The curriculum/courses are designed by the DAC (Departmental Advisory Committee) which are put before the BOS (Board of Studies) of the department. After incorporating the suggestions of BOS experts it is taken to Institute Senate. The program curriculum/courses are implemented after approval from the senate.

I. The courses and curriculum are improved on the basis of input from experts, industry and students of the program

II. New experiments are added in the lab every year for the better exposure of the students to upcoming instruments.

III. The students are also allotted new topics for their seminars as well as for minor and major projects.

IV. Feedback received from Students and alumni and subject experts.

Syllabus for each course of M. Tech (Instrumentation) program with title of course, course number, Contact hours, type of course, Course Assessment methods, Topics covered with Text books, and/or reference material are given as follows:

MASTER OF TECHNOLOGY(INSTRUMENTATION)

REVISED SCHEME OF EXAMINATION (FOUR SEMESTERS)

FIRST SEMESTER

S. No.	Course No.	Subject	Marks			Duration of End Sem. Exam	Schedule of Teaching			Credits
			End Sem Exam	Sessional	Total	Exam. Hours	L	T	P	
1.	PHY511T	Transducers	50	50	100	3	3	-	-	3
2.	PHY512T	Signal Processing	50	50	100	3	3	-	-	3
3.	PHY513T	X-rays and biomedical Instrumentation	50	50	100	3	3	-	-	3
4.	PHY514T (Elective)	Electro optical Instrumentation	50	50	100	3	3	-	-	3
5.	PHY515T (Elective)	High Vacuum Techniques	50	50	100	3	3	-	-	3
6.	PHY516P	Lab-I	40	60	100	4	-	-	-	2
7	PHY517S	Seminar				2	-	-	-	1
SECOND SEMESTER										
1.	PHY521T	Material Characterization Techniques	50	50	100	3	3	-	-	3
2.	PHY522T	Remote Sensing	50	50	100	3	3	-	-	3
3.	PHY523T (Elective)	Nuclear Instrumentation	50	50	100	3	3	-	-	3
4.	PHY524T (Elective)	Nano Sensors & Devices	50	50	100	3	3	-	-	3
5.	PHY525T (Elective)	Computer Technology	50	50	100	3	3	-	-	3
6.	PHY526P	Lab-II	40	60	100	4	-	-	-	2
7	PHY527S	Seminar				2	-	-	-	1
THIRD SEMESTER										
1.	Preparatory Work for Dissertation		-	-	-	-	-	-	20	10
FOURTH SEMESTER										
1.	Dissertation		-	-	-	-	-		32	16

MASTER OF TECHNOLOGY (INSTRUMENTATION)
1ST – SEMESTER

L	T			
3	0	Credits	:	03
		Sessional	:	50
Duration of Exam. 3 Hours		End Sem. Exam.	:	50
		Total	:	100

Transducers-PHY511T

Basic characteristics of measuring devices, Transducer classification Basic Requirements of a transducer

Displacement: Principles of Transduction, Resistive, Capacitive & Inductive transducers, LVDT, Hall Effect, Digital Transducers

Strain: Factors affecting Strain Measurements, Types of Strain Gauges, theory of Operation of resistance Strain Gauges, Types of electrical Strain Gauges, Materials for Strain Gauges, Gauging techniques, Strain Gauge Circuits, Temperature Compensation

Pressure: Transduction Methods, Diaphragms, Force-Balance Transducer, Piezoelectric Pressure Transducer, Vibrating Element Pressure Sensors

Flow: Classification of Flow meters, Head-Type of Flow Meters, Rotameter, Electromagnetic Flowmeter, Anemometers, Ultrasonic Flow Meter

Temperature: Temperature Scales, Resistance-Type Temperature sensors, Platinum Resistance Thermometer, Thermistors, Thermocouples, Solid-State Sensors, Quartz Thermometer, Temperature Measurement by Radiation Methods, Optical Pyrometer

Reference Books:

1. Instrument Science & Technology (Jones B.E. Adam Hilger**)**
2. Instrument Transducers: An introduction to their performance and design (Neubert H.K.P: Oxford)
3. Sensors and Transducers (Usher M.J: Macmillan)
4. Measurement Systems Application and design (Doebelin E.O: McGraw-Hill)
5. Principles of Measurement and Instrumentation (Marris A.S: Prentice Hall)
6. Instrumentation Devices systems (CS Rangan, GR Sharma and VS Mani, Tata Mcgraw)
7. Principles of Industrial Instrumentation (D. Patranabis Tata MC qraw)
8. Instrumentation Measurement and analysis (BC. Nakra, K.K. Chandhry Tata Mcgraw)

MASTER OF TECHNOLOGY (INSTRUMENTATION)
1ST – SEMESTER

L T				
3 0		Sessional	:	50
Duration of Exam. 3 Hours		End Sem. Exam.	:	50
		Total	:	100

SIGNAL PROCESSING- PHY512T

Signal conditioning - Active impedance Transformers, Low noise amplifiers, Chopper amplifiers, Instrumentation amplifier.

