second year B.Tech (Biomedical Engineering) 2019-2023 batch, the members suggested that few lecture topics can be taken by the industrial experts and they can share their industrial knowledge to student for motivating them to implement in mini project.

2. The Courses SBM1201 (Bioinstrumentation & measurements) & SBM1202 (Biosensors & transducers) has be merged into SBMA1301 (Biosensors & Measurements). The curriculum has been designed as per the industrial demands as suggested by the alumni.

3. SBMA1404 (Radioimaging & Therapeutics) few topics has been included in order to meet the relevant to the latest technologies as suggested by the industrial experts.

4. SBMA3004 (Analytical Instrumentation) Unit IV has been completely revised with Centrifugation, taking into consideration of the prerequisite knowledge of basic concepts in research and feedback obtained from students and faculty members in that subject.

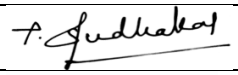
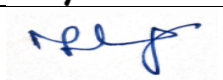
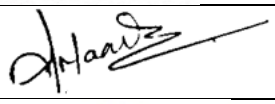
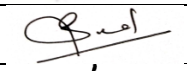
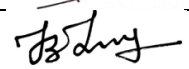
5. The Board ofMembers suggested that work shop, engineering drawing syllabus content were correlating on par to the demand of Biomedical engineering domain.

Members of Board of studies – Biomedical Engineering

EXTERNAL MEMBERS

1. Dr. **G. Harikrishnan**,
   Associate Professor & Research Coordinator,
   Department of Electrical & Electronics Engg.,
   Sree Vidyanikethan Engg. College, Tirupati
2. Dr. **C.M. Sujatha**,
   Associate Professor,Department of ECE, Anna University, Chennai

INTERNAL MEMBERS

S.No.	Name of the Internal Member	Signature
1	Dr. T. Sudhakar,HoD	
2	Dr. J. Premkumar	
3	Dr. Anima Nanda	
4	Dr. S. Krishnakumar	
5	Ms. Sindu Divakaran	
6	Ms. Bethanney Janney	
7	Mr. G. Umashankar	

S.No.	Course Code	Course Name	Deleted Topics	Added Topics
1	SBM1201	Bioinstrumentation & Measurements	**Unit 2,3,4**	**Unit 1 & 5 combined as a single unit 1**
2	SBM1202	Biosensors & transducers	**NIL**	**Unit 1,2, 3 & 5 combined as a Unit 2,3,5**
3	SBMA1301	Biosensors & Measurements	**NIL**	Biological Sensors: Study of various corpuscles like Pacinian, functions and modelling, Chemoreceptor, hot and cold receptors, baro-receptors, sensors for smell, sound, vision, osmolality and taste. Biosensors: Introduction, Advantages and limitations, various components of Biosensors, Biocatalysts based biosensors, bio-affinity based biosensors & microorganisms based biosensors, Types of membranes used in biosensor constructions, Electronic Nose – Unit 4
4	SBMA1404	Radioimaging & therapeutics	**NIL**	collimators, grids - bucky grids, Body section radiography, Xeroradiography Cine Angiography, Digital subtraction Angiography. Mammography and Dental x-

				ray unit
5	SBMA3004	Analytical Instrumentation	**Unit IV - Microscope and its types**	**Unit IV – Centrifugation & its types**
6	SEC1217	Basic Electronic Devices	**Unit 1** **Unit 2 -** **Transistor as a switch basewidth modulation** **Transistor breakdown applications** **Unit 5**	**Display devices – LED Laser diodes JFET,MOSFET,UJT, Thyristor, IGBT**
7	SEC1219	Linear Electronic Circuits	**Unit 1** **Unit 2 – Stability factor analysis** **Unit 3 distoration in amplifier medical applications** **Unit 5 – multivibrators**	**MOSFET, small signal analysis gain & frequency response** **Bismos cascade amplifier, differential amplifier common and differentmode analysis**
8	SBMA1305	Basic Electronic Devices, circuits& its applications		**Display devices – LED Laser diodes JFET,MOSFET,UJT, Thyristor, IGBT MOSFET, small signal analysis gain & frequency response** **Bismos cascade amplifier, differential amplifier common and differentmode analysis**

***SBM1201 (**Bioinstrumentation & Measurements), ***SBM1202** Biosensors & transducers **has been revised as a single course *SBMA1301 (Biosensors & Measurements)**
***SEC1217 (**Basic Electronic devices), ***SEC1219 (**Linear Electronics Circuits0) **has been revised as a single course *SBMA1305 (**Basic Electronic Devices, circuits & its applications)
Unit 2,3,4 - Deleted topics
***Unit 1, 2, 3 & 4 combined as a Unit 2,3,5 – Added topics**

SEC1217	BASIC ELECTRONIC DEVICES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To help the student understand the basics of the principles of circuit analysis and design
- To understand the basic concepts and characteristics of the electronic devices and circuits.

UNIT 1 SEMICONDUCTOR DIODE 9 Hrs.

Intrinsic and Extrinsic semiconductor, PN junction Diode: Construction, Working and VI Characteristics, Junction capacitance: Diffusion Capacitance and Transition Capacitance, Application of diode: Diode switch, Clipper, Clamper and Voltage multipliers - Zener diode - Zener voltage regulators. Applications - Devices - number

UNIT 2 BIPOLAR JUNCTION TRANSISTOR 9 Hrs.

Construction and Operation of NPN and PNP transistor - Characteristics of Common Base, Common Emitter and Common collector configuration, Transistor as Switch, Base width modulation, Transistor breakdown. Applications - Devices - number - examples.

UNIT 3 FIELD EFFECT TRANSISTOR 9 Hrs.

JFET: Construction, Operation and Characteristics, Expression for pinch off voltage and drain current, MOSFET: Enhancement mode and Depletion mode MOSFET operation and characteristics, handling precautions of MOSFET, FET as VVR - Comparison of MOSFET and JFET - Comparison of BJT and JFET.

UNIT 4 SPECIAL SEMICONDUCTOR DEVICES 9 Hrs.

SCR - UJT - DIAS - TRIAC - Varactor diode - PIN diode - Principle of photo electronic devices - Solar cell, Photo diode and Photo transistor - LED, LCD, LASER diode, CCD - Operation, Characteristics and Applications. Circuits

UNIT 5 PRINCIPLES OF CRT 9 Hrs.

Force on charged particle in electric field and magnetic field - Motion of charged particle in electric and magnetic field - Principles of CRT - Deflection and focusing of electron beam in CRT and TV picture tube-Orientation of electric and magnetic field in CRT - Applications of CRO.

Max. 45 Hours

Course Outcomes:

At the end of the course, the student should be able to:

CO1: To analyze the working and applications of different Semiconductor devices.
CO2: To compare the different characteristics of NPN,PNP and their different configurations
CO3: To Compare the various characteristics of Field Effect Transistors
CO4: To Analyze the operations of thyristor family and Photo- Electronic Devices
CO5: To apply the knowledge of working of Cathode Ray Tube in various measurements
CO6: To choose the particular semiconductor device for the desired application

TEXT / REFERENCE BOOKS

1. Millman and Halkias, Electronic devices and circuits, 2nd Edition, McGraw Hill Publication, 2007.
2. G.K.Mithal, Basic Electronic Devices and circuits, 2nd Edition, G.K.Publishers Pvt. Ltd., 1998.
3. David Bell,Fundamentals of Electronic Devices and Circuits, 5th Edition, Oxford University Press 2008.
4. Robert L. Boylestad, Electronic Devices and Circuit Theory, 6th Edition, PHI, 1998.
5. Ben G Streetman and Sanjay Banerjee, Solid State Electronic Devices, 6th Edition, Pearson Education, 2005.
6. Roody and Coolen, Electronic Communications, 4th Edition, Pearson Education, Reprint 2007.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SEC1219	LINEAR ELECTRONIC CIRCUITS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To familiarize the student with the analysis and design of basic transistor amplifier circuits, feedback amplifiers, wave shaping and multi vibrator circuits as applicable to design medical instruments

UNIT 1 RECTIFIERS AND POWER SUPPLIES 9 Hrs.

Half Wave and Full Wave Rectifier, Bridge rectifier - performance measures of rectifiers, filters: Full Wave rectifier with inductive filter, capacitive filter, LC filter, Regulators-Shunt and series voltage regulators - Performance measures of regulators - Simple power supply circuits for medical instruments.

UNIT 2 BIASING CIRCUITS AND SMALL SIGNAL BJT AMPLIFIERS 9 Hrs.

Biasing circuit of BJT, DC equivalent circuit of BJT, DC and AC Load Lines, Stability factor analysis, Small Signal Equivalent circuit - Calculation of gain, Input and Output Impedance of CB, CC and CE amplifiers using h- Parameters.

UNIT 3 MULTISTAGE AMPLIFIERS AND POWER AMPLIFIERS 9 Hrs.