Signal Processing circuits - Phase sensitive detector, absolute value detector, Peak detector, RMS converter, Linearisation., Multiplier, Modulation and demodulation.

Passive and active filters. Practical circuits and their characteristics, Analog filters and their use in frequency selective amplifiers. Signal analysis and its applications, Signal-to-noise ratio enhancement.

Data acquisition and conversion. Multiplexing and demulti-plexing., D/A and A/D convertors.
Elements of digital signal Processing**.**

Reference Books:

1. Instrumentation Devices & Systems by C.S.Rangan, GR Sarma & VSV Mani
2. Operational amplifiers and linear integrated circuits by Robert F Coughlin and Frederick F Driscoll
3. An introdcation to the analysis and processing of signals by paul A Lynn
4. Special purpose amplifiers by BS Sonde
5. Operational amplifiers and linear integrated circuits by Ramakant A Gayakwad.

MASTER OF TECHNOLOGY (INSTRUMENTATION)
1st - SEMESTER

L	T			
3	0		Sessional	: 50
Duration of Exam.	3 Hours		End Sem. Exam.	: 50
			Total	: 100

Credits : 03

X-RAYS & BIOMEDICAL INSTRUMENTATION-PHY513T

BIOPOTENTIALS AND ELECTRODES: Origin of Bioelectric potentials. The electrode-electrolyte system. Polarization, polarizable and non-polarizable electrodes. Skin contact impedance. Electrodes for ECG, EEG & EMG, Microelectrodes.

BIOMEDICAL RECORDERS; Electrocardiograph, electroencephalograph & Electromyograph, Blood pressure measurement: direct and indirect methods.

BLOOD FLOWMETERS: Electromagnetic, Ultrasonic, NMR and Laser Doppler Blood flowmeters.

PULMONARY FUNCTION ANALYSERS: Respiratory volumes, wedge and ultrasonic spirometers. Fleisch pneumo-tachometer.

X-RAY IMAGING: X-ray machine. Image intensifiers & image noise. X-ray computed tomography. Emission computed tomography.

MAGNETIC RESONANCE IMAGING: MRI, Benefits and limitations of MRI

ULTRASOUND IMAGING AND THERAPY: Physics of ultrasonic waves. Generation, detection, absorption, reflection and diffraction of ultrasonic waves. Pulse echo system. Ultrasonic scanning: A-scanners & B-scanners. Real time ultrasonic imaging systems. Therapy with ultrasonic waves, Biological effects of ultrasonic waves.

RADIOTHERPY: Radiobiology and radiation physics treatment planning, Particle beam therapy (hadrontherapy), biological effects,
Dosimetry in modern radiation therapy, Dose measurement.

BOOKS SUGGESTED:

1. A handbook of Biomedical Instrumentation by RS Khandpur
2. Biomedical Instrumentation & Measurement by Leslie Cromwell, Fred J Weibell & Erich A Pfeiffer.
3. Medical Instrumentation: Application and Design by Webster.
4. Medicine & Clinical Engineering by Bertil Jacobson & John G Webster.

MASTER OF TECHNOLOGY (INSTRUMENTATION)
1st - SEMESTER

L	T			
3	0	Credits	:	03
		Sessional	:	50
Duration of Exam.	3 Hours	End Sem. Exam.	:	50
		Total	:	100

ELECTRO-OPTICAL INSTRUMENTATION- PHY514T

Sources of IR, Visible, UV radiations, Constant illumination sources. Characteristics of laser radiation, and Different types of lasers and their applications. Detectors for IR Visible and UV radiations.

Design criteria of Opto-electronic systems. Prism, Grating and Filter monochromators, Spectrophotometers, Colorimeters, Flame-Photometers, Flourimeters and Turbidity meters.