Introduction to multistage amplifiers, Two stage RC Coupled amplifier, Darlington emitter follower amplifier, Bootstrap amplifier Introduction, Power Amplifiers: Class A Power Amplifier, Push Pull Principle, Class B push pull amplifier and complementary symmetry amplifier, Class C amplifier, Distortion in amplifiers - Medical applications.

UNIT 4 FEEDBACK AMPLIFIERS AND OSCILLATORS 9 Hrs.

Effects of negative feedback, Voltage series, voltage shunt, current series and current shunt feedback amplifiers, Barkhausen Criterion for Oscillation, Construction and working of RC, Wein bridge oscillator, Hartley Oscillator, Colpitts Oscillator, Crystal Oscillator - Medical applications

UNIT 5 TUNED AMPLIFIERS AND MULTIVIBRATORS 9 Hrs.

Single tuned amplifier, Stagger tuned amplifier, Tuned amplifier instability, Neutralization and Unilateralization, Multivibrators: Astable, Bi stable and monostable multivibrators.

Max. 45 Hours

Course Outcomes:

At the end of the course, the student should be able to:

CO1: Compare the various types of Rectifiers, Filters and regulators
CO2: Analyze the Hybrid model equivalentcircuit and small signal analysis ofamplifiers and Categorize the Biasing circuits of theTransistor
CO3: Analyze and Design multistage and power amplifiers
CO4: Design of Feedback Amplifiers And Oscillators
CO5: Design the different types of Tuned amplifiers and functioning of Multivibrator circuits
CO6: Construct the circuits for medical applications

TEXT / REFERENCE BOOKS

1. Robert L. Boystead and Louis Nashelky, Electronic Devices and Circuits, 8th Edition, PHI, 2005.
2. Theodore F. Bogart Jr., Jeffrey S. Beasley, Guillermo Rico, Electronic devices and circuits, PPH, 2004.
3. Millman & Halkias, Integrated Electronics, McGraw Hill International Edition. 1991
4. David A. Bell, Electronic Devices and Circuits, PHI, 2004

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBMA1305	BASIC ELECTRONIC DEVICES, CIRCUITS AND ITS APPLICATIONS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES:

The objective of this course is to expose the student to gain knowledge on semi conductor devices such as diode, transistor etc and to understand the analysis of different circuits like amplifier, oscillator etc.

UNIT I PN JUNCTION DEVICES

PN junction diode –structure, operation and V-I characteristics, diffusion and transient capacitance - Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes- Zener diode characteristics-Zener Reverse characteristics – Zener as regulator

UNIT II TRANSISTORS

BJT, JFET, MOSFET - structure, operation, characteristics and Biasing, UJT, Thyristor and IGBT - Structure and characteristics.

UNIT III AMPLIFIERS

BJT small signal model – Analysis of CE, CB, CC amplifiers-Gain and frequency response – MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS

Advantages of negative feedback – voltage / current, series / shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

On completion of this course the student will be familiar with

CO1: understands the characteristics of semiconductor diode and the design concepts of Rectifiers and Regulators.
CO2: explores the characteristics and biasing of various transistors.
CO3: explains the design and analysis of different amplifiers
CO4: interpretes the Frequency response of multistage and differential amplifiers
CO5: explains the importance of Tuned and power amplifier and its efficiency
CO6: analyse the effects of feedback on amplifier circuit and analysis of feedback amplifier and oscillators

Reference Books:

1. Electronics Principles by Albert Malvino [seventh Edition]
2. Electronics Device and circuits by S Salivahanan and N Suresh Kumar, McGraw Hill Publication [Second Edition or Higher Edition].
3. Electronics Device and circuits by Jacob Milman and Christos C. Halkias, Tata Macgraw Hill Publication [Second Edition].
4. Basic Electronics devices and Circuits by Mahesh B Patil, PHI Learning PVT. Ltd.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam duration:3Hrs.**

PARTA:10 questions of 2marks each- No choice **20 Marks**

PARTB: 2 questions from each unit of internal choice; each carrying 16 marks 80 **Marks**

SBM1202	BIOSENSORS AND TRANSDUCERS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To enable the student to gain knowledge about the measuring instruments and the methods of measurements
- To know about the types of transducers available and their applications in different fields.

UNIT 1 INTRODUCTION **9 Hrs.**

General measurement system - purpose, structure and elements-Transucers - Definition, Classification. Resistance type- strain gauges, thermometers, potentiometers. Capacitive type, Inductive type- variable reluctance and LVDT. Biomedical Applications.

UNIT 2 TRANSDUCERS **9 Hrs.**

Temperature transducers, Piezoelectric transducers, Piezo resistive transducers, Photoelectric transducers, Pressure transducers, Magnetostrictive transducers Biomedical applications.

UNIT 3 BIOPOTENTIAL ELECTRODES **9 Hrs.**

Half cell potential (or) Electrode potential, Types of Electrodes - Micro electrodes, Depth and needle electrodes, Surface electrodes, and Chemical electrodes. Catheter type electrodes, stimulation electrodes, electrode paste, electrode material.

UNIT 4 BIOSENSORS **9 Hrs.**

Introduction, biological elements, immobilization of biological components. Micro machined biosensor - cantilever based chemical sensors - Biosensors for diabetes mellitus, FAB. Biochip - introduction, gene chip.

UNIT 5 APPLICATIONS OF BIOSENSORS **9 Hrs.**

ISFET for glucose and urea. IMFET, MOSFET biosensors, affinity biosensor (catalytic biosensor), Enzyme electrodes, Ion exchange membrane electrodes.

Max. 45 Hours

Course Outcomes:

At the end of the course, the student should be able to:

CO1: Attain adequate knowledge about the measuring instruments used for measurement and detection of physical quantities

CO2: Identify the characteristics of various transducers and classify transducers

CO3: Attain adequate knowledge about the various electrodes and chemical sensors used for measurement and detection of physical quantities.

CO4: Apply the suitable design criteria for developing a Biosensor for a particular application.

CO5: Demonstrate the appropriate sensor approach which is most likely to meet a specific biosensor application

CO6: Predict the qualitative performance of advanced medical sensor.

TEXT / REFERENCE BOOKS

1. H.S. Kalsi, Electronic Instrumentation & Measurement, Tata McGraw HILL, 1995.
2. Brain R Eggins, Biosensors: An Introduction", John Wiley Publication.1996.
3. A. K.Sawhney, A course in Electronic Measurements and Instruments, Dhapat Rai & sons, 1991
4. John G Webster, Medical Instrumentation: Application and design, John Wiley Publications.2007.
5. John P Bentley, Principles of Measurement Systems, 3rd Edition, Pearson Education Asia, (2000 Indian reprint)
6. Geddes and Baker, Principles of Applied Biomedical Instrumentation, John Wiley Publications. 1975.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBM1201	BIOINSTRUMENTATION AND MEASUREMENTS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To study the static and dynamic behavior of analog and digital instruments and basic construction and working of AC and DC instruments for measurement of Voltage and Current.
- To obtain basic knowledge of digital instruments for measurement of voltage and current.
- To study signal generator and signal analysis. Also to study the different output devices analog and digital recorders.

UNIT 1 INTRODUCTION 9 Hrs.

Function elements of measuring instrument, Error in Measurement, Sources of Error, Static Characteristics: Accuracy, Sensitivity, Reproducibility, Drift, Static error types and Dead zone, Dynamic Characteristics: Speed of Response, Fidelity, Lag and Dynamic Error, Dynamic response of different order systems, Statistical Analysis: Mean, Deviation, Average deviations and Standard deviations, Measurement Standards, Bridge Circuits: Wheatstone bridge, Maxwell's bridge and Wein's bridge.

UNIT 2 BASICS OF ANALOG INSTRUMENTS 9 Hrs.

D'arsonval Galvanometer, Moving coil Instruments: Permanent magnet moving coil instrument, PMMC ammeter and PMMC voltmeter, Ohmmeter: Shunt type and Series type. Moving iron instruments: Attraction type, Repulsion type, MI Ammeter and MI Voltmeter, Electrodynamometer type instruments: Basic Electrodynamomter type instrument, Electrodynamometer type Ammeter and Electrodynamometer type voltmeter **-** Construction and working principle.

UNIT 3 BASICS OF DIGITAL INSTRUMENTS 9 Hrs.

Comparison between analog and digital instruments, Basic building block of a digital instrument, Ramp type digital voltmeter, Digital frequency meter, Digital phase meter and Digital storage oscilloscope.

UNIT 4 SIGNAL GENERATION AND SIGNAL ANALYSIS 9 Hrs.

Standard signal generator, AF Sine and square wave generator, Function generator, RF generator, Basic Wave Analyzer, Heterodyne wave analyzer Spectrum analyzer and Harmonic distortion analyzer.

UNIT 5 DISPLAY DEVICES AND RECORDERS 9 Hrs.

Digital Display System and Indicators: Classification of display devices, DOT MATRIX display, LED Seven Segment display, LED matric display, LCD seven segment display, Recorders: Graphic Recorders - Strip chart recorders, Galvanometer type recorders and Self balancing type potentiometric recorders, Magnetic tape recorders and Disc recorders.