BOOKS SUGGESTED

1. Optoelectronios: An introduction by J. Wilson & JFB Hawkes
2. Principals of Illumination by H. Cotton
3. Textbook of Illuminating Engineering by T.W.T. Walsh
4. Photoelectronic devices by J.B.Danoe
5. Lasers and optical engineering by P.Das
6. Applied Optics and Optical Engineering Vol.V by Rudolf Kingslake
7. Instrumental methods of chemical analysis by Willard Meritt and Dean
8. Lasers by Ghatak & Thyagrajan

MASTER OF TECHNOLOGY (INSTRUMENTATION)
1st - SEMESTER

L	T			
3	0	Credits	:	03
		Sessional	:	50
Duration of Exam. 3 Hours		End Sem. Exam.	:	50
		Total	:	100

HIGH VACUUM TECHNIQUES- PHY515T

Throughput, conductance and impedance, Production of vacuum-Mechanical pumps: Rotary pump, Roots pump & Turbomolecular pump, vapour jet and vapour diffusion pumps, their design Principles, construction, operational characteristics and use. Sorption of gases, gettering and getter-ion pumps, degassing of surfaces. Sputter- ion-pumps, Cryogenic pumps. Principle & working of various types of gauges, Leak detection. Materials, Fabrication techniques and vacuum components. Vacuum plumbing. Ultra high vacuum. Vacuum system design. Applications of high vacuum: vacuum coating, vacuum impregnation, freeze drying, fabrication of ICs, space simulation, ion implantation, particle accelerators, vacuum distillation.

BOOKS SUGGESTED:

1. Vacuum Science and Engineering by CM Van Atta
2. Vacuum Technology by Andrew Guthrie
3. Vacuum Technology – An introduction by LG Carpenter
4. Vacuum deposition of Thin Films by L. Holland
5. High Vacuum Engineering by Alfred E. Barrington
6. Vacuum Technology by A. Roth

MASTER OF TECHNOLOGY (INSTRUMENTATION)
2ND - SEMESTER

L	T			
3	0	Sessional	:	50
Duration of Exam. 3 Hours		End Sem. Exam.	:	50
		Total	:	100

MATERIALS CHARACTERISATION TECHNIQUES- PHY521T

X-Ray Methods:

Production and detection of X-rays, X-ray spectra, X-ray absorption and diffraction, Scattering factors (Atomic scattering factor and geometrical scattering factor), Reciprocal lattice, Diffractometers and spectrometers, Methods of analysis: Powder and Laue, Electron microproble analysis.

Electron microscopy: Electron microscope, construction, contrast, resolving power, depth of focus, specimen preparation, Scanning electron microscopy. Transmission electron microscope

Surface Analysis techniques:

Auger, ESCA, ISS, methods of surface analysis (principle, instrumentation and detection) Mass spectrometers and spectrographs, Mossbauer spectrometry, Nuclear magnetic resonance spectroscopy.

Thermal analysis: Gravimetric analysis, Differential thermal analysis.

BOOKS SUGGESTED:

1. X-ray diffraction methods by BD Culity
2. Instrumental methods of Chemical analysis: Willard Merritt and Dean
3. Methods of Chemical analysis by Ewings
4. Electron microscopy of thin crystals: Hirsch, Nicholson Pashley and Whelan

MASTER OF TECHNOLOGY (INSTRUMENTATION)
2ND - SEMESTER

L	T		
3	0	Sessional	: 50
Duration of Exam. 3 Hours		End Sem. Exam.	: 50
		Total	: 100

Credits : 03

REMOTE SENSING- PHY522T

Concept and foundations of remote sensing, Ideal remote sensing-System, Methodology, Resolutions-Spatial, Spectral, radiometric and temporal, Spectral signatures, Radiometric terms and definitions,. Interactions of electromagnetic radiation with earth's surface and earth's atmosphere. Microdensitometers, filters, Aerial cameras and photographs, Photographic resolution, modulation transfer function(MTF). Air photo Interpretation fundamental basic equipment. Aerial Sensor Imagery. Multispectral Scanners(MSS), Characteristics of MSS Images; Interpretation and applications of MSS imagery: Thermal IR line Scanner; Sideways-looking Airborne Radar(SLAR). Satellite Sensor Imagery-introduction, Earth Resources Satellites and Space remote Sensing Systems-LANDSAT, SPOT, IRS series. Image processing-Simple concepts and fundamental, continuous and discrete image processing, Digital Image Processor.
Remote Sensing relating instruments & Systems-IR spectrometer Radiometers, Scanners, LIDAR: Detectors & Systems: Detectors: Photoconductive, photodiodes, CCD, PMT & Vidicon, Characteristics of detectors. Remote Sensing Applications-Oceanography, Mineral resources Forestry, Stoke's parameters, Land use planning, weather, Global positioning System (GPS), GPS for ground truth collection.