Max. 45 Hours

Course Outcomes:

At the end of the course, the student should be able to:

CO1: Analyze the different characteristics of measuring instruments
CO2: Compare the working of few analog instruments that are used measure current, voltage and resistance
CO3: Apply the knowledge of working of digital instruments to measure digital parameters.
CO4: Choose proper device to generate or analyze signals.
CO5: Select instruments suitable for display and recording.
CO6: Choose a device for measuring a parameter or analyze a signal or display a measurement.

TEXT / REFERENCE BOOKS

1. A. K. Sawhney, A course in electronic Measurements and Instruments, Dhanpat Rai sons, 1991.
2. H.S. Kalsi, Electronic Instrumentation & Measurement, Tata McGraw HILL, 1995
3. W.D cooper and A. D. Helfrick, Electronic Instruments and Measurements Techniques, Prentice Hall of India-1991
4. E. O. Doeblin, Measurement System **-** Application & Design, Mc Graw Hill, 1990

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBMA1301	BIOSENSORS AND MEASUREMENTS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To provide the basics of measurements, knowledge on the principle and operation of different medical transducers.
- To introduce the application of sensors and transducers in the physiological parameter measuring system.

UNIT I MEASUREMENT SYSTEM 9 Hrs

Measurement System – Functional elements of an instrumentation system - Static and Dynamic Characteristics - Errors in Measurements and their statistical analysis – Calibration - Primary and secondary standards. Bridge Circuits: Wheatstone bridge, Maxwell's bridge, Wein's bridge and Schering bridge.

UNIT II PASSIVE AND ACTIVE TRANSDUCERS 9 Hrs

Classification of transducers and characteristics for selection of transducers - Resistive transducers-Strain Gauge, Capacitive transducer - various arrangements, Inductive transducer, LVDT, Passive types: RTD materials & range, relative resistance vs. temperature characteristics, thermistor characteristics, Active type: Thermocouple - characteristics. Piezoelectric active transducer- Equivalent circuit and its characteristics. photo multiplier tube (PMT), photovoltaic, photo conductive cells, photo diodes, phototransistor, Optical displacement sensors and optical encoders.

UNIT III BIO POTENTIAL ELECTRODES AND CHEMICAL SENSORS 9 Hrs

Electrodes Electrolyte Interface, Half-Cell Potential, Polarization, Polarizable and Non Polarizable, Electrodes, Reference Electrode, Hydrogen Electrode, Electrode Skin-Interface and Motion Artifact. Surface Electrodes. Oxygen electrodes, CO_2 electrodes, enzyme electrode, construction, ISFET for glucose, urea etc. fiber optic sensors.

UNIT IV BIOSENSORS 9 Hrs

Biological Sensors: Study of various corpuscles like Pacinian, functions and modelling, Chemoreceptor, hot and cold receptors, baro- receptors, sensors for smell, sound, vision, osmolality and taste.

Biosensors: Introduction, Advantages and limitations, various components of Biosensors, Biocatalysts based biosensors, bio-affinity based biosensors & microorganisms based biosensors, Types of membranes used in biosensor constructions, Electronic Nose.

UNIT V DISPLAY AND RECORDING DEVICES 9 Hrs

Digital Display System and Indicators: Classification of display devices, DOT Matrix display, Digital voltmeter, Multimeter, Digital storage oscilloscope, LCD monitor, PMMC writing systems. Recorders: Graphic recorders,strip chart recorders, Galvanometer type recorders and self balancing type potentiometric recorders, Magnetic tape recorders and Disc recorders. **Max. 45 Hrs**

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: understand the calibration procedure for the basic instruments involved in physiological parameter measurement.

CO2: identify the characteristics of various transducers and classify transducers.

CO3: Attain adequate knowledge about the various sensors and measuring instruments used for measurement and detection of physical quantities.

CO4: Demonstrate the concepts, types, working and practical applications of important biosensors.

CO5: Apply the suitable design criteria for developing a medical sensor for a particular application.

CO6: Employ Multimeter, CRO and different types of recorders for appropriate measurement.

TEXT / REFERENCE BOOKS

1. A. K. Sawhney, A course in electronic Measurements and Instruments, Dhanpat Rai sons, 2014
2. H.S. Kalsi, Electronic Instrumentation & Measurement, Tata McGraw HILL, 2011
3. John G. Webster, —Medical Instrumentation Application and Designll, 4th edition, Wiley India Pvt Ltd,New Delhi, 2015.
4. Transducers for Biomedical Measurements: Principles and Applications, Richard S.C. Cobbold, John Wiley & Sons, 2004.
5. Electronics in Medicine and Biomedical Instrumentation by Nandini K. Jog PHI Second Edition 2013.
6. Biomedical sensors – fundamentals and application by Harry N, Norton. 2001
7. Biomedical Transducers and Instruments, Tatsuo Togawa, Toshiyo Tamma and P. Ake Öberg, 2018

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SBM1205	RADIO IMAGING AND THERAPEUTICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To obtain the knowledge about the specialty of medicine those deals with the study and application of imaging technology and enable the students to understand about radiation therapy and effects of radiation.

UNIT 1 ELEMENTS OF RADIATION 9 Hrs.

Radioactive elements and Radioisotopes in medicine, Radioactivity, General properties of alpha, beta and gamma rays - Laws of radioactivity, Radioactive decay - alpha decay, beta decay, positron decay, decay energy and half-life. Radiation units-Roentgen, Rad - rem - sievert. Radiation sources - Natural and artificial radioactive sources.

UNIT 2 RADIATION GENERATORS 9 Hrs

Particle Accelerators- Cyclotron, Klystron, Magnetron, Cascade generator, Van De Graff generator X ray films, X ray film processing, X Ray cassettes, Intensifying screens-New phosphor technology, Photostimulable phosphor imaging.

UNIT 3 RADIO DIAGNOSIS 9 Hrs.

Fluoroscopy, Digital radiography, Angiography, Image intensifier, PET, SPECT, collimators, grids - bucky grids, Body section radiography, Xeroradiography

UNIT 4 RADIOTHERAPHY 9 Hrs

COBALT-60, Linac, Gamma camera, Nuclearscintigraphy, Brachytherapy, Cyber Knife, Gamma knife, Intraoperative radiotherapy

UNIT 5 RADIATION SAFETY MEASURES 9 Hrs.

Radiation Protection, Protective barrier-primary& secondary, Equivalent Dose, Biological effects of radiation, Somatic & genetic effects of radiation-LD 50/30, Effect of radiation on skin, blood forming organs, Personnel and area monitoring systems, Radiation measuring devices -dosimeter, survey meter.

Max. 45 Hours

Course Outcomes:

At the end of the course, the student should be able to:

CO1: Understanding the elements of radiation and radioactive decay involved in radiation therapy

CO2: Illustrate the working principle of radiation generators with the processing of X ray machine and its application

CO3: Understanding the technique of fluoroscopy and various radio diagnosis techniques

CO4: Demonstrate the applications of radiotherapy

CO5: Attain the adequate knowledge about radiation measurements and effect of radiation on body

CO6: Outline the methods of radiation safety.

TEXT / REFERENCE BOOKS

1. Thomas S. Curry, III, James E. Dowdey, Robert C. Murry J R., Christensen The Physics of Diagnostic Radiology Lea & Febiger 4th edition 1990.
2. Faiz M.Khan, The Physics of Radiation Therapy, 4th edition, 2009.
3. Gopal,B.Saha , Physics & Radiology of nuclear medicine, Springer 2nd Edition, 2006.
4. R.S Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw-Hill Publishing company Ltd, New Delhi, 1997.
5. K Thayalan, Basic Radiological Physics, Jaypee Brothers Medical Publishers (P) Ltd., 2001

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks : 80 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 12 marks **60 Marks**

SBMA1404	RADIO IMAGING AND THERAPEUTICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To provide the knowledge about the specialty of medicine in radiation therapy.
- To make the student understand about the application of imaging technology and effects of radiation

UNIT 1 ELEMENTS OF RADIATION 9 Hrs.

Radioactive elements and Radioisotopes in medicine, Radioactivity, General properties of alpha, beta and gamma rays - Laws of radioactivity, Radioactive decay - alpha decay, beta decay, positron decay, decay energy and half-life. Radiation units-Roentgen, Rad - rem - sievert. Radiation sources - Natural and artificial radioactive sources.

UNIT 2 RADIATION GENERATORS 9 Hrs

Particle Accelerators- Cyclotron, Klystron, Magnetron, Cascade generator, Van De Graff generator X ray films, X ray film processing, X Ray cassettes, Intensifying screens-New phosphor technology, Photostimulable phosphor imaging. collimators, grids - bucky grids, Body section radiography, Xeroradiography

UNIT 3 RADIO DIAGNOSIS 9 Hrs.