BOOKS SUGGESTED:

1. Remote Sensing and Image Interpretation(Lillesand, Kiefer) (John Wiley & Sons, Inc.)
2. Principles of Remote Sensing (Paul J.Curran-ELBS/Longman)
3. Remote Sensing-Optics and Optical systems (P.N.Slater, Addison-Wesley)

MASTER OF TECHNOLOGY (INSTRUMENTATION)
2nd – SEMESTER

L	T			
3	0	Credits	:	03
		Sessional	:	50
Duration of Exam. 3 Hours		End Sem. Exam.	:	50
		Total	:	100

NUCLEAR INSTRUMENTATION: PHY523T

Detection of nuclear radiations: Introduction, Principle of nuclear detections, various detectors-their characteristics and applications, Interaction of radiations with matter.

Detection devices: Gas ionization based detectors, ionization chambers, G.M.detectors, Proportional counters & their design considerations

Semiconductor radiation detectors: Homogeneous and Junction type (Diffused Junction, surface-barrier Junction, Lithium ion drifted Junction, High purity Ge detector), Characteristics, fabrication and design considerations.

Solid State Nuclear Track Detectors (SSNTD): Basics of track etch generation and applications, detection thresholds, restricted energy loss. Basics of active measurement techniques for environmental radioactivity; beta/gamma radiation survey meter, Alpha Guard and shielding materials.

Amplifiers and instrumentation circuits: Photomultiplier tube, Input amplifiers, fast pulse amplifiers, pulse shaping circuits, pulse height analyzers, coincidence and anti-coincidence circuits

SUGGESTED BOOK:

Nuclear Instrumentation: W.J.Price.
Solid State Nuclear Track Detectors- Principal and Applications: R.L.Fleischer, P. B.Price & R.M.Walker
Techniques for nuclear and particle physics experiments**:** W. R. Leo

MASTER OF TECHNOLOGY (INSTRUMENTATION)
2nd – SEMESTER

L	T			
3	0	Sessional	:	50
Duration of Exam. 3 Hours		End Sem. Exam.	:	50
		Total	:	100

Nanosensors and Devices- PHY524T

Nanosensors: Indroduction of nanosensors, nanoscale organization for sensors. Materials for nanosensors. Fabrication of sensors. Types of sensors : Gas sensors, magnetic sensors, piezeoelectric sensors, pressure sensors, Sensing Mechanisms in different sensors.

Physics of Nanoscale Devices: General Considerations, Electronic, optical, magnetic and mechanical properties at nanoscale materials.

Nanodevices: Megnetic data sources devices electronic, nanoelectromechnical devices, nanomotors spin valves STM, AFM, SET, HEMT, RTD.

Carbon nanotube based devices: structure and properties of CNTs, Carbon nanotube transistors, fabrication , properties and applications.

References:

1. W.R. Fahrner(Ed.) Nanotechnology and Nanoelectronics
2. Nano: The essentials by T. Pradeep
3. Carbon Nanotubes Science and Applications, M. Meyyapapn(Ed.), CRC Press
4. Molecular Electronic Devices, F.L.Carter et al(Ed);New York:North Holland
5. Nanotechnology-Basic Science and Emerging Technologies, Mick Wilson, Kamali Kannangra Geoff Smith, Michelle Simons and Burkhard Raguse, Overseas Press.

MASTER OF TECHNOLOGY (INSTRUMENTATION)

2nd - SEMESTER

L	T			
3	0	Credits	:	03
		Sessional	:	50
Duration of Exam. 3 Hours		End Sem. Exam.	:	50
		Total	:	100

COMPUTER TECHNOLOGY- PHY525T

Part A: Computer Architecture:

Introduction to Operation System, Programm Loops, Programming Arithmetic and Logic Operations, Subroutines, Input and Output Programming, Multiprogramming, time-sharing, distributed systems, real time system; overview of pipelining, array processing, multiprocessing, SISD, SIMD, MISD, MIMD architecture.

Part B: C Programming:

Constants, variables, data types; simple input-output statements like, scanf, printf, getch, getche, getchar, gets, putch, puts; loops; if-else; case structure; I-d and 2-d arrays; functions; programming using above statements.

1. Operating System Concepts –Silberschatz & Galvin, Addison Wesley.
2. Programming with C – B.S Gottfried, Schaum Series, TMH
3. Computer Architecture & Parallel Processing – Hwang & Briggs.
4. Computer system architecture, M. Morris Mano- PHI.