Fluoroscopy – Digital Fluoroscopy. Angiography, Cine Angiography, Digital subtraction Angiography. Mammography and Dental x-ray unit. Digital radiography, Angiography, Image intensifier, PET, SPECT,

UNIT RADIOTHERAPHY 9 Hrs

COBALT-60, Linac, Gamma camera, Nuclear scintigraphy, Brachytherapy, Cyber Knife, Gamma knife, Intraoperative radiotherapy

UNIT 5 RADIATION SAFETY MEASURES 9 Hrs.

Radiation Protection, Protective barrier-primary& secondary, Equivalent Dose, Biological effects of radiation, Somatic & genetic effects of radiation-LD 50/30, Effect of radiation on skin, blood forming organs, Personnel and area monitoring systems, Radiation measuring devices -dosimeter, survey meter.

Max. 45 Hours

Course outcomes:

On completion of the course students will be able to:

CO1: Understanding the elements of radiation and radioactive decay involved in radiation therapy

CO2: Illustrate the working principle of radiation generators with the processing of X ray machine and its application

CO3: Understanding the technique of fluoroscopy and various radio diagnosis techniques

CO4: Demonstrate the applications of radiotherapy

CO5: Attain the adequate knowledge about radiation measurements and effect of radiation on body

CO6: Outline the methods of radiation safety.

TEXT / REFERENCE BOOKS

1. Thomas S. Curry, III, James E. Dowdey, Robert C. Murry J R., Christensen The Physics of Diagnostic Radiology Lea & Febiger 6th edition 2008.
2. Faiz M.Khan, The Physics of Radiation Therapy, 4th edition, 2009.
3. Gopal,B.Saha , Physics & Radiology of nuclear medicine, Springer 2nd Edition, 2006.
4. R.S Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw-Hill Publishing company Ltd, New Delhi, and revised edition 2007.
5. K Thayalan, Basic Radiological Physics, Jaypee Brothers Medical Publishers (P) Ltd., revised edition 2005.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks : 100 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 16 marks 80 **Marks**

SBM1302	ANALYTICAL INSTRUMENTATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- Thecourseoffersawideportfolioofstudyprogramsintheareasoftechnology,engineeringandotherapplication fields.
- It provides an introduction to the fundamental principles of chemical measurement used in medical diagnosis, qualityassuranceandcontrolandresearchstudies.
- It helps understand and appreciate the role of instruments in solving problems in physical, chemicaland Biological source and discover the impact of the relevant scientific and technological advancements.

UNIT1 SPECTROPHOTOMETER 12Hrs

Analyticalmethodsandinstrumentationtypes,Electromagneticspectrum,Interactionofradiationwithmatter, Absorption spectra, Beer-Lambert's Law. Spectrophotometers: UV and visible ranges, single and Double Beam Instruments,FTIRandRamanSpectra-Basicprinciples,biomedicalapplications.

UNIT2 MASS SPECTROPHOTOMETER ANDRADIOCHEMICALINSTRUMENTS12Hrs.

Spectrofluorimeter,Flamephotometry-flameemissionspectrometer,atomicabsorptionspectrometer,Mass Spectrometer - Magnetic deflection - Time of flight - quadrupole - GCMS - Basic Principles and biomedical applications. Radiochemical Analytical Instruments - Radiation types - Ionization chamber - GM Counter - Proportionalcounter.

UNIT3 AUTOMATED BIOCHEMICAL ANALYZERANDELECTROPHORESIS12Hrs.

Systemconcepts-systemcomponents-samplercontrolunits-samplingmechanisms,dialyzer-samac-II, PrinciplesofElectrophoresis,Paperelectrophoresis,AgaroseGelElectrophoresis,Isoelectricfocusing,SDSPAGE, Pulse FieldElectrophoresis

UNIT4 MICROSCOPICTECHNIQUESANDGASANALYZER12Hrs.

Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic force Microscopy (AFM)andScanningTunnelingMicroscopy(STM),XrayDiffraction(XRD)-BasicPrinciplesandApplications,Gas Analyzers:ParamagneticOxygenAnalyzer,FlowAnalyzer-Ultrasound&NMRBloodflowanalyzer.

UNIT5 CHROMATOGRAPHY 12Hrs.

Principles,Typesofchromatography-PaperChromatography,ThinLayerChromatography,Column Chromatography, Ion exchange Chromatography, Gel permeation Chromatography, Gas Chromatography - High PressureLiquidChromatography-applicationsinbiomedicalfield.

Max. 60 Hours.

Course Outcomes:

At the end of the course, the student should be able to:

CO1-Understands the elements of UV visible radiation and to characterize their spectrum analysis

CO2-Illustrates the working principle emission of mass spectrum and radiation chamber

CO3-Explore the knowledge of electrophoresis and analyser to separate the constituents from a complex mixture

CO4-Analyse the working mechanism and correlate it with types of electron microscope

CO5-Determines the oxygen level using gas analyser by applying both electrostatic and magnetic properties.

CO6-Compares the types of chromatography and their importance and applications in biomedical field

TEXT / REFERENCE BOOKS

1. D.A.Skoog,F.J.Holler&T.A.Nieman,PrinciplesofInstrumentalAnalysis,5th Edition,1998.
2. WilliardH.H.,Merrit,DeanJ.A,SeattleF.L,CBS,InstrumentalMethodsofAnalysis,1995.
3. EwingG.W.,InstrumentalMethodsofAnalysis,McGrawHill,1992.
4. RobertD.BraunIntroductiontoInstrumentalAnalysis,McGrawHill,1987.
5. R.S.Khandpur,AHandbookofAnalyticalInstrumentation,2nd EditionTataMcGrawHillPublication,2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:80 **ExamDuration:3Hrs.**

PARTA:10questionsof2markseach-Nochoice**20Marks**

PARTB:2questionsfromeachunitofinternalchoice;eachcarrying12marks**60Marks**

SBMA3004	ANALYTICAL INSTRUMENTATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- The course offers a wide portfolio of study programs in the areas of technology, engineering and other application in biomedical fields.
- It provides an introduction to the fundamental principles of chemical measurement used in medical diagnosis, quality assurance and control and research studies.

UNIT 1 SPECTROPHOTOMETER 9 Hrs

Electromagnetic spectrum, interaction of radiations with matter, absorption spectra beer lamberts law, spectrophotometer uv and visible ranges, single and beam instruments, FTIR and raman spectra. spectroflourimeter, flame photometry, flame emission , atomic absorption spectrometer. Basic principles and biomedical applications.

UNIT 2 MASS SPECTROPHOTOMETER AND RADIOCHEMICAL INSTRUMENTS 9 Hrs.

Mass spectrometer, magnetic detection, time of flight, quadruple mass spectrophotometer, GCMS, LCMS, Basic principle biomedical applications. Radiochemical analytical instruments Radiation types ionization chamber, GM counter, proportional counter Liquid scintillation and applications.

UNIT 3 AUTOMATED BIOCHEMICAL ANALYZER AND ELECTROPHORESIS 9Hrs.

System concept , system components, sampler control units , sampling mechanism , dialyser, SAMACII .Principle of electrophoresis paper electrophoresis agarose gel electrophoresis Iso electric focussing , SDS page, pulse field electrophoresis and its applications

UNIT 4 CENTRIFUGATION AND GAS ANALYZER 9 Hrs.

Basic principles of centrifugation, instrumentation types, centrifugation preparative, differential centrifugation, density gradient centrifugation, Isopycnic centrifugation, Analytical centrifugation Basic principles and biomedical applications. Gas analyser paramagnetic oxygen analyzer

UNIT 5 CHROMATOGRAPHY 9 Hrs.

Principles types of chromatography, paper chromatography, thin layer chromatography ,column chromatography, ion exchange chromatography, gel permeation chromatography, high pressure liquid chromatography ,HPTLC and applications in biomedical.

Max. 45 Hours.

Course outcomes

On completion of the course, student will be able to

CO1: Understands the elements of UV visible radiation and to characterize their spectrum analysis
CO2: Illustrates the working principle emission of mass spectrum and radiation chamber
CO3: explore the knowledge of electrophoresis and analyser to separate the constituents frpm a complex mixture.
CO4: Analyse the sedimentation coefficient of the sample using centrifuge.
CO5: determines the oxygen level using gas analyser by applying both electrostatic and magnetic properties.
CO6: Compares the types of chromatography and their importance and applications in biomedical field.

TEXT / REFERENCE BOOKS

1. D.A. Skoog, F.J. Holler & T.A. Nieman, Principles of Instrumental Analysis, 5th Edition, 2008.
2. Williard H.H., Merrit, Dean J.A, Seattle F.L, CBS, Instrumental Methods of Analysis, 2005.
3. Ewing G.W., Instrumental Methods of Analysis, McGraw Hill, 2002.
4. Robert D. Braun Introduction to Instrumental Analysis, McGraw Hill, 2007.
5. R.S. Khandpur, A Handbook of Analytical Instrumentation, 2nd Edition Tata McGraw Hill Publication, 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration : 3 Hrs.**

PART A : 10 questions of 2 marks each - No choice **20 Marks**

PART B : 2 questions from each unit of internal choice; each carrying 16 marks **80 Marks**